Department of Science, Information Technology and Innovation

# Permian Galilee Springs Group

## Hydrogeology and ecology

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Queensland Government

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Front Cover: Edgbaston Springs and a spring (imaginatively) called “New Big”. There is Spinifex in the foreground, free water in the mid-ground, with some scalding in front and the far right rear. Photo: Queensland Herbarium.

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# Overview

On the exposed areas of the Galilee Basin sediments to the east of the Barcaldine supergroup are two small groups of springs that under the current definition are not part of the Great Artesian Basin. The Permian Galilee group overlie the Colinlea Sandstone, a lower unit of Permian age in the Galilee Basin which underlies the Eromanga Basin (the largest of the Basins collectively referred to as the Great Artesian Basin). The springs interpreted as having a source in the Permian sediments of the Galilee Basin are the outcrop Albro Springs, two vents with moderate flows (combined flow ~40 l/min), and the discharge Mellaluka (three vents with combined flow ~1200 l/min) and Lignum Spring (~0.5l/min) (Table 1).

**Table 1. Summary of the status of the springs in the Galilee Permian springs at the complex, wetland and vent scale.**

| | Complex | | | Wetland | | Vent | |
|---|---|---|---|---|---|---|---|
| | Active | Partially active | Inactive | Active | Inactive | Active | Inactive |
| Outcrop | 1 | 0 | 0 | 2 | 0 | 2 | 0 |
| Discharge | 1 | 0 | 0 | 2 | 0 | 4 | 0 |

# Hydrogeology

## Regional Geology

The Galilee Basin is a geological basin comprising a series of sedimentary formations deposited during the Permian and Triassic periods. The oldest sediments are of early Permian age and are overlain by the Colinlea Sandstone and the Bandanna Formation. Overlying the Permian deposits are the Triassic sediments, the Rewan Formation and Dunda Beds. The Dunda Beds are generally classified as consisting of coarse-grained sediments and therefore a water-bearing aquifer. The Rewan Formation generally consists of fine-grained material and is therefore generally considered as a confining aquitard. However, both these strata are non-uniform and include both coarse and fine-grained facies. The sediments dip east to west at an angle of about 1-2 degrees, although this dip angle seems to steepen slightly in the north near the Carmichael River

On the eastern edge of the Galilee Basin, the Colinlea Sandstone approaches the surface but in many areas is overlain by Tertiary sediments and Quaternary deposits. In the south-eastern corner of the Galilee Basin, the Colinlea Sandstone has extensive outcrop on the foothills of the Carnarvon Ranges (Figure 1). In the vicinity of the Permian Galilee Springs the base of the Galilee Basin sediments is composed of the Early Permian-Late Carboniferous Joe Joe Formation. There is an unconformity between the Joe Joe Formation and the overlying Colinlea Sandstone.

The Bandanna Formation overlies the Colinlea Sandstone. These units can be indistinguishable and are often grouped as the Betts Creek Beds. The Betts Creek Beds include coal seams that are generally referred to as seams A to F. These deposits are currently being targeted by mining proposals. In the Colinlea Sandstone, the coal seams occur amidst coarse-grained material that contains groundwater which is exploited by both artesian and non-artesian pastoral bores. The sediments dip east to west at an angle of about 1-2 degrees, although this dip angle seems to steepen slightly in the north near the Carmichael River. Overlying the Betts Creek Beds is the Rewan Formation, the oldest of the Triassic sedimentary layers. This sedimentary unit includes fine-grained material and is only rarely exploited for groundwater.

The surface extent of the Betts Creek Beds is difficult to define because its surface is weathered and it is buried beneath Cainozoic material including recent alluvium associated with the Belyando River and its tributaries. The extent of the Betts Creek Beds (Figure 1) has been interpreted from sources defined in Table 2.

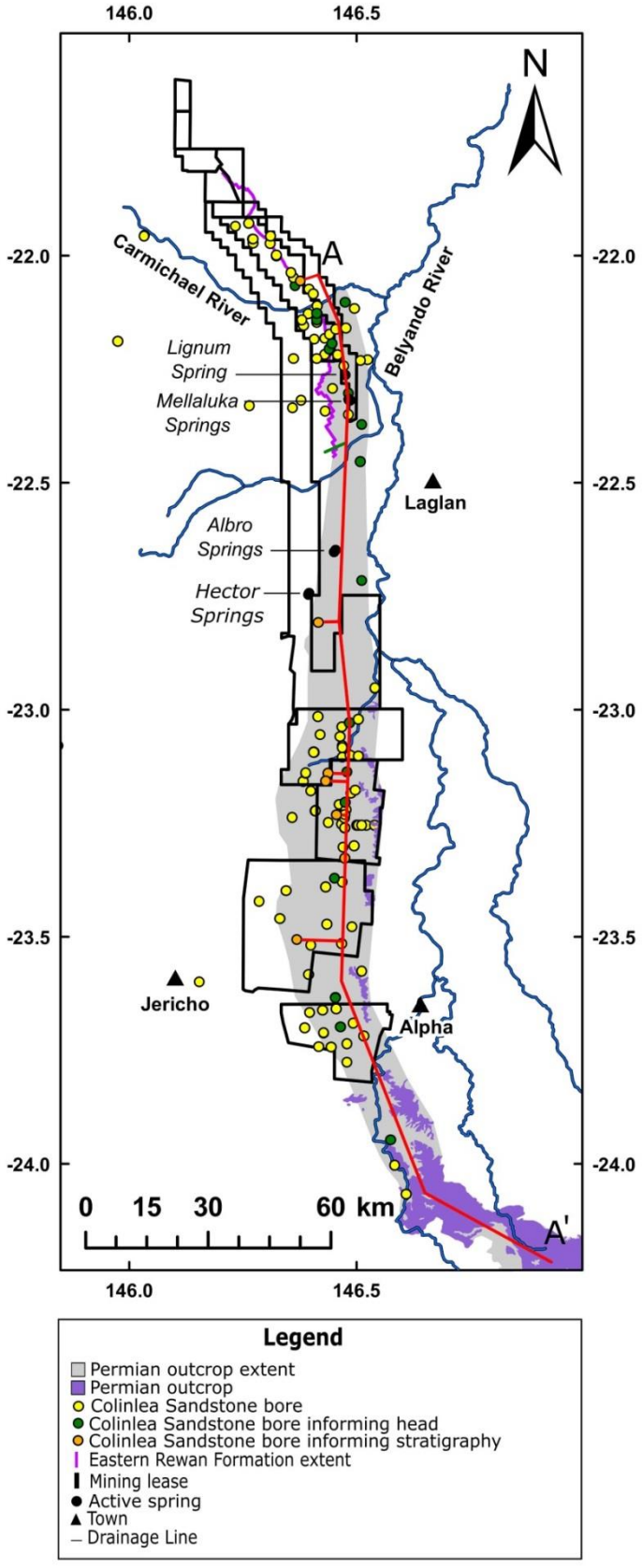


**Figure 1. Surface extent of Permian sediments in the Galilee Basin as derived from sources in Table 2. The Permian sediments are equivalent to the Betts Creek Beds except in the southern area (south of -23.85) where other Permian units associated with the Betts Creek Beds outcrop (referred to in this region as the Blackwater Group). The Colinlea Sandstone is not represented north of the Carmichael River but the eastern edge of the Rewan Formation is represented. The green line identifies the stratigraphy represented in Figure 2. The red line identifies the position of the stratigraphy represented on Figure 3.**

**Table 2. Source information for defining the surface extent of the Betts Creek Beds.**

| Latitude Range | Source |
|---|---|
| Western extent of Betts Creek Beds (eastern edge of Rewan Formation | |
| 21.8 – 22.4 | Geo-rectification of mapped Westmost Permian Overburden (inc Bandanna Formation) Adani (p. 12, GHD, 2013b) |
| 22.4 – 22.8 | Inference |
| 22.8 – 24.2 | Interpreted and supplied by Bleakley, A. , Jericho 55-14 (Vine et al., 1972b) and Tambo 55-2 (Exon et al., 1969) |
| 24.2 – 24.3 | Eastern edge of Rewan Formation Outcrop, Tambo 55-2 (Exon et al., 1969) |
| Eastern extent of Betts Creek Beds | |
| 22.1 – 24.0 | Colinlea outcrop, Galilee 55-10 (Vine et al., 1972a), inferred from Artesian Bores. |
| 24.0 – 23.0 | Colinlea outcrop, Jericho 55-14 (Vine et al., 1972b) |
| 24.0 – 24.2 | Colinlea outcrop, Tambo 55-2 (Exon et al., 1969) |

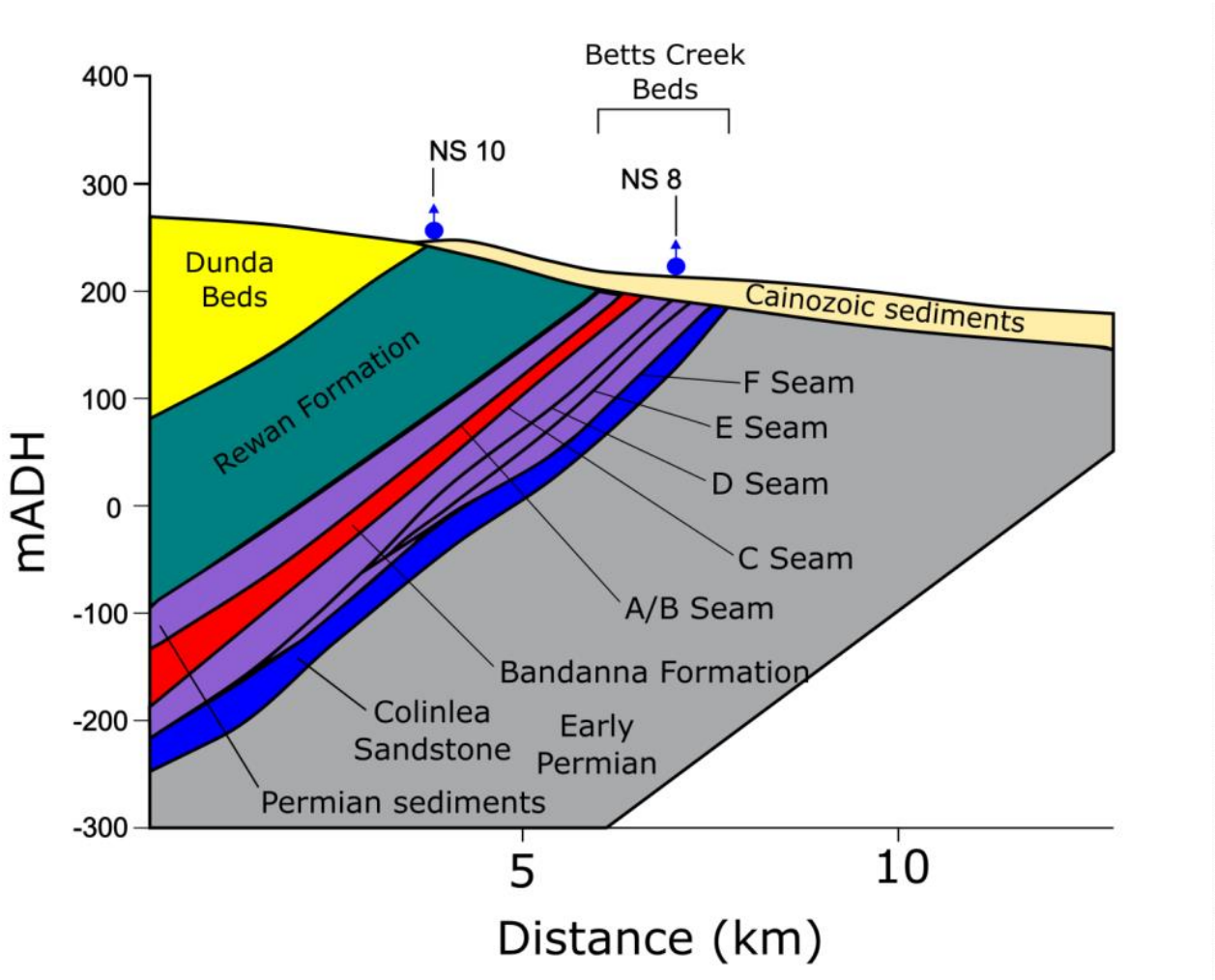


**Figure 2. Stratigraphy (see Figure 1) detailing the coal seams within the Betts Creek Formation (Colinlea Sandstone and Bandanna Formation) and their relationship with other sediments in the Galilee Basin.**

## Hydrology of the springs

The Permian Galilee Springs form a south-north line to the west of the Belyando River (Figure 1). These springs appear to overlie the basement strata of the Colinlea sandstone in the vicinity of the E and F coal seams (Figure 2). Off-set from this line to the south-west is Hector Springs (Figure 1). Due to its position and the inferred hydraulic head in the Colinlea Sandstone (Figure 3), Hector Springs has been interpreted as having its source in the Triassic units of the Galilee Basin and is considered in a separate section report .

The potentiometric surface derived from bores in the Colinlea Sandstone strongly suggests a predominantly south-north flow from the areas of outcrop at about 570 m altitude (Figure 3). This gradient is parallel with the ground surface, but perpendicular to the westward dip of the sediments. A downslope gradient in groundwater flow may be expected to the west given the dip in sediments (Figure 2). However, throughflow along the westward dipping sediments may be constrained because of a lack of connectivity between the deep sediments of the Galilee Basin at their western margin and the overlying basal units of the Eromanga Basin. The south-north flow structure seems to be the dominant influence on hydraulic head and spring flows.

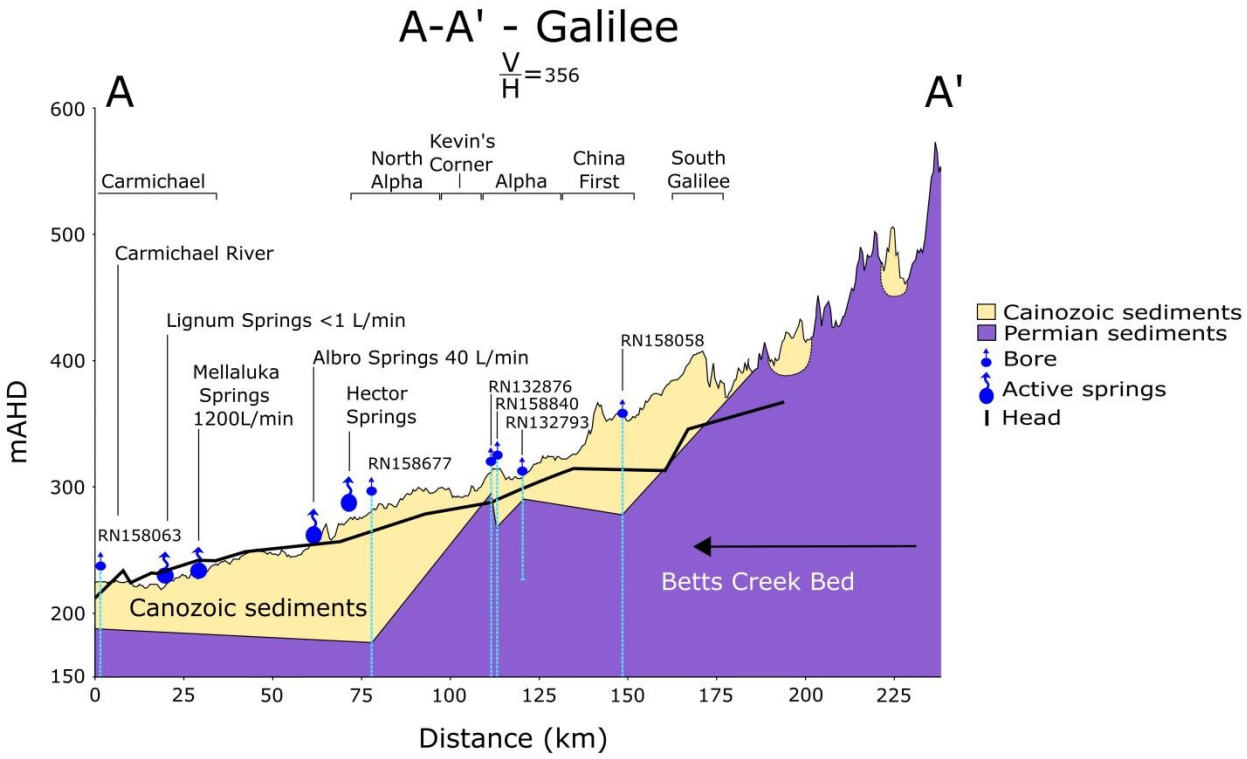


**Figure 3. North-south stratigraphy (see Figure 1) identifying the Permian sediments of the Galilee Basin, and the location of bores from which the stratigraphy and potentiometric head have been derived. Direction of inferred groundwater flow from south to north is indicated by the large arrow.**

There is a marginal but positive artesian head at Albro Springs and Mellaluka, while Lignum springs coincide with an area in the Colinlea Sandstone where artesian head reaches its maximum height (Figure 3). The reason that the springs emerge through the overlying Cainozoic sediments, including consolidated Tertiary sandstone and recent alluvium at particular locations is difficult to define. Given the marginal artesian head at Albro Springs it is likely that these springs are positioned where the surface of the Colinlea Sandstone is shallow or outcropping.

# Biological values

No endemic species are found in this group of springs, with only a couple of widespread wetland generalist species recorded in Albro and Lignum springs. The wetland vegetation in the Mellaluka Spring is dominated by the sedge *Baumea rubiginosa*, the fern *Cyclosorus interruptus* and the grasses *Imperata cylindrica* and *Phragmites australis*. The flora is relatively diverse, but all of the plant species have relatively widespread distributions on other wetlands. In 1960 the orchid *Spiranthes sinensis* (Figure 4) was collected by Queensland Government Botanist Selwyn Everist. This species has a widespread global distribution, but the population at Mellaluka is very disjunct. It was present but not flowering in 1998, but has not been seen since.

**Figure 4. *Spiranthes sinensis,* pictured here growing in Japan, is a cosmopolitan orchid with a global distribution, found at Mellaluka springs; © Daniel Wieczorek 2005, danwiz.com.**

# References

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