Australian Heritage Database

Places for Decision

Class : Natural

Identification

List:	**National Heritage List**
Name of Place:	Great Artesian Basin Springs: Elizabeth
Other Names:	
Place ID:	105821
File No:	4/08/222/0015
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:	Warra
Distance from town (km):	24
Direction from town:	S
Area (ha):	145
Address:	Springvale Rd, Warra, QLD
LGA:	Diamantina Shire QLD

Location/Boundaries:
About101ha, Springvale Road, 24km south of Warra, comprising Lot 1 on SP120220.

Assessor's Summary of Significance:

Elizabeth 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 relatively 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.

Elizabeth Springs is nationally significant as it holds a suite of species which are genetically and evolutionarily distinct from other Great Artesian Basin springs, including an endemic freshwater snail and an endemic fish species. Elizabeth Springs also holds four of the eleven known Great Artesian Basin spring wetland endemic plants, along with five plant species not recorded within 500 kilometres of the springs, which are indicative of a wetter past.

Elizabeth Springs is the only remaining relatively intact Great Artesian Basin spring with extant biota (fauna and flora) in far western Queensland and is regarded as one of the most important artesian springs because of its isolation, intactness and the extinction of other springs. Over 74% of the artesian springs in Queensland are extinct (no longer flowing) and all the artesian springs in New South Wales are extinct or badly damaged.

Draft Values:

Criterion	***Values***	***Rating***
A Events, Processes	Elizabeth 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 & 2008), and has also been ranked by CSIRO as a nationally 'significant' semi-arid and arid refugia in Australia for regional endemics of aquatic invertebrates (isopods, ostracods, and hydrobiid molluscs) and fish (Morton *et al*, 1995, p.11, p.119 & p.134). GAB artesian springs are important for illustrating the role of evolutionary refugia for relict species (Morton *et al*, 1995, p.11), which have evolved into distinct and endemic species in the GAB springs. Elizabeth Springs contains one artesian spring endemic hydrobiid snail, *Jardinella isolata* (ANHAT 2005 & 2008; Ponder and Clark 1990, p.301; Ponder *et al* 1995. p 554; Perez *et al* 2005); an endemic fish species the Elizabeth Springs goby *Chlamydogobius micropterus* (DEW 2007c & DEW2007a), and four of the 11 known GAB spring wetland endemic plants (Fensham *et al* 2004). Elizabeth Springs contains the threatened saltmarsh pipewort (*Eriocaulon carsonii)*, a relict species of tropical Australia	AT

that is largely endemic to the artesian springs of the GAB. They also contain three of the other GAB spring endemics: *Eragrostis fenshamii, Fimbristylis sp.* (RJ Fensham 3743) and *Myriophyllum artesium* (Fensham *et al* 2004; Rod Fensham, pers. comm., 28/10/2008). Elizabeth Springs also contains five other relict plant species, which are not recorded within 500 km of the springs: *Isotoma fluviatilis, Pennisetum alopecuroides, Plantago gaudichaudii, Schoenus falcatus* and *Utricularia caerulea* (Fensham *et al* 2004; Rod Fensham, pers. comm., 28/10/2008).

B Rarity AT

Extant artesian springs in the GAB are a geographically rare phenomenon, each one covering a tiny area within the basin. Over 74% of the GAB springs in Queensland are extinct (no longer flowing) and all the GAB artesian springs in New South Wales are extinct or badly damaged (Ponder 1989, p.416; Wilson 1995, p.12). Elizabeth Springs is regarded as one of the most important GAB artesian springs because of its isolation, relative intactness and the extinction of other springs in far Western Queensland (Fensham *et al* 2004; Ponder 2004 & 2006; Zeidler pers. comm. 2005).

D Principal characteristics of a class of places AT

The GAB is the world's largest example of an artesian basin and associated artesian springs (Harris 1992 p 157, Perez *et al* 2005). GAB artesian springs are the primary sources 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* 1995, 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). Elizabeth 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. (Ponder 2003, Fensham *et al* 2004). Species found at Elizabeth Springs include an endemic freshwater hydrobiid snail *Jardinella isolata,* and an endemic fish species, the Elizabeth Springs goby *Chlamydogobius micropterus* (ANHAT 2005 & 2008; Ponder and Clark 1990 p 301; Ponder *et al* 1995, p.554; Ponder 2003; Perez *et al* 2005; DEW 2007c & DE2007a). Elizabeth Springs is the only remaining relatively intact GAB spring with extant biota (fauna and flora) in far Western Queensland and holds a suite of species which are genetically and evolutionarily distinct from other GAB springs (Wilson 1995, p.2 & p.7; Fensham *et al* 2004; Ponder 2004; Ponder

pers. comm. 2004; Zeidler pers. comm. 2005; Rod Fensham, pers. comm., 28/10/2008).

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 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 furthest areas from the recharge areas has been moving through the GAB's porous rock strata (aquifers) for up to a million years. Elizabeth Springs are regarded as a discharge spring complex and consists of at least five active artesian mound springs together with a few semi-active mounds immediately adjacent.

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, but 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 Dalhousie, in northern South Australia. Some GAB artesian springs have associated discharge mounds that consist of mud, but most of the springs deposit calcium carbonate, especially the discharge springs, 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, with the resulting formation resembling 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 *et al* 2004), hence the use of the more readily interpreted term of 'artesian spring' rather than 'mound spring'.

Mound formation of GAB springs is controlled by a range of factors, including groundwater discharge and evaporation rates, hydrochemistry, influence of organic 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 of more than 740 000± years. Research (Habermahl 2006) has found large spring complex deposits reflect geological and hydrological changes in eastern and central Australia during the last Quaternary (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.

Elizabeth Springs form part of the Springvale River supergroup, one of the two most westerly supergroups in Queensland, and lie approximately 300 kilometres south-southeast of Mount Isa. The Springvale supergroup is a group of springs that, with the exception of Elizabeth Springs, are largely extinct or heavily modified. The main group of springs comprising Elizabeth Springs extends over an area of approximately 400 by 500 metres and consists of a series of low mounds and travertine-encrusted outflows. The mounds and surrounding outflows and seepages are well vegetated with sedges and a range of other species including large areas of the spring endemic *Eriocaulon carsonii*, the salt pipewort, which is a perennial and a nationally EPBC-listed threatened plant.

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) in isolated GAB artesian spring groups (Brown and Gibson 1983; Morton *et al*, 1995, p.11, p.119 & p.134). Hence artesian springs provide the localised habitat requirements for a suite of endemic (restricted to one or more GAB spring) fish and aquatic invertebrate

species which include hydrobiid molluscs, isopods, ostracods, amphipods, copepods and flatworms (Morton *et al*, 1995, p.11, p.119 & p.134).

GAB artesian 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 GAB artesian 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 23 taxa and five genera (Perez *et al* 2005), although each mound 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 GAB 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 being completely unrelated (Perez *et al* 2005).

The Elizabeth Springs, on its own and collectively with the other significant discharge springs comprising the GAB springs, are notable examples of the endemism exhibited by GAB artesian springs. Elizabeth Springs has one endemic snail and one endemic fish (Ponder 2004; Perez *et al* 2005). It also has four endemic GAB artesian spring plant species as well as five relict spring plant species, plants that have survived from when inland Australia was wetter (Fensham *et al* 2004). A number of other possible endemic invertebrates also exist at the springs (Ponder 2004). In addition at least one species of frog, four species of reptile, 50 species of birds, four species of mammals, and 13 species of plants are known from the vicinity of the springs from a species list generated by the Australian Natural Heritage Assessment Tool (ANHAT 2005 & 2008), and as detailed in an Queensland Herbarium report based on comprehensive ground surveys (Fensham *et al* 2004).

Analysis:

Claims

As Elizabeth Springs is an Australian Heritage Council (AHC) initiated assessment 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.

There is insufficient evidence that there are any historic or Indigenous 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 (also known as mound 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 *et al* 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 GAB 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 fauna and flora, as 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).

Elizabeth and Dalhousie 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 Leijs (SAM); Ivana Karanovic (WAM); & Patrick De Deckker (ANU) - all pers. comm.'s 1/3/05)

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

Elizabeth Springs is the fifth highest-ranking centre of endemism for arid zone hydrobiid snails, and contains one of the 23 known artesian spring endemic snails, *Jardinella isolata* (ANHAT 2005 & 2008, Ponder and Clark 1990 p 301, Ponder *et al* 1995 p 554). This species has been found to be genetically isolated from the other

snails in the Queensland radiation (Ponder and Clark 1990 p 346), and it is highly likely that this genetic isolation of biota is reflected in other invertebrate biota such as amphipods. Elizabeth Springs is the fifth highest arid zone centre of endemism for freshwater fish (ANHAT 2005), and supports an endemic fish species, the Elizabeth Springs goby (*Chlamydogobius micropterus*).

Comparative reports exist for the flora of GAB artesian springs in Queensland and South Australia (Fensham *et al* 2004, McLaren *et al* 1985), and there are few plant species endemic to particular artesian springs (Fensham *et al* 2004). Dalhousie and the Queensland GAB artesian springs were the richest artesian springs for the suite of endemic plants. Elizabeth Springs was ranked fourth in an analysis of 269 spring complexes in the GAB for flora conservation significance, with four of the 11 known GAB spring wetland endemic plants. The springs contain the endangered saltmarsh pipewort (*Eriocaulon carsonii),* a relict species of tropical Australia that is largely endemic to artesian springs of the GAB. The springs also contain three other GAB spring plant endemics *Eragrostis fenshamii, Fimbristylis* sp. (RJ Fensham 3743) and *Myriophyllum artesium* (Fensham *et al* 2004; Rod Fensham, pers. comm., 28/10/2008).

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), which indicates that Elizabeth Spring has been a significant freshwater refuge in the arid zone for at least the last few million years (Bowler 1982, p.43).

Elizabeth Springs has been ranked by CSIRO as a nationally 'significant' semi-arid and arid refugia in Australia (Morton *et al*, 1995, p.11, p.119 & p.134), which is supported by ANHAT analysis results which rank Elizabeth 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 pg 584).

Some of these endemics have affinities with geographically disjunct taxa in mesic, temperate environments of Australia such as Tasmania and Lord Howe Island (Ponder 2003, Wells pers. comm. 2005, Wilson 2003). The concentrations of such species in GAB artesian springs make them important long-term evolutionary arid zone refugia (Ponder 2003, De Deckker pers. comm. 2005). In addition to the endangered saltmarsh pipewort, the springs also contain five other relict plant species, which are not recorded within 500 km of the location of the springs: *Isotoma fluviatilis, Pennisetum alopecuroides, Plantago gaudichaudii, Schoenus falcatus* and *Utricularia caerulea* (Fensham *et al* 2004; Rod Fensham, pers. comm., 28/10/2008).

Fairfax and Fensham's 1998-2000 Queensland GAB study "confirmed and extended previous findings from South Australia (Ponder 1995) regarding the significance of the biological values of the springs emanating from the GAB" (Fensham *et al* 2004, p.583). The significance of Elizabeth Springs within the GAB is also reinforced by Fensham and Fairfax, where they noted "the spring wetlands discharging from the GAB in western Queensland were distinct from spring wetlands emanating from other

aquifers" (Fensham *et al* 2004, p.583).

Given the comparative significance of endemic and relict artesian spring flora and fauna in the arid zone, and their importance in illustrating evolutionary refugia, Elizabeth 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 (Morton *et al* 1995, p.11 & pp.132-134). 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 (Ponder 1986; GABCC, 1998, p29; Mudd, 2000, pp. 463-476).

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

The rarity of the extant existing GAB artesian springs is illustrated by a 1998 to 2000 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 artesian springs flowing near the rates observed a century earlier. Furthermore of these 107 spring-groups 43 are individual springs of which 32 (74%) are no longer active (Fairfax and Fensham 2002, p.210).

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

As one of a suite of five discharge springs Elizabeth 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 are the only permanent source of freshwater in the eastern portion of the arid zone of Australia (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, Elizabeth Springs has outstanding natural heritage value to the nation under criterion (b).

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 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).

Elizabeth Springs has one listed threatened species of hydrobiid snail, *Jardinella isolata*, listed as vulnerable on the IUCN red list. Elizabeth Springs also contain an endangered fish species, the Elizabeth Springs goby (*Chlamydogobius micropterus*), and an endangered freshwater plant species the saltmarsh pipewort (*Eriocaulon carsonii),* listed under the EPBC Act. However this is not significant at a national scale when compared with other concentrations of EPBC Act listed species in other arid zone areas, terrestrial or freshwater habitats, or elsewhere in Australia.

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

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 (Morton *et al* 1995, p.11 & pp.132-134), 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). The artesian springs of Elizabeth Springs are archetypal of 'soft-type springs' where there is little mound, and along with two other Queensland spring complexes are the best remaining, and most intact GAB spring complexes in Queensland. Therefore, together with the classic 'mound' springs of Dalhousie, Elizabeth Springs is a nationally representative example of a GAB spring, a unique landscape feature in arid Australia (Ponder 1986; Wilson 1995 p.2 & p.7; GABCC, 1998, p.29; Mudd 2000, pp. 463-476; Ponder pers. comm. 2004).

Elizabeth 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, including the Elizabeth Springs endemic freshwater hydrobiid snail *Jardinella isolata*, and an endemic fish species, the Elizabeth Springs goby *Chlamydogobius micropterus* (ANHAT 2005 & 2008; Ponder and Clark 1990, p.301; Ponder *et al* 1995, p.554; Ponder 2003; Perez *et al* 2005; DEW 2007c & DE2007a). Elizabeth Springs is the only remaining relatively intact GAB spring with extant biota (fauna and flora) in far Western Queensland and holds a suite of species which are genetically and evolutionarily distinct from other GAB springs (Wilson 1995 p 2 & p.7; Fensham *et al* 2004; Ponder 2004; Ponder pers. comm. 2004; Zeidler pers. comm. 2005).

Given the outstanding representative nature of these artesian springs, and the unique endemic fauna and flora they posses, Elizabeth Springs has outstanding natural 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;*

Criterion (i) *the place has outstanding heritage value to the nation because of the place's importance as part of Indigenous tradition.*

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

History:

Aborigines have used the artesian springs of the GAB for an extended period of time. Some of these GAB artesian springs feature in Aboriginal myths and hold significant spiritual and cultural values for indigenous communities. Artesian springs were and still are a valuable resource for the support of wildlife, and were a vital source of freshwater in an arid environment.

The need for fresh water was also obvious to the first European settlers who ventured west of the Great Dividing Range. These early settlers, encouraged by good seasons, brought their sheep and cattle out onto the great rolling plains. They soon learned that inland Australia was a harsh environment where droughts were common.

The inland of Australia is traversed by streams but these rarely flow and have few permanent waterholes. Unpredictable rainfall and high evaporation meant that early dams and earth tanks built to service the growing population and pastoral industry were unreliable. Permanent water supplies were needed to allow livestock to survive on the arid plains and to provide supplies for the growing service towns.

Europeans first discovered the artesian groundwater of the GAB in 1878 when a shallow bore sunk near Bourke in New South Wales produced flowing water. Many bores were soon drilled near the margins of the GAB in New South Wales and South Australia. In 1885 the Queensland Government Geologist decided to drill a deep bore at Blackall to try to prove the existence of deep artesian supplies in Queensland and provide reliable water supplies during the drought. However, before the completion of this bore, the first artesian flow in Queensland was obtained near Cunnamulla in 1887.

The number of bores drilled in Queensland increased from 34 to 524 in the ten year period from 1889 to 1899. By 1915 over 1 500 flowing artesian bores had been drilled throughout the Basin. The assurance of a reliable water supply for settlers and their stock meant the development of a valuable sheep and cattle industry. Thousands of kilometres of bore drains were excavated to distribute water around properties, thus allowing sheep and cattle to be raised on the vast Mitchell grass, mulga and spinifex plains. Bore drains are small, open channels that can extend 100 kilometres or more.

The water from the GAB continues to be of vital importance to outback regions of Queensland, New South Wales and South Australia. This water is often the only available supply for towns and properties for their domestic and stockwatering requirements. The GAB also supplies water for minor irrigation works, key mining and extractive industries, the petroleum industry, an emerging tourism industry and limited industrial purposes. Sound management of this important natural resource by the present users will ensure that future generations may also benefit from this reliable water source.

(Information sourced from QDNRW 2007)

Condition:

Surveys over the last twenty years have shown that most of the remaining active GAB artesian springs in Queensland are suffering damage from draw-down or stock. Trampling by stock or modification of the spring to improve access for stock is a serious threat to GAB 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. Modification of the spring, normally by digging the spring out to improve the pooling of water, removes the microhabitat altogether.

In 2004 there was evidence of cattle grazing within the Elizabeth Springs reserve, with some trampling of the seepages and outflows surrounding the mounds. However since fencing after 2004 the overall condition of the Elizabeth Springs has vastly improved reducing the previous impacts on the intact relictual biota.

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. A range of human activities that have been occurring over the last 120 years impacts GAB artesian springs. The most serious is groundwater extraction resulting in draw-down of water pressure at the spring, primarily but not exclusively due to numerous uncapped artesian bores and inefficient earth drains, and the loss or modification of microhabitat and ultimately the extinction of the spring. Groundwater extraction has been implicated in the extinction of many 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. Reductions in flow at Elizabeth Springs have been observed, although in some other springs flow appears to have stabilised. Draw-down remains the most serious threat to GAB artesian springs.

Lastly, the spread of the introduced mosquitofish (*Gambusia affinis*) is a threat to the freshwater endemics of all the GAB artesian springs. *Gambusia* has not been reported from Elizabeth Springs.

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 Great Artesian Basin, 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 - Morton *et al* 1995, p.119; Ponder pers. comm. 1/3/2005; Fairfax and Fensham 2002; Fensham and Fairfax 2003; &, QDNRW 2007.

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