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## Australian Heritage Database

### Places for Decision

Class : Natural

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#### Identification

**List:** National Heritage List  
**Name of Place:** Great Artesian Basin Springs: Witjira-Dalhousie  
**Other Names:** Dalhousie Mound Springs Area  
**Place ID:** 105819  
**File No:** 3/00/260/0045

**Nomination Date:** 09/07/2007  
**Principal Group:** Wetlands and Rivers

#### Status

**Legal Status:** 09/07/2007 - Nominated place  
**Admin Status:** 30/10/2008 - Assessment by AHC completed

#### Assessment

**Recommendation:** Place meets one or more NHL criteria  
**Assessor's Comments:**  
**Other Assessments:** :

#### Location

**Nearest Town:** Oodnadatta  
**Distance from town (km):** 118  
**Direction from town:** N  
**Area (ha):** 50700  
**Address:** Dalhousie ruin via Oodnadatta, SA, 5734  
**LGA:** Unincorporated (262) SA

#### Location/Boundaries:

About 50,700ha, 118km north of Oodnadatta and 38km south-east of Mount Dare Station, comprising the Dalhousie Springs Zone, Witjira National Park Management Plan Draft 2008. The exact boundary description of this zone can be obtained from the Department of the Environment, Water, Heritage and the Arts or the South Australian Department for Environment and Heritage. An approximate boundary is the area enclosed by a line joining the following points of Latitude and Longitude (GDA94) consecutively: 26.4708S 135.4251E, 26.4631S 135.4248E, 26.4557S 135.4257E, 26.4481S 135.4281E, 26.4414S 135.4314E, 26.4349S 135.4311E, 26.4279S 135.4276E, 26.4222S 135.4259E, 26.4163S 135.4251E, 26.3931S

135.4255E, 26.3874S 135.4263E, 26.3828S 135.4272E, 26.3772S 135.4293E, 26.3719S 135.4321E, 26.3516S 135.4475E, 26.3472S 135.4518E, 26.3315S 135.4727E, 26.3275S 135.4791E, 26.3249S 135.4850E, 26.3230S 135.4912E, 26.3221S 135.4957E, 26.3184S 135.5011E, 26.3150S 135.5082E, 26.3127S 135.5144E, 26.3111S 135.5224E, 26.3107S 135.5289E, 26.3115S 135.5623E, 26.3135S 135.5719E, 26.3157S 135.5779E, 26.3187S 135.5836E, 26.3222S 135.5889E, 26.3264S 135.5935E, 26.3311S 135.5975E, 26.3388S 135.6022E, 26.3473S 135.6051E, 26.3532S 135.6060E, 26.3591S 135.6060E, 26.3634S 135.6054E, 26.3686S 135.6246E, 26.3708S 135.6306E, 26.3737S 135.6363E, 26.3773S 135.6416E, 26.3837S 135.6483E, 26.3912S 135.6535E, 26.3967S 135.6561E, 26.4024S 135.6578E, 26.4082S 135.6587E, 26.4141S 135.6587E, 26.4200S 135.6579E, 26.4285S 135.6551E, 26.4338S 135.6522E, 26.4387S 135.6486E, 26.4432S 135.6443E, 26.4471S 135.6394E, 26.4504S 135.6340E, 26.4541S 135.6250E, 26.4556S 135.6187E, 26.4564S 135.6122E, 26.4565S 135.6056E, 26.4557S 135.5991E, 26.4535S 135.5899E, 26.4572S 135.5884E, 26.4619S 135.5859E, 26.4674S 135.5819E, 26.4762S 135.5740E, 26.4804S 135.5693E, 26.4918S 135.5697E, 26.5106S 135.5756E, 26.5201S 135.5774E, 26.5290S 135.5771E, 26.5348S 135.5758E, 26.5433S 135.5723E, 26.5504S 135.5684E, 26.5577S 135.5633E, 26.5621S 135.5590E, 26.5661S 135.5541E, 26.5725S 135.5443E, 26.5767S 135.5356E, 26.5787S 135.5294E, 26.5801S 135.5197E, 26.5802S 135.5007E, 26.5793S 135.4929E, 26.5772S 135.4854E, 26.5743S 135.4788E, 26.5711S 135.4733E, 26.5662S 135.4673E, 26.5607S 135.4624E, 26.5559S 135.4590E, 26.5599S 135.4493E, 26.5611S 135.4409E, 26.5611S 135.4329E, 26.5598S 135.4258E, 26.5568S 135.4176E, 26.5529S 135.4109E, 26.5469S 135.4042E, 26.5394S 135.3986E, 26.5313S 135.3947E, 26.5231S 135.3927E, 26.5149S 135.3922E, 26.5071S 135.3931E, 26.5000S 135.3952E, 26.4927S 135.3989E, 26.4858S 135.4041E, 26.4801S 135.4105E, 26.4744S 135.4188E, then directly to the point of commencement.

**Assessor's Summary of Significance:**

Witjira-Dalhousie Springs is one of a suite of nationally important artesian springs in the Great Artesian Basin, which is the world's largest artesian basin. The artesian springs have been the primary natural source of permanent water in most of the Australian arid zone over the last 1.8 Million years (the Pleistocene and Holocene periods). These artesian springs, also known as mound springs, provide vital habitat for more widespread terrestrial vertebrates and invertebrates with aquatic larval young, and are a unique feature of the arid Australian landscape.

As these artesian springs are some distance from each other in the Australian inland, and individually each one covers a tiny area, their isolation has allowed the freshwater animal lineages to evolve into distinct species, which include fish, aquatic invertebrates (crustacean and freshwater snail species) and wetland plants. This results in a high level of endemism, or species that are found nowhere else in the world.

Witjira-Dalhousie Springs is nationally significant as it holds a suite of species which are genetically and evolutionarily distinct from other Great Artesian Basin springs, including three endemic freshwater snails, five endemic fish species and at least seven endemic crustaceans (isopods, amphipods and ostracods). The outflows of Witjira-

Dalhousie Springs also support at least one endemic plant known only from the spring complex, a native tobacco, as well as at least six plant species better known from wetter areas to the south, including duck weed, which are indicative of a wetter past.

Mound springs in arid and semi arid Australia are associated with traditional stories and song lines, rain making rituals and evidence for concentrated Aboriginal occupation during dry seasons and periods of drought. The Witjira-Dalhousie Mound Springs are an outstanding example of how mound springs act as a refuge. The spring's significance is illustrated by the exceptionally large number of traditional song lines and story lines that originate or pass through the springs, the density of artefacts and the large size of Aboriginal camps at the springs, some up to a kilometre in length and thousands of square metres in extent (AARD 2008).

Witjira-Dalhousie Springs is regarded as one of the best examples of an artesian 'mound' spring complex in Australia, and Yeates (2001) also considers it "the best place (in Australia) to see the artesian processes and artesian springs in a natural state".

**Draft Values:**

<b>Criterion</b>	<b>Values</b>	<b>Rating</b>
A Events, Processes	<p>Witjira-Dalhousie Springs is one of a suite of important artesian discharge springs in the Great Artesian Basin (GAB) for endemic fish, invertebrates (including hydrobiid gastropod molluscs) and plants (ANHAT 2005 &amp; 2008). Witjira-Dalhousie is the most important place in the Australian arid zone for endemic fish (ANHAT 2005; Allen <i>et al</i> 2002; DEW 2007c; Morton <i>et al</i> 1995a, p.95). Witjira-Dalhousie Springs has also been ranked by CSIRO as a nationally 'highly significant' semi-arid and arid refugia in Australia for regional endemics of aquatic invertebrates (isopods, ostracods, and hydrobiid molluscs) and fish (Morton <i>et al</i>, 1995a, p.11, p.95 &amp; p.133).</p> <p>GAB artesian springs are important for illustrating the role of evolutionary refugia for relict animal and plant species (Morton <i>et al</i>, 1995a, p.11), which have evolved into distinct and endemic species in the GAB springs. Witjira-Dalhousie Springs contain five endemic species of fish: the Dalhousie mogurnda (<i>Mogurnda thermophila</i>), Dalhousie catfish (<i>Neosilurus gloveri</i>), Dalhousie hardyhead (<i>Craterocephalus dalhousiensis</i>), Glover's hardyhead (<i>C. gloveri</i>), and Dalhousie goby (<i>Chlamydogobius gloveri</i>) (Fensham <i>et al</i> 2007, p.13 &amp; p.42; Allen <i>et al</i> 2002; DEW 2007c; Morton <i>et al</i> 1995a, p.95). Witjira-Dalhousie Springs contain three endemic hydrobiid freshwater snail species: <i>Austropyrgus</i></p>	AT

*centralia*, *Caldicochlea globosa* and *Caldicochlea harrisi* (Fensham *et al* 2007, p.13 & p.42; ANHAT 2005 & 2008; Perez *et al* 2005; Morton *et al* 1995a, p.95; Ponder and Clark 1990, p 301; Ponder *et al* 1995, p.554). Witjira-Dalhousie Springs also has a phraetoicidean isopod (*Phreatomerus latipes*), which is endemic to Witjira-Dalhousie and the Lake Eyre springs, and two endemic amphipod species (*Phraetochiltonia anophthalma* and *Austrochiltonia dalhousiensis*), and five endemic ostracods (*Ngarawa dirga*, *Candanopsis sp.*, *Cyprideis sp.*, *Darwinula sp. Entocytheridae sp.*) (DEW 2007c; Morton *et al* 1995a & b). The outflows of Witjira-Dalhousie Springs also support at least one endemic plant known only from the spring complex, a native tobacco, *Nicotiana burbidgeae*, as well as at least six relict plant species better known from mesic areas to the south, including: duck weed (*Lemna disperma*), swamp twig-rush (*Baumea arthropphylla*), spike rush (*Eleocharis geniculata*), a fringe-rush (*Fimbristylis ferruginea*) and two herbs: shield pennywort (*Hydrocote verticullata*) and creeping brookweed (*Samolus repens*) (DEW 2007c; DEH(SA) 2007a; Morton *et al* 1995a, pp.95; Morton *et al* 1995b, pp.55-56; Mollemans 1989, pp.65-66; McLaren *et al* 1985, pp.9-12).

## B Rarity

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Extant artesian springs in the GAB are a geographically rare phenomenon, each one covering a tiny area within the basin. (Ponder 1989 p 416, Wilson 1995 p 12). Witjira-Dalhousie Springs is regarded as one of the most important artesian springs because of its isolation, relative intactness and the extinction of other springs in the GAB (Morton *et al* 1995a, p.95 & p.133; Morton *et al* 1995b, pp.55 & 64-65; Wolfgang Zeidler pers. comm. 1/3/2005; Ziedler and Ponder 1989, p.ix).

## D Principal

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characteristics of Mound springs in arid and semi arid Australia are associated a class of places with traditional stories and song lines, rain making rituals and evidence for concentrated Aboriginal occupation during dry seasons and periods of drought. The Witjira-Dalhousie Mound Springs are an outstanding example showing the principle characteristics of mound springs as a class of Aboriginal cultural places. They are located in one of the driest zones in Australia and the Lower Southern Arrernte and the Wangkangurru Traditional Owners relied on the springs as a refuge during the dry season and times of drought. They are associated with an exceptionally large number of traditional song lines and story lines (Hercus and

Sutton 1985; 64; Davey, Davies and Helman 1985), rainmaking rituals were performed there (Kimber 1997) and the density of artefacts and the large size of Aboriginal camp sites, some measuring up to a kilometre in length and thousands of square metres in extent, is unusual (Lampert 1985; Florek 1987, 1993; Kimber 1997; AARD 2008).

The GAB is the world's largest example of an artesian basin with its associated artesian springs an important component of the system (Harris 1992 p 157, Perez *et al* 2005). It is regarded as the best example of such an artesian system in Australia (Yeates 2001, pp.64-65; Morton *et al* 1995a, p.11, p.95 & pp.132-134; Morton *et al* 1995b, pp.65-66). Artesian springs are the primary source of permanent fresh water within the arid zone since at least the late Pleistocene (the last 1.8 Million years) and are therefore a unique feature of the arid Australian landscape (Ponder 1986 p 416; Morton *et al* 1995b, p. 55; Bowler 1982, pp.35-45). As the primary natural source of permanent fresh water in most of the arid zone, GAB artesian springs represent vital habitat for more widespread terrestrial vertebrates, and invertebrates with aquatic larvae (Ponder 1986, p 415). Witjira-Dalhousie Springs is one of a suite of important artesian discharge GAB Springs that are outstanding examples of the endemism exhibited by artesian springs individually and collectively. Species found at Witjira-Dalhousie Springs include endemic freshwater hydrobiid snails *Austropyrgus centralia*, *Caldicochlea globosa* and *C. harrisi*, and five endemic fish species, the Dalhousie mogurnda (*Mogurnda thermophila*), Dalhousie catfish (*Neosilurus gloveri*), Dalhousie hardyhead (*Craterocephalus dalhousiensis*), Glover's hardyhead (*C. gloveri*), and Dalhousie goby (*Chlamydogobius gloveri*) (Fensham *et al* 2007, p.13 & p.42; Perez *et al* 2005; Allen *et al* 2002; DEW 2007c; Ponder 2003; Fensham and Fairfax 2004; Morton *et al* 1995a, pp.55-56).

Witjira-Dalhousie Springs is regarded as one of the best examples of an artesian 'mound' spring complex in Australia (Morton *et al* 1995a, p.95 & pp.133), and Yeates (2001) also considers it "the best place (in Australia) to see the artesian processes and artesian springs in a natural state" (Yeates 2001, pp. 64-65). Kreig (1989) also states "as a geological feature the (Dalhousie Anticline) springs complex is unique in Australia. It illustrates on a huge scale the cause and effect of an artesian mound system", including "top of aquifer, mound spring material ... and large pools and rivulets of artesian water all convincingly displayed". These geological values are amply illustrated within the springs complex place, the core or 'hub' of the Dalhousie Anticline (Kreig 1989, p.26).

I Indigenous  
tradition

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Witjira-Dalhousie Mound Springs has outstanding heritage value to the nation for its association with an exceptional density of story or song lines most of which are associated with mound springs (Hercus and Sutton 1985; 64). There are twenty four recorded song lines that originate or pass through Witjira-Dalhousie Mound Springs including: the Kestrel story, the Printi and the Goanna Women, the Rain Ancestor (*Anintjola*), the Dog story, the Frill Neck Lizard story, the Boy from Dalhousie, the Goanna Party and the Echidna Woman, Old Man Kingfisher and Old Woman Kingfisher, the Blind Rainbow Snake, Old Man Rainbow Snake, Perentie and the Boys, the Big Boys, the Perentie Goanna Camp, the Perentie Staked His Foot and the Two Boys song line. Unlike the traditions associated with the mound spring groups at Lake Eyre and Lake Frome, a tradition has been recorded that explains why some of the mound springs at Witjira-Dalhousie produce hot water (Hercus nd.; Hercus and Sutton 1985).

### **Historic Themes:**

### **Nominator's Summary of Significance:**

### **Description:**

The Great Artesian Basin (GAB) is one of the largest artesian systems in the world and occupies about 22% of the Australian continent. Artesian springs lie around the rim of the GAB, occurring in complexes of springs known as a 'supergroup', and are the natural outlets of the artesian aquifers from which the groundwater of the GAB flows to the surface.

The artesian springs, also known as mound springs, are loosely divided into recharge springs and discharge springs. Recharge springs are primarily found along the GAB's eastern rim on the Great Dividing Range where the GAB aquifers outcrop in an area of relatively high rainfall allowing recharge. The recharge springs release excess GAB recharge water or, in topographic lows, intercept the GAB recharge aquifers. The western margin of the GAB also has an area where the GAB aquifers outcrop but recharge is minimal as rainfall is low and intermittent. Discharge springs are those that release groundwater that has entered the GAB from the recharge zones, which flows towards the GAB's southern, southwestern, western and northern margins. Groundwater dating research has found that water in the furthest areas from the recharge areas has been moving through the GAB's porous rock strata (aquifers) for up to a million years. Witjira-Dalhousie Springs are regarded as a discharge spring complex and consists of at least five active artesian springs together with a few semi-active artesian springs immediately adjacent. Sixty artesian springs exist in all.

There are eleven supergroups in the main part of the GAB extending from Bourke in New South Wales and Lake Eyre in South Australia, and two outlier spring

supergroups on Cape York Peninsula, including one on the Peninsula's northern tip. The GAB springs and spring complexes number around six hundred. However one 'spring' may represent between two and four hundred spring outlets and supergroups may be regional clusters of such springs, often covering relatively small areas. GAB springs range in size from small springs only a few metres across, such as Bundoona in southern Queensland, to major complexes of up to sixty springs with quite large pools such as Witjira-Dalhousie Springs, in northern South Australia. Some GAB artesian springs have associated discharge mounds that consist of mud, but most of the springs, especially the discharge springs, deposit calcium carbonate or other salts from the mineral-rich waters discharging from the springs. These evaporites typically form characteristic salt deposits around the spring outflow that can extend for several hundred metres as a distinctive white tail, sometimes yellow or even black, often with a central carbonate mound grading into sulphate and chloride salts. In many instances, particularly among South Australian GAB springs, these deposits combine with wind-blown sand, mud and accumulated plant debris to form mounds around the spring outflow. The resulting formation can resemble a small volcano, colloquially called a 'mound spring'. Many of the Queensland GAB springs are "softer" and fail to develop anything more substantial than a mound of a few centimetres to a few metres in height (Fensham and Fairfax 2004), hence the use of the more readily interpreted term of 'artesian spring' rather than 'mound spring'.

Mound formation of GAB springs is influenced by a range of factors, including groundwater discharge and evaporation rates, hydrochemistry, influence of organic material versus organic carbonate precipitation and local subsidence of the mound. Dating of GAB springs using thermoluminescence, uranium-thorium and carbon-14 dating of quartzose sands and carbonate springs deposits have produced dates up to more than 740 000 years. Research (Habermahl 2006) has found that large spring complex deposits reflect geological and hydrological changes in eastern and central Australia during the Quaternary (the last 2.6 million years) and provide an understanding of long-term changes prior to human intervention.

Habermahl (2006) also notes that groundwater dating, using carbon-14 and chlorine-36 studies, has found water aged several thousand years near recharge areas and more than a million years near the centre of the GAB. The groundwater moves slowly, at less than one metre per year to approximately five metres per year, generally in a south, southwest, west direction and also northwards in the northern portion of the GAB.

Witjira-Dalhousie Springs comprise a discrete supergroup of GAB discharge springs. This is the most northerly group of GAB springs in South Australia and is isolated from the other supergroups in South Australia as well as Queensland. The Witjira-Dalhousie Springs lie approximately 250 kilometres southsoutheast of Alice Springs and 120 kilometres north of Oodnadatta within the Witjira National Park, which is jointly managed by Indigenous traditional owners and South Australia's Department of the Environment and Heritage.

The Dalhousie supergroup contains approximately 60 springs including both active and extinct mounds, and contains a wide variety of geological features associated with the evolution and development of GAB artesian mound springs not seen in other springs. The springs environs extend over an area of approximately 50 980 hectares,

and the individual springs are surrounded by well-developed wetland vegetation, including large areas of the inland Paperbark (*Melaleuca glomerata*). Flow rates at Witjira-Dalhousie Springs are the highest in the GAB, with 41% and 90% of the natural discharge of the GAB in Australia and South Australia respectively, and results in overflow 'tails' which can extend for ten kilometres.

The Witjira-Dalhousie Springs form the only permanent surface water for 150 kilometres in any direction (DEH 2008; Macfarlane 2005). The importance of this resource to Aboriginal people is reflected in the number and types of sites recorded at Witjira-Dalhousie. Eight Aboriginal archaeological sites and thirty traditional story sites (AARD Register 2008) have been recorded although others probably occur in the area. The Aboriginal archaeological sites include old camps, stone arrangements and stone knapping sites. Some of the camps are exceptionally large with dense scatters of artefacts extending over a kilometre. Most of the tradition and story places are associated with mound springs.

GAB artesian springs are a significant refuge in arid and semi-arid Australia, providing one of the few sources of natural permanent water. Estimates of the age of artesian springs have concluded that individual springs may last for up to a few hundred thousand years, but spring groups collectively may last possibly up to several million years. The presence of such permanent freshwater in inland Australia over the past few million years has provided habitat for a wide array of fish, invertebrates and plants that have been "stranded" in GAB artesian springs as inland Australia has dried out.

Ecologically GAB artesian springs are considered an evolutionary refuge as they allow wetland dependent (specialised habitat) species to persist as their original geographic range becomes uninhabitable due to drying over an extended period of time because of climatic change.

With the contraction of their main range, relictual species are hypothesised to have evolved different characteristics from their original stock, leading to the high levels of endemism (the frequency of species with restricted distributions) present in isolated GAB artesian spring groups (Brown and Gibson 1983; Morton *et al*, 1995, p.11, p.119 & p.134). Artesian springs provide the localised habitat requirements for a suite of endemic fish and aquatic invertebrate species, including hydrobiid molluscs, isopods, ostracods, amphipods, copepods and flatworms (Morton *et al*, 1995a, p.11, p.119 & p.134).

GAB artesian springs, such as Witjira-Dalhousie Springs, hold plants and animals that have evolved into new species found nowhere else. The presence of endemic species, and large peat mounds, indicates that some GAB springs have been active for a very long time. Hydrobiid snails are the best studied of these endemic groups. Hydrobiid snails are the most diverse of all freshwater gastropods and frequently have small distribution ranges, resulting in high levels of endemism (Perez *et al* 2005). This makes them excellent candidates for evolutionary studies on endemism and speciation and for use as potential indicators (surrogates) of the importance of environments such as mound springs for other, less well-studied freshwater taxa (Ponder pers. comm. 2004, Perez *et al* 2005). Hydrobiid snails are particularly well represented in GAB artesian springs with well over twenty three taxa and five genera (Perez *et al*

2005), although each artesian spring complex or aggregation is separated by hundreds of kilometres. It has been hypothesised that this is a result of ancestral Gondwanan hydrobiids being stranded by the increasing aridity of inland Australia and being isolated in the permanent waters of artesian springs (De Deckker 1986, Ponder 1986, Perez *et al* 2005). Recent work has demonstrated that the GAB hydrobiid snails have evolved in three separate radiations, one in Queensland and two in South Australia, with the Queensland hydrobiids and those of South Australia, including Witjira-Dalhousie Springs, being completely unrelated (Perez *et al* 2005).

The Witjira-Dalhousie Springs, on their own and collectively with the other significant discharge springs comprising the GAB springs, are notable examples of the endemism exhibited by GAB artesian springs. Witjira-Dalhousie Springs have three species of endemic freshwater snails, five species of endemic fish, and six species of endemic crustacean (DEW 2007c; Morton *et al* 1995a & b; Ponder 2004; Perez *et al* 2005). There are also at least six southern relict plant species from when the arid zone was more mesic and at least one endemic species only found at the springs (DEW 2007c; DEH(SA) 2007a; McLaren *et al* 1985, Morton *et al* 1995a & b; Mollemans 1989). In addition at least two species of frog, 21 species of reptile, 149 species of birds, five species of mammals, seven species of freshwater snail, and 112 species of vascular plants are known from the vicinity of the springs from a species list generated by the Australian Natural Heritage Assessment Tool (ANHAT 2008) and as detailed in the Witjira National Park Draft Plan of Management (DEH, 2008, pp.28-31).

### **Analysis:**

### **Claims**

As Witjira-Dalhousie Springs is an Australian Heritage Council (AHC) nomination there are no specific claims against any criteria of the National Heritage List (NHL).

Natural values are considered under criteria (a), (b) and (d), using the Australian Natural Heritage Assessment Tool (ANHAT), relevant literature and expert opinion. Indigenous values are considered under criterion (d) and (i) using published information and site records held by the Aboriginal Affairs and Reconciliation Division, South Australia.

There is insufficient evidence of any historic values above the NHL threshold.

### **Criterion (a)**

*The place has outstanding heritage value to the nation because of the place's importance in the course, or pattern of Australia's natural or cultural history.*

### **Endemic and Relict Species and Refugia**

Endemic species (species with a limited distribution range) are an uncommon phenomena in the arid and semi-arid zones of Australia (Ponder 1986, Morton *et al* 1995a). The biological significance of Great Artesian Basin (GAB) springs lies

primarily in the high level of endemism exhibited by the freshwater fauna (Ponder 1986) but also in the existence of a small but unique flora (Fensham and Fairfax 2004).

There is little comparative data available at a national scale for this endemic biota except for freshwater fish and freshwater snails, both of which are well documented in ANHAT. These taxa were used as the best available surrogates for the wide array of endemic freshwater species associated with artesian springs. An ANHAT analysis was undertaken for the arid and semi-arid zone of Australia, and GAB springs were found to rank as the most significant places in the arid zone for both endemic freshwater snails and fish (ANHAT 2005 & 2008). The West MacDonnell Ranges were the only place ranking at an equivalent level for endemism (ANHAT 2005 & 2008), but the West MacDonnell's biota bears no common elements with GAB artesian spring biota in freshwater snails, fish and flora. The endemism in the West MacDonnell Ranges is associated with the complex environment of an elevated range and associated semi-permanent rivers (ANHAT 2005 & 2008).

Witjira-Dalhousie and Elizabeth Springs, are two of a suite of five discharge artesian springs with the highest endemicity rates of any surveyed springs in the GAB for freshwater fish and snails, and the highest in the arid zone with the exception of the West MacDonnell Ranges (ANHAT 2005 & 2008). This has been independently confirmed with biological specialists in the Australian (AM), South Australian (SAM) and Western Australian Museums (WAM) and the Australian National University (ANU); George Wilson & Winston Ponder (AM); Wolfgang Ziedler & Remko Leijts (SAM); Ivana Karanovic (WAM); & Patrick De Deckker (ANU) - all pers. comm.'s 1/3/05).

Witjira-Dalhousie and Elizabeth Springs, along with three other GAB springs complexes (Edgbaston, Bundoona and Freeling Springs), contain 19 of the 23 known artesian spring endemic hydrobiid snail molluscs, eleven artesian spring endemic vascular plants and all of the eight known artesian spring endemic fish. Artesian springs also contain large numbers of endemic invertebrate species for which national comparative information is insufficient including mites (Acaridae), flat worms (Polychaeta) dragonflies and damselflies (Odonata), caddisflies (Trichoptera), wolf spiders (Sparassidae), and crustaceans (Phraetoicoidean isopoda, Amphipoda and Ostracoda) (Morton *et al* 1995a & 1995b; Hirst pers. comm. 2004; Ponder 2003; Wells pers. comm. 2005; Wilson 2003).

Witjira-Dalhousie Springs is the highest-ranking centre of endemism for native freshwater fish in the Australian arid zone (ANHAT 2005). Witjira-Dalhousie Springs contain five endemic species of fish: the Dalhousie mogurnda (*Mogurnda thermophila*), Dalhousie catfish (*Neosilurus gloveri*), Dalhousie hardyhead (*Craterocephalus dalhousiensis*), Glover's hardyhead (*C. gloveri*), and Dalhousie goby (*Chlamydogobius gloveri*) (Fensham *et al* 2007, p.13 & p.42; Allen *et al* 2002; DEW 2007c; Morton *et al* 1995a, pp.55-56; Glover 1989, pp.89-111). Witjira-Dalhousie is the third highest-ranking centre of endemism for arid zone hydrobiid snails in Australia, and contains at least three of the twenty-three known artesian spring endemic snails: *Austropyrgus centralia*, *Caldicochlea globosa* and *Caldicochlea harrisi*, which are all endemic to the Witjira-Dalhousie Springs (Fensham *et al* 2007, pp.13 & p.42; ANHAT 2005 & 2008; Perez *et al* 2005; Ponder

and Clark 1990 p 301; Ponder *et al* 1995, p 554). The *Austropyrgus* species at Witjira-Dalhousie Springs represents an invasion of the arid zone by a single member of a species rich southeastern Australian genus, whilst *Caldicochlea* is another hydrobiid genus that has colonised the arid zone's GAB springs, including Witjira-Dalhousie Springs. Both the *Austropyrgus* and *Caldicochlea* invasions and radiations in the South Australian suite of the GAB artesian springs are phylogenetically distinct from the *Jardinella* hydrobiid snails' invasions and radiations into the Queensland GAB artesian springs (Perez *et al* 2005, pp.545-556; Ponder and Clark 1990, p 346).

It is highly likely that this genetic isolation of GAB spring biota is reflected in other invertebrate biota, especially amongst the crustacean amphipods, and an example of this potential is exhibited by Witjira-Dalhousie Springs, which has one of the best-studied freshwater crustacean faunas. Identified invertebrates include a phraetoicidean isopod (*Phreatomerus latipes*), which is endemic to Witjira-Dalhousie Springs and the Lake Eyre artesian springs, and until recently was the only known desert dwelling isopod. The phraetoicidean isopod was also identified at Bundoona Springs in southern Queensland. Two amphipods are also endemic to Witjira-Dalhousie: A blind species occurs in the seepages and underground waters (*Phraetochiltonia anophthalma*), and appears to be a relict from when inland Australia was more mesic; the second species is a surface-dwelling species (*Austrochiltonia dalhousiensis*). In addition the unnamed ostracod species *Candanopsis sp.*, *Cyprideis sp.*, *Darwinula sp.* *Entocytheridae sp.*, are all endemic to Witjira-Dalhousie Springs, while the ostracod *Ngarawa dirga* is endemic to the wider Witjira-Dalhousie and Lake Eyre artesian springs region (Zeidler 1989). There are another seven species of more widespread ostracods and eleven species of widespread copepods occurring at Witjira-Dalhousie (Morton *et al* 1995, p.95: & Morton *et al* 1995b, pp.57-58). This indicates that Witjira-Dalhousie Springs has the richest suite of crustaceans amongst the GAB artesian springs (Zeidler pers. comm. 2005).

Comparative reports exist for the flora of GAB artesian springs in Queensland and South Australia (Fensham *et al* 2007, pp.13-14 & p.41; Fensham and Fairfax 2004, McLaren *et al* 1985), and there are few plant species endemic to particular artesian springs (Fensham and Fairfax 2004). There are a number of plant species endemic to the artesian springs, which are widespread across the spring complexes. Witjira-Dalhousie Springs and the Queensland GAB artesian springs were the richest artesian springs for the suite of endemic plants. Witjira-Dalhousie Springs contains an endemic plant *Nicotiana burbridgeae*, and a number of outlier plant populations, which are thought to be relict plant species of the more mesic environments to the south, including common duckweed *Lemna disperma*, the only record for central Australia, and between at least five and ten plants, which are the only records for northern South Australia. These outlier species include: a swamp twig-rush (*Baumea arthropphylla*), spike rush (*Eleocharis geniculata*), a fringe-rush (*Fimbristylis ferruginea*), and two herbs: shield pennywort (*Hydrocote verticillata*), and creeping brookweed (*Samolus repens*). Potentially southern relict species also include: sea rush (*Juncus kraussii*), blady grass (*Imperata cylindrica*), slender knotweed (*Persicaria decipiens*), salt couch (*Sporobolus virginicus*) and the herb *Polygonum salicifolia* (DEW 2007c; DEH(SA) 2007a; Morton *et al* 1995a, pp.95; Morton *et al* 1995b, pp.55-56; Mollemans 1989, pp.65-66; McLaren *et al* 1985, pp.9-12). These relict plant species further suggest that artesian springs may represent important long-term evolutionary arid zone refugia (Morton *et al* 1995b, p.55; Ponder 2003, De

Deckker pers. comm. 2005). Witjira-Dalhousie is therefore particularly significant for the large number of relict plant species, of which at least six are southern relict species, as well as at least one endemic plant species, and is regarded as the most important spring complex for these values.

The presence of endemic species, and large peat mounds, indicates that some GAB springs have been active for a very long time (Fairfax and Fensham 2002, p.228). Morton *et al* (1995b) notes “that there has been significant drying of the Australian continent in the last 1 to 2 million years, with the central area of Australia becoming an arid environment (Bowler 1982). Because mound (artesian) springs are surrounded by arid country, the springs are the primary source of permanent fresh water within this desert environment and have been so since the late Pleistocene (Kreig 1989). This isolation of the mound springs has given rise to unusual ecological and evolutionary phenomena” (Morton *et al* 1995b, p.55). This therefore indicates that Witjira-Dalhousie Springs has been a significant freshwater refuge in the arid zone for at least the last few million years (Morton *et al* 1995b, p.55; Bowler 1982, pp.35-45).

Witjira-Dalhousie Springs has been ranked as a nationally ‘highly significant’ semi-arid and arid refugia in Australia (Morton *et al*, 1995a, p.11, p.95 & p.133), which is supported by ANHAT analysis results which rank Witjira-Dalhousie Springs as one of the five most important artesian springs in the GAB for endemic fish, invertebrates and plants (ANHAT 2005 & 2008). GAB artesian springs have been identified as nationally, and potentially internationally significant repositories of many unique and genetically diverse animals, including being one of the most significant refugia for endemic aquatic and wetland invertebrates (Greenslade *et al* 1985; Ponder *et al* 1995, p.584).

Some of these endemics have affinities with geographically disjunct taxa in mesic, temperate environments of Australia such as Tasmania and Lord Howe Island or, in the case of Phraetcoidean isopods, have long fossil histories (Ponder 2003, Wells pers. comm. 2005, Wilson 2003). The concentrations of such species in artesian springs makes these habitats important long-term evolutionary arid zone refugia (Ponder 2003, De Deckker pers. comm. 2005). Witjira-Dalhousie Springs contains one species of phraetcoidean isopod (*Phreatomerus latipes*), as well as several species which may be relictual including a decapod *Cherax* sp. Sokol (1989) and several hydrobiid snail species (Fensham *et al* 2007, p.13 & p.42; Morton *et al* 1995a, p.95; McLaren *et al* 1985; Ziedler 1989).

**Given the comparative significance of endemic and relict artesian spring flora and fauna in the arid zone, and their importance in illustrating evolutionary refugia, Witjira-Dalhousie Springs has outstanding natural heritage value to the nation under criterion (a).**

*Criterion (b)* The place has outstanding heritage value to the nation because of the place’s possession of uncommon, rare or endangered aspects of Australia’s natural or cultural history.

#### Rare Environments

The extant artesian springs of the GAB are regarded as the best examples of spring systems in Australia and one of the best in the world (Yeates 2001, pp.64-65; Morton

*et al* 1995a, p.11, p.95 & & pp.132-134; Morton *et al* 1995b, pp.65-66). The more than 600 spring groups located around the edge of the GAB (GABCC, 1998, p.29), which fall into eleven groups of artesian spring supergroups in the main part of the basin (Habermahl 2006, p.1), are regarded as unique landscape features in arid Australia (Ponder 1986; GABCC, 1998, p.29). The GAB artesian spring's principal significance lies in the fact that they are a primary source of surface water in arid to semi-arid Australia and are part of an artesian system that covers 22% of the Australian continent (Morton *et al* 1995b, p.55; Ponder 1986; GABCC, 1998, p.29; Mudd, 2000, pp. 463-476).

The GAB extends over 1.7 million square kilometres, equivalent to a fifth of Australia. While there are numerous artesian springs and spring complexes around the margin of the GAB, they are geographically an unusual phenomena as they cover highly restricted areas within the basin. For example, most artesian springs are only a few metres across, with the rare example being a hectare in extent. GAB artesian springs are therefore a geographically rare feature.

The rarity of the extant existing GAB artesian springs is illustrated by a 1998 to 2000 regional review and on-ground study of Queensland GAB spring floristics, which found that of 107 GAB spring-groups surveyed by J. Alfred Griffiths a century ago between 1896 and 1898, 87 (81%) spring-groups were no longer active, and of the remaining 20 at least eight had substantially reduced flows, leaving 12 springs flowing near the rates observed a century earlier (Fairfax and Fensham 2002, p.210).

Witjira-Dalhousie Springs is regarded as one of the most important artesian springs because of its isolation, relative intactness and the extinction of other springs in the GAB (Wolfgang Zeidler pers. comm. 1/3/2005; Morton *et al* 1995a, pp.64-65; Ziedler and Ponder 1989, p.ix). A range of human activities has severely impacted artesian springs in the GAB, due to draw-down exacerbated by stock damage. All the artesian springs in New South Wales are extinct or badly damaged, and less than 26% of the artesian GAB spring groups in Queensland are still flowing (Morton *et al* 1995a; Fensham and Fairfax 2002; Fensham and Fairfax 2004; Ponder 1989, p.416; Wilson 1995, p 12; Ponder pers. comm. 1/3/2005). Extent GAB artesian springs are significant as a rare habitat and a limited regional resource (Ponder 1995; Mudd, 2000, pp. 463-476; Fensham and Fairfax 2003; Ponder pers. comm. 1/3/2005).

As one of a suite of five discharge springs Witjira-Dalhousie Springs is an outstanding example of the ecological and scientific importance of GAB artesian springs (Ponder pers. comm. 1/3/2005; ANHAT 2005 & 2008), and is one of the only permanent sources of freshwater in the eastern portion of the arid zone of Australia (Morton *et al* 1995b, p.55; Mudd 2000, p. 463; Ponder pers. comm. 1/3/2005; Perez *et al* 2005).

**Given the rarity of intact and highly endemic GAB artesian springs, and the massive decline they have undergone, Witjira-Dalhousie Springs has outstanding natural heritage value to the nation under criterion (b).**

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#### EPBC-listed Communities & Species

The rarity of the ecological community, and the adverse risks facing GAB artesian

(mound) springs, is reflected in their listing as a threatened ecological community (endangered) under the Commonwealth EPBC Act titled “The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin”) (DEW 2007a). However, the presence of a single EPBC Act-listed community is not itself a sufficient reason for NHL listing under criterion (b).

**This value does not have outstanding natural heritage value to the nation under criterion (b).**

**Criterion (c)**

*The place has outstanding heritage value to the nation because of the place’s potential to yield information that will contribute to an understanding of Australia’s natural or cultural history*

**There is insufficient evidence to demonstrate that the place might have outstanding heritage value to the nation to be above threshold for this criterion.**

Criterion (d) *The place has outstanding heritage value to the nation because of the place’s importance in demonstrating the principal characteristics of:*

- (i) a class of Australia’s natural or cultural places; or*
- (ii) a class of Australia’s natural or cultural environments*

Natural values

The GAB is the world's largest example of an artesian basin with its associated artesian springs an important component of the system (Harris 1992 p 157, Perez *et al* 2005). It is regarded as the best example of such an artesian system in Australia (Yeates 2001, pp.64-65; Morton *et al* 1995a, p.11, p.95 & pp.132-134; Morton *et al* 1995b, pp.65-66), and is significant for its sheer size as this deep groundwater system covers a fifth (22%) of the Australian continent. GAB artesian springs are a principal source of surface water in arid to semi-arid inland Australia, and have been the primary sources of relatively fresh permanent water within the arid zone since at least the late Pleistocene (the last 1.8 Million years) and are therefore a unique feature of the arid Australian landscape (Ponder 1986 p 416, Morton *et al* 1995; p.55; Mudd, 2000, pp. 463-476). As one of the only natural sources of permanent fresh water in the arid zone, GAB artesian springs represent vital habitat for more widespread terrestrial vertebrates, and invertebrates with aquatic larvae (Ponder 1986 p 415).

Witjira-Dalhousie Springs is regarded as a 'highly significant' example of an artesian 'mound' spring complex in Australia (Morton *et al* 1995a). In a national geological places review prepared for the Australian Heritage Commission, Yeates (2001) considers it "the best place (in Australia) to see the artesian processes and artesian springs in a natural state", due to its combined springs aerial extent and comparatively high flow rates. Yeates also evaluates the site to be "of international significance" for these values (Yeates 2001, pp. 64-65). In addition Ziedler and Ponder (1989) consider Witjira-Dalhousie Springs to be "of national and world significance", and observe that they are "the largest (artesian) springs in Australia ... are so isolated from other bodies of permanent water that they contain many endemic animals"

(Ziedler and Ponder 1989, p.ix). Kreig (1989) also elaborates on the geomorphology demonstrated at the Witjira-Dalhousie Springs complex. He states that "as a geological feature the (Dalhousie Anticline) springs complex is unique in Australia. It illustrates on a huge scale the cause and effect of an artesian mound system, with fault traces, aquitard (a confining bed), top of aquifer, mound spring material both modern and pre-modern, and large pools and rivulets of artesian water all convincingly displayed" (Kreig 1989, p.26). Kreig also notes that as a component of a large geological structure (the Dalhousie Anticline) the spring's complex forms the 'hub' or core. This confirms Yeates 2001 assessment that the Witjira-Dalhousie Springs complex elegantly demonstrates the principal GAB spring processes, especially geological and geomorphological processes.

Morton *et al* (1995b) also support this international significance claim as their study notes Witjira-Dalhousie Springs to be the most significant of nine artesian springs within the Lake Eyre Basin, which collectively warrant further assessment of their international significance on the basis of the "unusual nature of the evolutionary radiations, which have taken place in the scattered isolated artesian springs of the Basin" (Morton *et al* 1995b, pp.64-65). Witjira-Dalhousie Springs has three species of freshwater snails, five species of fish, one species of plant and four species of crustacean found nowhere else (ANHAT 2005 & 2008; Perez *et al* 2005; Allen *et al* 2002; DEW 2007c; Morton *et al* 1995a & b; McLaren *et al* 1985). The artesian springs of Witjira-Dalhousie, which have the classic 'mound', together with the archetypal Queensland artesian 'soft-type springs' of Elizabeth Springs, are a nationally representative example of GAB springs, and are a unique landscape feature in arid Australia (Ponder pers comm. 2004, Wilson 1995 p 2 & p.7; Ponder 1986; GABCC, 1998, p.29; Mudd 2000, pp. 463-476).

Witjira-Dalhousie Springs therefore is one of a suite of important artesian discharge GAB Springs that are outstanding examples of the endemism exhibited by artesian springs individually and collectively, including the Witjira-Dalhousie Springs endemic freshwater hydrobiid snails *Austropyrgus centralia*, *Caldicochlea globosa* and *C. harrisi*, and five endemic fish species, the Dalhousie mogurnda (*Mogurnda thermophila*), Dalhousie catfish (*Neosilurus gloveri*), Dalhousie hardyhead (*Craterocephalus dalhousiensis*), Glover's hardyhead (*C. gloveri*), and Dalhousie goby (*Chlamydogobius gloveri*) (Fensham *et al* 2007, p.13 & p.42; Perez *et al* 2005; Allen *et al* 2002; DEW 2007c; Ponder 2003; Fensham and Fairfax 2004; Morton *et al* 1995a, pp.55-56).

**Given the outstanding representative nature of Witjira-Dalhousie Springs, and the unique endemic fauna and flora found here, the place has outstanding natural heritage value to the nation under criterion (d).**

#### Indigenous Values

The mound springs in the Witjira-Dalhousie, Lake Eyre and Lake Frome areas are historically and culturally important Aboriginal places (Ponder 2002). These three mound spring supergroups provide water when other sources have dried up. Aboriginal people would retreat to these areas in the dry season and in times of drought (Badman 2000). Mound spring groups in these areas are associated with and joined to each other by traditional Aboriginal song and story lines and are often

associated with rainmaking rituals. The importance of mound spring groups to Aboriginal people in arid and semi arid Australia is also reflected in the density of artefacts and the size of Aboriginal camp sites associated with these mound springs.

Witjira-Dalhousie Mound Springs is in one of the driest zones in Australia where the weather and rainfall is extremely unreliable (Ponder 2002; Hercus and Sutton 1985; Davey, Davies and Helman 1985; Kimber 1997). The extreme aridity and unpredictable rainfall in this part of Australia meant that the Lower Southern Arrernte and the Wangkangurru people were more dependent on mound springs than Aboriginal groups in the Lake Eyre and Lake Frome regions (Badman 2000). In drought or dry seasons people were tethered to the Witjira-Dalhousie Mound Springs, despite the very limited food resources, until it rained and people could spread across the country to use the newly available water and other resources.

The concentration of people at Witjira-Dalhousie during the dry months resulted in large, dense and complex camp sites forming around the mound springs. There are three recorded occupation sites at Witjira-Dalhousie that are up to a kilometre in length and thousands of square metres in extent (AARD 2008). While there are large sites at other mound springs in the other spring groups, they are usually smaller than the ones at Witjira-Dalhousie (Lampert 1985; Florek 1987, 1993; Kimber 1997). For example the largest site at Finnis Springs is only 500 metres long (RNE 2002).

When compared with mound springs in the Lake Eyre and Lake Frome areas, the mound springs at Witjira-Dalhousie are associated with numerous traditional story and song lines (Hercus and Sutton 1985; 64). These are central to the union between Lower Southern Arrernte and Wangkangurru and their country and helped successive generations to survive and travel to and from the mound springs safely. For example, the Two Boys song line which originates at Witjira-Dalhousie contains information on every waterhole or soak that was known in the Simpson Desert. Following this song line meant you could cross arid areas using the available water (Hercus and Potezny 1994).

Witjira-Dalhousie, in common with groups of mound springs at Lake Eyre and Lake Frome, was an important centre for the performance of rainmaking ceremonies (Kimber 1997). Witjira-Dalhousie was part of a large network of rain sites and the reason for the network was described by a Traditional Owner in the following way, 'it is because clouds go everywhere' (Hercus nd.).

The Witjira-Dalhousie Mound Springs are an outstanding demonstration of the principal characteristics of mound springs as a class of Aboriginal cultural places. They are associated with an exceptionally large number of traditional song lines and story lines (Hercus and Sutton 1985; 64; Davey, Davies and Helman 1985), they were a place where rainmaking rituals were performed (Kimber 1997) and the density of artefacts and the large size of Aboriginal camp sites associated with the mound springs is unusual (Lampert 1985; Florek 1987, 1993; Kimber 1997; AARD 2008).

**Given the exceptionally large number of traditional song lines and story lines and the density of artefacts and the unusually large size of Aboriginal camp sites, Witjira-Dalhousie Springs has outstanding Indigenous heritage value to the nation under criterion (d).**

*Criterion (e) the place has outstanding heritage value to the nation because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group;*

*Criterion (f) the place has outstanding heritage value to the nation because of the place's importance in demonstrating a high degree of creative or technical achievement at a particular period;*

*Criterion (g) the place has outstanding heritage value to the nation because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons;*

*Criterion (h) the place has outstanding heritage value to the nation because of the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history;*

**There is insufficient evidence that the place has outstanding heritage value to the nation to be above threshold for these criteria.**

**Criterion (i)**

*The place has outstanding heritage value to the nation because of the place's importance as part of Indigenous tradition.*

Indigenous values

During the 1970s and 1980s, Dr. Luise Hercus, a recognised expert in Aboriginal linguistics, interviewed and consulted many of the Traditional Owners of the springs in the Lake Eyre, Lake Frome and Dalhousie supergroups. Hercus's research indicated that the vast majority of the springs in the basin had traditional stories associated with them. The only springs that didn't were the ones where the water was undrinkable. Witjira-Dalhousie is exceptional among the mound spring groups because twenty four separate story and song lines have been recorded here compared with the average of three story lines associated with other mound spring groups (Hercus and Sutton 1985; 64; Davey, Davies and Helman 1985).

Major song lines originate at Witjira-Dalhousie or pass through the place. They include: the Kestrel story, the Printi and the Goanna Women, the Rain Ancestor (*Anintjola*), the Dog story, the Frill Neck Lizard story, the Boy from Dalhousie, the Goanna Party and the Echidna Woman, Old Man Kingfisher and Old Woman Kingfisher, the Blind Rainbow Snake, Old Man Rainbow Snake, Perentie and the Boys, the Big Boys, the Perentie Goanna Camp, the Perentie Staked His Foot and the Two Boys song line (AARD 2008; Hercus nd.; Hercus and Sutton 1985).

The stories and song lines from Witjira-Dalhousie helped successive Lower Southern Arrernte and Wangkangurru generations survive and travel to and from the mound springs safely. An example of this is the story of the Two Boys and their travels across the Simpson Desert and then through Queensland and back to just north of Witjira-Dalhousie in the Finke River area. The Two Boys song line contains information on every waterhole or soak that was known in the Simpson Desert.

Following this song line meant you could safely cross arid areas using the available water (Hercus and Potezny 1994).

Unlike the mound springs in the Lake Eyre and the Lake Frome supergroups, Witjira-Dalhousie has hot springs, which in Lower Southern Arrernte and Wangkangurru tradition is explained by the story of the 'boy who stole' which recounts why a fire stick was placed in the springs making them hot (Hercus and Sutton 1985).

**Witjira-Dalhousie Mound Springs has outstanding heritage value to the nation under criterion (i) for its association with an exceptional density of story and song lines, most of which are associated with mound springs. There are twenty four recorded song lines that originate or pass through Witjira-Dalhousie Mound Springs.**

### **History:**

The Lower Southern Arrernte and Wangkangurru people are responsible for the Witjira-Dalhousie Mound Springs which are an integral part of their *Altyerre/Tjukurpa*, traditional law and custom (DEH 2008; Ah Chee 2004). The Lower Southern Arrernte name for Witjira-Dalhousie Mound Springs is *Irrwanyere* which means "the healing springs". The Wangkangurru name for the springs is *Witjira* which is the name for the local paperbark tree (*Melaleuca glomerata*) (Hercus and Sutton 1985; DEH 2008; Ah Chee 2004).

The artesian mound springs of the Great Artesian Basin (GAB) were central to the survival of Indigenous groups in the semi-arid and arid areas of central, southern, eastern and northern Australia for at least the last 5,000 years (Lampert 1985).

The densest concentration of mound springs in this area occurs at Witjira-Dalhousie (Hercus and Sutton 1985). During the 1970s and 1980s Luise Hercus interviewed many of the traditional owners of the springs around the Lake Eyre Basin, including Witjira-Dalhousie Mound Springs. Hercus's research indicated that the vast majority of the springs in the basin had traditional stories and song lines associated with them. The only springs that didn't were where the water was undrinkable (Davey, Davies and Helman 1985).

The information Dr. Luise Hercus gathered during her linguistic work over 35 years indicated that each individual spring at Witjira-Dalhousie had a story associated with it, although some of those stories are now lost. She also recorded twenty four separate story and song lines associated with the mound springs at Witjira-Dalhousie which is exceptional when compared with the number of story lines associated with other mound springs sites in the GAB (Hercus and Sutton 1985). One of the most important song lines that originates at Witjira-Dalhousie is the Two Boys song line which is a Kingfisher 'Dreaming'. In the story the Two Boys crossed the Simpson Desert and then looped through Queensland and back to just north of Witjira-Dalhousie in the Finke River area. This song line contains information on every waterhole or soak that was known in the Simpson Desert. Following this song line meant you could cross the Simpson Desert using the available water (Hercus and

Sutton 1985; Hercus and Potezny 1994).

The Two Boys story also describes the introduction of new elements in the performance of rituals. This includes the use of feathers as ritual decorations where previously only paint was used in the *Warrthampa* ceremony. This ceremony, associated with the Emu story, also required a new and special way of vibrating and rattling boomerangs together (Hercus and Potezny 1994).

Other song lines associated with the Witjira-Dalhousie mound springs include; the Kestrel story, the Printi and the Goanna Women, the Rain Ancestor (*Anintjola*), the Dog story, the Frill Neck Lizard story, the Boy from Dalhousie, the Goanna Party and the Echidna Woman, the Blind Rainbow Snake, Old Man Rainbow Snake, and stories associated with the activities of Perentie, the monitor lizard.

Unlike the mound springs in the Lake Eyre and Lake Frome supergroups, Witjira-Dalhousie has hot springs, which in Aboriginal tradition are explained by the story of the 'boy who stole'. The story recounts how a boy stole a sacred object from an initiation ceremony and as he was being chased he stole a fire stick from an Ancestral Mosquito Woman. Upon reaching Witjira-Dalhousie he tried to get rid of the fire stick by putting it in one of the springs and as it was still burning it made the water hot (Hercus and Sutton 1985).

The weather and rainfall at Witjira-Dalhousie is extremely unreliable and unpredictable (Davey, Davies and Helman 1985; Kimber 1997). Lower Southern Arrernte and Wangkangurru use of the Witjira-Dalhousie area is unusual when compared with other parts of the GAB where people were less reliant on mound springs (Badman 2000). In drought or dry seasons the Lower Southern Arrernte and Wangkangurru were tethered to the Witjira-Dalhousie mound springs, which had very limited food resources. They remained there until it rained and they could spread across the country again to use the newly available resources. It is not surprising therefore that Witjira-Dalhousie Mound Springs was an important Rain Dreaming centre where Lower Southern Arrernte and Wangkangurru people gathered to sing songs to influence rain storm ancestors (Kimber 1997).

Ceremonies were conducted at Witjira-Dalhousie to ensure that the rain fell. The first description of these rain ceremonies was in 1886 by H. Dittrich. The description reports that there were a number of songs sung, the first being the one to get rid of the flies, then the cold water rain song, followed by the meat-food song then one for the rains that would bring grass and insects (Kimber 1997). There were other rain centres spread across the area as well as a vast interlinking network of traditional rain stories and rain-stone sites. A Traditional Owner, now deceased, stated to Hercus the reason for such a large network of rain sites "it is because clouds go everywhere" (Hercus nd.). Rain stories came into Witjira-Dalhousie and originated in Witjira-Dalhousie. Rain was a critical part of survival as Witjira-Dalhousie is in one of the most arid areas of Australia.

The concentration of Lower Southern Arrernte and Wangkangurru at Witjira-Dalhousie during the dry months has resulted in exceptionally large, dense and complex campsites around the mound springs, some up to a kilometre in length and thousands of square metres in extent (AARD 2008). These sites consist of large

numbers of stone artefacts, hearths and grinding stones. Sites found beyond the mound springs are less complex and are scattered across the landscape and tend to be smaller in size (Lampert 1985; Florek 1987, 1993; Kimber 1997).

The vast majority of Lower Southern Arrernte and Wangkangurru sites associated with the Witjira-Dalhousie Mound Springs date from the late Holocene. The dating is based on the site stratigraphy and the predominance of late Holocene small tools, tools including tulas, pirris, microliths and seed grinders. Only three springs, Witjira-Dalhousie, West Finnis and Welcome Springs, have evidence for earlier occupation emerging from sediments that might be older than the late Holocene (Lampert 1985).

The South Australian artesian spring supergroups, including the Witjira-Dalhousie Springs complex and the Lake Eyre springs supergroup, also played a vitally important part in the European exploration of Central Australia. The first recorded European sighting come from surveyors working on the Adelaide to Darwin Telegraph Line in December 1870. However Witjira-Dalhousie Springs did not become a focus for the line as the spring complex was too far to the east of the proposed direct route. Rather repeater stations were established at Charlotte Waters and Blood Creek, north-west of Witjira-Dalhousie Springs. Construction of the telegraph thus followed the direct 'spring route' and the South Australia artesian springs were used as 'stepping stones' by European explorers such as Eyre (1839), Babbage (1856), Warburton (1858) and Stuart (1859-62) (GABCC 1998, p.8).

However, Europeans moving into central Australia continued to visit and use the springs at Witjira-Dalhousie. During 1875 Lutheran missionaries on their way to Hermannsburg were forced to stay at Witjira-Dalhousie for over ten months due to drought indicating the importance of the springs (Morton and Mulvaney 1996). The excitement and wonderful impression created by the Witjira-Dalhousie 'spring country' was described by Giles (1894) in the following way, "an almost illimitable sight expanse of – welcome sight! – waving green reeds, with large pools of water at intervals ..." (Cohen 1989, p.13' in Ziedler and Cohen 1989). The party initially named the springs Lady Edith Springs for Lady Edith Ferguson (wife of the Governor of South Australia), however at her request, the name was changed to her family name Dalhousie.

The first pastoral lease in the area, which later became part of the Mount Dare property, was taken up by Ned Bagot in 1872 with the Dalhousie Homestead, stockyards and outbuildings constructed in the following decade. Initially sheep were the mainstay of pastoralism but by the early 1900s the focus shifted to cattle. Although many bores were sunk on Mount Dare station, Witjira-Dalhousie Springs remained vital for the survival of stock. The land was marginal pastoral country and, during the brief history of the industry, various leases were abandoned, particularly from the start of the twentieth century until just prior to the First World War. (DEH(SA), 2007e).

The creation of the pastoral runs did not immediately affect Aboriginal use and occupation of the mound springs and their cultural associations with their land. This changed when the influenza epidemic of 1919-1920 was followed by a measles outbreak. The epidemics had a devastating affect on the Aboriginal population and by the 1930s people were reduced to camping at ration depots and at stations where the

pastoralists allowed them to stay (Nicholson et al 1999).

The Dalhousie homestead was abandoned in about 1925. In the 1930s the lease was purchased by Edwin Lowe. The Lowe family held the lease till it was purchased by the South Australian Government in 1985 (Nicholson *et al.* 1999). In 1986 the area was declared a National Park. The Irrwanyere Aboriginal Corporation was formed to facilitate the management of what is now the Witjira National Park and Witjira-Dalhousie Mound Springs. On 5 October 1995, Traditional Owners and the South Australian Government signed a “Joint Management Agreement” and a 99 year lease for a large part of the Park. The Traditional Owners became the primary managers of the National Park. The lease between the South Australian Government and the Irrwanyere Aboriginal Corporation was the first in South Australia that let Aboriginal people manage a reserve gazetted under National Parks and Wildlife Act (ATNS 2007; DEH 2008).

### **Condition:**

The Witjira-Dalhousie Springs are located in Witjira National Park, which was declared on 21 November 1985 in recognition of its scientific and cultural values. Since the declaration of the National Park steadily increasing tourism has been noted as a potentially significant threat requiring management. Threats from tourism are both obvious (eg trampling by foot traffic and surface damage from vehicles) and less obvious (eg modification of water chemistry by the use of soaps, and sunscreens, by bathers in the springs).

Witjira-Dalhousie Springs has a range of feral species including camels, cattle, horses and rabbits. Although commercial grazing activities were suspended once the park was declared, trampling by feral stock, together with tourist foot traffic, remains a threat to the integrity of springs at Witjira-Dalhousie. Elsewhere in the wider GAB, trampling, and modification of the spring to improve access for stock in grazing areas, remain a serious threat to artesian springs. Trampling (also known as pugging) modifies the physical structure of the microhabitat, which are small scale habitat zones with different environment conditions, and if serious enough, removes the microhabitat entirely. Conversely, removal of grazing pressure altogether may also be a significant threat, at least in South Australia, where total exclusion of grazing appears to encourage overgrowth of water plants such as *Phragmites* and loss of microhabitat. However, this has not been reported from any of the Witjira-Dalhousie Springs outflows. Lastly, the spread of the introduced mosquito fish (*Gambusia affinis*) is a threat to the freshwater endemics of all the GAB artesian springs. *Gambusia* has not yet been reported in Witjira-Dalhousie Springs.

A July 2003 monitoring survey by South Australia’s Department of the Environment and Heritage found hundreds of Date Palm (*Phoenix dactylifera*) seedlings (parent stock of which are historical plantings from the 1800’s) establishing at the springs, with some smaller pools drying up where there are heavy infestations of Date Palm. The South Australian Witjira National Park website notes: “that the origin of the date palms is still being debated. Romantics believe the trees were planted by Afghan

cameleers, but there is firm evidence that dates were planted by the Lewis family who took over the lease of Dalhousie in 1896" (DEH(SA), 2007e). However there has also been excellent recovery of native plants since the park was proclaimed and subsequent application of feral animal controls (including the effects of the Rabbit-Calciavirus disease).

The endemic species associated with GAB artesian springs, particularly the vascular plants and invertebrates, appear to be highly sensitive to changes in water flow or conditions at the springs. This is at least in part due to the dependence of many species on microhabitats such as seepages of only a few millimetres depth. Over the last 120 years a range of human activities have impacted on GAB artesian springs. The most serious is groundwater extraction, primarily but not exclusively due to numerous uncapped artesian bores and inefficient earth drains, resulting in draw-down of water pressure at the spring, and the loss or modification of microhabitat and ultimately the extinction of the spring. Groundwater extraction has already been implicated in the extinction of many GAB artesian springs and has been partly addressed by the extensive GAB bore-capping programme. Extraction for other uses such as mining and town water supply remains a substantial impact. Draw-down remains the most serious threat to GAB artesian springs. For example Fensham *et al* (2007) note that some of the South Australian artesian discharge springs, such as the Venable and Priscilla spring groups in the Lake Eyre supergroups, have lost a suite of 'locally' endemic species including hydrobiid snails and crustaceans, most likely due to groundwater extraction (Fensham *et al* 2007, pp.14-16 & pp.41-45).

To provide recent historical condition information a recognised GAB hydrogeology expert, Dr M.A. (Rien) Habermehl, provided the following statement:  
"Four petroleum exploration wells drilled in the region east, west, north, northeast and east of Witjira-Dalhousie Springs during the 1960s did not encounter oil or gas, and were converted into waterbores and flowed from the Great Artesian Basin aquifers from the 1960s onwards. The wells west and northeast of Witjira-Dalhousie Springs, which were as close as approximately 10 and 20 km from the springs, were plugged (filled with cement) by the South Australian (SA) Mines Department during the late 1980s and early 1990s. The well east of Witjira-Dalhousie Springs was rehabilitated with a new control valve, and at the request of the SA Department of the Environment left flowing artesian groundwater at a reduced rate during the late 1980s and early 1990s. The well north of Witjira-Dalhousie Springs in the Northern Territory was rehabilitated with a new control valve in the early 2000s, and left flowing artesian groundwater. Both of these latter two wells (one in SA and one in NT) are located in between the red sand dunes of the Simpson Desert and created and maintain large lakes of fresh water in this arid environment, which has attracted birds and other wildlife in this arid region. This wildlife has been diverted from Witjira-Dalhousie Springs and is anomalous to the arid Simpson Desert region".

Dr Habermehl goes on to state:

"The long term artesian groundwater flow from the wells, which obtain(ed) their flowing artesian groundwater from the same Great Artesian Basin aquifers as the Witjira-Dalhousie Springs, will have had an effect on the artesian pressures and flows of the Witjira-Dalhousie Springs. The continuing, substantial flows from the two wells in SA and NT could still influence the Dalhousie Springs (Dr M.A. (Rien) Habermehl, BRS, pers.comm., 30 Oct. 2007)."

Smith (1989) also stated that Witjira-Dalhousie Springs “discharge appears to have declined over the approximately 11 year period between gaugings, with total spring discharge 6% lower in 1985 than in 1974, total spring discharge in 1974 was 651 L/s (20 500ML/y) ... total spring discharge in 1985 was 612 L/s (19 300ML/y)”, a ML/y being a flow of 1 000 000 litres of freshwater per year. However Smith also states that this finding needs to be qualified by the fact that “the ill-defined channels and thick vegetation and make discharge rate measurements difficult ... seasonal, climatic and diurnal influences may have an unknown effect upon results ... total spring discharge values include a 30% estimated values obtained when channel configuration was unsuitable for flow gauging or vegetation too thick”. Smith sums up by noting “the 6% discrepancy between 1974 and 1985 may well lie within the limits of experimental error” (Smith 1989, p.30), and recommends further monitoring resolution on the methods (Smith 1989, p.34-35).

The GAB Sustainability Initiative (GABSI) is a jointly funded initiative of the Federal and State governments and pastoral bore owners. GABSI aims to preserve the pressure of the GAB, and reduce water waste, through rehabilitating uncontrolled bores and replacing bore drains with polyethylene pipes, tanks and troughs for livestock water. Although a substantial number of bores are now being fully controlled with water distributed by pipelines to tanks and troughs, about 80% of the total outflow from the Basin is still wasted because of inefficient water delivery systems.

Condition report drawn from - Fensham *et al* 2007; Dr Habermehl pers.comm. 30/10/07; Wetlands Australia 2004; Morton *et al* 1995a, p.119; Ponder pers. comm. 1/3/2005; Fairfax and Fensham 2002; Fensham and Fairfax 2003; Smith 1989.

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