REVIEW OF THE BOTANICAL VALUES

ON THE

SOUTH WEST YARRAGADEE PROJECT AREAS

Prepared for:

Water Corporation

Prepared by:

Mattiske Consulting Pty Ltd

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MATTISKE CONSULTING PTY LTD

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1. SUMMARY

The survey area occurs within the Menzies and Warren botanical districts of the Southwestern Botanical Province as recognised by Diels (1906) and later developed by Gardner (1942) and Beard (1979, 1980). The vegetation within the botanical district is determined mainly by the underlying landforms, soils and climate (Diels 1906; Williams 1932, 1942; Speck 1952, 1958; Lange 1960; Churchill 1961, 1968; Smith 1974; Seddon 1972; Havel 1968, 1975a, 1975b; Heddle *et al*. 1980; Beard 1981; Mattiske and Havel 1998; Havel 2000).

The latest total drawdown modelling indicated that the regional groundwater levels vary at the respective sites. On current interpretations of the potential longer-term (30years) total drawdown will have the following implications for the botanical values in the areas as highlighted:

Swan Coastal Plain – potential implications for both rare and endangered flora, as well as several threatened ecological communities. This area was included in the desktop review of potential issues (Mattiske Consulting Pty Ltd 2003, 2004a), but was not included in the detailed investigations in 2004 (Mattiske Consulting Pty Ltd 2005). The implications of the latter raises a range of issues as some species and communities that are threatened or endangered are restricted geographically to the southern Swan Coastal Plain.

The most recent borefield design indicates that the critically endangered "Shrublands on southern Swan Coastal Plain Ironstones (10b)" may be influenced by regional groundwater changes. This community and the associated rare and endangered species are the most critical biological values that currently require management and a review of mitigation options. Further studies are required to assess the extent of the potential regional groundwater drawdowns.

Rosa Brook - in view of the nature of the valley system, it is predicted that any potential impacts on the botanical values will be relatively minor along the creekline and on the lower valley slopes near the creekline. These systems are critical for a range of aquatic invertebrates and fish species that are restricted to the tributaries of the Blackwood in the area (ECNRM 2005; Morgan and Beatty 2005). Therefore maintenance of local pools and aquatic systems appear to be more critical for the fauna species than the flora species.

None of the plant communities described in the Rosa Brook area are classified as Threatened Ecological Communities as described by Department of Conservation and Land Management (2005c) or listed as Threatened Ecological Communities under the EPBC Act (1999).

No rare or priority flora species were recorded as being restricted to these tributaries. No rare or priority flora species were recorded as being highly dependent on regional groundwater systems in the Rosa Brook tributaries. Less than 5% of the 169 plant taxa recorded on the Rosa Brook tributaries are considered to be highly dependent on regional groundwater. None of these plant taxa are restricted to these tributaries.

St John Brook - in view of the nature of the valley system, it is predicted that any potential impacts on the botanical values will be relatively minor along the creekline and on the lower valley slopes near the creekline. These systems are critical for a range of aquatic invertebrates and fish species that are restricted to the tributaries of the Blackwood in the area (ECNRM 2005; Morgan and Beatty 2005). Therefore maintenance of local pools and aquatic systems appear to be more critical for the fauna species than the flora species.

None of the plant communities described in the St John Brook area are classified as Threatened Ecological Communities as described by Department of Conservation and Land Management (2005c) or listed as Threatened Ecological Communities under the EPBC Act (1999).

Two priority flora species were recorded in these tributaries. These two Priority species, *Tyrbastes glaucescens* (ms) (P4) and *Stylidium barleei* (P3) are highly dependent on the availability of water near the creekline. Neither of the Priority species are restricted to this valley system. Only a small proportion of the 221 plant taxa recorded on the St John Brook tributaries are considered to be highly dependent on regional groundwater. None of these plant taxa are restricted to these tributaries.

Poison Gully – in view of the nature of the valley system, it is predicted that this impact on the botanical values will be largely confined to the swamp areas (A1, A2, B1) and the narrow creeklines (C1). The swamps between 200 metres or so upstream of Blackwood Road and downstream of Blackwood Road will be the most impacted (ie. in the area where the Yarragadee formation intercepts the valley system). The swamps (A4) in the upper reaches of the valley system and A3 (Pig swamp) occur on extensive clays with perched water tables and are not likely to be impacted on by any changes in regional groundwater levels.

None of the plant communities described in the Poison Gully area are classified as Threatened Ecological Communities as described by Department of Conservation and Land Management (2005c) or listed as Threatened Ecological Communities under the EPBC Act (1999).

No rare or priority flora species were recorded as being restricted to these tributaries. Two Priority 3 flora species were recorded as being highly dependent on regional groundwater systems in the Poison Gully tributary. Less than 10% of the 225 plant taxa recorded on the Poison Gully tributary are considered to be highly dependent on regional groundwater. None of these plant taxa are restricted to these tributaries.

Milyeannup Brook – in view of the nature of the valley system, it is predicted that this impact on the botanical values will be relatively minor along the creekline and on the lower valley slopes near the creekline. These systems are critical for a range of aquatic invertebrates and fish species that are restricted to the tributaries of the Blackwood in the area (ECNRM 2005; Morgan and Beatty 2005). Therefore maintenance of local pools and aquatic systems appear to be more critical for the fauna species than the flora species.

None of the plant communities described in the Poison Gully area are classified as Threatened Ecological Communities as described by Department of Conservation and Land Management (2005c) or listed as Threatened Ecological Communities under the EPBC Act (1999).

No rare or priority flora species were recorded as being restricted to these tributaries. One Priority 3 flora species was recorded as being highly dependent on regional groundwater systems in the Milyeannup Brook tributary. Less than 4% of the 180 plant taxa recorded on the Milyeannup Brook tributary are considered to be highly dependent on regional groundwater. None of these plant taxa are restricted to these tributaries.

Reedia Swamps - potential implications for both priority flora, as well as a Priority 1 threatened ecological community. The implications of the latter raises a range of issues as some species and communities that are threatened or endangered are restricted geographically to the Reedia Swamps. On current modelling results these areas appear to be avoided in terms of longer-term drawdowns of the regional groundwater levels. In view of the degree of significance of these systems (priority flora, critically endangered frogs and Priority 1 threatened ecological community) care should be taken to avoid any impacts on this area.

No rare or priority flora species were recorded as being restricted to these tributaries. Two Priority 3 and one Priority 4 flora species were recorded as being highly dependent on regional groundwater systems in the Reedia Swamp tributaries. 13.14% of the 175 plant taxa recorded in the Reedia swamp tributaries are considered to be highly dependent on regional groundwater. *Reedia spathacea* (P4) is restricted to these tributaries.

Scott Coastal Plain - potential implications for both a range of endangered flora, as well as the Scott Coastal Plain ironstone threatened ecological community. On the basis of current interpretations, the potential impacts have in part been understated as there were a few difficulties extrapolating bore data to the swamps. Of the swamps and ecosystems involved the most critical relate to the poorly represented communities on the Scott Coastal Plain, rather than the more widespread Nillup Plain. The Scott Coastal Plain has been largely cleared for agricultural activities; whilst the Nillup Plain occurs largely within State Forest areas. Therefore the implications for the range of species and plant communities that occur on the shallow seasonally inundated areas on the Scott Coastal Plain require consideration. Small changes in these systems can lead to major changes in species and communities.

The most recent borefield design indicates that the endangered "Scott River Ironstone Association" on the western Scott Coastal Plain may be influenced by regional groundwater changes. This community and the associated rare and endangered species are the most critical biological values that currently require management and a review of mitigation options.

One Priority 4 flora species was recorded as being highly dependent on the regional groundwater systems in the Nillup and Scott Coastal Plain transect areas. Less than 4% of the 231 plant taxa recorded on the Scott Coastal Plain are considered to be highly dependent on regional groundwater. Some plant species on the Scott Coastal Plain are restricted to these swamp and ironstone communities.

The number of species (and rare and priority species) which are highly dependent on the regional groundwater, appears to be low in relation to the extent of the swamps and this in part appears to reflect the potential inaccuracies in extrapolating from localised monitoring bores across extensive swamps. Therefore the number of species that are highly dependent on groundwater should be much higher than that summarised in the text above. The difficulty of extrapolating from only several bores at each transect is reflected in some fifteen species, which are listed as having a low dependency rather than a high dependency. Therefore the findings for these plains appear to be less reliable than the findings for other areas. This discrepancy requires clarification in future monitoring programs.

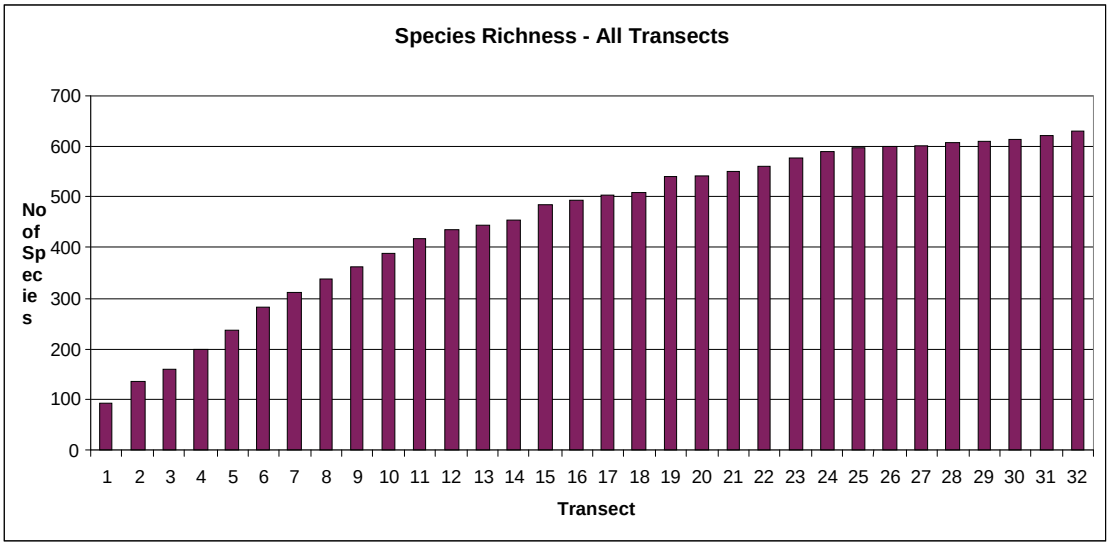
2. CLASSIFICATION METHODS AND ASSUMPTIONS

In defining the susceptibility of a range of flora and vegetation value to potential changes in local hydrological conditions it is important to clarify the classification methods and also the assumptions made in the data collation, interpretation and presentations.

2.1 Confidence in coverage of Flora Species

A species area graph was prepared for each sample area. The graphs indicated that the sampling regime enabled coverage of most of the species in the project area (as the rate of increase in species recorded decreased as the number of transects increased). Therefore, although one cannot ensure that all species are covered in any sampling regime, the results indicated that the probability of missing some of the rare and priority species was relatively low.

The extent of the surveys and studies undertaken to date indicate that the likelihood of locating more rare or endangered species in the valley systems and swamps as investigated is relatively low. The approach taken on the rare and endangered flora was considered to be very conservative with an emphasis on potential species and taxon being highlighted in all phases of the studies.



2.2 Vegetation Complexes

The approach adopted within the System 6 and the Regional Forest Agreement (RFA) mapping projects (Heddle *et al.* 1980 and Mattiske and Havel 1998) to the definition of vegetation complexes was reliant on the earlier understanding that there were strong and inherent relationships between the underlying landforms, soils and climate. Therefore the vegetation mapping undertaken during these programs extends the more classical approach to vegetation mapping by incorporating not only the structural and floristic components but also extending the definition of mapping units to include relationships with underlying landform, soils, local hydrological conditions and climatic conditions.

Whilst this approach is open to some criticism it provides a clear basis for interpreting regional patterns in flora and vegetation which is critical to the issues at hand.

The limitations of such a regional approach is the scale that the work can be undertaken, in the face of a shortage of on-ground resources and the limitations of mapping at a scale of 1:50,000 initially for an intended final mapping product at 1:250,000. Therefore the scale of the information enables a regional overview, however is not suitable for local interpretations.

The only other detailed mapping available for the southwest forest regions at a regional scale is that of Beard (Beard 1979, 1980, 1981 and 1990) and Hopkins *et al.* (2001). The latter is an updated version of the earlier State wide work of Beard. This work provides a basis for Statewide studies and is reliant on mainly structural and dominant species for mapping unit definitions. As the vegetation complex definitions provide a more detailed regional overview for the southwest forest it is intended to rely on this information for the current interpretation.

2.3 Site-Vegetation Types

The approach adopted for defining and mapping the key valley systems in the Southwest Yarragadee project area was based on the earlier technique developed by Havel (1975a, 1975b) for the Northern Jarrah Forest and as modified by Mattiske Consulting Pty Ltd in more detailed vegetation studies on a range of project areas in the southwest forest region. In many ways the concept is similar to that applied at a regional scale for the vegetation complexes, but by utilising the site-vegetation types at a local scale it is possible to define the local plant communities and by incorporating the site descriptions extend the information available for these communities through the definition of the site-vegetation types (i.e. incorporating the soils, topography, slope, aspect, soil moisture regimes).

In the Southwest Yarragadee project areas this was feasible for some valley systems by extrapolating from transect data and aerial photographic interpretations. At this juncture it is important to point out that the valley systems were not mapped on a regular and close grid pattern (as would be the normal approach) as the emphasis in the recent botanical studies was on the transect approach in selective targeted areas (Mattiske Consulting Pty Ltd, 2005). This level of mapping when applied in specific areas provides a comprehensive summary of the local community values.

2.4 Floristic Associations

The approach adopted by Gibson *et al.* (1994) for the Swan Coastal Plain plant communities was based on the floristic composition of the communities. In the consideration of the Swan Coastal Plain, this work is critical for the regional assessment of the significance of the communities. Although the 1994 studies did not map the communities as defined on the Swan Coastal Plain, subsequent work by the Department of Conservation and Land Management Threatened Ecological Communities unit has delineated many of these areas on the southern Swan Coastal Plain.

2.5 Species

Several approaches were taken to addressing the potential impacts on the plant species. The first approach was to extract the species that are currently known to occur on the soils with higher seasonal soil moisture levels and the second approach was to extract the species with recognised conservation status and review their regional and local significance in relation to their individual capacities to tolerate potential changes in soil moisture levels. Many of the species which have been recognised as rare, priority or endangered species are either geographically restricted species or species that are restricted to specific site conditions. In other instances some of the Priority species are poorly known. In other words the appropriate field studies have not been undertaken.

There is a need to recognise that little is known about the biology and regeneration strategies of the different species that occur in the different areas and therefore a series of assumptions have been made based on their lifeforms, possible root depths and potential regeneration strategies in relation to their ability to tolerate both shifts in soil moisture levels (over both short term time frames as well as long term time frames).

In the absence of detailed information on the biology of individual species and their regeneration strategies, it has been assumed that longer-lived perennial species may be more vulnerable to local changes in hydrological site conditions. In contrast small herbaceous species that are shallow rooted are less likely to be influenced by changes in seasonally moister soils, as the shallow rooted species tend to be dependent on the seasonal rainfall events.

2.6 Groundwater Dependency Versus Soil Moisture Dependency

The degree of dependency of vegetation on regional groundwater, where available, was based on the geology, hydrogeology and bore data as supplied by the Water Corporation. In addition, detailed observations on local soil types and plant lifeforms were taken into consideration in determining the potential interaction and dependency of different plant species and communities on groundwater systems. In the following text – the terms groundwater dependent (GD), perched groundwater (PG) and seasonally moister soils (MS) are used in the Tables as presented.

In determining this relationship there was a need to rely on the data as supplied by the Water Authority for the respective transects. In utilizing this data it should be recognised that here was a degree of extrapolation from the one or two bores located in the field near the transects. The latter may have led to some local inaccuracies in the depth to water table results for the respective transects. This concern relates to the occurrence of some species in areas, which would have been expected to have occurred in shallow water table areas.

The dependency on perched groundwater tables was based primarily on observations and soil types (largely clays). The determination of risk in these categories is less reliable than the determination of risk in relation to regional groundwater levels and soil moisture levels. Nevertheless the recent hydro geological and botanical studies have increased the overall reliability of such correlations.

2.7 Limitations and Gaps

The key areas under consideration for potential drawdown over a thirty-year period are the southern areas of the Swan Coastal Plain, the Blackwood Plateau, the selected tributaries of the Blackwood systems and the Scott Coastal Plain. The Reedia swamp areas have also been included as a result of their potential significance for the rare frogs and also the associated Reedia species and the proposed threatened ecological community.

The vegetation complexes for this wider area were chosen irrespective of their location within the landscape. It should be noted at this stage, that the level of mapping varies between the southern Swan Coastal Plain and the RFA vegetation mapping area and the northern section of the Busselton mapping sheet (which was completed during the RFA mapping process but not included in the RFA mapping outputs – Mattiske and Havel 1998). This variation is obvious in the area east of Busselton where the different intensities of mapping were very apparent (e.g. Ludlow River, between Bunbury and Busselton).

These vegetation complexes were then ranked as High, Medium or Low Potential GDE's on the basis of the position in the landscape, the structure of the communities, the floristic composition of the communities and the depth to water table information. The initial interpretation was summarised in the Mattiske Consulting Pty Ltd (2003, 2004a) and reviewed following the more detailed studies in 2004 by Mattiske Consulting Pty Ltd (2005).

This enabled the development of lengthy table to be developed which incorporated data from the RFA mapping project by Mattiske and Havel (1998) as well as the linkages with underlying landforms, soils and soil hydrology (as defined by Churchward and McArthur (1980), Churchward (1992) and Tille and Lantzke (1990)) and information from the recent survey work.

3. EAST SWAN COASTAL PLAIN

The Bunbury and Capel area occurs on the southern sections of the Drummond Botanical District within the SouthWest Botanical Province as defined by Beard (1980). Within this area the biological features were grouped by both vegetation complexes (as defined by Heddle *et al*. 1980 and Mattiske and Havel 1998) and into types of ecosystems.

3.1 Vegetation Complexes

In the Bunbury/Capel area some thirteen vegetation complexes as defined by Heddle *et al.* (1980) and Mattiske and Havel (1998) in the potent support groundwater dependent ecosystems (Mattiske Consulting Pty Ltd 2003). These vegetation complexes include a range of plant communities on the area that could potentially be groundwater dependent ecosystems. These communities can be subdivided into the following main structural units:

- fringing woodlands on the drainage lines (Swan –33 and Dardanup – 34 complexes),
- woodlands along creeks and minor gullies (Guildford – 32 and Southern River – 42 complexes),
- woodlands, shrublands, heaths and sedgelands in swamps and seasonally inundated areas (Bassendean – 44, Karrakatta Central and South - 49, Abba (AB, Aw) and Yoongarillup (Y, Yw, 56) complexes and to a lesser extent Ludlow – LW, Lw), and
- halophytic complexes and woodlands on the estuarine areas (Vasse complex - 57).

The total risks (0-3 and 3-6) occur primarily in the Abba, Yoongarillup and Ludlow complexes in the southern section of the eastern Swan Coastal Plain and near the interface of the Bassendean, Guildford and Karrakatta Central and South near Bunbury. Of these the vegetation on the lower slopes of the Whicher escarpment and the lower lying swamps in the area still remain the most vulnerable to changes in local site conditions. In determining the significance of the potential changes that may occur in local hydrological site conditions the extent that these changes may influence the native vegetation in these areas is also influenced by many other factors such as clearing for agricultural and urbanisation.

In reviewing the extent of native vegetation remaining on the southern Swan Coastal Plain it is very apparent that large sections of the area have already been cleared and developed. The latter clearing in itself has in part increased the value on the remnant vegetation on this section of the Swan Coastal Plain.

3.2 Vegetation Complexes – Potential Risks

In summary the key vegetation complexes that will be potentially influenced by longer-term drawdowns in the area will be:

- the sumplands, damplands and wetlands within the low-lying areas of the Bassendean (44) and the Karrakatta Central and South (49) complexes, located north of Boyanup Road and south of the Preston River.
- woodlands along creeks and minor gullies (Guildford complex 32), and
- woodlands, shrublands, heaths and sedgelands in swamps and seasonally inundated areas (Abba (in particular Aw and AB) and Yoongarillup complexes (in particular Yw and Y)).

3.3 Threatened Ecological Communities

There are a range of threatened ecological communities that occur in the southern section of the Swan Coastal Plain, namely:

1. Shrublands on southern Swan Coastal Plain Ironstones (Busselton area) (10b based on Gibson *et al.* 1994) – Swan Coastal Plain. CR – Critically Endangered (State level) and EN – Endangered (EPBCAct 1999)

This threatened ecological community occurs on the Pinjarra Plain below the Whicher Scarp. This community occurs in areas that may be at risk from changes in local hydrological conditions to the south and east of Busselton. The values in this community also include a large range of rare and priority species that are listed both at the State level under the Wildlife Conservation Act (1950), but also at the Federal level under the Environmental Protection Biodiversity Conservation Act (1999). This community is at high risk from minor changes in local and regional groundwater levels. This community is restricted to localised pockets and is threatened by other activities in the area (including mining, the development of infrastructure corridors and agricultural activities).

2. Shrublands on calcareous silts of the Swan Coastal Plain (18 based on Gibson *et al*. 1994) – Swan Coastal Plain. VN – Vulnerable (State level)

   This threatened ecological community occurs north of Bunbury on the calcareous silts associated with lake deposits on the Swan Coastal Plain. This community occurs north of the potential area of influence.

3. Southern wet shrublands, Swan Coastal Plain (2 based on Gibson *et al*. 1994) – Swan Coastal Plain. EN - Endangered (State level)

   This threatened ecological community occurs on the seasonally wet and inundated areas on the Pinjarra Plain on the Swan Coastal Plain to the south and southeast of Busselton. The values in this community also include a range of rare and priority species that are listed both at the State level under the Wildlife Conservation Act (1950), but also at the Federal level under the Environmental Protection Biodiversity Conservation Act (1999). This community is at high risk from minor changes in local and regional groundwater levels. This community is restricted to localised pockets and is threatened by other activities in the area (including the development of infrastructure corridors and agricultural activities).

4. *Eucalyptus calophylla – Kingia australis* woodlands on heavy soils (3a based on Gibson *et al.* 1994) – Swan Coastal Plain. CR – Critically Endangered (State level) and EN – Endangered (EPBCAct 1999)

   This threatened ecological community occurs on the Pinjarra Plain on the fluviatile soils (Guildford Plain) on the Swan Coastal Plain. The values in this community may include a range of rare and priority species that are listed both at the State level under the Wildlife Conservation Act (1950), but also at the Federal level under the Environmental Protection Biodiversity Conservation Act (1999). This community is at moderate risk from minor changes in local soil moisture levels.

   In view of this community's location on clay loam soils on the fluviatile fans on the Pinjarra Plain, it is unlikely that changes in groundwater levels will directly influence this community. However as changes in groundwater levels may influence general soil moisture availability in some areas, the risk has been defined as moderate. This community is restricted to localised pockets and is threatened by other activities in the area (including the development of infrastructure corridors and agricultural activities).

5. *Eucalyptus calophylla* woodlands on heavy soils of the southern Swan Coastal Plain (1b based on Gibson *et al.* 1994) – Swan Coastal Plain. VN – Vulnerable (State level)

   This threatened ecological community occurs on the Pinjarra Plain on the Swan Coastal Plain. The values in this community also include a range of rare and priority species that are listed both at the State level under the Wildlife Conservation Act (1950), but also at the Federal level under the Environmental Protection Biodiversity Conservation Act (1999). This community is at moderate risk from minor changes in local soil moisture levels. In view of this community's location on clay loam soils on the fluviatile fans on the Pinjarra Plain, it is unlikely that changes in groundwater levels will directly influence this community. However as changes in groundwater levels may influence general soil moisture availability in some areas, the risk has been defined as moderate.

This community is restricted to localised pockets and is threatened by other activities in the area (including the development of infrastructure corridors and agricultural activities).

6. *Eucalyptus calophylla – Eucalyptus marginata* woodlands on sandy clay soils of the southern Swan Coastal Plain (3b based on Gibson *et al*. 1994) – Swan Coastal Plain. VN – Vulnerable (State level)

   This threatened ecological community occurs on the Pinjarra Plain on the Swan Coastal Plain. The values in this community may include a range of rare and priority species that are listed both at the State level under the Wildlife Conservation Act (1950), but also at the Federal level under the Environmental Protection Biodiversity Conservation Act (1999). This community is at moderate risk from minor changes in local soil moisture levels. In view of this community's location on sandy clay soils on fluviatile fans on the Pinjarra Plain, it is unlikely that changes in groundwater levels will directly influence this community. However as changes in groundwater levels may influence general soil moisture availability in some areas, the risk has been defined as moderate. This community is restricted to localised pockets and is threatened by other activities in the area (including the development of infrastructure corridors and agricultural activities).

7. Herb rich saline shrublands in clay pans of the southern Swan Coastal Plain (7 based on Gibson *et al.* 1994) – Swan Coastal Plain. VN – Vulnerable (State level)

   This threatened ecological community occurs on clay pans which are seasonally wet and inundated areas on the Pinjarra Plain on the Swan Coastal Plain. The values in this community may include a range of rare and priority species that are listed both at the State level under the Wildlife Conservation Act (1950), but also at the Federal level under the Environmental Protection Biodiversity Conservation Act (1999). This community occurs in the area southeast and east of Busselton and near Mandurah.

   This community is at moderate to high risk from minor changes in local and regional groundwater levels. There is a need to further clarify the extent these clay pans are perched above the groundwater systems, and therefore the relative reliance on moister soils following seasonal rains versus moisture from groundwater systems. This community is restricted to localised pockets and is threatened by other activities in the area (including the development of infrastructure corridors and agricultural activities).

8. Herb rich shrublands in clay pans of the southern Swan Coastal Plain (8 based on Gibson *et al.* 1994) – Swan Coastal Plain. VN – Vulnerable (State level)

   This threatened ecological community occurs on clay pans on the Pinjarra Plain which are seasonally wet and inundated areas on the Swan Coastal Plain. The values in this community may include a range of rare and priority species that are listed both at the State level under the Wildlife Conservation Act (1950), but also at the Federal level under the Environmental Protection Biodiversity Conservation Act (1999). This community is at moderate to high risk from minor changes in local and regional groundwater levels. There is a need to further clarify the extent these clay pans are perched above the groundwater systems, and therefore the relative reliance on moister soils following seasonal rains versus moisture from groundwater systems. This community is restricted to localised pockets and is threatened by other activities in the area (including the development of infrastructure corridors and agricultural activities).

9. Dense shrublands on clay flats of the southern Swan Coastal Plain (9 based on Gibson *et al.* 1994) – Swan Coastal Plain. VN – Vulnerable (State level)

   This threatened ecological community occurs on clay flats on the Swan Coastal Plain. The values in this community may include a range of rare and priority species that are listed both at the State level under the Wildlife Conservation Act (1950), but also at the Federal level under the Environmental Protection Biodiversity Conservation Act (1999).

This community occurs on the eastern fringes of the Swan Coastal Plain, including east of Busselton. This community is at moderate to high risk from minor changes in local and regional groundwater levels. There is a need to further clarify the extent these clay pans are perched above the groundwater systems, and therefore the relative reliance on moister soils following seasonal rains versus moisture from groundwater systems. This community is restricted to localised pockets and is threatened by other activities in the area (including the development of infrastructure corridors and agricultural activities).

10. Shrublands on dry clay flats of the southern Swan Coastal Plain (10a based on Gibson *et al.* 1994) – Swan Coastal Plain. EN – Endangered (State level)

    This threatened ecological community occurs on dry clay flats on the Swan Coastal Plain. The values in this community may include a range of rare and priority species that are listed both at the State level under the Wildlife Conservation Act (1950), but also at the Federal level under the Environmental Protection Biodiversity Conservation Act (1999). This community is at low to moderate risk from minor changes in local and regional groundwater levels. There is a need to further clarify the extent these clay pans are perched above the groundwater systems, and therefore the relative reliance on moister soils following seasonal rains versus moisture from groundwater systems. This community is restricted to localised pockets and is threatened by other activities in the area (including the development of infrastructure corridors and agricultural activities).

In summary, the key threatened ecological communities that may be influenced by longer-term drawdowns in the area are summarised in Table SCP1 below. In delineating those with a higher risk, the susceptibility of the community, its underlying soil type, the reliance on regional groundwaters and the location were all taken into consideration.

Table SCP1: Summary of Threatened Ecological Communities that may be influenced by the Drawdown trends on the Swan Coastal Plain

No.	Description	Gibson *et al.* (1994)	State (CALM 2005b)	Federal (EPBCAct 1999)	Potential Risk
1.	Shrublands on southern Swan Coastal Plain Ironstones (Busselton area)	10b	CR	EN	High
2.	Shrublands on calcareous silts of the Swan Coastal Plain	18	VN	-	Low
3.	Southern wet shrublands, Swan Coastal Plain	2	EN	-	High
4.	*Eucalyptus calophylla – Kingia australis* woodlands on heavy soils	3a	CR	EN	Mod
5.	*Eucalyptus calophylla* woodlands on heavy soils of the southern Swan Coastal Plain	1b	VN	-	Mod
6.	*Eucalyptus calophylla – Eucalyptus marginata* woodlands on sandy clay soils of the southern Swan Coastal Plain	3b	VN	-	Mod
7.	Herb rich saline shrublands in clay pans of the southern Swan Coastal Plain	7	VN	-	Mod-High
8.	Herb rich shrublands in clay pans of the southern Swan Coastal Plain	8	VN	-	Mod-High
9.	Dense shrublands on clay flats of the southern Swan Coastal Plain	9	VN	-	Mod-High
10.	Shrublands on dry clay flats of the southern Swan Coastal Plain	10a	EN	-	Low-Mod

3.4 Flora Values

130 of the 1486 vascular plant taxa recorded in the wider Southwest Yarragadee project area occur on the Swan Coastal Plain (SCP), Table SCP2 (based on Mattiske Consulting Pty Ltd 2003, with additional data from Mattiske Consulting Pty Ltd 2005).

Whilst many of these are unlikely to be in the localised fringing vegetation and swamps, a significant number of these species may occur in groundwater dependent ecosystems.

Of these 130 taxon the following taxon are considered to be highly dependent on the availability of regional groundwater (Table SCP2):

- 7 Endangered taxon (pursuant to the EPBC Act 1999)
- 2 Vulnerable taxon (pursuant to the EPBC Act 1999)
- 14 Rare taxon (pursuant to the Wildlife Conservation Act 1950)
- 6 Priority 1 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 6 Priority 2 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 14 Priority 3 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 9 Priority 4 taxon (as defined by the Department of Conservation and Land Management 2005a)

Of these 130 taxon the following taxon are considered to be moderately dependent on the availability of regional groundwater (Table SCP2):

- 4 Endangered taxon (pursuant to the EPBC Act 1999)
- 5 Vulnerable taxon (pursuant to the EPBC Act 1999)
- 9 Rare taxon (pursuant to the Wildlife Conservation Act 1950)
- 4 Priority 1 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 8 Priority 2 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 18 Priority 3 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 11 Priority 4 taxon (as defined by the Department of Conservation and Land Management 2005a)

Of these 130 taxon the following taxon are considered to have a low dependency on the availability of regional groundwater (Table SCP2):

- 2 Endangered taxon (pursuant to the EPBC Act 1999)
- 1 Vulnerable taxon (pursuant to the EPBC Act 1999)
- 5 Rare taxon (pursuant to the Wildlife Conservation Act 1950)
- 6 Priority 1 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 3 Priority 2 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 9 Priority 3 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 8 Priority 4 taxon (as defined by the Department of Conservation and Land Management 2005a)

The likelihood of these species being influenced by local changes in groundwater levels is increased if the plants are longer-lived perennial species. In contrast small herbaceous species that are shallow rooted are less likely to be influenced by changes in groundwater as the shallow rooted species tend to be dependent on the seasonal rainfall events which lead to increases in moister soils.

3.5 Recommendations and Offsetting Options

The southern Swan Coastal Plain has been subjected to extensive clearing for agricultural activities, some local clearing for mining activities and more recently urbanisation in near coastal areas. The majority of the rare and endangered species and communities occur on isolated remnant pockets or strips (road verges) of native vegetation. Consequently the management of the ecosystems and the species within these systems becomes a complex matter.

Several options exist for offsetting any long-term impacts of drawdown in the area. These could include:

1. Contribution to research funding addressing definition of values in the area and also management options for minimising long-term drawdowns by active management of catchments.
2. Searching for offsets, preferably on nearby private properties that support similar biodiversity values. Arrangements can then be made for purchase or covenants on values.
3. Reviewing options for reducing potential drawdowns through designing different options for water extraction from the Yarragadee system.
4. Undertake further on-ground investigations to clarify whether the biodiversity values highlighted in the previous text are impacted by the potential long-term drawdown as suggested. It should be noted that although the Swan Coastal Plain was covered in the initial desktop review by Mattiske Consulting Pty Ltd (2003, 2004a), it was not covered in detailed field investigations in 2004 (Mattiske Consulting Pty Ltd 2005).

Table SCP2: Summary of Conservation Status of Species on the Swan Coastal Plain and the Potential Dependency of Groundwater and Moister Soils

SCC – State Conservation Code (Wildlife Conservation Act 1999)
FCC – Federal Conservation Code (EPBC Act 1999)
RG – Regional Groundwater
PG – Perched Groundwater
MS – Moister Soils (generally from seasonal rainfall events)
^ - Risk assessment based initially on lifeform and information on habitat preference in relation to regional groundwater

Genus	Species	SCC	FCC	RG ^	PG^	MS^
Grevillea	*maccutcheonii*	R	E	H	H	H
Petrophile	*latericola* (ms)	R	E	H	H	H
Lambertia	*echinata* subsp. *occidentalis*	R	E	H	M	H
Lambertia	*orbifolia* subsp. Scott River Plains (L.W. Sage 684) (pn)	R	E	H	M	H
Verticordia	*densiflora* var. *pedunculata*	R	E	H	M	M
Verticordia	*plumosa* var. *ananeotes*	R	E	H	M	M
Verticordia	*plumosa* var. *vassensis*	R	E	H	M	M
Caladenia	*busselliana*	R	E	M	M	H
Drakaea	*elastica*	R	E	M	-	H
Dryandra	*mimica*	R	E	M	M	M
Dryandra	*nivea* subsp. *uliginosa*	R	E	M	M	M
Caladenia	*caesarea* subsp. *maritima*	R	E	L	-	M
Caladenia	*huegelii*	R	E	L	-	M
Eleocharis	*keigheryi*	R	V	H	H	H
Grevillea	*elongata*	R	V	H	H	H
Tetraria	*australiensis*	R	V	M	M	M
Diuris	*drummondii*	R	V	M	M	M
Drakaea	*micrantha* (ms)	R	V	M	M	M
Dryandra	*squarrosa* subsp. *argillacea*	R	V	M	M	M
Brachysema	*modestum*	R	V	M	M	M
Daviesia	*elongata* subsp. *elongata*	R	V	L	L	L
Hydatella	*dioica*	R		H	H	H
Synaphea	*Stenoloba*	R		H	H	H
Brachyscias	*verecundus*	R		H	H	H
Chamelaucium	*roycei* (ms)	R		H	H	H
Darwinia	sp. Williamson (G.J. Keighery 12717) (pn)	R		H	H	H
Grevillea	*brachystylis* subsp. *grandis* (ms)	R		L	L	M
Caladenia	*procera*	R		L	-	L
Carex	*tereticaulis*	P1		H	H	H
Schoenus	*pennisetis*	P1		H	H	H
Schoenus	sp. Jindong (R.D.Royce 2485) (pn)	P1		H	H	H
Pterostylis	*turfosus*	P1		H	H	H
Synaphea	*odocoileops*	P1		H	H	H
Andersonia	*ferricola* (ms)	P1		H	H	H
Caustis	sp. Boyanup (G.S.McCutcheon 1706) (pn)	P1		M	M	M
Synaphea	*stenoloba*	P1		M	M	M
Nemcia	*cordata* (ms)	P1		M	M	M

Table SCP2: Summary of Conservation Status of Species on the Swan Coastal Plain and the Potential Dependency of Groundwater and Moister Soils

SCC – State Conservation Code (*Wildlife Conservation Act* 1999) and CALM (2005a)
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RG – Regional Groundwater
PG – Perched Groundwater
MS – Moister Soils (generally from seasonal rainfall events)
^ - Risk assessment based initially on lifeform and information on habitat preference in relation to regional groundwater

Genus	Species	SCC	FCC	RG^	PG^	MS^
Tripterococcus	*paniculatus* (ms)	P1		M	M	M
Austrofestuca	*littoralis*	P1		L	-	L
Boronia	*humifusa*	P1		L	-	L
Thomasia	*laxiflora*	P1		L	-	L
Calothamnus	sp. Whicher (B.J. Keighery & N. Gibson 230) (pn)	P1		L	-	L
Eucalyptus	*relictua* (ms)	P1		L	-	L
Eucalyptus	x *mundijongensis*	P1		L	-	L
Schoenus	*capillifolius*	P2		H	H	H
Grevillea	*manglesioides* subsp. *ferricola*	P2		H	H	H
Cardamine	*paucijuga*	P2		H	H	H
Boronia	*capitata* subsp. *gracilis*	P2		H	H	H
Amperea	*protensa*	P2		H	H	H
Calothamnus	sp. Scott River (R.D. Royce 84) (pn)	P2		H	H	H
Chordifex	*isomorphus*	P2		M	M	M
Synaphea	*petiolaris* subsp. *simplex*	P2		M	M	M
Leptomeria	*furtiva*	P2		M	M	M
Amperea	*micrantha*	P2		M	L	M
Calytrix	sp. Tutunup (G.J. Keighery & N. Gibson 2953) (pn)	P2		M	M	M
Mitreola	*minima*	P2		M	M	M
Stylidium	*rigidifolium*	P2		M	M	M
Craspedia	*argillicola* (ms)	P2		M	M	L
Caladenia	*abbreviata* (ms)	P2		L	L	L
Dryandra	*sessilis* var. *cordata*	P2		L	-	L
Leucopogon	*plumuliflorus*	P2		L	-	L
Schoenus	*benthamii*	P3		H	H	H
Chordifex	*gracilior*	P3		H	H	H
Lepyrodia	*heleocharoides*	P3		H	H	H
Meeboldina	*thysanantha* (ms)	P3		H	H	H
Chamaescilla	*gibsonii*	P3		H	H	H
Pultenaea	*pinifolia*	P3		H	H	H
Boronia	*anceps*	P3		H	H	H
Boronia	*tetragona*	P3		H	H	H
Eryngium	*ferox* (ms)	P3		H	H	H
Andersonia	*amabile* (ms)	P3		H	H	H
Stylidium	*leeuwinense*	P3		H	H	H
Stylidium	*longitubum*	P3		H	H	H
Blennospora	*doliiformis*	P3		H	H	H

Table SCP2: Summary of Conservation Status of Species on the Swan Coastal Plain and the Potential Dependency of Groundwater and Moister Soils

SCC – State Conservation Code (*Wildlife Conservation Act* 1999) and CALM (2005a)
FCC – Federal Conservation Code (*EPBC Act* 1999)
RG – Regional Groundwater
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^ - Risk assessment based initially on lifeform and information on habitat preference in relation to regional groundwater

Genus	Species	SCC	FCC	RG^	PG^	MS^
Rhodanthe	*pyrethrum*	P3		H	H	H
Loxocarya	*magna*	P3		M	M	M
Conospermum	*paniculatum*	P3		M	M	M
Grevillea	*brachystylis* subsp. *brachystylis*	P3		M	M	M
Hakea	*oldfieldii*	P3		M	M	M
Isopogon	*formosus* subsp. *dasylepis*	P3		M	M	M
Synaphea	*hians*	P3		M	M	M
Acacia	*horridula*	P3		M	-	M
Acacia	*semitrullata*	P3		M	M	M
Chorizema	*carinatum*	P3		M	M	M
Pultenaea	*radiata*	P3		M	M	M
Tetratheca	*similis*	P3		M	M	M
Verticordia	*attenuata*	P3		M	M	M
Haloragis	*tenuifolia*	P3		M	M	M
Myriophyllum	*echinatum*	P3		M	M	M
Eryngium	*subdecumbens* (ms)	P3		M	M	M
Sphenotoma	*parviflorum*	P3		M	L	M
Dampiera	*heteroptera*	P3		M	M	M
Stylidium	*barleei*	P3		M	M	M
Platysace	*ramosissima*	P3		L	-	L
Johnsonia	*inconspicua*	P3		L	-	L
Lambertia	*multiflora* var. *darlingensis*	P3		L	-	L
Chorizema	*reticulatum*	P3		L	-	L
Jacksonia	*sericea*	P3		L	-	L
Tetratheca	*parvifolia*	P3		L	-	L
Lasiopetalum	*membranaceum*	P3		L	-	L
Pimelea	*ciliata* subsp. *longituba*	P3		L	-	L
Leucopogon	*oliganthus*	P3		L	-	L
Aponogeton	*hexatepalus*	P4		H	H	H
Schoenus	*natans*	P4		H	H	H
Tyrbastes	*glaucescens*	P4		H	H	H
Microtis	*media* subsp. *quadrata*	P4		H	H	H
Banksia	*meisneri* subsp. *ascendens*	P4		H	H	H
Rumex	*drummondii*	P4		H	H	M
Aotus	*carinata*	P4		H	H	H
Villarsia	*Submerse*	P4		H	H	H
Anthotium	*junciforme*	P4		H	-	H

Table SCP2: Summary of Conservation Status of Species on the Swan Coastal Plain and the Potential Dependency of Groundwater and Moister Soils

SCC – State Conservation Code (*Wildlife Conservation Act* 1999) and CALM (2005a)
FCC – Federal Conservation Code (*EPBC Act* 1999)
RG – Regional Groundwater
PG – Perched Groundwater
MS – Moister Soils (generally from seasonal rainfall events)
^ - Risk assessment based initially on lifeform and information on habitat preference in relation to regional groundwater

Genus	Species	SCC	FCC	RG^	PG^	MS^
Asplenium	*aethiopicum*	P4		M	M	M
Caladenia	*plicata*	P4		M	M	M
Caladenia	*speciosa*	P4		M	-	M
Drosera	*marchantii* subsp. *marchantii*	P4		M	-	M
Acacia	*flagelliformis*	P4		M	-	M
Jacksonia	*sparsa (*ms)	P4		M	-	M
Pultenaea	*skinneri*	P4		M	-	M
Boronia	*tenuis*	P4		M	M	M
Chamelaucium	*erythrochlorum* (ms)	P4		M	M	M
Eucalyptus	*rudis* subsp. *cratyantha*	P4		M	-	M
Verticordia	*lehmannii*	P4		M	M	M
Tripterococcus	*brachylobus* (ms)	P4		L	L	M
Thysanotus	*glaucus*	P4		L	-	L
Caladenia	*interjacens*	P4		L	-	L
Caladenia	*longicauda* subsp. *clivicola*	P4		L	L	L
Franklandia	*triaristata*	P4		L	-	L
Hibbertia	*montana*	P4		L	-	L
Eucalyptus	*macrocarpa* subsp. *elachantha*	P4		L	-	L
Eucalyptus	*marginata* x *megacarpa*	P4		L	-	L

4. ROSA BROOK

Rosa Brook occurs in the centre of the Blackwood Plateau, to the north of the Blackwood River into which it discharges. The majority of the catchment retains native vegetation. Rosa Brook does not have a perennial flow, typically flowing from early winter through to late spring. Nevertheless localised pools persist in the Brook during the year.

The Rosa Brook area occurs on the southern sections of the Menzies Botanical District within the SouthWest Botanical Province as defined by Beard (1980). Within this area the biological features were grouped by both vegetation complexes (as defined by Heddle *et al.* 1980 and Mattiske and Havel 1998) and into types of ecosystems.

4.1 Vegetation Complexes

In the Rosa Brook area some four vegetation complexes as defined by Heddle *et al.* (1980) and Mattiske and Havel (1998) may potentially support groundwater dependent ecosystems (Mattiske Consulting Pty Ltd 2003). These vegetation complexes include a range of plant communities on the area that could potentially be groundwater dependent ecosystems. These communities can be subdivided into the following main structural units:

- Riverine fringing woodlands and forests on the Blackwood River (BK),
- Fringing creekline woodlands and forests on the Darradup (DP) valley floors and swamps, and
- Upper gullies of the side tributaries supporting woodlands and forests in Bidella (BD) and Jalbaragup (JL) on minor drainage lines.

The total risks (0-3 and 3-6) occur primarily in the Darradup vegetation complex and to a lesser extent the wider valleys of the Blackwood (BK). Of these the vegetation within the creekline of the Darradup vegetation complex has the highest potential to be influenced by changes in local site conditions. In determining the significance of the potential changes that may occur in local hydrological site conditions the extent will be influenced by seasonal rainfall events and the management of the forest utilisation of the water within the catchments. It is predicted that the width and extent of the creekline vegetation will shift down the slope and then downstream of these potential changes occur in these systems. The seasonal flows are critical to the vegetation along the creek lines, as well as the fauna species dependent on the maintenance of the water flows and quality in these creek lines. The vegetation within Bidella and Jalbaragup vegetation complexes is dependent largely on seasonal rainfall events. The soil types within these areas are largely clay-loams and loams and therefore will hold water more favourably than sandy soils and therefore the impacts in the Bidella and Jalbaragup vegetation complexes will be less than in the creekline and lower slopes of the Blackwood and Jalbaragup complexes.

4.2 Vegetation Complexes – Potential Risks

In summary the key vegetation complexes that will be potentially influenced by longer-term drawdowns in the area will be:

- Riverine fringing woodlands and forests on the Blackwood River (BK), and
- Fringing creekline woodlands and forests on the Darradup (DP) valley floors and swamps.

These vegetation complexes are well represented (both greater than 42% in formal reserves – Conservation Commission 2003) in the regional context and therefore at this level of classification the impacts on these types on a regional scale should be minimal (Table 4 in Mattiske Consulting Pty Ltd 2005).

4.3 Threatened Ecological Communities

None of the plant communities described in the survey area are classified as Threatened Ecological Communities as described by English and Blyth (1997, 1999) or listed as Threatened Ecological Communities under the EPBC Act (1999).

4.4 Site-Vegetation Types

The site-vegetation types that dominant the Darradup and Blackwood vegetation complexes include the C1, C4, C5, Q1, T1 and W1 types as defined by Mattiske Consulting Pty Ltd (2005). Of these the variants of the "C" site-vegetation type are the most likely to be influenced initially by any changes in the local hydrological conditions.

C1: Open forest of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* - *Eucalyptus patens* over *Trymalium floribundum, Taxandria linearifolia, Taxandria parviceps, Hypocalymma cordifolium, Astartea scoparia* and *Gastrolobium bilobum* over *Baumea vaginalis* and *Lepidosperma gladiatum.*

C4: Open forest of *Corymbia calophylla* - *Eucalyptus patens* - *Banksia littoralis* with occasional *Banksia seminuda* over *Agonis flexuosa, Trymalium floribundum* and *Taxandria linearifolia* over *Bossiaea aquifolium* subsp. *laidlawiana, Lepidosperma gladiatum, Lepidosperma tetraquetrum* and *Baumea vaginalis.*

C5: Open forest of *Eucalyptus rudis – Agonis flexuosa – Melaleuca rhaphiophylla* over patches of *Melaleuca viminea, Astartea scoparia, Taxandria linearifolia* and *Lepidosperma gladiatum, Lepidosperma tetraquetrum* and *Baumea vaginalis.*

W1: Open forest of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* - *Eucalyptus patens* over *Pteridium esculentum* and *Acacia alata* var. *alata*.

T1: Open forest of *Corymbia calophylla* - *Eucalyptus marginata* subsp. *marginata* over occasional *Banksia littoralis, Agonis flexuosa* over *Pteridium esculentum, Clematis pubescens and Leucopogon verticillatus, Leucopogon australis, Bossiaea linophylla* and *Acacia browniana* var. *browniana.*

Q1: Open forest of *Corymbia calophylla* - *Eucalyptus patens* - *Eucalyptus rudis – Eucalyptus marginata* subsp. *marginata* over occasional *Banksia littoralis* over *Pteridium esculentum, Gastrolobium bilobum, Acacia alata* var. *alata* and *Trymalium floribundum*

The potential impacts on the other site-type vegetation types will be slightly less as the fertility levels in the clay loams may in part compensate for changes in ground water levels.

The potential changes if the local hydrological conditions shift to the drier or xeric end of the continuum will be a reduction in size and extent of the creekline fringing vegetation types (C1, C4 and C5) and a reduction in the extent of the types on the valley slopes (T1, W1 and Q1).

All of these site vegetation types are well-represented in the nearby valley systems and as such at the site-vegetation type level of classification the impacts on these types on a regional scale should be minimal (Table 5 in Mattiske Consulting Pty Ltd 2005).

4.5 Flora Values

57 of the 1486 vascular plant taxa recorded in the wider Southwest Yarragadee project area potentially occur near Rosa Brook (RB), Table RB1 (based on Mattiske Consulting Pty Ltd 2003, with additional data from Mattiske Consulting Pty Ltd 2005).

Whilst many of these are unlikely to be in the localised fringing vegetation and swamps, a significant number of these species may occur in groundwater dependent ecosystems.

Of these 57 taxon the following taxon are considered to be highly dependent on the availability of regional groundwater (Table RB1):

- 1 Endangered taxon (pursuant to the EPBC Act 1999)
- No Vulnerable taxon (pursuant to the EPBC Act 1999)
- 1 Rare taxon (pursuant to the Wildlife Conservation Act 1950)
- No Priority 1 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 3 Priority 2 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 4 Priority 3 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 6 Priority 4 taxon (as defined by the Department of Conservation and Land Management 2005a)

Of these 57 taxon the following taxon are considered to be moderately on the availability of regional groundwater (Table RB1):

- 3 Endangered taxon (pursuant to the EPBC Act 1999)
- 2 Vulnerable taxon (pursuant to the EPBC Act 1999)
- 5 Rare taxon (pursuant to the Wildlife Conservation Act 1950)
- 2 Priority 1 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 2 Priority 2 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 6 Priority 3 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 11 Priority 4 taxon (as defined by the Department of Conservation and Land Management 2005a)

Of these 57 taxon the following taxon are considered to have a low dependency on the availability of regional groundwater (Table RB1):

- 1 Endangered taxon (pursuant to the EPBC Act 1999)
- 1 Vulnerable taxon (pursuant to the EPBC Act 1999)
- 4 Rare taxon (pursuant to the Wildlife Conservation Act 1950)
- 3 Priority 1 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 3 Priority 2 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 4 Priority 3 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 3 Priority 4 taxon (as defined by the Department of Conservation and Land Management 2005a)

The likelihood of these species being influenced by local changes in groundwater levels is increased if the plants are longer-lived perennial species. In contrast small herbaceous species that are shallow rooted are less likely to be influenced by changes in groundwater as the shallow rooted species tend to be dependent on the seasonal rainfall events which lead to increases in moister soils.

As a result of recent surveys in Rosa Brook, three Priority species were located within the valley system under consideration, namely:

. *Stylidium barleei* (P3) – this species occurs in both drier and moist sites, so is moderately dependent on the maintenance of regional groundwater levels.

. *Tyrbastes glaucescens* (P4) – this species occurs in the seasonally waterlogged and dry areas, so is moderately dependent on the maintenance of regional groundwater levels.. *Conospermum paniculatum* (P3) – this species occurs in minor gullies, swamps and dry areas, so is moderately dependent on the maintenance of regional groundwater levels.

The other species listed in Table RB2 and as highlighted (*#*) have been recorded in nearby tributaries and similar environments on the Blackwood Plateau, namely – *Cyathochaeta teretifolia* (P3), *Meeboldina thysanantha* (P3) and *Reedia spathacea* (P4). Of the latter three species, *Reedia spathacea* is unlikely to be present in Rosa Brook as the soil types are locally different from those in the valley systems further west where this taxon (and its associated proposed threatened ecological community occur).

As indicated in Table RB3 – only a small number of the species recorded on the three established transects are highly dependent on regional groundwater levels.

This in part reflects the narrow width of the creekline vegetation (Mattiske Consulting Pty Ltd 2005). As indicated in previous studies the vegetation within these systems forms a continuum with species varying in their tolerance of different site conditions. The latter concept is illustrated in Table RB3, where the species vary in their site tolerances of different environments (including the parameter depth to water table as supplied in Table RB3). These depths to water table were based on data as supplied by the Water Corporation at the time of the 2005 studies by Mattiske Consulting Pty Ltd.

On the basis of previous studies in different areas within the southwest forest region, local shifts in species and vegetation in response to changes in water availability are reflected over short periods (decades) and therefore on the basis of the predicted drawdowns it is reasonable to predict that there may be some local subtle changes in species composition within the Rosa Brook catchment as species shift on local scales in response to potential changes in local hydrological site conditions. In view of the nature of the valley system, it is predicted that this impact will be relatively minor along the creekline and on the lower valley slopes near the creekline. The data as presented in Table RB3 should assist in this initial monitoring of shifts.

Table RB2: Summary of Conservation Status of Species on the Blackwood Plateau (Blackwood South (BS) and Blackwood North (BN)), which may occur near Rosa Brook and the Potential Dependency of Groundwater and Moister Soils

SCC – State Conservation Code (*Wildlife Conservation Act* 1999) and CALM (2005a)
FCC – Federal Conservation Code (*EPBC Act* 1999)
RG – Regional Groundwater
PG – Perched Groundwater
MS – Moister Soils (generally from seasonal rainfall events)
^ - Risk assessment based initially on lifeform and information on habitat preference in relation to regional groundwater
- denotes number of quadrats that taxon were recorded in recent studies (Mattiske Consulting Pty Ltd 2005)

Genus	Species	SCC	FCC	BS^^	BN^^	RG^	PG^	MS^
Verticordia	*plumosa* var. *vassensis*	R	E		1	H	M	M
Drakaea	*elastica*	R	E		1	M	-	M
Dryandra	*mimica*	R	E		1	M	M	M
Dryandra	*nivea* subsp. *uliginosa*	R	E		1	M	M	M
Caladenia	*huegelii*	R	E	1	1	L	-	M
Drakaea	*micrantha* (ms)	R	V	1	1	M	M	M
Dryandra	*squarrosa* subsp. *argillacea*	R	V		1	M	M	M
Laxmannia	*jamesii*	R	V		1	L	-	L
Grevillea	*brachystylis* subsp. *grandis* (ms)	R			1	L	L	M
Hemigenia	*ramosissima*	R			1	L	-	L
Nemcia	*cordata* (ms)	P1		1	1	M	M	M
Synaphea	?*otiostigma*	P1		1	1	M	M	M
Caladenia	*uliginosa* subsp. *patulens*	P1		1	1	L	L	L
Eucalyptus	*relictua* (ms)	P1			1	L	-	L
Thomasia	*laxiflora*	P1			1	L	-	L
Grevillea	*manglesioides* subsp. *ferricola*	P2			1	H	H	H
Hybanthus	*volubilis*	P2			1	H	H	H
Leptinella	*drummondii*	P2		1	1	H	-	H
Amperea	*micrantha*	P2		1	1	M	L	M
Synaphea	*petiolaris* subsp. *simplex*	P2		1	1	M	M	M
Actinotus	*whicheranus*	P2			1	L	-	L
Leucopogon	*compactus*	P2			1	L	-	L
Leucopogon	*plumuliflorus*	P2			1	L	-	L
Aotus	*cordifolia*	P3			1	H	H	H
Cyathochaeta	*teretifolia*	P3		*10*	*2*	H	H	H
Meeboldina	*thysanantha* (ms)	P3		*2*		H	H	H
Pultenaea	*pinifolia*	P3			1	H	H	H
Acacia	*semitrullata*	P3		1	1	M	M	M
Dampiera	*heteroptera*	P3		1		M	M	M
Hakea	*oldfieldii*	P3			1	M	M	M
Isopogon	*formosus* subsp. *dasylepis*	P3			1	M	M	M
Pultenaea	*radiata*	P3		1	1	M	M	M
Synaphea	*otiostigma*	P3		1	1	M	M	M
Conospermum	*paniculatum*	P3		1	*1*	L	L	M
Stylidium	*barleei*	P3		*1*	*2*	L	L	M
Chorizema	*reticulatum*	P3		1	1	L	-	L
Thysanotus	*gageoides*	P3			1	L	-	L
Hypocalymma	*cordifolium* subsp. *minus* (ms)	P4			1	H	L	H

Table RB2: Summary of Conservation Status of Species on the Blackwood Plateau (Blackwood South (BS) and Blackwood North (BN)), which may occur near Rosa Brook and the Potential Dependency of Groundwater and Moister Soils

SCC – State Conservation Code (*Wildlife Conservation Act* 1999) and CALM (2005a)
FCC – Federal Conservation Code (*EPBC Act* 1999)
RG – Regional Groundwater
PG – Perched Groundwater
MS – Moister Soils (generally from seasonal rainfall events)
^ - Risk assessment based initially on lifeform and information on habitat preference in relation to regional groundwater
- denotes number of quadrats that taxon were recorded in recent studies (Mattiske Consulting Pty Ltd 2005)

Genus	Species	SCC	FCC	BS^^	BN^^	RG^	PG^	MS^
Lambertia	*rariflora* subsp. *rariflora*	P4			1	H	H	H
Melaleuca	*basicephala*	P4		1		H	H	H
Reedia	*spathacea*	P4		*2*		H	H	H
Tyrbastes	*glaucescens*	P4				H	H	H
Villarsia	*submersa*	P4				H	H	H
Acacia	*tayloriana*	P4		1		M	M	M
Caladenia	*arrecta*	P4		1		M	M	M
Caladenia	*plicata*	P4		1	1	M	M	M
Chamelaucium	*erythrochlorum* (ms)	P4		1	1	M	M	M
Drosera	*marchantii* subsp. *marchantii*	P4			1	M	-	M
Eucalyptus	*rudis* subsp. *cratyantha*	P4			1	M	-	M
Grevillea	*drummondii*	P4			1	M	M	M
Pultenaea	*skinneri*	P4		1	1	M	-	M
Stylidium	*plantagineum*	P4		1		M	M	M
Synaphea	*acutiloba*	P4		1	1	M	M	M
Verticordia	*lehmannii*	P4		1	1	M	M	M
Astroloma	sp. Nannup (R.D. Royce 3978) (pn)	P4		1	1	L	L	L
Franklandia	*triaristata*	P4			1	L	-	L
Thysanotus	*glaucus*	P4		1	1	L	-	L

Table RB3: Summary of Species Preferences for Different Site Preferences at Rosa Brook

^ - Risk assessment based initially on potential dependency on regional groundwater, lifeform and habitat preference

Species	Risk^ RG	<1M RB	1-3M RB	>3M RB
Species largely Dependent on Wetter Sites				
Baumea juncea	H	2		
Astartea scoparia	H	2		
Taxandria linearifolia (ms)	H	3	3	
Hypocalymma cordifolium	H	3	2	
Lepidosperma squamatum	H	2	2	3
Banksia littoralis	H	2	1	
Logania vaginalis	H	1		
Tyrbastes glaucescens P4	H	1	1	
Species largely Dependent on Moister Sites				
Darwinia citriodora	M-H	2	12	2
Hakea amplexicaulis	M-H	1	22	19
Dasypogon hookeri	M-H	1	14	15
Lepidosperma gladiatum	M-H	2	3	5
Tetraria capillaris	M-H	1	9	8
Patersonia umbrosa var. *xanthina*	M-H	1	8	2
Opercularia hispidula	M-H	1	4	1
Ricinocarpos glaucus	M-H	1	3	2
Tremandra diffusa	M-H	1	3	1
Trymalium floribundum	M-H	1	2	2
Grevillea diversifolia subsp. *diversifolia*	M-H	1	2	2
Calycopeplus oligandrus	M-H	1	2	
Trymalium floribundum subsp. *trifidum*	M-H	1	1	
Acacia obovatus	M		7	6
Cyathochaeta avenacea	M		11	11
Lindsaea linearis	M		7	
Clematis pubescens	M		5	5
Trichocline spathulata	M		5	2
Xanthorrhoea gracilis	M		5	
Hakea lasianthoides	M		4	3
Bossiaea linophylla	M		4	
Mirbelia dilatata	M		3	5
Persoonia longifolia	M		3	4
Xanthorrhoea preissii	M		3	
Philotheca spicata	M		3	
Banksia grandis	M		2	1
Villarsia albiflora	M		2	
Lomandra caespitosa	M		2	
Lomandra pauciflora	M		1	1
Lomandra drummondii	M		1	1
Lepidosperma leptostachyum	M		1	1
Banksia seminuda	M		2	
Gonocarpus benthamii subsp. *benthamii*	M		1	1
Thysanotus ?thyrsoideus	M		1	
Astroloma ciliatum	M		1	
Andersonia latiflora	M		1	
Acacia saligna	M		1	

Table RB3: Summary of Species Preferences for Different Site Preferences at Rosa Brook

^ - Risk assessment based initially on potential dependency on regional groundwater, lifeform and habitat preference

Species	Risk^ RG	<1M RB	1-3M RB	>3M RB
Species largely Dependent on Moister Sites				
Tetratheca setigera	M		1	
Acacia myrtifolia	M		1	
Amphipogon amphipogonoides	L		5	1
Pimelea ?imbricata var. *piligera*	L		3	
Desmocladus fasciculatus	L		2	2
Platysace compressa	L		2	1
Caesia micrantha	L		2	1
Wahlenbergia littoricola	L		2	
Thysanotus manglesianus	L		2	
Thelymitra ?canaliculata	L		2	
Pimelea longiflora subsp. *longiflora*	L		2	
Logania serpyllifolia subsp. *angustifolia*	L		2	
Orthrosanthus polystachyus	L		1	1
Agrostocrinum scabrum	L		1	1
Drosera platystigma	L		1	
Species largely Dependent on Drier Sites				
Tetrarrhena laevis	L	2	17	30
Taxandria parviceps (ms)	L	2	6	28
Loxocarya cinerea	L	2	4	23
Pteridium esculentum	L	2	3	22
Stylidium sp. Mt Barker(E.J.Croxford 1906)	L	2	2	12
Hovea elliptica	L	1	18	28
Eucalyptus marginata subsp. *marginata*	L	1	11	35
Corymbia calophylla	L	1	10	22
Leucopogon verticillatus	L	1	9	13
Acacia pulchella	L	1	4	6
Caladenia flava	L	1	2	15
Trymalium ledifolium var. *rosmarinifolium*	L		7	16
Tetraria octandra	L		4	7
Adenanthos obovatus	L		4	6
Leucopogon australis	L		3	33
Hypocalymma angustifolium	L		3	6
Platysace tenuissima	L		2	6
Lepidosperma pubisquameum	L		2	6
Petrophile diversifolia	L		2	5
Thysanotus dichotomus	L		2	4
Billardiera laxiflora	L		2	4
Hibbertia amplexicaulis	L		1	32
Acacia lateriticola	L		1	20
Scaevola calliptera	L		1	17
Amperea simulans	L		1	17
Logania serpyllifolia subsp. *serpyllifolia*	L		1	15
Pentapeltis peltigera	L		1	14
Lagenophora huegelii	L		1	13
Agonis flexuosa	L		1	13

Table RB3: Summary of Species Preferences for Different Site Preferences at Rosa Brook

^ - Risk assessment based initially on potential dependency on regional groundwater, lifeform and habitat preference

Species	Risk^ RG	<1M RB	1-3M RB	>3M RB
Species largely Dependent on Drier Sites				
Bossiaea ornate	L		1	7
Opercularia apiciflora	L		1	6
Microlaena stipoides	L		1	5
Podocarpus drouynianus	L		1	4
Levenhookia pusilla	L		1	4
Boronia megastigma	L		1	3
Lomandra preissii	L		1	2
Gastrolobium bilobum	L		1	2
Boronia crenulata subsp. *pubescens*	L			21
Xanthosia candida	L			19
Hakea lissocarpha	L			13
Xanthosia ciliata	L			12
Lasiopetalum floribundum	L			11
Macrozamia riedlei	L			9
Bossiaea eriocarpa	L			9
Drosera microphylla	L			8
Thomasia rhynchocarpa	L			6
Lomandra sonderi	L			5
Dryandra lindleyana	L			5
Desmocladus flexuosus	L			5
Daucus glochidiatus	L			5
Dampiera linearis	L			5
Anarthria prolifera	L			5
Xylomelum occidentale	L			4
Kingia australis	L			4
Dodonaea viscosa subsp. *angustissima*	L			4
Acacia extensa	L			4
Stylidium adnatum	L			3
Stackhousia monogyna	L			3
Leucopogon capitellatus	L			3
Grevillea pulchella subsp. *ascendens*	L			3
Gastrolobium cuneatum	L			3
Chorizema ilicifolium	L			3
Calothamnus pallidifolius	L			3
Boronia fastigiate	L			3
Acacia divergens	L			3
Stylidium junceum subsp. *brevius*	L			2
Pimelea hispida	L			2
Patersonia occidentalis	L			2
Oxalis corniculata	L			2
Microtis media	L			2
Lomandra hermaphrodita	L			2
Lobelia alata	L			2
Lechenaultia biloba	L			2
Labichea punctata	L			2
Isotropis cuneifolia subsp. *cuneifolia*	L			2
Isopogon sphaerocephalus	L			2
Gompholobium polymorphum	L			2

Table RB3: Summary of Species Preferences for Different Site Preferences at Rosa Brook

^ - Risk assessment based initially on potential dependency on regional groundwater, lifeform and habitat preference

Species	Risk^ RG	<1M RB	1-3M RB	>3M RB
Species largely Dependent on Drier Sites				
Eucalyptus aff. *drummondii*	L			2
Chamaescilla corymbosa	L			2
Calytrix flavescens	L			2
Callistachys lanceolata	L			2
Xanthosia atkinsoniana	L			1
Synaphea ?petiolaris (possibly new species)	L			1
Stypandra glauca	L			1
Stylidium rhynchocarpum	L			1
Stylidium barleei P3	L			1
Sphaerolobium medium	L			1
Pterostylis vittate	L			1
Poranthera microphylla	L			1
Persoonia elliptica	L			1
Monotaxis occidentalis	L			1
Marianthus coeruleo-punctatus	L			1
Lomandra ?sonderi	L			1
Lepidosperma gracile	L			1
Johnsonia lupulina	L			1
Hypolaena exsulca	L			1
Hydrocotyle callicarpa	L			1
Hibbertia pilosa	L			1
Hibbertia commutate	L			1
Grevillea trifida	L			1
Gompholobium cyaninum (ms)	L			1
Eucalyptus patens	L			1
Eriochilus dilatatus	L			1
Daviesia decurrens	L			1
Dampiera alata	L			1
Corybas ?recurvus	L			1
Conospermum paniculatum P3	L			1
Amphipogon setaceus	L			1
Dasypogon bromeliifolius	L			1

4.6 Recommendations and Offsetting Options

The Rosa Brook area occurs primarily within State Forest and National Park boundaries supporting native forests. The number of rare and endangered species and communities is relatively low and in view of their regional occurrence any local changes in regional groundwater levels, providing these are not rapid, should have minimal impacts on this valley system.

Several options exist for offsetting any long-term impacts of drawdown in the area. These could include:

1. Contribution to research funding addressing definition of values in the area and also management options for minimising long-term drawdowns by active management of forested catchments.
2. Reviewing options for reducing potential drawdowns through designing different options for water extraction from the Yarragadee system.
3. Undertake further on-ground investigations to clarify whether the biodiversity values highlighted in the previous text are impacted by the potential long-term drawdown as suggested.

5. ST JOHN BROOK

St John Brook occurs on the eastern section of the Blackwood Plateau, to the north of the Blackwood River into which it discharges. The majority of the catchment retains native vegetation. St John Brook does not have a perennial flow along the entire length, although the lower reaches do have perennial flows. Therefore localised pools persist in the Brook during the year.

The St John Brook area occurs on the southern section of the Menzies Botanical District within the SouthWest Botanical Province as defined by Beard (1980). Within this area the biological features were grouped by both vegetation complexes (as defined by Heddle *et al.* 1980 and Mattiske and Havel 1998) and into types of ecosystems.

5.1 Vegetation Complexes

In the St John Brook area some four vegetation complexes as defined by Heddle *et al.* (1980) and Mattiske and Havel (1998) may potentially support groundwater dependent ecosystems (Mattiske Consulting Pty Ltd 2003). These vegetation complexes include a range of plant communities on the area that could potentially be groundwater dependent ecosystems. These communities can be subdivided into the following main structural units:

- Riverine fringing woodlands and forests on the Blackwood River (BK),
- Fringing creekline woodlands and forests on the Darradup (DP) valley floors and swamps, and
- Upper gullies of the side tributaries supporting woodlands and forests in Jalbaragup (JL) on minor drainage lines.

The total risks (0-3 and 3-6) occur primarily in the Darradup vegetation complex and to a lesser extent the wider valleys of the Blackwood (BK). Of these the vegetation within the creekline of the Darradup vegetation complex has the highest potential to be influenced by changes in local site conditions. In determining the significance of the potential changes that may occur in local hydrological site conditions the extent will be influenced by seasonal rainfall events and the management of the forest utilisation of the water within the catchments. It is predicted that the width and extent of the creekline vegetation will shift down the slope and then downstream of these potential changes occur in these systems. The seasonal flows are critical to the vegetation along the creek lines, as well as the fauna species dependent on the maintenance of the water flows and quality in these creek lines. The vegetation within Jalbaragup vegetation complex is dependent largely on seasonal rainfall events. The soil types within these areas are largely clay-loams and loams and therefore will hold water more favourably than sandy soils and therefore the impacts in the Jalbaragup vegetation complex will be less than in the creekline and lower slopes of the Blackwood and Jalbaragup complexes.

5.2 Vegetation Complexes – Potential Risks

In summary the key vegetation complexes that will be potentially influenced by longer-term drawdowns in the area will be:

- Riverine fringing woodlands and forests on the Blackwood River (BK), and
- Fringing creekline woodlands and forests on the Darradup (DP) valley floors and swamps.

These vegetation complexes are well represented (both greater than 42% in formal reserves – Conservation Commission 2003) in the regional context and therefore at this level of classification the impacts on these types on a regional scale should be minimal (Table 4 in Mattiske Consulting Pty Ltd 2005).

5.3 Threatened Ecological Communities

None of the plant communities described in the survey area are classified as Threatened Ecological Communities as described by English and Blyth (1997, 1999) or listed as Threatened Ecological Communities under the EPBC Act (1999).

5.4 Site-Vegetation Types

The site-vegetation types that dominant the St John Brook tributaries include the C1, C2, C3, Q1, Q2 and W1 types as defined by Mattiske Consulting Pty Ltd (2004b). Of these the variants of the "C" site-vegetation type are the most likely to be influenced initially by any changes in the local hydrological conditions.

S1: Open forest of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* over occasional *Banksia grandis* over *Podocarpus drouynianus*, *Xanthorrhoea preissii* and *Macrozamia riedlei.*

C1: Open forest of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* - *Eucalyptus patens* over *Trymalium floribundum, Taxandria linearifolia, Taxandria parviceps*, *Hypocalymma cordifolium, Astartea scoparia* and *Gastrolobium bilobum* over *Baumea vaginalis* and *Lepidosperma gladiatum*.

C2: Open forest of *Eucalyptus rudis* - *Corymbia calophylla* - *Banksia seminuda* over *Callistachys lanceolata, Taxandria linearifolia* and *Astartea scoparia* over *Baumea vaginalis* and *Lepidosperma gladiatum.*

C3: Woodland of *Eucalyptus rudis* - *Eucalyptus patens* over thicket of *Acacia divergens, Taxandria parviceps, Acacia pulchella* and *Astartea scoparia.*

W1: Open forest of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* - *Eucalyptus patens* over *Pteridium esculentum* and *Acacia alata* var. *alata*.

U1: Open forest of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* and over *Trymalium floribundum* with other large shrubs.

Q1: Open forest of *Corymbia calophylla* - *Eucalyptus patens* - *Eucalyptus rudis* – *Eucalyptus marginata* subsp. *marginata* over occasional *Banksia littoralis* over *Pteridium esculentum, Gastrolobium bilobum, Acacia alata* var. *alata* and *Trymalium floribundum*

Q2: Open forest of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* over *Trymalium floribundum, Gastrolobium bilobum* and other large shrubs on loamy soils.

5.5 Flora Values

57 of the 1486 vascular plant taxa recorded in the wider Southwest Yarragadee project area potentially occur near St John Brook (SJB), Table SJB1 (based on Mattiske Consulting Pty Ltd 2003, with additional data from Mattiske Consulting Pty Ltd 2004a, 2004b, 2005).

Whilst many of these are unlikely to be in the localised fringing vegetation and swamps, a significant number of these species may occur in groundwater dependent ecosystems.

Of these 57 taxon the following taxon are considered to be highly dependent on the availability of regional groundwater (Table SJB1):

- 1 Endangered taxon (pursuant to the EPBC Act 1999)
- No Vulnerable taxon (pursuant to the EPBC Act 1999)
- 1 Rare taxon (pursuant to the Wildlife Conservation Act 1950)
- No Priority 1 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 3 Priority 2 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 4 Priority 3 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 6 Priority 4 taxon (as defined by the Department of Conservation and Land Management 2005a)

Of these 57 taxon the following taxon are considered to be moderately on the availability of regional groundwater (Table SJB1):

- 3 Endangered taxon (pursuant to the EPBC Act 1999)
- 2 Vulnerable taxon (pursuant to the EPBC Act 1999)
- 5 Rare taxon (pursuant to the Wildlife Conservation Act 1950)
- 2 Priority 1 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 2 Priority 2 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 6 Priority 3 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 11 Priority 4 taxon (as defined by the Department of Conservation and Land Management 2005a)

Of these 57 taxon the following taxon are considered to have a low dependency on the availability of regional groundwater (Table SJB1):

- 1 Endangered taxon (pursuant to the EPBC Act 1999)
- 1 Vulnerable taxon (pursuant to the EPBC Act 1999)
- 4 Rare taxon (pursuant to the Wildlife Conservation Act 1950)
- 3 Priority 1 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 3 Priority 2 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 4 Priority 3 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 3 Priority 4 taxon (as defined by the Department of Conservation and Land Management 2005a)

The likelihood of these species being influenced by local changes in groundwater levels is increased if the plants are longer-lived perennial species. In contrast small herbaceous species that are shallow rooted are less likely to be influenced by changes in groundwater as the shallow rooted species tend to be dependent on the seasonal rainfall events which lead to increases in moister soils.

As a result of recent surveys in St John Brook, two Priority species were located within the valley system under consideration, namely:

. *Stylidium barleei* (P3) – this species occurs in both drier and moist sites, so is moderately dependent on the maintenance of regional groundwater levels.

. *Tyrbastes glaucescens* (P4) – this species occurs in the seasonally waterlogged and dry areas, so is moderately dependent on the maintenance of regional groundwater levels..

The other species listed in Table SJB2 and as highlighted (*#*) have been recorded in nearby tributaries and similar environments on the Blackwood Plateau, namely – *Cyathochaeta teretifolia* (P3), *Meeboldina thysanantha* (P3) and *Reedia spathacea* (P4). Of the latter three species, *Reedia spathacea* is unlikely to be present in St John Brook as the soil types are locally different from those in the valley systems further west where this taxon (and its associated proposed threatened ecological community occur).

On the basis of previous studies in different areas within the southwest forest region, local shifts in species and vegetation in response to changes in water availability are reflected over short periods (decades) and therefore on the basis of the predicted drawdowns it is reasonable to predict that there may be some local subtle changes in species composition within the St John Brook catchment as species shift on local scales in response to potential changes in local hydrological site conditions. In view of the nature of the valley system, it is predicted that this impact will be relatively minor along the creekline and on the lower valley slopes near the creekline.

Table SJB1: Summary of Conservation Status of Species on the Blackwood Plateau (Blackwood South (BS) and Blackwood North (BN)), which may occur near St John Brook and the Potential Dependency of Groundwater and Moister Soils

SCC – State Conservation Code (*Wildlife Conservation Act* 1999) and CALM (2005a)
FCC – Federal Conservation Code (*EPBC Act* 1999)
RG – Regional Groundwater
PG – Perched Groundwater
MS – Moister Soils (generally from seasonal rainfall events)
^ - Risk assessment based initially on lifeform and information on habitat preference in relation to regional groundwater
** - denotes taxon were recorded in recent studies (Mattiske Consulting Pty Ltd 2004b)

Genus	Species	SCC	FCC	BS^^	BN^^	RG^	PG^	MS^
Verticordia	*plumosa* var. *vassensis*	R	E		1	H	M	M
Drakaea	*elastica*	R	E		1	M	-	M
Dryandra	*mimica*	R	E		1	M	M	M
Dryandra	*nivea* subsp. *uliginosa*	R	E		1	M	M	M
Caladenia	*huegelii*	R	E	1	1	L	-	M
Drakaea	*micrantha* (ms)	R	V	1	1	M	M	M
Dryandra	*squarrosa* subsp. *argillacea*	R	V		1	M	M	M
Laxmannia	*jamesii*	R	V		1	L	-	L
Grevillea	*brachystylis* subsp. *grandis* (ms)	R			1	L	L	M
Hemigenia	*ramosissima*	R			1	L	-	L
Nemcia	*cordata* (ms)	P1		1	1	M	M	M
Synaphea	?*otiostigma*	P1		1	1	M	M	M
Caladenia	*uliginosa* subsp. *patulens*	P1		1	1	L	L	L
Eucalyptus	*relictua* (ms)	P1			1	L	-	L
Thomasia	*laxiflora*	P1			1	L	-	L
Grevillea	*manglesioides* subsp. *ferricola*	P2			1	H	H	H
Hybanthus	*volubilis*	P2			1	H	H	H
Leptinella	*drummondii*	P2		1	1	H	-	H
Amperea	*micrantha*	P2		1	1	M	L	M
Synaphea	*petiolaris* subsp. *simplex*	P2		1	1	M	M	M
Actinotus	*whicheranus*	P2			1	L	-	L
Leucopogon	*compactus*	P2			1	L	-	L
Leucopogon	*plumuliflorus*	P2			1	L	-	L
Aotus	*cordifolia*	P3			1	H	H	H
Cyathochaeta	*teretifolia*	P3		1	1	H	H	H
Meeboldina	*thysanantha* (ms)	P3		1		H	H	H
Pultenaea	*pinifolia*	P3			1	H	H	H
Acacia	*semitrullata*	P3		1	1	M	M	M
Dampiera	*heteroptera*	P3		1		M	M	M
Hakea	*oldfieldii*	P3			1	M	M	M
Isopogon	*formosus* subsp. *dasylepis*	P3			1	M	M	M
Pultenaea	*radiata*	P3		1	1	M	M	M
Synaphea	*otiostigma*	P3		1	1	M	M	M
Conospermum	*paniculatum*	P3		1	1	L	L	M
Stylidium	*barleei*	P3			**	L	L	M
Chorizema	*reticulatum*	P3		1	1	L	-	L
Thysanotus	*gageoides*	P3			1	L	-	L
Hypocalymma	*cordifolium* subsp. *minus (*ms)	P4			1	H	L	H

Table SJB1: Summary of Conservation Status of Species on the Blackwood Plateau (Blackwood South (BS) and Blackwood North (BN)), which may occur near St John Brook and the Potential Dependency of Groundwater and Moister Soils

SCC – State Conservation Code (*Wildlife Conservation Act* 1999) and CALM (2005a)
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RG – Regional Groundwater
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^ - Risk assessment based initially on lifeform and information on habitat preference in relation to regional groundwater
** - denotes taxon were recorded in recent studies (Mattiske Consulting Pty Ltd 2004b)

Genus	Species	SCC	FCC	BS^^	BN^^	RG^	PG^	MS^
Lambertia	*rariflora* subsp. *rariflora*	P4			1	H	H	H
Melaleuca	*basicephala*	P4		1		H	H	H
Reedia	*spathacea*	P4		1		H	H	H
Tyrbastes	*glaucescens*	P4			**	H	H	H
Villarsia	*submersa*	P4				H	H	H
Acacia	*tayloriana*	P4		1		M	M	M
Caladenia	*arrecta*	P4		1		M	M	M
Caladenia	*plicata*	P4		1	1	M	M	M
Chamelaucium	*erythrochlorum* (ms)	P4		1	1	M	M	M
Drosera	*marchantii* subsp. *marchantii*	P4			1	M	-	M
Eucalyptus	*rudis* subsp. *cratyantha*	P4			1	M	-	M
Grevillea	*drummondii*	P4			1	M	M	M
Pultenaea	*skinneri*	P4		1	1	M	-	M
Stylidium	*plantagineum*	P4		1		M	M	M
Synaphea	*acutiloba*	P4		1	1	M	M	M
Verticordia	*lehmannii*	P4		1	1	M	M	M
Astroloma	sp. Nannup (R.D. Royce 3978) (pn)	P4		1	1	L	L	L
Franklandia	*triaristata*	P4			1	L	-	L
Thysanotus	*glaucus*	P4		1	1	L	-	L

5.6 Recommendations and Offsetting Options

The St John Brook area occurs primarily within State Forest and National Park boundaries supporting native forests. The number of rare and endangered species and communities is relatively low and in view of their regional occurrence any local changes in regional groundwater levels, providing these are not rapid, should have minimal impacts on this valley system.

Several options exist for offsetting any long-term impacts of drawdown in the area. These could include:

1. Contribution to research funding addressing definition of values in the area and also management options for minimising long-term drawdowns by active management of forested catchments.
2. Reviewing options for reducing potential drawdowns through designing different options for water extraction from the Yarragadee system.

Undertake further on-ground investigations to clarify whether the biodiversity values highlighted in the previous text are impacted by the potential long-term drawdown as suggested.

6. POISON GULLY

Poison Gully occurs south of the Blackwood River into which it discharges. The catchment is largely native vegetation and the flows in part are influenced by the proximity of the Brockman Highway.

Poison Gully has a perennial flow in the lower part of the catchment (near the Yarragadee Formation outcropping near Blackwood Road). Localised pools persist in the lower parts of Poison Gully during the year.

The Poison Gully area occurs on the southern sections of the Menzies Botanical District within the SouthWest Botanical Province as defined by Beard (1980). Within this area the biological features were grouped by both vegetation complexes (as defined by Heddle *et al.* 1980 and Mattiske and Havel 1998) and into types of ecosystems.

6.1 Vegetation Complexes

In the Poison Gully area some two vegetation complexes as defined by Heddle *et al.* (1980) and Mattiske and Havel (1998) may potentially support groundwater dependent ecosystems (Appendix C). These vegetation complexes include a range of plant communities on the area that could potentially be groundwater dependent ecosystems. These communities can be subdivided into the following main structural units:

- Upper gullies of the side tributaries supporting woodlands and forests in Bidella (BD), and
- Jalbaragup (JL) on minor drainage lines.

The total risks (0-3 and 3-6) occur primarily in the Jalbaragup vegetation complex and to a lesser extent the wider valleys of the Bidella (BD). Of these the vegetation within the swamps and near the creekline of the Jalbaragup vegetation complex has the highest potential to be influenced by changes in local site conditions. In determining the significance of the potential changes that may occur in local hydrological site conditions the extent will be influenced by seasonal rainfall events and the management of the forest utilisation of the water within the catchments. It is predicted that the width and extent of the creekline and swamp vegetation will shift down the slope and then downstream of these potential changes occur in these systems. The seasonal flows are critical to the vegetation along the creek lines and the local groundwater levels, as well as the fauna species dependent on the maintenance of the water flows and quality in these creek lines. The soil types within these areas are largely sandy soils to sandy-clays and therefore water is able to move rapidly.

6.2 Vegetation Complexes – Potential Risks

In summary the key vegetation complexes that will be potentially influenced by longer-term drawdowns in the area will be:

- Upper gullies of the side tributaries supporting woodlands and forests in Bidella (BD), and
- Jalbaragup (JL) on minor drainage lines.

These vegetation complexes are represented (28.40% and 13.70% respectively in formal reserves – Conservation Commission 2003) in the regional context and therefore at this level of classification the impacts on these types on a regional scale should be minimal (Table 4 in Mattiske Consulting Pty Ltd 2005).

6.3 Threatened Ecological Communities

None of the plant communities described in the survey area are classified as Threatened Ecological Communities as described by English and Blyth (1997, 1999) or listed as Threatened Ecological Communities under the EPBC Act (1999).

6.4 Site-Vegetation Types

The site-vegetation types that dominant the Jalbaragup and the Bidella vegetation complexes include the A1, A2, A3, A4, B1, C1, C4, C5 and D3 types as defined by Mattiske Consulting Pty Ltd (2005). Of these the variants of the "A1, A2, A3, B1 and C1" site-vegetation type are the most likely to be influenced initially by any changes in the local hydrological conditions.

D3: Woodland of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* over *Baeckea camphorosmae, Hypocalymma angustifolium* and *Meeboldina* species.

B1: Low open forest of *Eucalyptus marginata* subsp. *marginata – Corymbia calophylla – Xylomelum occidentale* - *Banksia attenuata* - *Banksia ilicifolia* over *Taxandria parviceps, Hypocalymma angustifolium* and *Acacia extensa* and a range of low shrubs and herbs.

A1: Closed heath of *Taxandria parviceps, Taxandria linearifolia, Hypocalymma angustifolium, Beaufortia sparsa, Hypocalymma cordifolium* and *Acacia divergens* over range of sedges with pockets of *Melaleuca preissiana* and *Banksia littoralis.*

A2: Closed heath of *Melaleuca lateritia* over *Baumea vaginalis, Myriophyllum ?limnophilum* and *Triglochin huegelii.*

A3: Closed heath of *Melaleuca lateritia, Taxandria linearifolia, Hypocalymma angustifolium, Beaufortia sparsa,* over range of sedges with pockets of *Eucalyptus rudis* and *Banksia littoralis*.

A4: Low sedgeland of *Schoenus subfascicularis* to Open Heath of *Acacia pulchella* var. *pulchella, Adenanthos meisneri, Sphaerolobium fornicatum* and *Daviesia decurrens.*

B1: Open woodland of *Banksia attenuata – Banksia ilicifolia – Eucalyptus marginata* subsp. *marginata* over *Taxandria parviceps, Hypocalymma ericifolium, Pultenaea reticulata, Dasypogon bromeliifolius* and *Leucopogon glabellus.*

C1: Open forest of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* - *Eucalyptus patens* over *Trymalium floribundum, Taxandria linearifolia, Taxandria parviceps, Hypocalymma cordifolium, Astartea scoparia* and *Gastrolobium bilobum* over *Baumea vaginalis* and *Lepidosperma gladiatum.*

C4: Open forest of *Corymbia calophylla* - *Eucalyptus patens* - *Banksia littoralis* with occasional *Banksia seminuda* over *Agonis flexuosa, Trymalium floribundum* and *Taxandria linearifolia* over *Bossiaea aquifolium* subsp. *laidlawiana, Lepidosperma gladiatum, Lepidosperma tetraquetrum* and *Baumea vaginalis.*

C5: Open forest of *Eucalyptus rudis – Agonis flexuosa – Melaleuca rhaphiophylla* over patches of *Melaleuca viminea, Astartea scoparia, Taxandria linearifolia* and *Lepidosperma gladiatum, Lepidosperma tetraquetrum* and *Baumea vaginalis.*

Of these site-vegetation types, the variation in the swamp vegetation types (A1 to A4) reflects the significance of the local hydrological soil conditions and the soil types (sands - A1 and A2 versus clays A3 and A4). Of the site-vegetation types as mapped the variants of A, B, C and D and to a lesser degree T and Q occur on seasonally wet to moist soils and therefore may respond to changes in regional groundwater and soil moisture levels. The communities A3 (Pig Swamp) and A4 as defined occur on perched clay soil and are unlikely to be influenced by changes in regional groundwater.

The potential changes if the local hydrological conditions shift to the drier or xeric end of the continuum will be a reduction in size and extent of the swamp (A1 to A2) and creekline fringing vegetation types (C1) and a reduction in the extent of the types on the valley slopes (D3, T1, W1 and Q1). All of these site vegetation types are well-represented in the nearby valley systems and as such at the site-vegetation type level of classification the impacts on these types on a regional scale should be minimal (Table 5 in Mattiske Consulting Pty Ltd 2005).

6.5 Flora Values

61 of the 1486 vascular plant taxa recorded in the wider Southwest Yarragadee project area potentially occur near Poison Gully (PG), Table PG1 (based on Mattiske Consulting Pty Ltd 2003, with additional data from Mattiske Consulting Pty Ltd 2005).

Whilst many of these are unlikely to be in the localised fringing vegetation and swamps, a significant number of these species may occur in groundwater dependent ecosystems.

Of these 61 taxon the following taxon are considered to be highly dependent on the availability of regional groundwater (Table PG1):

. 1 Endangered taxon (pursuant to the EPBC Act 1999)
. No Vulnerable taxon (pursuant to the EPBC Act 1999)
. 1 Rare taxon (pursuant to the Wildlife Conservation Act 1950)
. No Priority 1 taxon (as defined by the Department of Conservation and Land Management 2005a)
. 3 Priority 2 taxon (as defined by the Department of Conservation and Land Management 2005a)
. 4 Priority 3 taxon (as defined by the Department of Conservation and Land Management 2005a)
. 6 Priority 4 taxon (as defined by the Department of Conservation and Land Management 2005a)

Of these 61 taxon the following taxon are considered to be moderately on the availability of regional groundwater (Table PG1):

. 3 Endangered taxon (pursuant to the EPBC Act 1999)
. 2 Vulnerable taxon (pursuant to the EPBC Act 1999)
. 5 Rare taxon (pursuant to the Wildlife Conservation Act 1950)
. 2 Priority 1 taxon (as defined by the Department of Conservation and Land Management 2005a)
. 2 Priority 2 taxon (as defined by the Department of Conservation and Land Management 2005a)
. 10 Priority 3 taxon (as defined by the Department of Conservation and Land Management 2005a)
. 11 Priority 4 taxon (as defined by the Department of Conservation and Land Management 2005a)

Of these 61 taxon the following taxon are considered to have a low dependency on the availability of regional groundwater (Table PG1):

. 1 Endangered taxon (pursuant to the EPBC Act 1999)
. 2 Vulnerable taxon (pursuant to the EPBC Act 1999)
. 5 Rare taxon (pursuant to the Wildlife Conservation Act 1950)
. 3 Priority 1 taxon (as defined by the Department of Conservation and Land Management 2005a)
. 3 Priority 2 taxon (as defined by the Department of Conservation and Land Management 2005a)
. 3 Priority 3 taxon (as defined by the Department of Conservation and Land Management 2005a)
. 3 Priority 4 taxon (as defined by the Department of Conservation and Land Management 2005a)

The likelihood of these species being influenced by local changes in groundwater levels is increased if the plants are longer-lived perennial species. In contrast small herbaceous species that are shallow rooted are less likely to be influenced by changes in groundwater as the shallow rooted species tend to be dependent on the seasonal rainfall events which lead to increases in moister soils.

As a result of recent surveys in Poison Gully, one Rare flora species and six Priority species were located within the valley system under consideration, namely:

- *Daviesia elongata* subsp. *elongata* (Rare) – this taxon occurs on the fringes of the valley system and is unlikely to be influenced by any changes to regional groundwater levels.
- *Cyathochaeta teretifolia* (P3) – this taxon occurred in several of the transects and will be influenced by changes in regional groundwater levels. This species is not restricted to the Poison Gully valley system.
- *Stylidium barleei* (P3) – this taxon occurred in a range of sites and will not be influenced markedly by changes to regional groundwater levels.
- *Gonocarpus pusillus* (P3) - this taxon occurs on the fringes of the valley system and is unlikely to be influenced by any changes to regional groundwater levels.
- *Amperea protensa* (P3) – this taxon was restricted within this valley system and is unlikely to be influenced by changes in regional groundwater levels as it occurs on moister soils on the fringes of the valley systems. This species is not restricted to the Poison Gully valley system.
- *Meeboldina thysanantha* (P3) – this taxon was restricted within this valley system and is unlikely to be influenced by changes in regional groundwater levels as it occurs on moister soils on the fringes of the valley systems. This species is not restricted to the Poison Gully valley system.
- *Cyathochaeta stipoides* (P3) – this taxon was restricted within this valley system and will be influenced by changes in regional groundwater levels. This species is not restricted to the Poison Gully valley system.

As indicated in Table PG2 – a significant number of the species recorded on the six established transects are highly dependent on regional groundwater levels. This in part reflects the variety of soil and site conditions within the valley system (clays to highly leached and course sands) and the extent of the swamps within this valley system (Mattiske Consulting Pty Ltd 2005). As indicated in previous studies the vegetation within these systems forms a continuum with species varying in their tolerance of different site conditions. The latter concept is illustrated in Table PG2, where the species vary in their site tolerances of different environments (including the parameter depth to water table as supplied in Table PG2). These depths to water table were based on data as supplied by the Water Corporation at the time of the 2005 studies by Mattiske Consulting Pty Ltd.

On the basis of previous studies in different areas within the southwest forest region, local shifts in species and vegetation in response to changes in water availability are reflected over short periods (decades) and therefore on the basis of the predicted drawdowns it is reasonable to predict that there may be some local subtle changes in species composition within the Poison Gully catchment as species shift on local scales in response to potential changes in local hydrological site conditions. The exception to this interpretation is the swamp area (A4) in the upper reaches of the valley system, which occurs on an extensive clays with a perched water table. In view of the nature of the valley system, it is predicted that this impact will be largely confined to the swamp area between 200metres or so upstream of Blackwood Road and downstream of Blackwood Road until the C1 site-vegetation type is replaced by C4 site-vegetation type. The data as presented in Table PG2 should assist in this initial monitoring of shifts.

Table PG1: Summary of Conservation Status of Species on the Blackwood Plateau (Blackwood South (BS) and Blackwood North (BN)), which may occur near Poison Gully and the Potential Dependency of Groundwater and Moister Soils

SCC – State Conservation Code (*Wildlife Conservation Act* 1999) and CALM (2005a)
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MS – Moister Soils (generally from seasonal rainfall events)
^ - Risk assessment based initially on lifeform and information on habitat preference in relation to regional groundwater
- denotes number of quadrats that taxon were recorded in recent studies (Mattiske Consulting Pty Ltd 2005)

Genus	Species	SCC	FCC	BS^^	BN^^	RG^	PG^	MS^
Verticordia	*plumosa* var. *vassensis*	R	E		1	H	M	M
Drakaea	*elastica*	R	E		1	M	-	M
Dryandra	*mimica*	R	E		1	M	M	M
Dryandra	*nivea* subsp. *uliginosa*	R	E		1	M	M	M
Caladenia	*huegelii*	R	E	1	1	L	-	M
Drakaea	*micrantha* (ms)	R	V	1	1	M	M	M
Dryandra	*squarrosa* subsp. *argillacea*	R	V		1	M	M	M
Laxmannia	*jamesii*	R	V		1	L	-	L
Daviesia	*elongata subsp. elongata*	R	V	*1*		L	-	M
Grevillea	*brachystylis* subsp. *grandis* (ms)	R			1	L	L	M
Hemigenia	*ramosissima*	R			1	L	-	L
Nemcia	*cordata* (ms)	P1		1	1	M	M	M
Synaphea	?*otiostigma*	P1		1	1	M	M	M
Caladenia	*uliginosa* subsp. *patulens*	P1		1	1	L	L	L
Eucalyptus	*relictua* (ms)	P1			1	L	-	L
Thomasia	*laxiflora*	P1			1	L	-	L
Grevillea	*manglesioides* subsp. *ferricola*	P2			1	H	H	H
Hybanthus	*volubilis*	P2			1	H	H	H
Leptinella	*drummondii*	P2		1	1	H	-	H
Amperea	*micrantha*	P2		1	1	M	L	M
Synaphea	*petiolaris* subsp. *simplex*	P2		1	1	M	M	M
Actinotus	*whicheranus*	P2			1	L	-	L
Leucopogon	*compactus*	P2			1	L	-	L
Leucopogon	*plumuliflorus*	P2			1	L	-	L
Aotus	*cordifolia*	P3			1	H	H	H
Cyathochaeta	*teretifolia*	P3		*10*	*2*	H	H	H
Cyathochaeta	*stipoides*	P3		*1*		H	H	H
Pultenaea	*pinifolia*	P3			1	H	H	H
Meeboldina	*thysanantha* (ms)	P3		*2*		M	M	H
Amperea	*protensa*	P3		*1*		M	-	H
Acacia	*semitrullata*	P3		1	1	M	M	M
Conospermum	*paniculatum*	P3		1	*1*	M	M	M
Dampiera	*heteroptera*	P3		1		M	M	M
Hakea	*oldfieldii*	P3			1	M	M	M
Isopogon	*formosus* subsp. *dasylepis*	P3			1	M	M	M
Pultenaea	*radiata*	P3		1	1	M	M	M
Stylidium	*barleei*	P3		*1*	*2*	M	M	M

Table PG1: Summary of Conservation Status of Species on the Blackwood Plateau (Blackwood South (BS) and Blackwood North (BN)), which may occur near Rosa Brook and the Potential Dependency of Groundwater and Moister Soils

SCC – State Conservation Code (*Wildlife Conservation Act* 1999) and CALM (2005a)
FCC – Federal Conservation Code (*EPBC Act* 1999)
RG – Regional Groundwater
PG – Perched Groundwater
MS – Moister Soils (generally from seasonal rainfall events)
^ - Risk assessment based initially on lifeform and information on habitat preference in relation to regional groundwater
- denotes number of quadrats that taxon were recorded in recent studies (Mattiske Consulting Pty Ltd 2005)

Genus	Species	SCC	FCC	BS^^	BN^^	RG^	PG^	MS^
Synaphea	*otiostigma*	P3		1	1	M	M	M
Chorizema	*reticulatum*	P3		1	1	L	-	L
Gonocarpus	*pusillus*	P3		*1*		L	-	L
Thysanotus	*gageoides*	P3			1	L	-	L
Hypocalymma	*cordifolium* subsp. *minus (*ms)	P4			1	H	L	H
Lambertia	*rariflora* subsp. *rariflora*	P4			1	H	H	H
Melaleuca	*basicephala*	P4		1		H	H	H
Reedia	*spathacea*	P4		*2*		H	H	H
Tyrbastes	*glaucescens*	P4				H	H	H
Villarsia	*submerse*	P4				H	H	H
Acacia	*tayloriana*	P4		1		M	M	M
Caladenia	*arrecta*	P4		1		M	M	M
Caladenia	*plicata*	P4		1	1	M	M	M
Chamelaucium	*erythrochlorum* (ms)	P4		1	1	M	M	M
Drosera	*marchantii* subsp. *marchantii*	P4			1	M	-	M
Eucalyptus	*rudis* subsp. *cratyantha*	P4			1	M	-	M
Grevillea	*drummondii*	P4			1	M	M	M
Pultenaea	*skinneri*	P4		1	1	M	-	M
Stylidium	*plantagineum*	P4		1		M	M	M
Synaphea	*acutiloba*	P4		1	1	M	M	M
Verticordia	*lehmannii*	P4		1	1	M	M	M
Astroloma	sp. Nannup (R.D. Royce 3978) (pn)	P4		1	1	L	L	L
Franklandia	*triaristata*	P4			1	L	-	L
Thysanotus	*glaucus*	P4		1	1	L	-	L

Table PG2: Summary of Species Preferences for Different Site Preferences at Poison Gully

^ - Risk assessment based initially on potential dependency on regional groundwater, lifeform and habitat preference

Species	Risk^ RG	<1M RB	1-3M RB	>3M RB
Species largely Dependent on Wetter Sites				
Schoenus efoliatus	H	12	1	
Taxandria linearifolia (ms)	H	17	5	
Cyathochaeta teretifolia P3	H	32	17	15
Astartea scoparia	H	17	4	3
Callistemon glaucus	H	16	1	2
Empodisma gracillimum	H	15	2	
Beaufortia sparsa	H	11	2	2
Taxandria fragrans (ms)	H	9	2	3
Siloxerus filifolius	H	3		
Bossiaea rufa	H	2	1	
Chorizandra enodis	H	2		
Leucopogon distans subsp. *distans* (ms)	H	2		
Pimelea lehmanniana subsp. *?nervosa*	H	1		
Acacia pulchella var. *glaberrima*	H	1		
Andersonia micrantha	H	1		
Aotus sp.Scott River(K.F.Kenneally 2371)	H	1		
Banksia littoralis	H	1		
Cosmelia rubra	H	1		
Cyathochaeta stipoides P3	H	1		
Hodgsoniola junciformis	H	1		
Lycopodiella serpentine	H	1		
Scaevola calliptera	M	9	2	3
Kunzea recurve	M	7		3
Drosera pulchella	M	3	1	
Stylidium ciliatum	M	2	1	
Centrolepis inconspicua	M	2		
Drosera bulbosa	M	1		
Isolepis stellata	M	1		
Monotaxis occidentalis	M	1		
Tricoryne humilis	M	1		
Species largely Dependent on Moister Sites				
Xanthorrhoea preissii	M	12	3	9
Gastrolobium cuneatum	M	9	10	
Leucopogon australis	M	7	5	3
Dodonaea viscosa subsp. *angustissima*	M	6	7	
Stylidium barleei P3	M	5	4	4
Tetraria capillaris	M	4	5	4
Melaleuca preissiana	M	4	4	1
Cyathochaeta avenacea	M	3	5	
Eucalyptus rudis	M	2	3	
Mesomelaena graciliceps	M	2	2	
Tetraria octandra	M	1	3	1
Hakea varia	M	1	3	
Mirbelia dilatata	M	1	3	
Lepidosperma pubisquameum	M	1	2	
Meeboldina decipiens subsp. *depilata* (ms)	M	1	2	

Table PG2: Summary of Species Preferences for Different Site Preferences at Poison Gully

^ - Risk assessment based initially on potential dependency on regional groundwater, lifeform and habitat preference

Species	Risk^ RG	<1M RB	1-3M RB	>3M RB
Species largely Dependent on Moister Sites				
Acacia applanata	M	1	1	
Acacia pulchella	M	1	1	
Hovea chorizemifolia	M		2	1
Persoonia saccata	M		2	1
Hibbertia amplexicaulis	M		2	
Meeboldina thysanantha (ms) P3	M		2	
Leptocarpus tenax	M		2	
Nuytsia floribunda	M		1	1
Amperea protensa P3	M		1	
Deyeuxia quadriseta var. *quadriseta*	M		1	
Gonocarpus ?hexandrus	M		1	
Hakea amplexicaulis	M		1	
Hypocalymma angustifolium	M		1	
Ricinocarpos glaucus	M		1	
Tetraria ?octandra	M		1	
Viminaria juncea	M		1	
Levenhookia pusilla	L	4	2	3
Caesia micrantha	L	2	5	
Tetrarrhena laevis	L	1	4	2
Anigozanthos flavidus	L	1	2	
Stylidium spathulatum	L	1	4	
Stylidium aff. piliferum	L	1	1	
Platysace filiformis	L		2	1
Pimelea hispida	L		2	
Trichocline spathulata	L		2	
Drosera stolonifera subsp. *stolonifera*	L		1	
Kennedia microphylla	L		1	
Lobelia alata	L		1	
Orthrosanthus laxus var. *laxus*	L		1	
Species largely Dependent on Drier Sites				
Dasypogon bromeliifolius	L	19	9	62
Anarthria scabra	L	17	10	56
Hypolaena exsulca	L	17	3	27
Anarthria prolifera	L	15	10	51
Adenanthos obovatus	L	15	6	26
Lyginia imberbis	L	14		24
Pultenaea reticulata	L	9	6	23
Actinotus glomeratus	L	12	2	24
Melaleuca thymoides	L	8	3	46
Taxandria parviceps (ms)	L	10	3	24
Drosera sp. (climbing)	L	6	6	30
Adenanthos meisneri	L	5	6	38
Sphenotoma gracile	L	5	2	7
Lomandra nigricans	L	5		22
Lomandra caespitosa	L	5		9

Table PG2: Summary of Species Preferences for Different Site Preferences at Poison Gully

^ - Risk assessment based initially on potential dependency on regional groundwater, lifeform and habitat preference

Species	Risk^ RG	<1M RB	1-3M RB	>3M RB
Species largely Dependent on Drier Sites	L			
Dampiera linearis	L	4	2	61
Lomandra sonderi	L	4		15
Drosera erythrorhiza	L	4		8
Sphaerolobium fornicatum	L	4		8
Acacia pulchella var. *pulchella*	L	3	7	26
Eucalyptus marginata subsp. *marginata*	L	3	6	25
Leucopogon glabellus	L	3	5	37
Trachymene pilosa	L	3	4	67
Stylidium scandens	L	3	4	31
Hypocalymma robustum	L	3	3	18
Bossiaea praetermissa	L	3	2	8
Cassytha pomiformis	L	4		4
Schoenus subfascicularis	L	3		49
Billardiera variifolia	L	3		15
Lindsaea linearis	L	2	6	19
Desmocladus fasciculatus	L	2	3	22
Phlebocarya ciliata	L	2	2	25
Chamaescilla corymbosa	L	2	1	44
Leucopogon distans subsp. *contractus* (ms)	L	2	1	25
Stylidium luteum subsp. *luteum*	L	2		7
Persoonia longifolia	L	3	1	3
Cassytha glabella forma *casuarinae*	L	2	1	3
Podocarpus drouynianus	L	1	4	19
Allocasuarina fraseriana	L	1	3	25
Amperea simulans	L	1	3	6
Jacksonia horrida	L	1	2	25
Conostylis setigera subsp. *setigera*	L	1	2	6
Lepidosperma squamatum	L	1		9
Prasophyllum aff. *parvifolium* (earlier flowering variant)	L	1		9
Laxmannia sessiliflora subsp. *australis*	L	1		5
Haemodorum spicatum	L	1		3
Pimelea longiflora subsp. *longiflora*	L	1		3
Phyllangium paradoxum	L	1		2
Drosera platystigma	L	1		1
Andersonia aristata	L		4	6
Lomandra spartea	L		4	6
Xylomelum occidentale	L		3	11
Gompholobium confertum	L		3	5
Corymbia calophylla	L		2	4
Tetratheca setigera	L		1	33
Acacia stenoptera	L		1	26
Conostephium pendulum	L		1	24
Petrophile linearis	L		1	12
Boronia spathulata	L		1	10
Hovea trisperma	L		1	8
Logania serpyllifolia subsp. *angustifolia*	L		1	3
Pentapeltis peltigera	L		1	3

Table PG2: Summary of Species Preferences for Different Site Preferences at Poison Gully

^ - Risk assessment based initially on potential dependency on regional groundwater, lifeform and habitat preference

Species	Risk^ RG	<1M RB	1-3M RB	>3M RB
Species largely Dependent on Drier Sites	L			
Boronia fastigiate	L		1	2
Eriochilus dilatatus	L		1	2
Hypocalymma ericifolium	L			36
Hibbertia glomerate	L			20
Stylidium luteum subsp. *glaucifolium*	L			19
Conostylis serrulata/laxiflora	L			15
Darwinia vestita	L			14
Hibbertia quadricolor	L			14
Loxocarya cinerea	L			14
Xanthosia tasmanica	L			14
Calytrix flavescens	L			13
Daviesia rhombifolia	L			13
Hibbertia pilosa	L			12
Banksia attenuate	L			10
Gompholobium polymorphum	L			10
Daviesia decurrens	L			9
Dryandra lindleyana	L			9
Isopogon sphaerocephalus	L			9
Sphaerolobium drummondii	L			9
Pyrorchis nigricans	L			8
Stylidium repens	L			8
Billardiera laxiflora	L			7
Banksia grandis	L			6
Daviesia cordata	L			6
Hibbertia ?ferruginea	L			6
Pimelea ?imbricata var. *piligera*	L			6
Schoenus sublateralis	L			6
Comesperma ciliatum	L			5
Lomandra hermaphrodita	L			5
Neurachne alopecuroidea	L			5
Pithocarpa pulchella var. *melanostigma*	L			5
Thysanotus manglesianus/patersonii	L			5
Amphipogon setaceus	L			4
Bossiaea ornata	L			4
Daviesia physodes	L			4
Gompholobium tomentosum	L			4
Gonocarpus pusillus P3	L			4
Leptomeria cunninghamii	L			4
Leucopogon racemulosus	L			4
Olax benthamiana	L			4
Patersonia occidentalis	L			4
Stylidium diversifolium	L			4
Banksia ilicifolia	L			3
Gompholobium scabrum	L			3
Hakea ruscifolia	L			3
Hibbertia spicata subsp. *spicata*	L			3
Acacia extensa	L			2

Table PG2: Summary of Species Preferences for Different Site Preferences at Poison Gully

^ - Risk assessment based initially on potential dependency on regional groundwater, lifeform and habitat preference

Species	Risk^ RG	<1M RB	1-3M RB	>3M RB
Species largely Dependent on Drier Sites	L			
Comesperma virgatum	L			2
Latrobea diosmifolia	L			2
Leporella fimbriata	L			2
Lomandra ?sonderi	L			2
Opercularia hispidula	L			2
Persoonia elliptica	L			2
Pimelea ?lehmanniana subsp. *nervosa*	L			2
Acacia browniana var. *browniana*	L			1
Acidonia microcarpa	L			1
Boronia crenulata subsp. *pubescens*	L			1
Burchardia umbellata	L			1
Chorizema retrorsum	L			1
Conospermum capitatum	L			1
Conostylis serrulata	L			1
Daviesia elongata subsp. *elongata* R	L			1
Drosera ?menziesii	L			1
Gompholobium ovatum	L			1
Gompholobium preissii	L			1
Hibbertia acerosa	L			1
Johnsonia lupulina	L			1
Logania serpyllifolia subsp. *serpyllifolia*	L			1
Lomandra micrantha subsp. *micrantha*	L			1
Macrozamia riedlei	L			1
Persoonia graminea	L			1
Petrophile acicularis	L			1
Philotheca spicata	L			1
Platysace compressa	L			1
Platysace tenuissima	L			1
Pterostylis vittata	L			1
Sphaerolobium medium	L			1
Stackhousia monogyna	L			1
Stirlingia simplex	L			1
Stylidium amoenum	L			1
Stylidium schoenoides	L			1
Tetratheca hirsuta	L			1
Thysanotus pseudojunceus	L			1
Xanthorrhoea gracilis	L			1
Xanthosia candida	L			1
Xyris gracillima	L			1

6.6 Recommendations and Offsetting Options

The Poison Gully area occurs primarily within State Forest supporting native vegetation. The number of rare and priority species and communities is slightly higher than in the tributaries to the north of the Blackwood River. The latter differences in part reflect the local rapid changes in the swamp vegetation types along Poison Gully. Any local changes in regional groundwater levels, providing these are not rapid, should been confined to the swamp areas near Blackwood Road within this valley system.

Several options exist for offsetting any long-term impacts of drawdown in the area. These could include:

1. Contribution to research funding addressing definition of values in the area and also management options for minimising long-term drawdowns by active management of forested catchments.
2. Reviewing options for reducing potential drawdowns through designing different options for water extraction from the Yarragadee system.
3. Undertake further on-ground investigations to clarify whether the biodiversity values highlighted in the previous text are impacted by the potential long-term drawdown as suggested.

7. MILYEANNUP BROOK

Milyeannup Brook occurs south of the Blackwood River into which it discharges. The catchment is largely native vegetation and the flows in part are influenced by the proximity of the Brockman Highway.

Milyeannup Brook has a perennial flow in the lower part of the catchment (near the Yarragadee Formation oucropping near Brockman Highway). Localised pools persist in the lower parts of the Milyeannup Brook during the year.

The Milyeannup Brook area occurs on the southern sections of the Menzies Botanical District within the SouthWest Botanical Province as defined by Beard (1980). Within this area the biological features were grouped by both vegetation complexes (as defined by Heddle *et al.* 1980 and Mattiske and Havel 1998) and into types of ecosystems.

7.1 Vegetation Complexes

In the Milyeannup Brook area some two vegetation complexes as defined by Heddle *et al.* (1980) and Mattiske and Havel (1998) may potentially support groundwater dependent ecosystems (Appendix C). These vegetation complexes include a range of plant communities on the area that could potentially be groundwater dependent ecosystems. These communities can be subdivided into the following main structural units:

- Upper gullies of the side tributaries supporting woodlands and forests in Bidella (BD), and
- Jalbaragup (JL) on minor drainage lines.

The total risks (0-3 and 3-6) occur primarily in the Jalbaragup vegetation complex and to a lesser extent the wider valleys of the Bidella (BD). Of these the vegetation within the swamps and near the creekline of the Jalbaragup vegetation complex have the highest potential to be influenced by changes in local site conditions. In determining the significance of the potential changes that may occur in local hydrological site conditions the extent will be influenced by seasonal rainfall events and the management of the forest utilisation of the water within the catchments. It is predicted that the width and extent of the creekline and swamp vegetation will shift down the slope and then downstream of these potential changes occur in these systems. The seasonal flows are critical to the vegetation along the creek lines and the local groundwater levels, as well as the fauna species dependent on the maintenance of the water flows and quality in these creek lines. The soil types within these areas are largely sandy soils to sandy-clays and therefore water is able to move rapidly.

7.2 Vegetation Complexes – Potential Risks

In summary the key vegetation complexes that will be potentially influenced by longer-term drawdowns in the area will be:

- Upper gullies of the side tributaries supporting woodlands and forests in Bidella (BD), and
- Jalbaragup (JL) on minor drainage lines.

These vegetation complexes are represented (28.40% and 13.70% respectively in formal reserves – Conservation Commission 2003) in the regional context and therefore at this level of classification the impacts on these types on a regional scale should be minimal (Table 4 in Mattiske Consulting Pty Ltd 2005).

7.3 Threatened Ecological Communities

None of the plant communities described in the survey area are classified as Threatened Ecological Communities as described by English and Blyth (1997, 1999) or listed as Threatened Ecological Communities under the EPBC Act (1999).

7.4 Site-Vegetation Types

The site-vegetation types that dominant the Jalbaragup and the Bidella vegetation complexes include the C1, C4, C5, D1 and W1 types as defined by Mattiske Consulting Pty Ltd (2005). Of these the variants of the "C1 and C4" site-vegetation type are the most likely to be influenced initially by any changes in the local hydrological conditions.

D1: Low open forest of *Banksia attenuata – Eucalyptus marginata* subsp. *marginata* over *Taxandria parviceps, Mesomelaena tetragona, Hakea ruscifolia, Melaleuca thymoides* and a range of low shrubs and herbs.

C1: Open forest of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* - *Eucalyptus patens* over *Trymalium floribundum, Taxandria linearifolia, Taxandria parviceps, Hypocalymma cordifolium, Astartea scoparia* and *Gastrolobium bilobum* over *Baumea vaginalis* and *Lepidosperma gladiatum.*

C4: Open forest of *Corymbia calophylla - Eucalyptus patens* - *Banksia littoralis* with occasional *Banksia seminuda* over *Agonis flexuosa, Trymalium floribundum* and *Taxandria linearifolia* over *Bossiaea aquifolium* subsp. *laidlawiana, Lepidosperma gladiatum, Lepidosperma tetraquetrum* and *Baumea vaginalis*.

C5: Open forest of *Eucalyptus rudis – Agonis flexuosa – Melaleuca rhaphiophylla* over patches of *Melaleuca viminea, Astartea scoparia, Taxandria linearifolia* and *Lepidosperma gladiatum, Lepidosperma tetraquetrum* and *Baumea vaginalis.*

W1: Open forest of *Eucalyptus marginata* subsp. *marginata* - *Corymbia calophylla* - *Eucalyptus patens* over *Pteridium esculentum* and *Acacia alata* var. *alata*.

Of these site-vegetation types, the variants of C, D and W and to a lesser degree T and Q occur on seasonally wet to moist soils and therefore may respond to changes in regional groundwater and soil moisture levels. The community C1 is the site-vegetation type that is most likely to be influenced by changes in regional groundwater.

The potential changes if the local hydrological conditions shift to the drier or xeric end of the continuum will be a reduction in size and extent of the creekline fringing vegetation types (C1) and a reduction in the extent of the types on the valley slopes (D1, W1 and T1). All of these site vegetation types are well-represented in the nearby valley systems and as such at the site-vegetation type level of classification the impacts on these types on a regional scale should be minimal (Table 5 in Mattiske Consulting Pty Ltd 2005).

7.5 Flora Values

62 of the 1486 vascular plant taxa recorded in the wider Southwest Yarragadee project area potentially occur near Milyeannup Brook (ML), Table ML1 (based on Mattiske Consulting Pty Ltd 2003, with additional data from Mattiske Consulting Pty Ltd 2005).

Whilst many of these are unlikely to be in the localised fringing vegetation and swamps, a significant number of these species may occur in groundwater dependent ecosystems.

Of these 62 taxon the following taxon are considered to be highly dependent on the availability of regional groundwater (Table ML1):

- 1 Endangered taxon (pursuant to the EPBC Act 1999)
- No Vulnerable taxon (pursuant to the EPBC Act 1999)
- 1 Rare taxon (pursuant to the Wildlife Conservation Act 1950)
- No Priority 1 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 3 Priority 2 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 4 Priority 3 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 5 Priority 4 taxon (as defined by the Department of Conservation and Land Management 2005a)

Of these 62 taxon the following taxon are considered to be moderately on the availability of regional groundwater (Table ML1):

- 3 Endangered taxon (pursuant to the EPBC Act 1999)
- 2 Vulnerable taxon (pursuant to the EPBC Act 1999)
- 5 Rare taxon (pursuant to the Wildlife Conservation Act 1950)
- 2 Priority 1 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 2 Priority 2 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 10 Priority 3 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 12 Priority 4 taxon (as defined by the Department of Conservation and Land Management 2005a)

Of these 62 taxon the following taxon are considered to have a low dependency on the availability of regional groundwater (Table ML1):

- 1 Endangered taxon (pursuant to the EPBC Act 1999)
- 2 Vulnerable taxon (pursuant to the EPBC Act 1999)
- 5 Rare taxon (pursuant to the Wildlife Conservation Act 1950)
- 3 Priority 1 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 3 Priority 2 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 4 Priority 3 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 4 Priority 4 taxon (as defined by the Department of Conservation and Land Management 2005a)

The likelihood of these species being influenced by local changes in groundwater levels is increased if the plants are longer-lived perennial species. In contrast small herbaceous species that are shallow rooted are less likely to be influenced by changes in groundwater as the shallow rooted species tend to be dependent on the seasonal rainfall events which lead to increases in moister soils.

As a result of recent surveys in Milyeannup Brook, four Priority species were located within the valley system under consideration, namely:

- *Boronia ?crenulata* var. *angustifolia* (P4) - this taxon occurs on the fringes of the valley system and is unlikely to be influenced by any changes to regional groundwater levels.
- *Cyathochaeta teretifolia* (P3) – this taxon occurred in several of the transects and may be influenced by changes in regional groundwater levels. This species is not restricted to the Milyeannup Brook valley system and on this transect it was recorded on the valley slopes.
- *Tyrbastes glaucescens* (P4) – this species occurs in the seasonally waterlogged and dry areas, so is moderately dependent on the maintenance of regional groundwater levels..
- *Meeboldina thysanantha* (P3) – this taxon was restricted within this valley system and is unlikely to be influenced by changes in regional groundwater levels as it occurs on moister soils on the fringes of the valley systems. This species is not restricted to the Poison Gully valley system.

As indicated in Table ML2 – only a small number of the species recorded on the four established transects are highly dependent on regional groundwater levels. This in part reflects the narrow width of the creekline vegetation (Mattiske Consulting Pty Ltd 2005). As indicated in previous studies the vegetation within these systems forms a continuum with species varying in their tolerance of different site conditions. The latter concept is illustrated in Table ML2, where the species vary in their site tolerances of different environments (including the parameter depth to water table as supplied in Table ML2. These depths to water table were based on data as supplied by the Water Corporation at the time of the 2005 studies by Mattiske Consulting Pty Ltd.

On the basis of previous studies in different areas within the southwest forest region, local shifts in species and vegetation in response to changes in water availability are reflected over short periods (decades) and therefore on the basis of the predicted drawdowns it is reasonable to predict that there may be some local subtle changes in species composition within the Milyeannup Brook catchment as species shift on local scales in response to potential changes in local hydrological site conditions. In view of the nature of the valley system, it is predicted that this impact will be relatively minor along the creekline and on the lower valley slopes near the creekline. The data as presented in Table ML2 should assist in this initial monitoring of shifts.

Table ML1: Summary of Conservation Status of Species on the Blackwood Plateau (Blackwood South (BS) and Blackwood North (BN)), which may occur near Milyeannup Brook and the Potential Dependency of Groundwater and Moister Soils

SCC – State Conservation Code (*Wildlife Conservation Act* 1999) and CALM (2005a)
FCC – Federal Conservation Code (*EPBC Act* 1999)
RG – Regional Groundwater:
PG – Perched Groundwater
MS – Moister Soils (generally from seasonal rainfall events)
^ - Risk assessment based initially on lifeform and information on habitat preference in relation to regional groundwater
- denotes number of quadrats that taxon were recorded in recent studies (Mattiske Consulting Pty Ltd 2005)

Genus	Species	SCC	FCC	BS^^	BN^^	RG^	PG^	MS^
Verticordia	*plumosa* var. *vassensis*	R	E		1	H	M	M
Drakaea	*elastica*	R	E		1	M	-	M
Dryandra	*mimica*	R	E		1	M	M	M
Dryandra	*nivea* subsp. *uliginosa*	R	E		1	M	M	M
Caladenia	*huegelii*	R	E	1	1	L	-	M
Drakaea	*micrantha* (ms)	R	V	1	1	M	M	M
Dryandra	*squarrosa* subsp. *argillacea*	R	V		1	M	M	M
Laxmannia	*jamesii*	R	V		1	L	-	L
Daviesia	*elongata subsp. elongata*	R	V	*1*		L	-	M
Grevillea	*brachystylis* subsp. *grandis* (ms)	R			1	L	L	M
Hemigenia	*ramosissima*	R			1	L	-	L
Nemcia	*cordata* (ms)	P1		1	1	M	M	M
Synaphea	?*otiostigma*	P1		1	1	M	M	M
Caladenia	*uliginosa* subsp. *patulens*	P1		1	1	L	L	L
Eucalyptus	*relictua* (ms)	P1			1	L	-	L
Thomasia	*laxiflora*	P1			1	L	-	L
Grevillea	*manglesioides* subsp. *ferricola*	P2			1	H	H	H
Hybanthus	*volubilis*	P2			1	H	H	H
Leptinella	*drummondii*	P2		1	1	H	-	H
Amperea	*micrantha*	P2		1	1	M	L	M
Synaphea	*petiolaris* subsp. *simplex*	P2		1	1	M	M	M
Actinotus	*whicheranus*	P2			1	L	-	L
Leucopogon	*compactus*	P2			1	L	-	L
Leucopogon	*plumuliflorus*	P2			1	L	-	L
Aotus	*cordifolia*	P3			1	H	H	H
Cyathochaeta	*teretifolia*	P3		*10*	*2*	H	H	H
Cyathochaeta	*stipoides*	P3		*1*		H	H	H
Pultenaea	*pinifolia*	P3			1	H	H	H
Meeboldina	*thysanantha* (ms)	P3		*2*		M	H	H
Amperea	*protensa*	P3		*1*		M	-	H
Acacia	*semitrullata*	P3		1	1	M	M	M
Conospermum	*paniculatum*	P3		1	*1*	M	M	M
Dampiera	*heteroptera*	P3		1		M	M	M
Hakea	*oldfieldii*	P3			1	M	M	M
Isopogon	*formosus* subsp. *dasylepis*	P3			1	M	M	M
Pultenaea	*radiata*	P3		1	1	M	M	M
Stylidium	*barleei*	P3		*1*	*2*	M	M	M

Table ML1: Summary of Conservation Status of Species on the Blackwood Plateau (Blackwood South (BS) and Blackwood North (BN)), which may occur near Milyeannup Brook and the Potential Dependency of Groundwater and Moister Soils

SCC – State Conservation Code (*Wildlife Conservation Act* 1999) and CALM (2005a)
FCC – Federal Conservation Code (*EPBC Act* 1999)
RG – Regional Groundwater
PG – Perched Groundwater
MS – Moister Soils (generally from seasonal rainfall events)
^ - Risk assessment based initially on lifeform and information on habitat preference in relation to regional groundwater
- denotes number of quadrats that taxon were recorded in recent studies (Mattiske Consulting Pty Ltd 2005)

Genus	Species	SCC	FCC	BS^^	BN^^	RG^	PG^	MS^
Synaphea	*otiostigma*	P3		1	1	M	M	M
Chorizema	*reticulatum*	P3		1	1	L	-	L
Gonocarpus	*pusillus*	P3		*1*		L	-	L
Thysanotus	*gageoides*	P3			1	L	-	L
Hypocalymma	*cordifolium* subsp. *minus (*ms)	P4			1	H	L	H
Lambertia	*rariflora* subsp. *rariflora*	P4			1	H	H	H
Melaleuca	*basicephala*	P4		1		H	H	H
Reedia	*spathacea*	P4		*2*		H	H	H
Villarsia	*submersa*	P4				H	H	H
Tyrbastes	*glaucescens*	P4				M	H	H
Acacia	*tayloriana*	P4		1		M	M	M
Caladenia	*arrecta*	P4		1		M	M	M
Caladenia	*plicata*	P4		1	1	M	M	M
Chamelaucium	*erythrochlorum* (ms)	P4		1	1	M	M	M
Drosera	*marchantii* subsp. *marchantii*	P4			1	M	-	M
Eucalyptus	*rudis* subsp. *cratyantha*	P4			1	M	-	M
Grevillea	*drummondii*	P4			1	M	M	M
Pultenaea	*skinneri*	P4		1	1	M	-	M
Stylidium	*plantagineum*	P4		1		M	M	M
Synaphea	*acutiloba*	P4		1	1	M	M	M
Verticordia	*lehmannii*	P4		1	1	M	M	M
Astroloma	sp. Nannup (R.D. Royce 3978) (pn)	P4		1	1	L	L	L
Franklandia	*triaristata*	P4			1	L	-	L
Boronia	*?crenulata var. angustifolia*	P4		*1*		L	-	L
Thysanotus	*glaucus*	P4		1	1	L	-	L

Table ML2: Summary of Species Preferences for Different Site Preferences at Milyeannup Brook

^ - Risk assessment based initially on potential dependency on regional groundwater, lifeform and habitat preference

Species	Risk^ RG	<1M RG	1-3M RG	>3M RG
Species largely Dependent on Wetter Sites				
Astartea scoparia	H	2		
Baumea vaginalis	H	2		
Taxandria linearifolia (ms)	H	3	1	
Boronia denticulata	H	2	1	1
Astartea leptophylla	H	1		
Banksia littoralis	H	1		
Gonocarpus hexandrus subsp. *integrifolius*	H	1		
Isotropis cuneifolia subsp. *cuneifolia*	M	1		
Lepidosperma effusum	M	1		
Lomandra integra	M	1		
Species largely Dependent on Moister Sites				
Trymalium floribundum	M-H	4	11	11
Banksia seminuda	M-H	4	10	10
Tremandra diffusa	M-H	2	9	8
Petrophile diversifolia	M-H	2	7	3
Stylidium rhynchocarpum	M	2	8	6
Mirbelia dilatata	M	2	6	6
Pteridium esculentum	M	1	6	3
Lepidosperma gladiatum	M	1	5	4
Tyrbastes glaucescens P4	M	2	4	9
Thysanotus dichotomus	M		6	4
Grevillea diversifolia subsp. *diversifolia*	M		2	2
Cyathochaeta avenacea	M		2	1
Hemigenia rigida	M		2	
Meeboldina decipiens	M		4	4
Agonis flexuosa	M		4	2
Adenanthos barbiger subsp. *intermedius* (ms)	M		2	3
Hypocalymma cordifolium	M		2	3
Lyginia imberbis	M		2	3
Astroloma ciliatum	M		1	1
Calytrix flavescens	M		1	
Gastrolobium ebracteolatum	M		1	
Hibbertia lasiopus	M		1	
Meeboldina thysanantha (ms) P3	M		1	
Pimelea spectabilis	M		1	
Platysace filiformis	L		9	5
Orthrosanthus laxus var. *laxus*	L		5	3
Anigozanthos flavidus	L		2	3
Drosera stolonifera subsp. *stolonifera*	L		1	1
Thelymitra crinite	L		1	1
Agrostocrinum scabrum	L		1	
Burchardia umbellate	L		1	
Lyperanthus serratus	L		1	

Table ML2: Summary of Species Preferences for Different Site Preferences at Milyeannup Brook

^ - Risk assessment based initially on potential dependency on regional groundwater, lifeform and habitat preference

Species	Risk^ RG	<1M RG	1-3M RG	>3M RG
Species largely Dependent on Drier Sites				
Hovea elliptica	L	9	13	29
Corymbia calophylla	L	4	14	31
Acacia browniana var. *browniana*	L	4	13	27
Hakea lasianthoides	L	4	11	18
Patersonia occidentalis	L	4	5	34
Tetraria capillaris	L	3	11	25
Leucopogon verticillatus	L	3	1	15
Loxocarya cinerea	L	2	17	61
Leucopogon australis	L	2	11	25
Hibbertia amplexicaulis	L	2	8	34
Tetrarrhena laevis	L	2	8	25
Lepidosperma gracile	L	2	7	9
Desmocladus fasciculatus	L	2	3	36
Opercularia hispidula	L	2	3	20
Monotaxis occidentalis	L	2	3	13
Amphipogon amphipogonoides	L	2	1	6
Lobelia alata	L	2		3
Trymalium ledifolium var. *rosmarinifolium*	L	1	14	16
Eucalyptus marginata subsp. *marginata*	L	1	8	46
Adenanthos obovatus	L	1	4	20
Dasypogon hookeri	L	1	4	11
Lindsaea linearis	L	1	3	36
Drosera sp. (climbing)	L	1	3	21
Acacia pulchella	L	1	3	9
Bossiaea ornata	L	1	1	34
Scaevola calliptera	L	1	1	16
Hakea amplexicaulis	L	1	1	12
Stylidium scandens	L	1	1	12
Pterostylis vittata	L	1	1	11
Logania serpyllifolia subsp. *angustifolia*	L	1	1	10
Persoonia longifolia	L	1	1	8
Xanthosia candida	L	1		13
Acacia extensa	L		5	15
Acacia pulchella var. *pulchella*	L		4	25
Podocarpus drouynianus	L		4	20
Bossiaea linophylla	L		4	19
Xanthorrhoea preissii	L		4	18
Dasypogon bromeliifolius	L		3	16
Anarthria scabra	L		3	15
Tetratheca setigera	L		3	14
Lomandra pauciflora	L		3	11
Caladenia flava	L		3	8
Anarthria prolifera	L		2	6
Lomandra spartea	L		2	6
Eriochilus dilatatus	L		1	13
Philotheca spicata	L		1	9
Johnsonia lupulina	L		1	8
Leucopogon capitellatus	L		1	8

Table ML2: Summary of Species Preferences for Different Site Preferences at Milyeannup Brook

^ - Risk assessment based initially on potential dependency on regional groundwater, lifeform and habitat preference

Species	Risk^ RG	<1M RG	1-3M RG	>3M RG
Species largely Dependent on Drier Sites				
Tetraria octandra	L		1	7
Xanthorrhoea gracilis	L		1	6
Platysace compressa	L		1	5
Allocasuarina fraseriana	L		1	4
Chamaescilla corymbosa	L		1	4
Leucopogon glabellus	L		1	4
Lomandra hermaphrodita	L		1	4
Jacksonia horrida	L		1	2
Thysanotus manglesianus/patersonii	L		1	2
Hovea chorizemifolia	L			23
Hypolaena exsulca	L			15
Banksia grandis	L			13
Pentapeltis peltigera	L			13
Xylomelum occidentale	L			12
Platytheca galioides	L			11
Conostylis setigera subsp. *setigera*	L			9
Gompholobium marginatum	L			9
Opercularia echinocephala	L			9
Dampiera linearis	L			6
Lepidosperma squamatum	L			6
Lomandra sonderi	L			6
Macrozamia riedlei	L			6
Melaleuca thymoides	L			6
Gompholobium tomentosum	L			5
Hibbertia quadricolor	L			5
Isopogon sphaerocephalus	L			5
Platysace tenuissima	L			5
Sphaerolobium medium	L			5
Taxandria parviceps (ms)	L			5
Boronia crenulata subsp. *pubescens*	L			4
Gompholobium polymorphum	L			4
Hypocalymma robustum	L			4
Lomandra preissii	L			4
Phlebocarya ciliata	L			4
Pimelea ?lehmanniana	L			4
Pyrorchis nigricans	L			4
Billardiera variifolia	L			3
Gompholobium knightianum	L			3
Haemodorum sp.	L			3
Hibbertia commutata	L			3
Lomandra nigricans	L			3
Patersonia pygmaea	L			3
Pimelea ?imbricata var. *piligera*	L			3
Tricoryne elatior	L			3
Actinotus glomeratus	L			2
Amperea simulans	L			2
Andersonia sp.	L			2
Conostylis aculeata subsp. *aculeata*	L			2

Table ML2: Summary of Species Preferences for Different Site Preferences at Milyeannup Brook
^ - Risk assessment based initially on potential dependency on regional groundwater, lifeform and habitat preference

Species	Risk^ RG	<1M RG	1-3M RG	>3M RG
Species largely Dependent on Drier Sites				
Daviesia decurrens	L			2
Gahnia aristata	L			2
Grevillea trifida	L			2
Leptomeria squarrulosa	L			2
Levenhookia pusilla	L			2
Logania serpyllifolia subsp. *serpyllifolia*	L			2
Lomandra ?sonderi	L			2
Marianthus drummondianus	L			2
Pimelea ?lehmanniana subsp. *nervosa*	L			2
Stylidium junceum subsp. *brevius*	L			2
Acacia luteola	L			1
Acacia stenoptera	L			1
Acacia urophylla	L			1
Acacia willdenowiana	L			1
Andersonia caerulea	L			1
Boronia ?crenulata var. *angustifolia* P4	L			1
Bossiaea eriocarpa	L			1
Conostylis laxiflora	L			1
Dampiera alata	L			1
Daviesia cordata	L			1
Drosera erythrorhiza	L			1
Drosera platystigma	L			1
Goodeniaceae sp.	L			1
Hakea ceratophylla	L			1
Hakea ruscifolia	L			1
Hibbertia pilosa	L			1
Hibbertia racemosa	L			1
Hodgsoniola junciformis	L			1
Lagenophora huegelii	L			1
Logania vaginalis	L			1
Lomandra ?drummondii	L			1
Lomandra caespitosa	L			1
Persoonia elliptica	L			1
Ricinocarpos glaucus	L			1
Stylidium ecorne	L			1
Styphelia tenuiflora	L			1
Tetratheca hirsuta	L			1
Trichocline spathulata	L			1
Xanthosia ciliata	L			1

7.6 Recommendations and Offsetting Options

The Milyeannup Brook area occurs primarily within State Forest supporting native vegetation. The number of rare and priority species and communities are slightly higher than in the tributaries to the north of the Blackwood River. The latter differences in part reflect the local rapid changes in the swamp vegetation types along Poison Gully. Any local changes in regional groundwater levels, providing these are not rapid, should been confined to the swamp areas near Blackwood Road within this valley system.

Several options exist for offsetting any long-term impacts of drawdown in the area. These could include:

1. Contribution to research funding addressing definition of values in the area and also management options for minimising long-term drawdowns by active management of forested catchments.
2. Reviewing options for reducing potential drawdowns through designing different options for water extraction from the Yarragadee system.
3. Undertake further on-ground investigations to clarify whether the biodiversity values highlighted in the previous text are impacted by the potential long-term drawdown as suggested.

8. REEDIA SWAMPS

Reedia swamps occur south and north of the Blackwood River into which it discharges. The catchment is largely native vegetation.

Reedia swamps support localised small ponds of ater and also a narrow channel of creekline flow. The critical component of the Reedia swamps are the valley floors which support the proposed threatened ecological community (CALM 2005c) and the habitat for the critical frog species.

The Reedia swamps occur, within the southern tributaries of the Blackwood River, within the Menzies Botanical District within the SouthWest Botanical Province as defined by Beard (1980). Within this area the biological features were grouped by both vegetation complexes (as defined by Heddle *et al.* 1980 and Mattiske and Havel 1998) and into types of ecosystems.

8.1 Vegetation Complexes

In the Reedia swamps, some two vegetation complexes as defined by Heddle *et al.* (1980) and Mattiske and Havel (1998) may potentially support groundwater dependent ecosystems (Appendix C). These vegetation complexes include a range of plant communities on the area that could potentially be groundwater dependent ecosystems. These communities can be subdivided into the following main structural units:

- Upper gullies of the side tributaries supporting woodlands and swamps in Jalbaragup (JL), and
- The swamps within the Nillup (Nw) valley systems.

The total risks (0-3 and 3-6) occur in a few localised patches with the Jalbaragup and Nillup vegetation complexes. Of these the vegetation within the swamps have the highest potential to be influenced by changes in local site conditions. In determining the significance of the potential changes that may occur in local hydrological site conditions the extent will be influenced by seasonal rainfall events and the management of the forest utilisation of the water within the catchments. It is predicted that the width and extent of the creekline and swamp vegetation will shift down the slope and then downstream of these potential changes occur in these systems. This is critical within these valley systems. The seasonal flows are critical to the vegetation along the creeklines and the local groundwater levels, as well as the fauna species dependent on the maintenance of the water flows and quality in these creeklines and swamps. The critically endangered frogs are restricted within these swamps and therefore any changes to these systems may have major influences on these systems.

8.2 Vegetation Complexes – Potential Risks

In summary the key vegetation complexes that will be potentially influenced by longer-term drawdowns in the area will be:

- Upper gullies of the side tributaries supporting woodlands and swamps in Jalbaragup (JL), and
- The swamps within the Nillup (Nw) valley systems.

The vegetation within these valley systems are variable, and whilst the Bullich forests are well represented in the conservation estate, the Reedia swamp vegetation is very restricted to a few valleys. The Reedia swamp vegetation is restricted to the wet clay-loam and in this respect varies from other valley systems within the Southwest Yarragadee project area. This type of soil is capable of supporting water in pools and therefore seasonal rainfalls are also critical to the maintenance of these systems. The relationship of these swamp communities with regional groundwater systems is less certain at this juncture.

These vegetation complexes are represented (13.70% and 29.53% respectively in formal reserves – Conservation Commission 2003) in the regional context and therefore at this level of classification the impacts on these types on a regional scale should be minimal (Table 4 in Mattiske Consulting Pty Ltd 2005).

8.3 Threatened Ecological Communities

The Reedia swamp communities are listed as a Priority 1 threatened ecological community by the Department of Conservation and Land Management (CALM 2005c). This community has not been formally listed by the State Minister for Environment and is not listed as a Threatened Ecological Community under the EPBC Act (1999).

8.4 Site-Vegetation Types

The site-vegetation types were not mapped in these catchments, but would include A5, C6 and D4 as defined by Mattiske Consulting Pty Ltd (2005). Of these the variants of the "A5 and C6" site-vegetation type are the most likely to be influenced initially by any changes in the local hydrological conditions.

A5: Sedgeland of *Reedia spathacea, Meeboldina* species and *Leptocarpus tenax* to Open Heath of *Taxandria linearifolia, Hypocalymma angustifolium*, *Beaufortia sparsa* and *Astartea scoparia.*

C6: Open forest of *Eucalyptus megacarpa over Astartea scoparia, Anarthria prolifera, Cyathochaeta teretifolia* and *Leptocarpus tenax.*

D4: Woodland of *Eucalyptus marginata* subsp. *marginata – Corymbia calophylla* over *Taxandria parviceps, Acacia divergens, Acacia browniana* var. *browniana, Cyathochaeta teretifolia* and *Leptocarpus tenax.*

Of these site-vegetation types, the variants of A and C and to a lesser degree D occur on seasonally wet to moist soils and therefore may respond to changes in regional groundwater and soil moisture levels. The communities A5 and C6 are the site-vegetation types that are most likely to be influenced by changes in regional groundwater.

The potential changes if the local hydrological conditions shift to the drier or xeric end of the continuum will be a reduction in size and extent of the creekline fringing vegetation types (C1) and a reduction in the extent of the types on the valley floors and slopes (A5 and D4). The C1 and D4 site vegetation types are well represented in the nearby valley systems; however the A5 community is very restricted and under consideration for listing as a threatened ecological community (Mattiske Consulting Pty Ltd 2005, CALM 2005c).

8.5 Flora Values

62 of the 1486 vascular plant taxa recorded in the wider Southwest Yarragadee project area potentially occur near the Reedia swamps (RS), Table RS1 (based on Mattiske Consulting Pty Ltd 2003, with additional data from Mattiske Consulting Pty Ltd 2005).

Whilst many of these are unlikely to be in the localised fringing vegetation and swamps, a significant number of these species may occur in groundwater dependent ecosystems.

Of these 62 taxon the following taxon are considered to be highly dependent on the availability of regional groundwater (Table RS1):

. 1 Endangered taxon (pursuant to the EPBC Act 1999)
. No Vulnerable taxon (pursuant to the EPBC Act 1999)
. 1 Rare taxon (pursuant to the Wildlife Conservation Act 1950)
. No Priority 1 taxon (as defined by the Department of Conservation and Land Management 2005a)
. 3 Priority 2 taxon (as defined by the Department of Conservation and Land Management 2005a)
. 6 Priority 3 taxon (as defined by the Department of Conservation and Land Management 2005a)
. 5 Priority 4 taxon (as defined by the Department of Conservation and Land Management 2005a)

Of these 62 taxon the following taxon are considered to be moderately on the availability of regional groundwater (Table RS1):

. 3 Endangered taxon (pursuant to the EPBC Act 1999)
. 2 Vulnerable taxon (pursuant to the EPBC Act 1999)
. 5 Rare taxon (pursuant to the Wildlife Conservation Act 1950)
. 2 Priority 1 taxon (as defined by the Department of Conservation and Land Management 2005a)
. 2 Priority 2 taxon (as defined by the Department of Conservation and Land Management 2005a)
. 8 Priority 3 taxon (as defined by the Department of Conservation and Land Management 2005a)
. 12 Priority 4 taxon (as defined by the Department of Conservation and Land Management 2005a)

Of these 62 taxon the following taxon are considered to have a low dependency on the availability of regional groundwater (Table RS1):

. 1 Endangered taxon (pursuant to the EPBC Act 1999)
. 2 Vulnerable taxon (pursuant to the EPBC Act 1999)
. 5 Rare taxon (pursuant to the Wildlife Conservation Act 1950)
. 3 Priority 1 taxon (as defined by the Department of Conservation and Land Management 2005a)
. 3 Priority 2 taxon (as defined by the Department of Conservation and Land Management 2005a)
. 3 Priority 3 taxon (as defined by the Department of Conservation and Land Management 2005a)
. 4 Priority 4 taxon (as defined by the Department of Conservation and Land Management 2005a)

The likelihood of these species being influenced by local changes in groundwater levels is increased if the plants are longer-lived perennial species. In contrast small herbaceous species that are shallow rooted are less likely to be influenced by changes in groundwater as the shallow rooted species tend to be dependent on the seasonal rainfall events which lead to increases in moister soils.

As a result of recent surveys in Reedia swamps, five Priority species were located within the swamp systems under consideration, namely:

- *Stylidium barleei* (P3) - this taxon occurs on the fringes of the valley system and is unlikely to be influenced by any changes to regional groundwater levels. This species is not restricted to the Reedia swamps.
- *Amperea protensa* (P3) – this taxon occurs in the swamp floors and on the lower slopes and therefore may be influenced by changes in regional groundwater levels. This species is not restricted to the Reedia swamps.
- *Reedia spathacea* (P4) – this taxon occurs in the swamp floors and on the lower slopes and therefore may be influenced by changes in regional groundwater levels. This species is very restricted in geographical extent and therefore these populations are critical to this species.
- *Cyathochaeta teretifolia* (P3) – this taxon occurred in several of the transects and may be influenced by changes in regional groundwater levels. This species is not restricted to the Reedia swamps.
- *Tyrbastes glaucescens* (P4) – this species occurs on the fringes of the swamp areas, so it may be influenced by changes in regional groundwater levels.

As indicated in Table RS2 – a range of species recorded on the three established transects are highly dependent on regional groundwater levels. This in part reflects the width of the swamps within these valley systems (Mattiske Consulting Pty Ltd 2005). As indicated in previous studies the vegetation within these systems forms a continuum with species varying in their tolerance of different site conditions. The latter concept is illustrated in Table RS2, where the species vary in their site tolerances of different environments (including the parameter depth to water table as supplied in Table RS2. These depths to water table were based on data as supplied by the Water Corporation at the time of the 2005 studies by Mattiske Consulting Pty Ltd.

On the basis of previous studies in different areas within the southwest forest region, local shifts in species and vegetation in response to changes in water availability are reflected over short periods (decades) and therefore on the basis of the predicted drawdowns it is reasonable to predict that there may be some local subtle changes in species composition within the Reedia Swamps as species shift on local scales in response to potential changes in local hydrological site conditions. In view of the nature of the valley system, it is predicted that this impact will be significant as several critically endangered frog species are restricted to Reedia swamps and the environment in which these species occur. The data as presented in Table RS2 should assist in this initial monitoring.

Table RS1: Summary of Conservation Status of Species on the Blackwood Plateau (Blackwood South (BS) and Blackwood North (BN)), which may occur near the Reedia Swamps and the Potential Dependency of Groundwater and Moister Soils

SCC – State Conservation Code (*Wildlife Conservation Act* 1999) and CALM (2005a)
FCC – Federal Conservation Code (*EPBC Act* 1999)
RG – Regional Groundwater:
PG – Perched Groundwater
MS – Moister Soils (generally from seasonal rainfall events)
^ - Risk assessment based initially on lifeform and information on habitat preference in relation to regional groundwater
- denotes number of quadrats that taxon were recorded in the recent studies (Mattiske Consulting Pty Ltd 2005)

Genus	Species	SCC	FCC	BS^^	BN^^	RG^	PG^	MS^
Verticordia	*plumosa* var. *vassensis*	R	E		1	H	M	M
Drakaea	*elastica*	R	E		1	M	-	M
Dryandra	*mimica*	R	E		1	M	M	M
Dryandra	*nivea* subsp. *uliginosa*	R	E		1	M	M	M
Caladenia	*huegelii*	R	E	1	1	L	-	M
Drakaea	*micrantha* (ms)	R	V	1	1	M	M	M
Dryandra	*squarrosa* subsp. *argillacea*	R	V		1	M	M	M
Laxmannia	*jamesii*	R	V		1	L	-	L
Daviesia	*elongata subsp. elongata*	R	V	*1*		L	-	M
Grevillea	*brachystylis* subsp. *grandis* (ms)	R			1	L	L	M
Hemigenia	*ramosissima*	R			1	L	-	L
Nemcia	*cordata* (ms)	P1		1	1	M	M	M
Synaphea	?*otiostigma*	P1		1	1	M	M	M
Caladenia	*uliginosa* subsp. *patulens*	P1		1	1	L	L	L
Eucalyptus	*relictua* (ms)	P1			1	L	-	L
Thomasia	*laxiflora*	P1			1	L	-	L
Grevillea	*manglesioides* subsp. *ferricola*	P2			1	H	H	H
Hybanthus	*volubilis*	P2			1	H	H	H
Leptinella	*drummondii*	P2		1	1	H	-	H
Amperea	*micrantha*	P2		1	1	M	L	M
Synaphea	*petiolaris* subsp. *simplex*	P2		1	1	M	M	M
Actinotus	*whicheranus*	P2			1	L	-	L
Leucopogon	*compactus*	P2			1	L	-	L
Leucopogon	*plumuliflorus*	P2			1	L	-	L
Aotus	*cordifolia*	P3			1	H	H	H
Cyathochaeta	*teretifolia*	P3		*10*	*2*	H	H	H
Cyathochaeta	*stipoides*	P3		*1*		H	H	H
Meeboldina	*thysanantha* (ms)	P3		*2*		H	H	H
Pultenaea	*pinifolia*	P3			1	H	H	H
Amperea	*protensa*	P3		*1*		H	-	H
Acacia	*semitrullata*	P3		1	1	M	M	M
Conospermum	*paniculatum*	P3		1	*1*	M	M	M
Dampiera	*heteroptera*	P3		1		M	M	M
Hakea	*oldfieldii*	P3			1	M	M	M
Isopogon	*formosus* subsp. *dasylepis*	P3			1	M	M	M
Pultenaea	*radiata*	P3		1	1	M	M	M
Stylidium	*barleei*	P3		*1*	*2*	M	M	M

Table RS1: Summary of Conservation Status of Species on the Blackwood Plateau (Blackwood South (BS) and Blackwood North (BN)), which may occur near the Reedia Swamps and the Potential Dependency of Groundwater and Moister Soils

SCC – State Conservation Code (*Wildlife Conservation Act* 1999) and CALM (2005a)
FCC – Federal Conservation Code (*EPBC Act* 1999)
RG – Regional Groundwater
PG – Perched Groundwater
MS – Moister Soils (generally from seasonal rainfall events)
^ - Risk assessment based initially on lifeform and information on habitat preference in relation to regional groundwater
- denotes number of quadrats that taxon were recorded in the recent studies (Mattiske Consulting Pty Ltd 2005)

Genus	Species	SCC	FCC	BS^^	BN^^	RG^	PG^	MS^
Synaphea	*otiostigma*	P3		1	1	M	M	M
Chorizema	*reticulatum*	P3		1	1	L	-	L
Gonocarpus	*pusillus*	P3		*1*		L	-	L
Thysanotus	*gageoides*	P3			1	L	-	L
Hypocalymma	*cordifolium* subsp. *minus (*ms)	P4			1	H	L	H
Lambertia	*rariflora* subsp. *rariflora*	P4			1	H	H	H
Melaleuca	*basicephala*	P4		1		H	H	H
Reedia	*spathacea*	P4		*2*		H	H	H
Villarsia	*submersa*	P4				H	H	H
Tyrbastes	*glaucescens*	P4		*2*		M	H	H
Acacia	*tayloriana*	P4		1		M	M	M
Caladenia	*arrecta*	P4		1		M	M	M
Caladenia	*plicata*	P4		1	1	M	M	M
Chamelaucium	*erythrochlorum* (ms)	P4		1	1	M	M	M
Drosera	*marchantii* subsp. *marchantii*	P4			1	M	-	M
Eucalyptus	*rudis* subsp. *cratyantha*	P4			1	M	-	M
Grevillea	*drummondii*	P4			1	M	M	M
Pultenaea	*skinneri*	P4		1	1	M	-	M
Stylidium	*plantagineum*	P4		1		M	M	M
Synaphea	*acutiloba*	P4		1	1	M	M	M
Verticordia	*lehmannii*	P4		1	1	M	M	M
Astroloma	sp. Nannup (R.D. Royce 3978) (pn)	P4		1	1	L	L	L
Franklandia	*triaristata*	P4			1	L	-	L
Boronia	*?crenulata var. angustifolia*	P4		*1*		L	-	L
Thysanotus	*glaucus*	P4		1	1	L	-	L

Table RS2: Summary of Species Preferences for Different Site Preferences at Reedia Swamps

^ - Risk assessment based initially on potential dependency on regional groundwater, lifeform and habitat preference

Species	Risk^ RG	<1M RG	1-3M RG	>3M RG
Species largely Dependent on Wetter Sites				
Boronia juncea subsp. *micrantha*	H	2		
Boronia molloyae	H	2		
Baumea preissii	H	1		
Proteaceae sp. (BT19)	H	1		
Tremandra diffusa	H	1		
Boronia sp. (SC303)	H	2	1	1
Pimelea hispida	H	3	1	1
Amperea protensa P3	H	5	3	
Reedia spathacea P4	H	8		
Taxandria fragrans (ms)	H	9	4	
Xyris indivisa	H	10	10	
Sphaerolobium fornicatum	H	12	4	
Xyris gracillima	H	16	2	
Boronia denticulata	H	18	3	2
Beaufortia sparsa	H	21	6	
Lepidosperma ?longitudinale	H	28	6	1
Schoenus ?nitens	H	29	11	
Leptocarpus tenax	H	32	17	
Homalospermum firmum	H	36	7	
Taxandria linearifolia (ms)	H	36	16	
Empodisma gracillimum	H	37	12	
Astartea scoparia	H	44	12	1
Cyathochaeta teretifolia P3	H	50	16	5
Dampiera hederacea	M	1		
Drosera hamiltonii	M	1		
Drosera sp.	M	1		
Goodenia pulchella	M	1		
Hydrocotyle sp. (GM102)	M	1		
Lyginia imberbis	M	1		
Platychorda rivalis	M	1		
Prasophyllum macrostachyum	M	1		
Stypandra glauca	M	1		
Xanthosia atkinsoniana	M	7	3	
Gonocarpus diffusus	M	8	1	
Orthrosanthus ?laxus	M	14	2	
Acacia pulchella var. *glaberrima*	M	16	7	
Cassytha glabella forma *casuarinae*	M	20	10	2
Species largely Dependent on Moister Sites				
Hypolaena exsulca	M	1	1	1
Actinotus laxus	M	1	1	
Loxocarya cinerea	M	1	1	
Diaspasis filifolia	M	1	2	
Sporadanthus rivularis (ms)	M	1	2	
Acacia myrtifolia	M	1	3	2
Pimelea ?imbricata var. *piligera*	M	1	3	3

Table RS2: Summary of Species Preferences for Different Site Preferences at Reedia Swamps

^ - Risk assessment based initially on potential dependency on regional groundwater, lifeform and habitat preference

Species	Risk^ RG	<1M RG	1-3M RG	>3M RG
Species largely Dependent on Moister Sites				
Tetratheca setigera	M	1	5	1
Comesperma virgatum	M	3	4	
Amphipogon setaceus	M	2	2	
Patersonia occidentalis	M	2	3	1
Acacia divergens	M	2	15	
Anarthria prolifera	M	5	18	6
Taraxis grossa	M	6	9	
Mesomelaena graciliceps	M		5	
Leucopogon hirsutus	M	7	9	
Acacia extensa	M		1	
Acacia pulchella	M		1	
Baumea acuta	M		1	
Eutaxia epacridoides subsp. *epacridoides*	M		1	
Hakea ceratophylla	M		1	
Schizaea fistulosa	M		1	
Thomasia rhynchocarpa	M		1	
Adenanthos obovatus	M		2	
Tyrbastes glaucescens P4	M		3	
Xanthorrhoea preissii	M		4	3
Eucalyptus megacarpa	M		4	
Schoenus efoliatus	M		5	4
Dasypogon hookeri	M		6	2
Eucalyptus marginata subsp. *marginata*	M		12	6
Corymbia calophylla	M		15	4
Stylidium barleei P3	M		3	7
Isotropis cuneifolia subsp. *cuneifolia*	L	1	2	
Xanthosia singuliflora	L	1	2	
Stylidium scandens	L	1	3	2
Scaevola calliptera	L	1	6	4
Allocasuarina fraseriana	L	1	19	7
Dasypogon bromeliifolius	L	3	7	3
Lindsaea linearis	L	3	8	5
Drosera sp. (climbing)	L	8	16	15
Dampiera linearis	L	8	20	9
Xanthosia candida	L		1	
Xanthosia tasmanica	L	4	4	2
Agrostocrinum scabrum	L		1	
Amphipogon amphipogonoides	L		1	
Billardiera laxiflora	L		1	
Caladenia flava	L		1	
Conostylis aculeate subsp. *aculeata*	L		1	
Conostylis serrulate/laxiflora	L		1	
Logania serpyllifolia subsp. *angustifolia*	L		1	
Opercularia echinocephala	L		1	
Phlebocarya ciliata	L		1	
Pimelea lehmanniana	L		1	

Table RS2: Summary of Species Preferences for Different Site Preferences at Reedia Swamps

^ - Risk assessment based initially on potential dependency on regional groundwater, lifeform and habitat preference

Species	Risk^ RG	<1M RG	1-3M RG	>3M RG
Species largely Dependent on Moister Sites				
Ptilotus manglesii	L		1	
Stylidium calcaratum	L		1	
Thysanotus manglesianus/patersonii	L		1	
Drosera platystigma	L		2	
Gompholobium confertum	L		2	
Phyllangium paradoxum	L		2	
Velleia trinervis	L		2	
Centrolepis aristate	L		3	
Johnsonia lupulina	L		3	
Platysace tenuissima	L		4	2
Lomandra caespitose	L		3	1
Platysace pendula	L		3	1
Anigozanthos flavidus	L		4	
Leucopogon australis	L		6	3
Anarthria scabra	L		6	4
Thysanotus pseudojunceus	L		9	3
Tetrarrhena laevis	L		9	4
Species largely Dependent on Drier Sites				
Hibbertia hypericoides	L	2	7	14
Xylomelum occidentale	L	1		4
Taxandria parviceps (ms)	L	3	13	15
Caladenia sp.	L	1	1	2
Acacia browniana var. *browniana*	L	1	1	4
Lepidosperma tenue	L			1
Boronia crenulata subsp. *pubescens*	L		1	1
Haemodorum sp.	L		1	1
Hovea elliptica	L		1	1
Lepidosperma gracile	L		1	1
Leptomeria cunninghamii	L		1	1
Opercularia hispidula	L		1	1
Macrozamia riedlei	L		1	2
Philotheca spicata	L		1	2
Pimelea sp. (LM65)	L		1	2
Pterostylis vittate	L		1	2
Schoenus ?cruentus	L		1	2
Stylidium sp. Mt Barker(E.J.Croxford 1906)	L		1	2
Persoonia longifolia	L		1	3
Chamaescilla corymbose	L		1	4
Lomandra drummondii	L		1	4
Hibbertia amplexicaulis	L		1	7
Logania serpyllifolia subsp. *serpyllifolia*	L		2	2
Lomandra sonderi	L		2	2
Platysace compressa	L		2	2
Tetraria octandra	L		2	2
Lepidosperma pubisquameum	L		2	5

Table RS2: Summary of Species Preferences for Different Site Preferences at Reedia Swamps

^ - Risk assessment based initially on potential dependency on regional groundwater, lifeform and habitat preference

Species	Risk^ RG	<1M RG	1-3M RG	>3M RG
Species largely Dependent on Drier Sites				
Levenhookia pusilla	L		3	4
Eriochilus dilatatus	L		4	4
Cyathochaeta avenacea	L		4	8
Desmocladus fasciculatus	L		5	7
Tetraria capillaries	L		5	8
Pentapeltis peltigera	L		9	12
Lomandra spartea	L			7
Hypocalymma angustifolium	L			4
Lepidosperma squamatum	L			4
Hakea amplexicaulis	L			2
Prasophyllum parvifolium	L			2
Pteridium esculentum	L			2
Pterostylis sp. (GM12)	L			2
Stylidium amoenum	L			2
Acacia lateriticola	L			2
Adenanthos barbiger subsp. *intermedius* (ms)	L			2
Adenanthos meisneri	L			2
Boronia fastigiate	L			2
Caladenia sp. (GM30)	L			2
Gompholobium tomentosum	L			2
Acacia gilbertii	L			1
Acacia obovate	L			1
Agonis flexuosa	L			1
Banksia grandis	L			1
Billardiera floribunda	L			1
Billardiera variifolia	L			1
Boronia crenulate	L			1
Chorizema ilicifolium	L			1
Gompholobium polymorphum	L			1
Goodenia eatoniana	L			1
Hibbertia commutata	L			1
Hibbertia quadricolor	L			1
Hibbertia stellaris	L			1
Hovea chorizemifolia	L			1
Labichea punctata	L			1
Lomandra preissii	L			1
Pultenaea brachytropis	L			1
Schoenus ?efoliatus	L			1
Stylidium luteum subsp. *glaucifolium*	L			1
Thomasia foliosa	L			1
Trachymene pilosa	L			1

8.6 Recommendations and Offsetting Options

The Reedia swamps occur primarily within State Forest and National Parks supporting native vegetation. The number of rare and priority species and communities are regionally and nationally significant and therefore any direct or indirect impacts on this area should be avoided. The swamps are currently monitored by CALM researchers and the sensitivity of these areas is acknowledged. The occurrence of the critically endangered frogs within the proposed threatened ecological community reflects the significance of these valley systems.

The options for management of these swamps would be enhanced by additional support and funding so that these regionally and nationally significant ecosystems could be maintained. The options could include:

1. Contribution to research funding addressing definition of values in the area and also management options for minimising long-term drawdowns by active management of the upper reaches of the forested catchments.
2. Reviewing options for reducing potential drawdowns through designing different options for water extraction from the Yarragadee system.
3. Undertake further on-ground investigations to investigate the critical factors supporting the range of critically endangered frogs and their associated habitats.

9. SCOTT COASTAL PLAIN (EAST AND WEST)

Scott Coastal Plain (East and West) occurs south of the Blackwood Plateau. The catchment is a mixture of partially cleared agricultural holdings and patches of native vegetation.

The Scott Coastal Plain is a mixture of erosional soils and sandy deposits and as such supports a range of vegetation communities ranging from scattered small rises which occur as elevated areas above extensive low lying damplands and sumplands. The critical component of these swamps relates to the variation in underlying soil types (ironstone to sands). These local site variations lead to subtle changes in the availability of both water from regional groundwater systems, perched water tables and soil moisture from seasonal rainfall events.

The Scott Coastal Plain occurs within the Warren Botanical District within the SouthWest Botanical Province as defined by Beard (1980). Within this area the biological features were grouped by both vegetation complexes (as defined by Heddle *et al.* 1980 and Mattiske and Havel 1998) and into types of ecosystems.

9.1 Vegetation Complexes

The Scott Coastal Plain supports some eight vegetation complexes as defined by Heddle *et al.* (1980) and Mattiske and Havel (1998) may potentially support groundwater dependent ecosystems (Appendix C). These vegetation complexes include a range of plant communities on the area that could potentially be groundwater dependent ecosystems. These communities can be subdivided into the following main structural units:

- Upper gullies of the side tributaries supporting woodlands and swamps in Cleave (CV) and Coate (CE), and
- The swamps within the Nillup (Nw) valley systems,
- The Swamps within the Scott Coastal Plain (Swi, Sw, Sd and Swd),
- Jangardup (JN) supporting a range of swamp types.

The total risks (0-3 and 3-6) occur in a few localised patches with the Scott (Sw, Swi, Swd), Jangardup (JN), Coate (CE), Cleave (CV) and Nillup (Nw) vegetation complexes. Of these the vegetation within the swamps have the highest potential to be influenced by changes in local site conditions. In determining the significance of the potential changes that may occur in local hydrological site conditions the extent will be influenced by seasonal rainfall events and the management of the agricultural holdings in the area (including blue gum plantations and potato farming). It is predicted that the width and extent of the creekline and swamp vegetation will shift down the slope and then downstream of these potential changes occur in these systems. This is critical within these damplands and sumplands, particularly on the ironstone communities.

The seasonal levels are critical to the flora and vegetation on the extensive swamps, as well as the fauna species dependent on the maintenance of the water flows and quality in these swamps.

9.2 Vegetation Complexes – Potential Risks

In summary the key vegetation complexes that will be potentially influenced by longer-term drawdowns in the area will be:

- Upper gullies of the side tributaries supporting woodlands and swamps in Cleave (CV) and Coate (CE), and
- The swamps within the Nillup (Nw) valley systems,
- The Swamps within the Scott Coastal Plain (Swi, Sw, Sd and Swd),
- Jangardup (JN) supporting a range of swamp types.

The vegetation within these extensive swamps is very variable, with subtle changes in elevation (centimetres) resulting in rapid changes in flora and vegetation within the swamps. The local types of soil are critical in determining the potential for changes in regional groundwater levels influencing the swamp vegetation.

The majority of the vegetation complexes are well represented in formal reserves (Cleave 63.19%, Coate 25.69%, Nillup (Nw) – 29.53%, Scott (Sd – 26.27% and Swd – 52.25%), Jangardup 43.28%); however Sw and Swi are not represented in any conservation estate areas (Conservation Commission 2003). Some patches have been set aside on private property for conservation, nevertheless the ironstone communities (Swi), which support a large range of rare and endangered species are not represented in the conservation estate. Therefore these latter ironstone communities are regionally and nationally significant.

9.3 Threatened Ecological Communities

The ironstone communities on the Scott Coastal Plain – "Scott River Ironstone Association" are listed as Endangered by the Department of Conservation and Land Management (CALM 2005c). This community has not been formally listed by the State Minister for Environment and is not listed as a Threatened Ecological Community under the EPBC Act (1999). This community is equivalent to the vegetation complex Swi and patches of ironstone within Sw, Swd and Sd, which were too small to map at a regional scale.

9.4 Site-Vegetation Types

The site-vegetation types were not mapped in these catchments, but would include A6, A7 and J1 as defined by Mattiske Consulting Pty Ltd (2005). Of these the variants of the "A6 and A7" site-vegetation type are the most likely to be influenced initially by any changes in the local hydrological conditions.

A6: Open heath of *Melaleuca lateritia* over *Triglochin huegelii, Myriophyllum ?limnophilum, Baumea vaginalis* and a range of fringing sedges of *Meeboldina* species.

A7: Open heath of *Astartea scoparia, Taxandria linearifolia, Homalospermum firmum* over patches of dense sedges including *Cyathochaeta teretifolia, Lepidosperma ?longitudinale*, patches of *Reedia spathacea* and species of *Meeboldina* and *Leptocarpus.*

J1: Open woodland of *Eucalyptus marginata* subsp. *marginata – Corymbia calophylla – Nuytsia floribunda* over *Anarthria prolifera, Anarthria scabra, Dasypogon bromeliifolius, Hypolaena exsulca* and *Euchilopsis linearis* over a range of low shrubs and herbs.

Of these site-vegetation types, the variants of A and to a lesser degree J1 occur on seasonally wet to moist soils and therefore may respond to changes in regional groundwater and soil moisture levels. The communities A6 and A7 are the site-vegetation types that are most likely to be influenced by changes in regional groundwater.

The potential changes if the local hydrological conditions shift to the drier or xeric end of the continuum will be a reduction in size and extent of the swamps (A6 and A7). The A types are extensive in the area, but are vulnerable to very subtle changes in groundwater and soil moisture levels. The seasonal flooding of the sedgelands within these systems is critical to the survival of some of these species (Mattiske Consulting Pty Ltd 2005).

9.5 Flora Values

65 of the 1486 vascular plant taxa recorded in the wider Southwest Yarragadee project area potentially occur near the Scott Coastal Plain (SRCP), Table SRCP1 (based on Mattiske Consulting Pty Ltd 2003, with additional data from Mattiske Consulting Pty Ltd 2005).

Whilst many of these are unlikely to be in the localised fringing vegetation and swamps, a significant number of these species may occur in groundwater dependent ecosystems.

Of these 65 taxon the following taxon are considered to be highly dependent on the availability of regional groundwater (Table SRCP1):

- No Endangered taxon (pursuant to the EPBC Act 1999)
- 2 Vulnerable taxon (pursuant to the EPBC Act 1999)
- 1 Presumed Extinct taxon (Wildlife Conservation Act 1999).
- 3 Rare taxon (pursuant to the Wildlife Conservation Act 1950)
- 2 Priority 1 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 5 Priority 2 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 10 Priority 3 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 10 Priority 4 taxon (as defined by the Department of Conservation and Land Management 2005a)

Of these 65 taxon the following taxon are considered to be moderately on the availability of regional groundwater (Table SRCP1):

- 2 Endangered taxon (pursuant to the EPBC Act 1999)
- 1 Vulnerable taxon (pursuant to the EPBC Act 1999)
- 3 Rare taxon (pursuant to the Wildlife Conservation Act 1950)
- 5 Priority 1 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 5 Priority 2 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 10 Priority 3 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 6 Priority 4 taxon (as defined by the Department of Conservation and Land Management 2005a)

Of these 65 taxon the following taxon are considered to have a low dependency on the availability of regional groundwater (Table RS1):

- No Endangered taxon (pursuant to the EPBC Act 1999)
- No Vulnerable taxon (pursuant to the EPBC Act 1999)
- No Rare taxon (pursuant to the Wildlife Conservation Act 1950)
- No Priority 1 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 1 Priority 2 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 2 Priority 3 taxon (as defined by the Department of Conservation and Land Management 2005a)
- 2 Priority 4 taxon (as defined by the Department of Conservation and Land Management 2005a)

The likelihood of these species being influenced by local changes in groundwater levels is increased if the plants are longer-lived perennial species. In contrast small herbaceous species that are shallow rooted are less likely to be influenced by changes in groundwater as the shallow rooted species tend to be dependent on the seasonal rainfall events which lead to increases in moister soils.

As a result of recent surveys on the Scott Coastal Plain, seven Priority species were located within the swamp systems under consideration, namely:

- *Stylidium barleei* (P3) - this taxon occurs on the fringes of the swamps and is unlikely to be influenced markedly by any changes to regional groundwater levels. This species is not restricted to the Scott Coastal Plain.
- *Stylidium* aff. *ireneae* (P4) - this taxon occurs on the fringes of the swamps and is unlikely to be influenced markedly by any changes to regional groundwater levels. This species is not restricted to the Scott Coastal Plain.
- *Gonocarpus pusillus* (P3) – this taxon occurs on the drier sites and is therefore unlikely to be influenced by any changes to regional groundwater levels. This species is not restricted to the Scott Coastal Plain.
- *Melaleuca basicephala* (P4) – this taxon occurs on the drier sites and is therefore unlikely to be influenced by any changes to regional groundwater levels. This species is not restricted to the Scott Coastal Plain.
- *Astartea* sp. Scott River (D. Backshall 88233) (pn) (P4) – this taxon occurs in the swamp floors and on the lower slopes and therefore may be influenced by changes in regional groundwater levels. This species is geographically restricted to the Scott Coastal Plain and westwards to Augusta .
- *Conospermum paniculatum (*P3) – this taxon occurs on the fringes of the swamps and is unlikely to be influenced markedly by any changes to regional groundwater levels. This species is not restricted to the Scott Coastal Plain.
- *Meeboldina crassipes* (P3) – this taxon occurs on the fringes of the swamps and is unlikely to be influenced markedly by any changes to regional groundwater levels. This species is not restricted to the Scott Coastal Plain.

As indicated in Table SRCP2 – a range of species recorded on the five established transects are highly dependent on regional groundwater levels. This in part reflects the width of the swamps on the Scott Coastal Plain (Mattiske Consulting Pty Ltd 2005). As indicated in previous studies the vegetation within these systems forms a continuum with species varying in their tolerance of different site conditions. The latter concept is illustrated in Table SRCP2, where the species vary in their site tolerances of different environments (including the parameter depth to water table as supplied in Table SRCP2. These depths to water table were based on data as supplied by the Water Corporation at the time of the 2005 studies by Mattiske Consulting Pty Ltd. The difficulty of extrapolating from only several bores at each transect was illustrated by the range of species (^^) that would normally be associated with wetter soils. Therefore the lack of local depth to water table data may have influenced the interpretation in some of these local transects. This discrepancy requires clarification in future monitoring programs.

On the basis of previous studies in different areas within the southwest forest region, local shifts in species and vegetation in response to changes in water availability are reflected over short periods (decades) and therefore on the basis of the predicted drawdowns it is reasonable to predict that there may be some local subtle changes in species composition within the Scott Coastal Plain swamps as species shift on local scales in response to potential changes in local hydrological site conditions. In view of the nature of the swamps, it is predicted that this impact will be significant as the swamps occur on extensive flat which are dependent on regional groundwater levels and seasonal inundation. The data as presented in Table SRCP2 should assist in this initial monitoring.

Table SRCP1: Summary of Conservation Status of Species on the Scott Coastal Plain (SRCP), which may occur near the Swamps and the Potential Dependency of Groundwater and Moister Soils

SCC – State Conservation Code (*Wildlife Conservation Act* 1999) and CALM (2005a)
FCC – Federal Conservation Code (*EPBC Act* 1999)
RG – Regional Groundwater:
PG – Perched Groundwater
MS – Moister Soils (generally from seasonal rainfall events)
^ - Risk assessment based initially on lifeform and information on habitat preference in relation to regional groundwater
- denotes number of quadrats that taxon were recorded in recent studies (Mattiske Consulting Pty Ltd 2005)

Genus	Species	SCC	FCC	SRCP^^	RG^	PG^	MS^
Leptomeria	*dielsiana*	X	V	1			
Dryandra	*nivea* subsp. *uliginosa*	R	E	1	M	M	M
Lambertia	*orbifolia* subsp. Scott River Plains (L.W. Sage 684) (pn)	R	E	1	M	M	M
Grevillea	*brachystylis* subsp. *australis*	R	V	1	H	H	H
Meziella	*rifida*	R	V	1	H	H	H
Caladenia	*harringtoniae*	R	V	1	M	M	H
Darwinia	*ferricola (ms)*	R		1	H	H	H
Philydrella	*pygmaea* subsp. *minima*	P1		1	H	H	H
Plumatichilos	*turfosus*	P1		1	H	H	H
Calothamnus	sp. Whicher (B.J. Keighery & N. Gibson 230) (pn)	P1		1	M	M	M
Thysanotus	*formosus*	P1		1	M	M	M
Nemcia	*cordata* (ms)	P1		1	M	M	M
Thomasia	*brachystachys*	P1		1	M	M	M
Pericalymma	*megaphyllum*	P1		1	M	M	M
Grevillea	*manglesioides* subsp. *ferricola*	P2		1	H	H	H
Amperea	*protensa*	P2		1	H	H	H
Hybanthus	*volubilis*	P2		1	H	H	H
Calothamnus	sp. Scott River (R.D. Royce 84) (pn)	P2		1	H	H	H
Melaleuca	*incana* subsp. Gingilup (N. Gibson & M. Lyons 593) (pn)	P2		1	H	H	H
Conospermum	*quadripetalum*	P2		1	M	M	M
Andersonia	*longifolia*	P2		1	M	M	M
Chordifex	*isomorphus*	P2		1	M	M	M
Persoonia	*hakeiformis*	P2		1	M	M	M
Leptomeria	*furtiva*	P2		1	M	M	M
Caladenia	*abbreviata* (ms)	P2		1	L	-	L
Chordifex	*gracilior*	P3		1	H	H	H
Meeboldina	*thysanantha* (ms)	P3		1	H	H	H
Grevillea	*papillosa*	P3		1	H	H	H
Hakea	*tuberculata*	P3		1	H	H	H
Jansonia	*formosa*	P3		1	H	H	H
Pultenaea	*pinifolia*	P3		1	H	H	H
Boronia	*anceps*	P3		1	H	H	H
Actinotus	sp. Walpole (J.R. Wheeler 3786) (pn)	P3		1	H	H	H

Table SRCP1: Summary of Conservation Status of Species on the Scott Coastal Plain (SRCP), which may occur near the Swamps and the Potential Dependency of Groundwater and Moister Soils

SCC – State Conservation Code (*Wildlife Conservation Act* 1999) and CALM (2005a)
FCC – Federal Conservation Code (*EPBC Act* 1999)
RG – Regional Groundwater:
PG – Perched Groundwater
MS – Moister Soils (generally from seasonal rainfall events)
^ - Risk assessment based initially on lifeform and information on habitat preference in relation to regional groundwater
- denotes number of quadrats that taxon were recorded in recent studies (Mattiske Consulting Pty Ltd 2005)

Genus	Species	SCC	FCC	SRCP^^	RG^	PG^	MS^
Andersonia	*amabile* (ms)	P3		1	H	H	H
Blennospora	*doliiformis*	P3		1	H	H	H
Bossiaea	*disticha*	P3		1	M	M	M
Cyathochaeta	*stipoides*	P3		1	M	M	M
Loxocarya	*magna*	P3		1	M	M	M
Meeboldina	*crassipes*	P3		*1*	M	M	M
Conospermum	*paniculatum*	P3		*1*	M	M	M
Isopogon	*formosus* subsp. *dasylepis*	P3		1	M	M	M
Chorizema	*carinatum*	P3		1	M	M	M
Pultenaea	*radiata*	P3		1	M	M	M
Sphenotoma	*parviflorum*	P3		1	M	M	M
Stylidium	*barleei*	P3		*2*	M	M	M
Gonocarpus	*pusillus*	P3		*3*	L	L	
Dampiera	*heteroptera*	P3		1	L	-	L
Reedia	*spathacea*	P4		1	H	H	H
Tyrbastes	*glaucescens*	P4		1	H	H	H
Adenanthos	*detmoldii*	P4		1	H	H	H
Adenanthos	x *pamela*	P4		1	H	H	H
Banksia	*meisneri* subsp. *ascendens*	P4		1	H	H	H
Aotus	*carinata*	P4		1	H	H	H
Hypocalymma	*cordifolium* subsp. *minus (*ms)	P4		1	H	H	H
Villarsia	*submersa*	P4		1	H	H	H
Anthotium	*junciforme*	P4		1	H	H	H
Astartea	sp. Scott River (D. Backshall 88233) (pn)	P4		*2*	H	H	H
Astroloma	sp. Nannup (R.D. Royce 3978) (pn)	P4		1	M	M	M
Asplenium	*aethiopicum*	P4		1	M	M	M
Microtis	*pulchella*	P4		1	M	M	M
Acacia	*tayloriana*	P4		1	M	M	M
Calothamnus	*pallidifolius*	P4		1	M	M	M
Verticordia	*lehmannii*	P4		1	M	M	M
Melaleuca	*basicephala*	P4		*3*	L	L	H
Stylidium	aff. *ireneae*	P4		*1*	L	-	L

Table SRCP2: Summary of Species Preferences for Different Site Preferences on Scott Coastal Plain

^ - Risk assessment based initially on potential dependency on regional groundwater, lifeform and habitat preference

Species	Risk^ RG	<1M RG	1-3M RG	>3M RG
Species largely Dependent on Wetter Sites				
Hakea ceratophylla	H	17	10	12
Mesomelaena tetragona	H	13	16	4
Calothamnus lateralis	H	11		5
Boronia defoliata	H	10		4
Gymnoschoenus anceps	H	8	1	1
Astartea sp.Scott River(D.Backshall 88233) P4	H	8		2
Hakea sulcata	H	7		
Schoenus laevigatus	H	1		
Xyris roycei	H	1		
Conostylis serrulata	M	9	1	2
Sporadanthus strictus (ms)	M	8	1	
Pimelea lanata	M	7	5	
Lomandra ?nigricans	M	4	1	
Pimelea angustifolia	M	3	1	2
Diaspasis filifolia	M	3		
Agrostocrinum scabrum	M	1		
Dampiera leptoclada	M	1		
Goodenia lancifolia	M	1		
Species largely Dependent on Moister Sites				
Cyathochaeta avenacea	M	6	27	25
Meeboldina crassipes P3	M		18	
Pericalymma ellipticum var. *ellipticum*	M	20	16	52
Taxandria linearifolia (ms)	M-H		16	2
Taxandria parviceps (ms)	M	9	15	69
Hibbertia amplexicaulis	M		14	13
Beaufortia sparsa	M-H	8	12	17
Lindsaea linearis	M		12	13
Gahnia decomposita	M		12	
Hakea varia	M-H		12	
Acacia mooreana	M-H	4	11	
Boronia megastigma	M		11	11
Eucalyptus megacarpa	M-H		11	
Lepidosperma pubisquameum	M	4	10	8
Hemigenia humilis	M	4	10	7
Hovea elliptica	M		10	4
Leptocarpus laxus	M-H	8	9	1
Xanthorrhoea preissii	M	7	9	57
Eutaxia epacridoides subsp. *epacridoides*	M	18	8	18
Baxteria australis	M	6	8	
Hakea falcate	M	3	8	18
Loxocarya cinerea	M		8	7
Empodisma gracillimum	M		8	1
Acacia hastulata	M	8	7	7
Eucalyptus marginata subsp. *marginate*	M	1	6	29
Aotus gracillima	M	1	5	
Conospermum paniculatum P3	M		4	3

Table SRCP2: Summary of Species Preferences for Different Site Preferences on Scott Coastal Plain

^ - Risk assessment based initially on potential dependency on regional groundwater, lifeform and habitat preference

Species	Risk^ RG	<1M RG	1-3M RG	>3M RG
Species largely Dependent on Moister Sites				
Grevillea diversifolia subsp. *diversifolia*	M		4	
Stylidium barleei P3	M		3	3
Hakea amplexicaulis	M		3	2
Leucopogon hirsutus	M		3	2
Boronia spathulata	M		3	1
Banksia littoralis	M		3	
Melaleuca incana subsp. *incana*	M		3	
Sphenotoma capitatum	M	6	2	20
Sphaerolobium fornicatum	M	2	2	5
Petrophile diversifolia	M		2	2
Xyris laxiflora	M		1	
Eucalyptus patens	M		1	1
Acacia divergens	M		1	
Boronia molloyae	M		1	
Cassytha racemosa forma *?racemosa*	L	1	6	4
Amphipogon setaceus	L	6	5	15
Dampiera linearis	L	1	5	54
Billardiera variifolia	L		5	3
Adenanthos obovatus	L	6	4	45
Cassytha glabella forma *casuarinae*	L	2	4	31
Drosera pulchella	L	2	4	7
Lechenaultia biloba	L	1	4	15
Lepidosperma gracile	L		4	2
Dasypogon bromeliifolius	L	8	3	61
Scaevola calliptera	L	5	3	15
Amphipogon laguroides subsp. *laguroides*	L	4	3	6
Logania serpyllifolia subsp. *serpyllifolia*	L		3	2
Pimelea lehmanniana subsp. *?nervosa*	L		3	
Stylidium aff. *ireneae* P4	L		3	
Stypandra glauca	L		2	1
Hydrocotyle hirta	L		2	
Ptilotus manglesii	L		2	
Tetratheca setigera	L		2	
Thysanotus thyrsoideus	L		2	
Neurachne alopecuroidea	L	1	1	
Jacksonia floribunda	L		1	
Chordifex amblycoleus	L	5		6
Amphipogon amphipogonoides	L	2		2
Chaetanthus tenellus	L	2		1
Species largely Dependent on Drier Sites				
Anarthria prolifera	L	1	2	38
Evandra aristate	L	1	2	35
Johnsonia lupulina	L	1	2	17
Tetraria capillaries	L	1	2	10
Meeboldina scariosa ^^	L	6	1	16

Table SRCP2: Summary of Species Preferences for Different Site Preferences on Scott Coastal Plain

^ - Risk assessment based initially on potential dependency on regional groundwater, lifeform and habitat preference

Species	Risk^ RG	<1M RG	1-3M RG	>3M RG
Species largely Dependent on Drier Sites				
Xanthosia tasmanica	L	4	1	8
Leucopogon aff. pendulus	L	2	1	33
Lepidosperma striatum	L	5	1	5
Melaleuca preissiana ^^	L	2	1	9
Schoenus discifer	L	1	1	13
Sphaerolobium medium	L	1	1	4
Desmocladus flexuosus	L	1	2	5
Stylidium squamosotuberosum	L	1	2	5
Anarthria scabra	L		1	56
Hypolaena exsulca	L		2	47
Drosera sp. (climbing)	L	1		42
Andersonia caerulea	L		1	34
Mesomelaena graciliceps	L		1	34
Stylidium scandens	L			31
Acacia browniana var. *browniana*	L		3	28
Acacia myrtifolia	L			22
Schoenus efoliatus	L			22
Leucopogon australis	L		9	19
Phlebocarya ciliata	L			17
Podocarpus drouynianus	L		2	16
Actinotus glomeratus	L			15
Platysace compressa	L		3	14
Leucopogon alternifolius	L			14
Pimelea imbricata var. *imbricata*	L			14
Drosera erythrorhiza	L			13
Hibbertia stellaris	L			13
Stylidium amoenum	L		6	12
Sphenotoma gracile	L			12
Astartea scoparia ^^	L		9	11
Sphenotoma squarrosum	L		1	11
Melaleuca basicephala P4 ^^	L	1		11
Melaleuca thymoides	L	1		11
Hypocalymma robustum	L			11
Leucopogon glabellus	L			11
Pultenaea ochreata	L			11
Corymbia calophylla	L		8	10
Lomandra hermaphrodita	L	1		10
Xylomelum occidentale	L			10
Lyginia imberbis	L	2		9
Haemodorum spicatum	L			9
Leucopogon gilbertii	L			9
Petrophile linearis	L			9
Patersonia occidentalis	L		4	8
Leptomeria cunninghamii	L	1		8
Boronia denticulata	L			8
Bossiaea praetermissa	L			8

Table SRCP2: Summary of Species Preferences for Different Site Preferences on Scott Coastal Plain

^ - Risk assessment based initially on potential dependency on regional groundwater, lifeform and habitat preference

Species	Risk^ RG	<1M RG	1-3M RG	>3M RG
Species largely Dependent on Drier Sites				
Euchilopsis linearis ^^	L			8
Homalospermum firmum ^^	L			8
Platysace filiformis	L			8
Stylidium repens	L			8
Latrobea diosmifolia	L	3		7
Schoenus cruentus	L	1		7
Andersonia sprengelioides	L			7
Desmocladus fasciculatus	L			7
Hypocalymma angustifolium ^^	L			7
Leucopogon distans subsp. *distans* (ms)	L			7
Nuytsia floribunda	L			7
Pultenaea reticulata	L			7
Thysanotus sparteus	L			7
Xyris lanata ^^	L	4		6
Bossiaea ornata	L			6
Lepidium didymum	L			6
Macrozamia riedlei	L			6
Schoenus asperocarpus ^^	L			6
Taxandria fragrans (ms) ^^	L			6
Villarsia lasiosperma ^^	L			6
Banksia grandis	L		5	5
Leucopogon verticillatus	L		4	5
Taxandria inundata (ms) ^^	L		4	5
Acacia alata var. alata	L		2	5
Tetrarrhena laevis	L		1	5
Chaetanthus leptocarpoides	L			5
Drosera platystigma	L			5
Gonocarpus pusillus P3	L			5
Lepidosperma longitudinale	L			5
Leucopogon unilateralis	L			5
Persoonia longifolia	L			5
Stylidium guttatum	L			5
Acacia uliginosa	L			4
Daviesia preissii	L			4
Isotropis cuneifolia subsp. *cuneifolia*	L			4
Kunzea recurve	L			4
Leucopogon sp.Windy Harbour(A.Strid 21460)	L			4
Lomandra caespitose	L			4
Lomandra nigricans	L			4
Meeboldina denmarkica	L			4
Meeboldina tephrina (ms)	L			4
Mirbelia dilatata	L			4
Platychorda applanate	L			4
Stylidium mimeticum	L			4
Trachymene pilosa	L			4
Hibbertia trichocalyx	L			3

Table SRCP2: Summary of Species Preferences for Different Site Preferences on Scott Coastal Plain

^ - Risk assessment based initially on potential dependency on regional groundwater, lifeform and habitat preference

Species	Risk^ RG	<1M RG	1-3M RG	>3M RG
Species largely Dependent on Drier Sites	L			
Hypolaena pubescens	L			3
Jacksonia horrida	L			3
Lepyrodia muirii	L			3
Leucopogon ?pulchellus (southern variant)	L			3
Lomandra sonderi	L			3
Strangea stenocarpoides	L			3
Stylidium glaucum subsp. *angustifolium*	L			3
Taxandria juniperina ^^	L			3
Thelymitra crinita	L			3
Velleia trinervis	L			3
Adenanthos barbiger subsp. *intermedius* (ms)	L		1	2
Acacia browniana var. *endlicheri*	L			2
Adenanthos meisneri	L			2
Banksia attenuate	L			2
Baumea vaginalis ^^	L			2
Chamaescilla corymbosa	L			2
Eutaxia virgata	L			2
Gompholobium ?burtonioides	L			2
Hypocalymma ericifolium	L			2
Labichea punctata	L			2
Melaleuca pauciflora ^^	L			2
Pentapeltis peltigera	L			2
Pteridium esculentum	L			2
Schoenus acuminatus	L			2
Stylidium luteum subsp. *glaucifolium*	L			2
Thelymitra macrophylla	L			2
Thysanotus triandrus	L	1		1
Acacia luteola	L			1
Boronia crenulata subsp. *pubescens*	L			1
Bossiaea eriocarpa	L			1
Caladenia flava	L			1
Callistachys lanceolata	L			1
Chorizema rhombeum	L			1
Chorizema spathulatum	L			1
Comesperma flavum	L			1
Comesperma virgatum	L			1
Drosera menziesii subsp. *menziesii*	L			1
Drosera neesii subsp. *neesii*	L			1
Eriochilus dilatatus	L			1
Lagenophora huegelii	L			1
Lepidosperma squamatum	L			1
Leptospermum laevigatum	L			1
Philotheca spicata	L			1
Pimelea ?imbricata var. *piligera*	L			1
Pimelea longiflora subsp. *longiflora*	L			1
Pyrorchis nigricans	L			1

Table SRCP2: Summary of Species Preferences for Different Site Preferences on Scott Coastal Plain

^ - Risk assessment based initially on potential dependency on regional groundwater, lifeform and habitat preference

Species	Risk^ RG	<1M RG	1-3M RG	>3M RG
Species largely Dependent on Drier Sites	L			
Stylidium aff. luteum	L			1
Stylidium assimile	L			1
Tetraria octandra	L			1
Trymalium ledifolium var. rosmarinifolium	L			1

9.6 Recommendations and Offsetting Options

The Scott Coastal Plain area is a mosaic of private landholdings and areas of State Forest. Some of the private landholdings have been cleared for agriculture and therefore management of this area becomes more complex. The number of rare and priority species and communities are relatively high, and this increases on the Scott mapping units (SW, Swi, Swd) in areas where the ironstone occurs near the surface. Any local changes in regional groundwater levels will have significant impacts on the local swamp communities, however these impacts could be reduced if the changes occur over a longer period.

Several options exist for offsetting any long-term impacts of drawdown in the area. These could include:

1. Contribution to research funding addressing definition of values in the area and also management options for minimising long-term drawdowns by active management of forested catchments.
2. Reviewing options for reducing potential drawdowns through designing different options for water extraction from the Yarragadee system.
3. Undertake further on-ground investigations to clarify whether the biodiversity values highlighted in the previous text are impacted by the potential long-term drawdown as suggested.

10. DISCUSSION ON TOTAL DRAWDOWN ON BOTANICAL VALUES

The latest total drawdown modelling indicated that the regional groundwater levels vary at the respective sites. On current interpretations of the potential longer-term (30years) total drawdown will have the following implications for the botanical values in the areas as highlighted:

Swan Coastal Plain – potential implications for both rare and endangered flora, as well as several threatened ecological communities. This area was included in the desktop review of potential issues (Mattiske Consulting Pty Ltd 2003, 2004a), but was not included in the detailed investigations in 2004 (Mattiske Consulting Pty Ltd 2005). The implications of the latter raises a range of issues as some species and communities that are threatened or endangered are restricted geographically to the southern Swan Coastal Plain.

The most recent borefield design indicates that the critically endangered "Shrublands on southern Swan Coastal Plain Ironstones (10b)" may be influenced by regional groundwater changes. This community and the associated rare and endangered species are the most critical biological values that currently require management and a review of mitigation options. Further studies are required to assess the extent of the potential regional groundwater drawdowns.

Rosa Brook - in view of the nature of the valley system, it is predicted that any potential impacts on the botanical values will be relatively minor along the creekline and on the lower valley slopes near the creekline. These systems are critical for a range of aquatic invertebrates and fish species that are restricted to the tributaries of the Blackwood in the area (ECNRM 2005; Morgan and Beatty 2005). Therefore maintenance of local pools and aquatic systems appear to be more critical for the fauna species than the flora species.

None of the plant communities described in the Rosa Brook area are classified as Threatened Ecological Communities as described by Department of Conservation and Land Management (2005c) or listed as Threatened Ecological Communities under the EPBC Act (1999).

No rare or priority flora species were recorded as being restricted to these tributaries. No rare or priority flora species were recorded as being highly dependent on regional groundwater systems in the Rosa Brook tributaries. Less than 5% of the 169 plant taxa recorded on the Rosa Brook tributaries are considered to be highly dependent on regional groundwater. None of these plant taxa are restricted to these tributaries.

St John Brook - in view of the nature of the valley system, it is predicted that any potential impacts on the botanical values will be relatively minor along the creekline and on the lower valley slopes near the creekline. These systems are critical for a range of aquatic invertebrates and fish species that are restricted to the tributaries of the Blackwood in the area (ECNRM 2005; Morgan and Beatty 2005). Therefore maintenance of local pools and aquatic systems appear to be more critical for the fauna species than the flora species.

None of the plant communities described in the St John Brook area are classified as Threatened Ecological Communities as described by Department of Conservation and Land Management (2005c) or listed as Threatened Ecological Communities under the EPBC Act (1999).

Two priority flora species were recorded in these tributaries. These two Priority species, *Tyrbastes glaucescens* (ms) (P4) and *Stylidium barleei* (P3) are highly dependent on the availability of water near the creekline. Neither of the Priority species are restricted to this valley system. Only a small proportion of the 221 plant taxa recorded on the St John Brook tributaries are considered to be highly dependent on regional groundwater. None of these plant taxa are restricted to these tributaries.

Poison Gully – in view of the nature of the valley system, it is predicted that this impact on the botanical values will be largely confined to the swamp areas (A1, A2, B1) and the narrow creeklines (C1). The swamps between 200 metres or so upstream of Blackwood Road and downstream of Blackwood Road will be the most impacted (ie. in the area where the Yarragadee formation intercepts the valley system). The swamps (A4) in the upper reaches of the valley system and A3 (Pig swamp) occur on extensive clays with perched water tables and are not likely to be impacted on by any changes in regional groundwater levels.

None of the plant communities described in the Poison Gully area are classified as Threatened Ecological Communities as described by Department of Conservation and Land Management (2005c) or listed as Threatened Ecological Communities under the EPBC Act (1999).

No rare or priority flora species were recorded as being restricted to these tributaries. Two Priority 3 flora species were recorded as being highly dependent on regional groundwater systems in the Poison Gully tributary. Less than 10% of the 225 plant taxa recorded on the Poison Gully tributary are considered to be highly dependent on regional groundwater. None of these plant taxa are restricted to these tributaries.

Milyeannup Brook – in view of the nature of the valley system, it is predicted that this impact on the botanical values will be relatively minor along the creekline and on the lower valley slopes near the creekline. These systems are critical for a range of aquatic invertebrates and fish species that are restricted to the tributaries of the Blackwood in the area (ECNRM 2005; Morgan and Beatty 2005). Therefore maintenance of local pools and aquatic systems appear to be more critical for the fauna species than the flora species.

None of the plant communities described in the Poison Gully area are classified as Threatened Ecological Communities as described by Department of Conservation and Land Management (2005c) or listed as Threatened Ecological Communities under the EPBC Act (1999).

No rare or priority flora species were recorded as being restricted to these tributaries. One Priority 3 flora species was recorded as being highly dependent on regional groundwater systems in the Milyeannup Brook tributary. Less than 4% of the 180 plant taxa recorded on the Milyeannup Brook tributary are considered to be highly dependent on regional groundwater. None of these plant taxa are restricted to these tributaries.

Reedia Swamps - potential implications for both priority flora, as well as a Priority 1 threatened ecological community. The implications of the latter raises a range of issues as some species and communities that are threatened or endangered are restricted geographically to the Reedia Swamps. On current modelling results these areas appear to be avoided in terms of longer-term drawdowns of the regional groundwater levels. In view of the degree of significance of these systems (priority flora, critically endangered frogs and Priority 1 threatened ecological community) care should be taken to avoid any impacts on this area.

No rare or priority flora species were recorded as being restricted to these tributaries. Two Priority 3 and one Priority 4 flora species were recorded as being highly dependent on regional groundwater systems in the Reedia Swamp tributaries. 13.14% of the 175 plant taxa recorded in the Reedia swamp tributaries are considered to be highly dependent on regional groundwater. *Reedia spathacea* (P4) is restricted to these tributaries.

Scott Coastal Plain - potential implications for both a range of endangered flora, as well as the Scott Coastal Plain ironstone threatened ecological community. On the basis of current interpretations, the potential impacts have in part been understated as there were a few difficulties extrapolating bore data to the swamps. Of the swamps and ecosystems involved the most critical relate to the poorly represented communities on the Scott Coastal Plain, rather than the more widespread Nillup Plain. The Scott Coastal Plain has been largely cleared for agricultural activities; whilst the Nillup Plain occurs largely within State Forest areas. Therefore the implications for the range of species and plant communities that occur on the shallow seasonally inundated areas on the Scott Coastal Plain require consideration. Small changes in these systems can lead to major changes in species and communities.

The most recent borefield design indicates that the endangered "Scott River Ironstone Association" on the western Scott Coastal Plain may be influenced by regional groundwater changes. This community and the associated rare and endangered species are the most critical biological values that currently require management and a review of mitigation options.

One Priority 4 flora species was recorded as being highly dependent on the regional groundwater systems in the Nillup and Scott Coastal Plain transect areas. Less than 4% of the 231 plant taxa recorded on the Scott Coastal Plain are considered to be highly dependent on regional groundwater. Some plant species on the Scott Coastal Plain are restricted to these swamp and ironstone communities. The number of species (and rare and priority species) which are highly dependent on the regional groundwater, appears to be low in relation to the extent of the swamps and this in part appears to reflect the potential inaccuracies in extrapolating from localised monitoring bores across extensive swamps. Therefore the number of species that are highly dependent on groundwater should be much higher than that summarised in the text above. The difficulty of extrapolating from only several bores at each transect is reflected in some fifteen species, which are listed as having a low dependency rather than a high dependency. Therefore the findings for these plains appear to be less reliable than the findings for other areas. This discrepancy requires clarification in future monitoring programs.

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