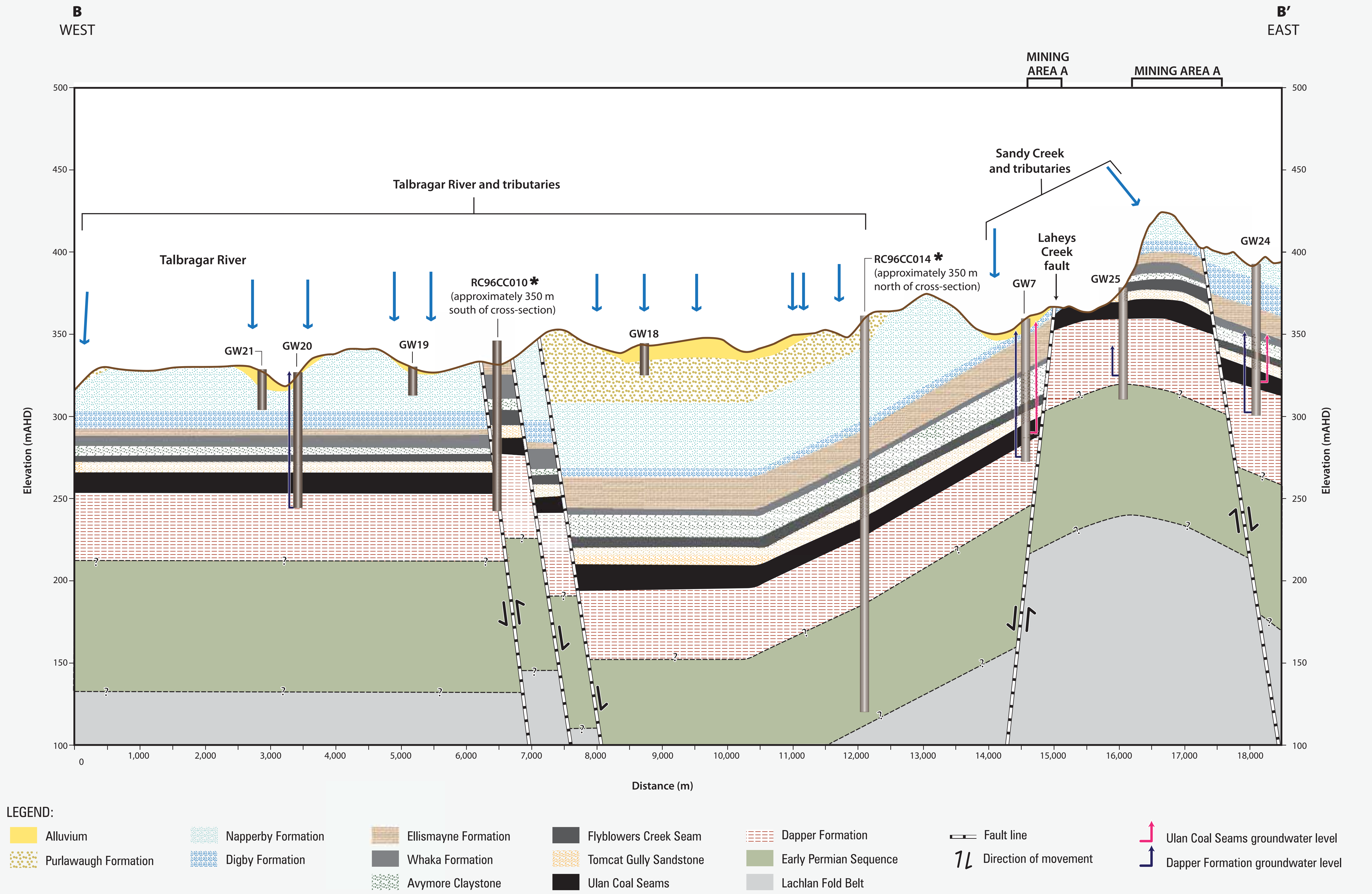
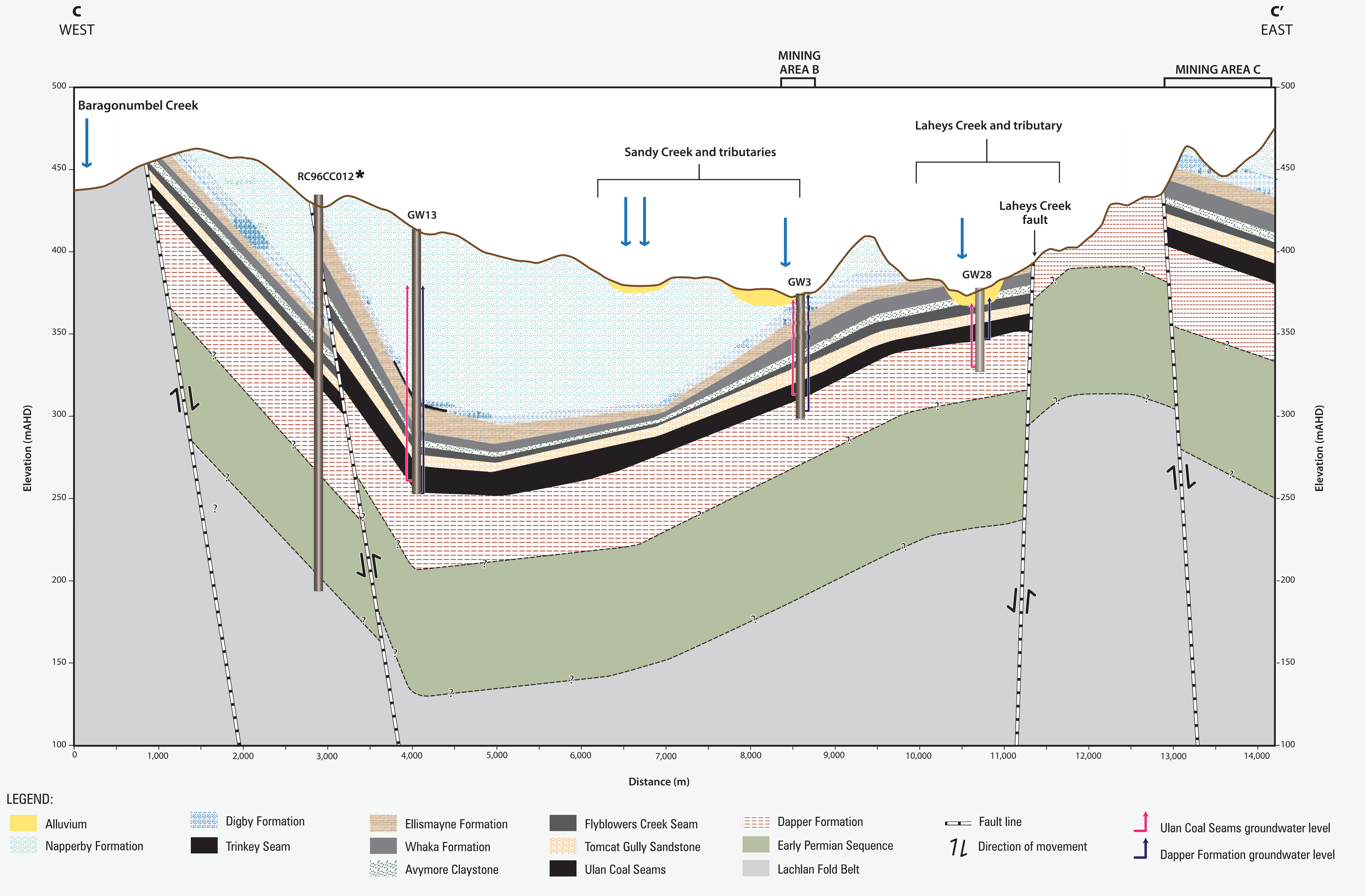
PARSONS BRINCKERHOFF

COBBORA COAL PROJECT
CHC PTY LTD



Note: **RC96CC0** bores were drilled as part of the CRA exploration program (Menpes, 1997)*

Figure 2.5 Conceptual hydrogeological cross-section B - B′



Note: * RC96CC0** bores were drilled as part of the CRA exploration program (Menpes, 1997)

Figure 2.6 Conceptual hydrogeological cross-section C - C'

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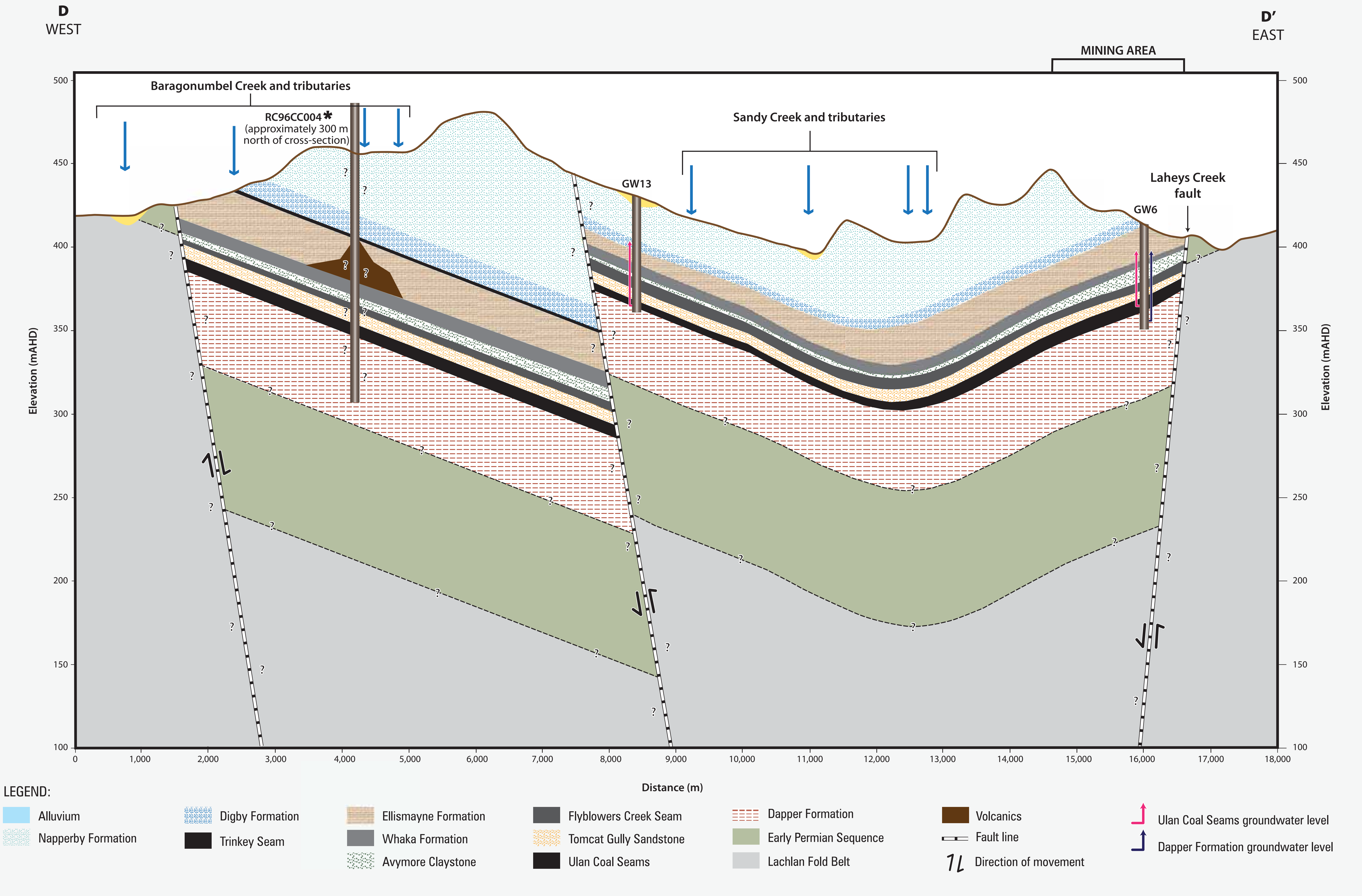

Note: ✱ RC96CC0** bores were drilled as part of the CRA exploration program (Menpes, 1997)

Figure 2.7 Conceptual hydrogeological cross-section D - D′

Table 2.1 Summary of geological stratigraphy

Period	Group	Formation	Description	Thickness	Gunnedah Basin nomenclature
Quaternary		Alluvium	Gravels and sand with some clay layers associated with stream and river channels and floodplains	Up to 28 m (Talbragar River)	Alluvium
Tertiary		Basalts	Topographically inverted tertiary basalt flows forming caps on hills in the assessment area, with some intrusive formations	Variable	Basalts
Jurassic		Pilliga Sandstone	Fine to coarse sandstone	>100 m	Pilliga Sandstone
		Purlawaugh Formation	Mudstone, siltstone and sandstone	>100 m	Purlawaugh Formation
Triassic		Napperby Formation	Siltstone and sandstone	~100 m (maximum)	Napperby Formation
	Narrabeen Group	Digby Formation	Fluvial lithic and quartz conglomerates, sandstones and minor fine-grained sediments	~20 m	Digby Formation
Permian	Dunedoo Formation	Trinkey Seam	Coal	2–5 m	Nea Subgroup
	Dunedoo Formation	Ellismayne Formation	Interbedded siltstone, sandstone and claystone	2–18 m	Nea Subgroup
	Dunedoo Formation	Whaka Formation	Interbedded carbonaceous claystone and tuff with stony coal seams	2–14 m	Nea Subgroup
	Dunedoo Formation	Avymore Claystone	Claystone	1–13 m	Coogal Subgroup
	Dunedoo Formation	Flyblowers Creek Seam	Coal seam with minor tuff	3–5 m	Coogal Subgroup
	Dunedoo Formation	Tomcat Gully Sandstone	Coarse sandstone and conglomerate, some shale	3–13 m	Coogal Subgroup
	Dunedoo Formation	Upper Ulan Seam	Coal, minor tuff; coal content increases with depth	3–5 m	Coogal Subgroup
	Dunedoo Formation	C-Marker Clay	Claystone	0.1–5 m	Coogal Subgroup
	Dunedoo Formation	Lower Ulan Seam	Coal interbedded with tuff and shale; coal content increases with depth	2–5 m	Coogal Subgroup
	Dunedoo Formation	Dapper Formation	Coarse sandstone and lithic conglomerates	~60 m	Brothers Subgroup
		Early Permian sequence	Interbedded shales, siltstones and fine sandstone	Unknown	Watermark, Porcupine and Maules Creek formations
Silurian	Mumbil Group	Glenski Formation	Felsic to rhyolitic tuff and tuffaceous sedimentary rocks	Unknown	
	Chesleigh Group	Piambong Formation	Quartzose to quartz-lithic sandstone and	Unknown	

Period	Group	Formation	Description	Thickness	Gunnedah Basin nomenclature
			siltstone, tuff and volcaniclastic horizons		
	Tanabutta Group	Dungeree Volcanics	Rhyolite to dacite lava, limestones, polymictic conglomerate, shale, slate and volcanic-rich sandstone	Unknown	
Ordovician	Carbonne Group	Tucklan Formation	Sedimentary rocks of mafic volcanic origin	Unknown	

The Project is situated in an area of complex geology at the boundary between the Gunnedah Basin and the Lachlan Orogen. The Laheys Creek Fault intersects the assessment area on the eastern side trending north-north-west, with another unnamed fault trending parallel to and about 8–9 km to the west of the Laheys Creek Fault.

2.2 Available data

2.2.1 Pre-existing data

Prior to the commencement of baseline data collection for the current Project, the following data sources were available:

- NSW Office of water (NOW) database, providing borehole logs with lithological data and historical groundwater levels.
- Borehole logs and a digital elevation model of surface topography (20 m resolution) provided by Marston mining consultants.
- Geological maps of the area, produced by the Geological Survey of NSW – 1:100,000 scale (Meakin et al. 1999) and 1:250,000 scale (Meakin & Morgan 1999).
- Bureau of Meteorology (BoM) weather stations; 062013 Gulgong (BoM 2011a) and 064009 Dunedoo (BoM 2011b) near the assessment area, providing rainfall data from 1881 to the present day. These have been supplemented by data collected at the site since February 2009.
- Bureau of Meteorology weather station 065035 (Wellington), providing evaporation data from 1965 to 2005.

2.2.2 Data collected as part of the current study

The following key information was obtained during the course of the current study and considered during development of the groundwater model:

- Proposed mine plan provided by CHC (2011).
- Pumping test data from tests carried out between October 2009 and December 2011.
- Slug test data from tests carried out in November 2011.
- Lithological and packer test data from drilling conducted between August 2009 and December 2011.

- Groundwater levels from October 2009 onwards.

A more detailed description of Parsons Brinckerhoff's field program and the data collected is provided in the accompanying Cobbora Coal Project - Groundwater Assessment (Parsons Brinckerhoff 2013a).

2.3 Pre-existing conceptual model of the groundwater system

An integrated study of geophysical, geological, hydrogeochemical and hydrogeological data in the Gunnedah Basin, conducted by Schofield and Jankowski (2003), suggests that both regional and local groundwater systems operate in the assessment area. The study suggests that the local groundwater system, which exists within the Permian to recent geological strata, can be divided into deep, intermediate and shallow components.

The deep component is conceptualised as being dominated by fracture flow, and (locally) under artesian pressure, extending from the early Permian units to the base of the Napperby Formation (see Table 2.1).

The intermediate component is conceptualised as a leaky aquitard that acts as a mixing zone between the deep and shallow parts of the system, extending from the Napperby Formation to the top of the Purlawaugh Formation.

The shallow component is present within the Quaternary sediments and Jurassic Pilliga Sandstone. The conceptual model suggests that groundwater within the shallow component is controlled by the influx and lateral migration of surface waters. Groundwater within the regional system, as proposed by Schofield and Jankowski (2003), is controlled by the fabric of Palaeozoic basement rocks, and is inferred to flow towards the north-west.