Coast and Country Association of Queensland Inc. & Ors
v Hancock Coal Pty Ltd,

Land Court of Queensland Proceeding MRA082-13 & EPA083-13

Objection to Mining lease and Environmental Authority for Alpha Coal Mine

Expert report on groundwater impacts to the Land Court by Dr John Webb

Date: 27 June 2013

Degulla Lagoon, ~35 km north of proposed Alpha Coal Mine.
Photo taken by J. Webb, 17 June, 2013

Contents

1 Introduction

1.1 Expert details, experience and qualifications

1.1.1 Name and address

[1] John Webb
Associate Professor in Environmental Geoscience
La Trobe University,
Melbourne, Victoria 3086

1.1.2 Qualifications

[2] BSc Hons (University of Queensland) 1973. Awarded First Class Honours
PhD (University of Queensland) 3/9/1982.

1.1.3 Experience

[3] I have over 30 years' experience in geology and 20 years' experience in hydrogeology, both in terms of practice and tertiary level teaching. I have supervised 25 PhD students, 4 MSc students and 86 Honours students in a variety of geological and hydrogeological projects. I have participated in over 40 consulting projects, and have been an invited member of 3 expert panels to assess groundwater and contaminated site management. Over the past 12 years I have acted as an expert witness in 6 court cases on hydrogeological and hydrogeochemical topics, including VCAT hearings.

[4] Attachment A to this report is my curriculum vitae.

1.2 Background

[5] The Alpha Coal Mine is a proposed open-cut coal mine north of the township of Alpha. Approximately 2.6 billion tonnes of thermal coal are located within Mining Lease Application 70426; about one-third of the mining lease area (which covers ~65,000 hectares) will be disturbed by mining operations. The mining lease application is for 40 years with an annual extraction rate of around 45 million tonnes per annum run-of-mine (ROM) coal. Hancock Coal Pty Ltd applied for an environmental authority (mining lease) (**EA**) under the *Environmental Protection Act 1994* (Qld) (**EP Act**) and a mining lease under the *Mineral Resources Act 1989* (Qld) for the Project on or about 17 December 2009, having previously submitted an EIS in November 2010, a supplementary EIS in August 2011, an addendum to the supplementary EIS in November 2011, and additional supplementary documentation in May 2012 (together, the **EIS Reports**), for approval under the *State Development and Public Works Organisation Act 1971* (Qld) (**SDPWO Act**). The Coordinator-General's Evaluation Report on the mine under the SDPWO Act was delivered on 29 May 2012. The Coordinator-General recommended that the mine be approved subject to conditions. On behalf of Coast and Country Association of Queensland Inc. an objection to the applications for a mining lease and an environmental authority was submitted by the Environmental Defenders Office (Qld) Inc. on 20 February 2013.

1.3 Instructions

[6] On 16 April 2013, I was instructed by Sean Ryan, Senior Solicitor, Environmental Defenders Office (Qld) Inc. on behalf of Coast and Country Association of Queensland Inc. to prepare a report setting out my opinion as to:

- whether there is sufficient information to form an adequate scientific basis for approval of the Alpha Coal Mine having regard in particular to potential groundwater impacts and the reasons for my view;
- whether, having regard to all of the available material, there are issues that should be examined in more detail or additional lines of inquiry in relation to groundwater that should be explored before approval is granted and the reasons for my view; and
- whether, having reviewed all of the EIS documents, I agree with the conclusion of Coordinator-General's assessment in relation to groundwater and the reasons for my view.

[7] Attachment B to this report is the letter of instructions.

[8] I acknowledge that, prior to preparing this report, I was instructed on an expert's duty in accordance with rule 426 of the *Uniform Civil Procedure Rules 1999* and I understand and have discharged that duty.

[9] I also verify that no instructions were given or accepted to adopt, or reject, any particular opinion in preparing my report.

1.4 Methodology

[10] For this report, I examined the available geological and hydrogeological information in the EIS Reports on the Alpha coal mine. The conceptual geological model used in these reports (Figure 1), delineating the inferred subsurface location and arrangement of the strata, shows the modelled aquifer (CD-DE sandstones) dipping to the west, whereas the potentiometric surface of this aquifer dips to the east. The potentiometric surface (the height of the water level in bores screened within the CD-DE sandstones) measures the groundwater pressure; groundwater always flows from areas of high hydraulic pressure to areas of low hydraulic pressure. Therefore groundwater flow in the aquifer must be towards the east, following the dip of the potentiometric surface, but the conceptual hydrogeological cross-section used in the hydrogeological EIS Reports (Figure 1) shows groundwater flow down the dip of the aquifer to the west.

[11] Therefore, I first reinterpreted the geology of the area using the available 1:250,000 Jericho geological map (SF55-14; Bureau of Mineral Resources 1972), remote sensing data, particularly airborne radiometric data, a 2004 Landsat 5 image of the area, processed using ENVI, and Google Earth images of the area. From this I developed a geological model for the area, which recognised that the strata are folded and therefore do not dip uniformly to the west. The axes of the broad anticlinal folds approximately coincide with the topographic divide of the Great Dividing Range in the area, and form a groundwater divide where most recharge is occurring (see sections 3 and 4 of this report). The geological model was assessed during a site visit, including an overflight in a light plane, and dips of bedding consistent with the model were found.

[12] The revised hydrogeological model allowed the regional impacts of the Alpha mine to be better assessed, and in particular showed that although the existing hydrogeological modelling of the impact of the mine is of high quality and meets normal industry requirements, it underestimates the impact of the mine towards the north, because, most importantly, it has not incorporated the effect of groundwater flow interception (see section 5 in this report). It probably also underestimates the impact of the mine towards the south, because it has not incorporated the effect of recharge along the Great Dividing Range (see section 5 in this report).

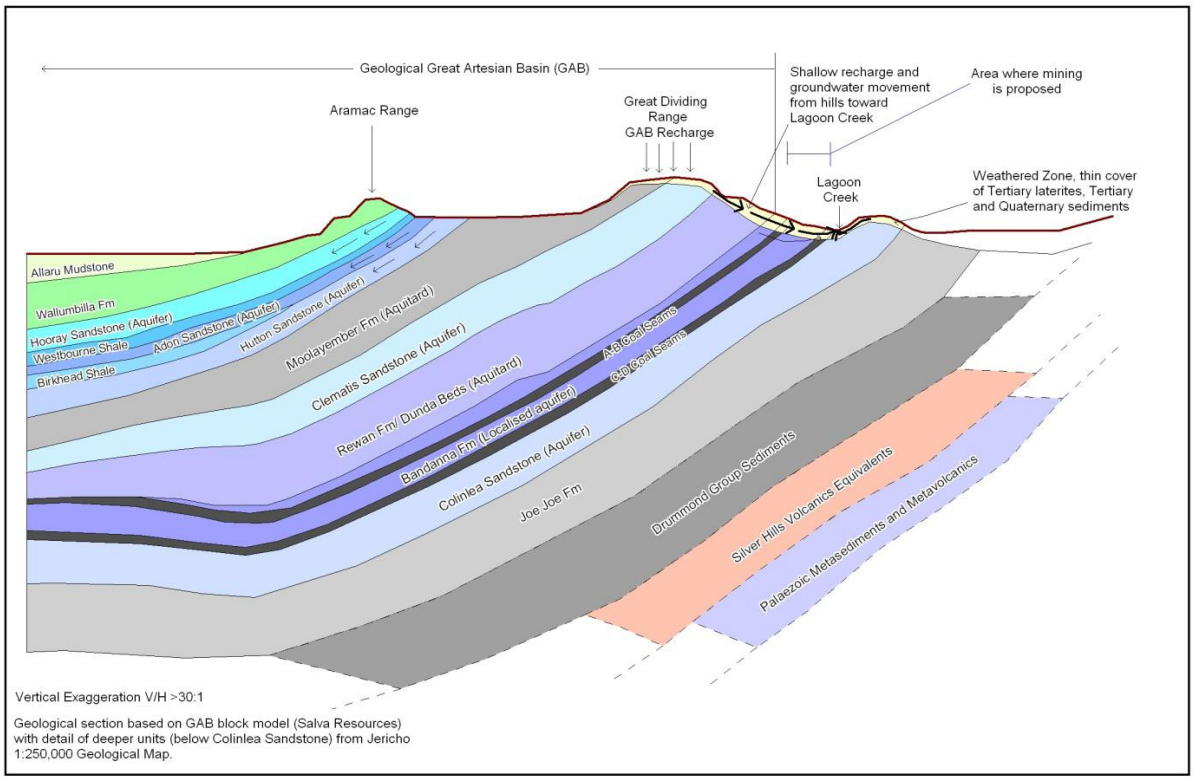


Figure 1: Conceptual geological model used in URS Groundwater Modelling Report for Alpha Coal Project 28 March 2012 (Figure 4-11 in that report).

1.5 Assistance

[13] The new conceptual geological and hydrogeological model in this report was developed entirely by myself using the available 1:250,000 geological map, airborne radiometric and magnetic data obtained from Geological Survey of Queensland, a 2004 Landsat 5 image of the area obtained from the Australian Greenhouse Office, and Google Earth images of the area downloaded by myself using Shape2Earth. The Landsat image was processed using ENVI and all data was interpreted using the GIS program Global Mapper.

[14] As part of the preparations for this report, I examined the area around the mine site, including an overflight in a light plane, in the company of Dr Gavin Mudd, Faculty of Engineering, Monash University, who is appearing as an expert witness for another of the objectors in the case. I also

spoke to some of the landholders in the area. The insights gained from this visit helped to inform my report.

1.6 References

[15] I referred to the following maps and reports in preparing this report:

- 1:250,000 Jericho geological map (SF55-14; Bureau of Mineral Resources 1972);
- EIS Volume 1 (20/12/2010):
  - Section 00 Executive Summary;
  - Section 01 Introduction;
  - Section 02 Description of the Project,
- EIS Volume 2 (05/11/2010):
  - Section 4 Geology;
  - Section 11 Surface Water;
  - Section 12 Groundwater,
- EIS Volume 4:
  - Appendix G Cumulative Impacts (05/11/2010),
- EIS Volume 5:
  - Appendix F1 Geomorphology Technical Report (09/2010);
  - Appendix F3 Site Water Management System and Water Balance Technical Report (14/09/2010);
  - Appendix F4 Surface Water Quality Technical Report (09/2010);
  - Appendix G Groundwater (14/09/2010);
  - Appendix J1 Geochemical Report (30/09/2010),
- Supplementary EIS Volume 2:
  - Appendix I Coal Mine-Surface Water Summary (05/09/2011);
  - Appendix J Coal Mine-Geomorphology Technical Report (06/2011);
  - Appendix M Coal Mine-Surface Water Quality Technical Report (13/04/2011);
  - Appendix N Coal Mine-Groundwater and Final Void Report (05/09/2011);
  - Appendix O Coal Mine-Groundwater Bore Survey Report (28/07/2011),
- Additional Supplementary Documentation:
  - URS Groundwater Modelling Report (28/03/2012),
- Coordinator General's Evaluation Report on the environmental impact statement (24/05/2012);
- Interim Independent Expert Scientific Committee on Coal Seam Gas and Coal Mining: Advice to decision maker on coal mining project (20/6/2012);
- Alpha Coal Mine Environmental Management Plan (30/11/2012);
- Expert report to the Land Court by Mark Stewart (30/05/2013);
- Expert report to the Land Court by Iain Donald Hair (29/05/2013);
- Waratah Coal's China First Environmental Impact Statement: Volume 5, Appendix 14 – Groundwater (25/9/2010);
- Crosbie, R., et al. 2012, *New insights to the chemical and isotopic composition of rainfall across Australia*, CSIRO Water for a Healthy Country Flagship, Publication.

2 Summary Report

2.1 Questions 1 and 2:

Is there sufficient information to form an adequate scientific basis for approval of the Alpha Coal Mine, having regard in particular to potential groundwater impacts?

Having regard to all of the available material, are there issues that should be examined in more detail or additional lines of inquiry in relation to groundwater that should be explored before approval is granted?

[16] These two questions are most easily answered together. At present there is insufficient information to determine the overall groundwater impacts of the Alpha Coal Mine, and some issues need to be examined in more detail.

2.1.1 Additional modelling

[17] In particular, although the groundwater modelling is high quality and consistent with standard professional practice, there are significant shortcomings which need to be remedied by incorporating:

- The revised geological model proposed here (see section 3 in the main report);
- The level of recharge demonstrated here (section 4.4 in the main report, particularly paragraphs 52 and 53, and section 5, paragraph 66);
- A decreasing rather than constant head southern boundary (paragraph 65 in the main report); and
- Most importantly, a decreasing rather than constant head northern boundary (section 5 in the main report, particularly paragraphs 60 to 64).

[18] The revised modelling will allow the impacts of the mining on areas to the north to be more accurately determined. At present these impacts are significantly underestimated and will extend much further north than presently modelled, potentially as far as the springs and lagoon on Degulla property, which could be negatively affected (see Figures 2 and 3 for locations of properties and surface water features in relation to the Alpha coal mine and other MLAs in the Galilee Basin).

[19] The modelling also needs to be extended to consider the regional impacts of permanently removing a significant amount of groundwater from the Burdekin River basin. At present the regional impacts on groundwater have not been adequately assessed, particularly in terms of the cumulative impacts from both mines.

2.1.2 Additional data/monitoring

[20] There are sufficient bores within the Alpha lease area for satisfactory modelling of the impact of the mine on the groundwater system within the mining lease, and enough monitoring bores to record this impact during and after mining. However, there are insufficient bores to the north of the Kevin's Corner lease, where, as discussed in paragraphs 60 to 64, mine dewatering is likely to permanently impact surface drainages, springs and any bores used for stock watering and/or domestic use, and where the saline plume from the final void after mining finishes will also have

an impact, as discussed in paragraphs 70 to 72. At present no monitoring bores are proposed in this area at all. At least 3 sets of nested bores should be drilled adjacent to Sandy Creek, spaced evenly between the northern edge of the Kevin's Corner lease and Degulla Lagoon. The shallower bore in each nest should be screened in the creek alluvium, and the deeper bore in the CD sandstone. All bores should have loggers installed.

2.2 Question 3:

Having reviewed all of the EIS documents, do I agree with the Coordinator-General's assessment in relation to groundwater?

2.2.1 Assessment

[21] The Coordinator-General's Evaluation Report contains the following comments:

- *That "the revised groundwater model provides a comprehensive predictive analysis of the groundwater impacts arising from both the Alpha and adjacent Kevin's Corner mines over the life of these projects." (page 63)*

[22] I disagree. As detailed in paragraphs 60 to 64, the groundwater impacts to the north of the mine site are significantly underestimated, due to a lack of consideration of the effect of the mine dewatering on northwards groundwater flow. In addition, the model does not take account of the likely recharge along the Great Dividing Range, or the fact that mine dewatering is so much greater than recharge that the impact of dewatering will also extend further upgradient than presently modelled.

- *That "groundwater quality will be maintained through conditions attached to the EA under the EP Act." (page 69)*

[23] I disagree. Long term modelling of the composition of lake water in the final void after mining is complete shows that it will become progressively more saline over time due to evaporation, until eventually it will become too saline for cattle watering. Northwards groundwater seepage from the lake means that this saline water will contaminate the groundwater to the north, forming a saline plume that will degrade the groundwater quality.

- *That "the additional modelling undertaken by the proponent, particularly with the advantage of monitoring data from the pre-mining test pit, has not identified a significant likelihood of impacts on surface aquifers outside the immediate mine footprint." (page 68)*

[24] It is true that modelling has not identified groundwater impacts on surface aquifers (Tertiary and Quaternary sediments) outside the mine area, but once the modelling is redone with the revisions suggested in section 2.1.1, the groundwater impacts are likely to prove much more substantial than presently modelled. This will be particularly true to the north, where decreased groundwater flow is likely to reduce artesian pressures and therefore decrease spring flows, and possibly also negatively impact surface water features like Degulla lagoon.

- *That, in relation to the project as a whole, "sufficient information has been provided to enable the necessary evaluation of potential impacts attributable to the project." (page 253)*

[25] I disagree with respect to groundwater. As discussed in section 2.1.1, the modelling needs to be redone to incorporate the revised geological model proposed here, the level of recharge demonstrated here, and decreasing rather than constant head southern and northern boundaries. Only then can the potential impacts of the mine on groundwater around the mine site, particularly to the north, be evaluated.

2.2.2 Conditions and recommendations

[26] The Coordinator-General's Evaluation Report specified 3 conditions and 4 recommendations in relation to groundwater. I agree with all of them; I have specific comments on some of them.

- *Condition 2 – Regional groundwater monitoring and reporting program*

[27] These are excellent conditions, in particular the emphasis on off-lease impacts and the need for a basin-wide groundwater model as part of a regional cumulative impact assessment. The basin modelling needs to be carried out for the eastern margin of the Galilee Basin, and, more importantly, the Burdekin River basin.

- *Recommendation 1, Part B, Appendix 3 – Water security*

[28] This is an important recommendation, particularly as it specifies both short and long term implications. However, it considers water security only for groundwater users; water security for the environment also needs to be taken into account.

- *Recommendation 2, Part B, Appendix 3 – Groundwater modelling*

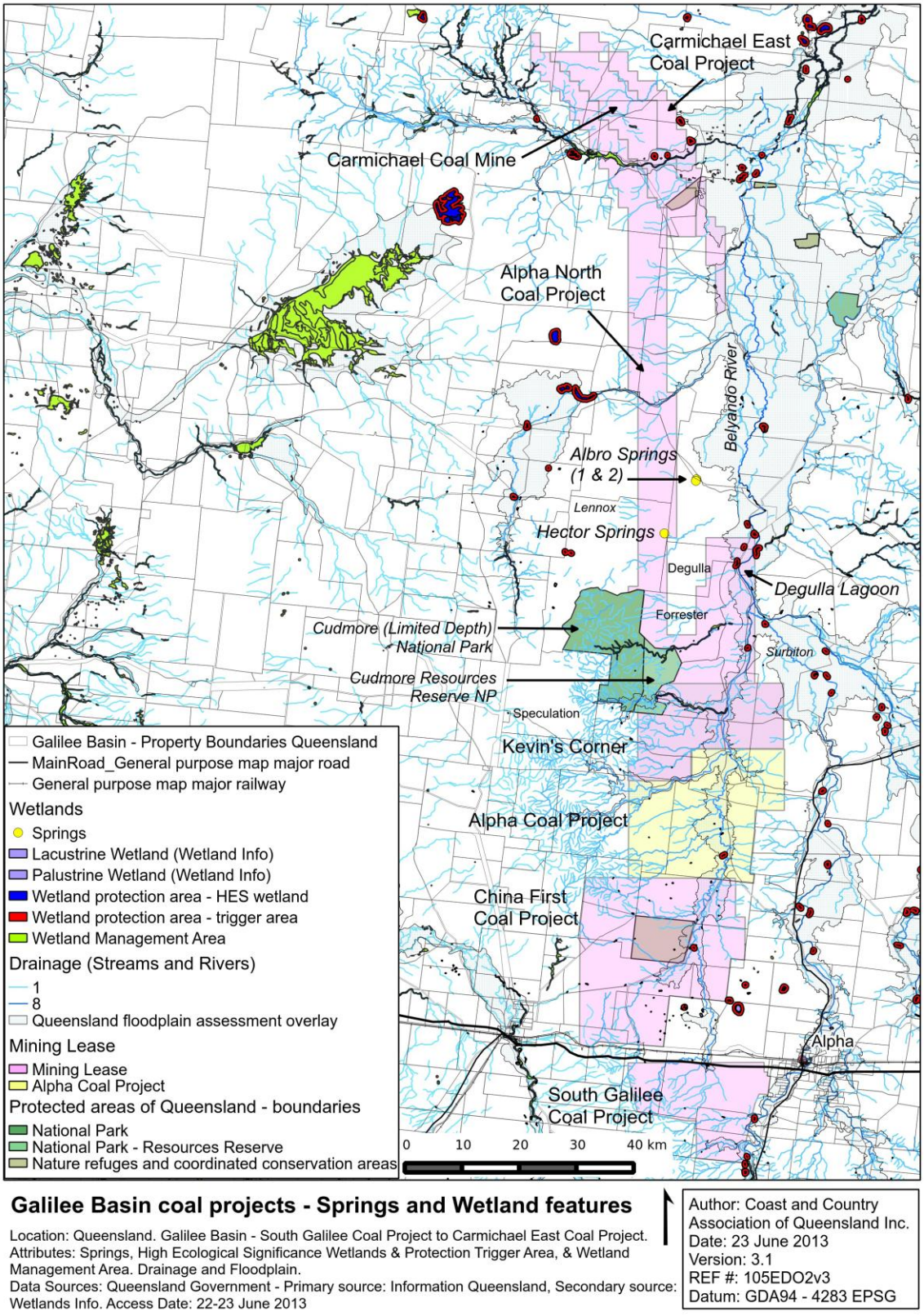
[29] The model recalibration every 3 to 5 years will enable any changes in the hydrogeological system to be readily identified. The modelling also needs to be revised as specified in section 2.1.1 above.

- *Recommendation 3, Part B, Appendix 3 - Monitoring*

[30] The recommendations are very good; the monitoring bores need to include the additional bores specified in section 2.1.2 above.

- *Condition 11 – Regional water plan*

[31] The identification of linkages between formations, in terms of determining the regional interaction between surface water and groundwater, needs to take into account the revised conceptual geological model of the area presented here, and in particular if there are fault/joint controls that have not yet been determined.



Galilee Basin coal projects - Springs and Wetland features

Location: Queensland. Galilee Basin - South Galilee Coal Project to Carmichael East Coal Project.
Attributes: Springs, High Ecological Significance Wetlands & Protection Trigger Area, & Wetland Management Area. Drainage and Floodplain.
Data Sources: Queensland Government - Primary source: Information Queensland, Secondary source: Wetlands Info. Access Date: 22-23 June 2013

Author: Coast and Country Association of Queensland Inc.
Date: 23 June 2013
Version: 3.1
REF #: 105EDO2v3
Datum: GDA94 - 4283 EPSG

Figure 2: Galilee Basin coal projects – Springs and Wetland features, showing MLAs and property names

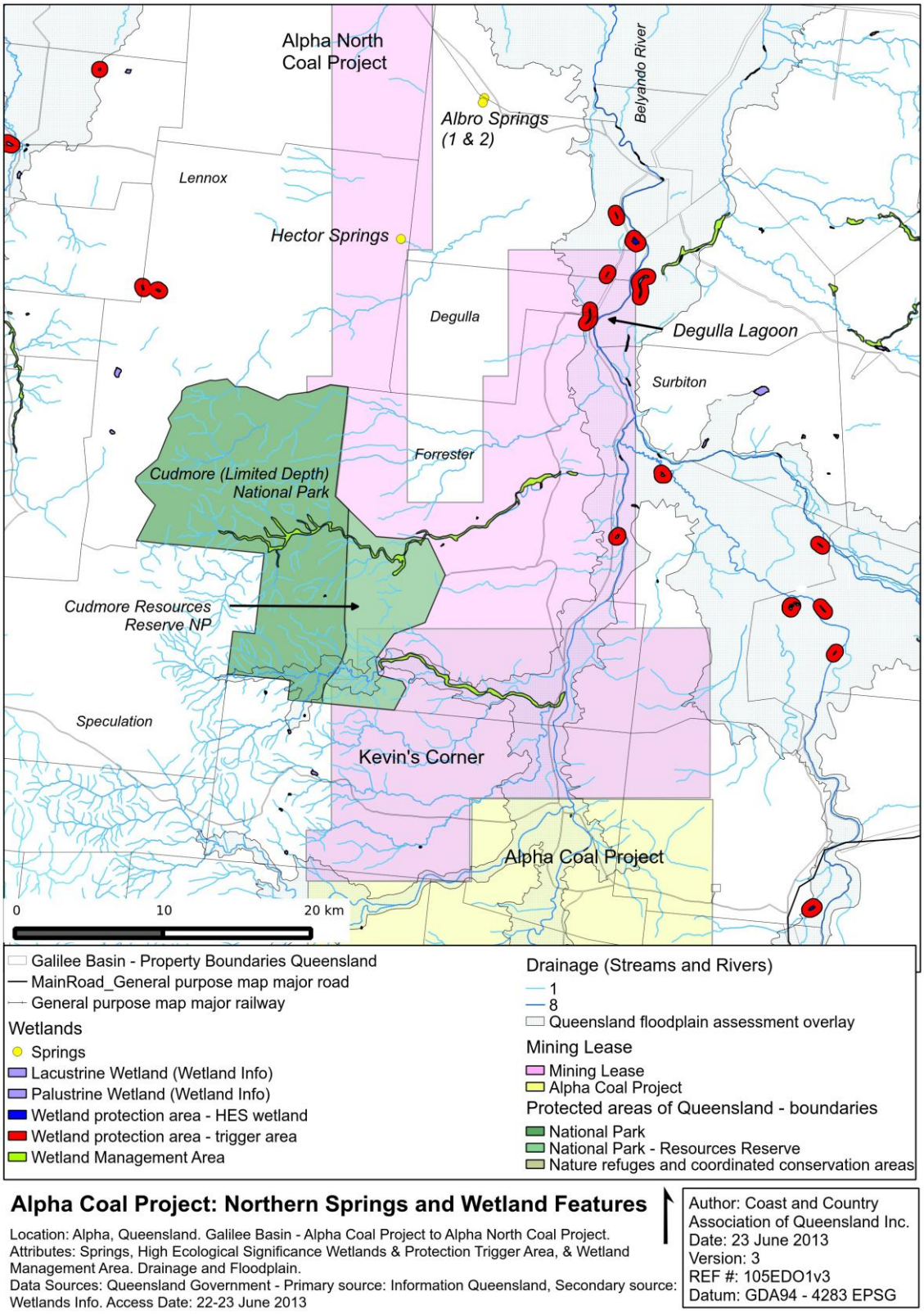


Figure 3: Alpha Coal Project – Northern Springs and Wetland features, showing property names

3 Conceptual Geological Model

[32] The geology of the proposed Alpha mine site consists of a conformable sequence of Permian and Triassic strata (Joe Joe Formation, Colinlea Sandstone, Bandanna Formation, Rewan Formation, Dundal Beds and Clematis Sandstone, in stratigraphic order). These are overlain by Tertiary laterite (ferricrete), which consists either of a thin iron-cemented sandstone unconformably overlying the Permian-Triassic strata, or of a very strongly ferruginised weathering profile developed on these strata; the profile varies in thickness from a few cm to several meters. The Tertiary laterite covers the lower-lying parts of the area as a more or less continuous subhorizontal sheet, but has been partially removed by erosion from the hills. Quaternary unconsolidated sediments overlie the laterite, and range in thickness from absent to a few cm on the hills, to >10 m along the main creeks.

[33] The Permian and Triassic strata are stated in all the reports on the proposed Alpha mine to dip uniformly at 0.5-2° to the west, but this is an oversimplification of the geology of the area.

[34] Along the Great Dividing Range the Permian and Triassic strata, together with the unconformably overlying Tertiary laterite, have been folded into two broad, low angle anticlines separated by a syncline; axes trend south-southeast - north-northwest and plunge shallowly towards the north-northwest (Figure 4d). The crests of the anticlines approximately define the drainage divide of the Great Dividing Range in this area, which is a subtle topographic feature with a maximum of only 200 m of relief. An additional syncline to the east is occupied by the valley of Lagoon Creek. Dips on the limbs of the folds are very shallow (maximum of a few degrees). The four folds converge towards the south-southeast; to the south of the proposed Alpha mine site the central anticline and syncline merge, so that only two fold axes are present (Figure 4d).

[35] The folding can be mapped from the Triassic sandstone outcrops, which dip very shallowly to the east on the eastern flank of the Great Dividing Range in the Cudmore National Park area, and from the outcrops of Tertiary laterite, which are clearly evident on Landsat images of the area (particularly the RGB 457, Tasseled Cap RGB Brightness Greenness Wetness, and PCA RGB 123 images; Figure 5a,b,d). The broad valley occupied by the Lennox and Speculation properties (see Figures 2 and 3) defines the central syncline, and is underlain by Tertiary laterite, which is exposed around the edges and along a drainage line through the centre. The anticlines either side of this syncline can be defined by the dip of the Tertiary laterite. The crests of these anticlines have been breached by erosion, giving rise to areas of broken topography such as that within Cudmore National Park. Removal of parts of the Tertiary laterite along the anticline crests has exposed the underlying Clematis Sandstone, Dundal Beds and Rewan Formation (Figure 4b,c); the outcrop areas of the Rewan Formation can be clearly identified on the radiometric image of the area, because of their high-potassium signature (reddish on the RGB K-Th-U image; Figure 5c).

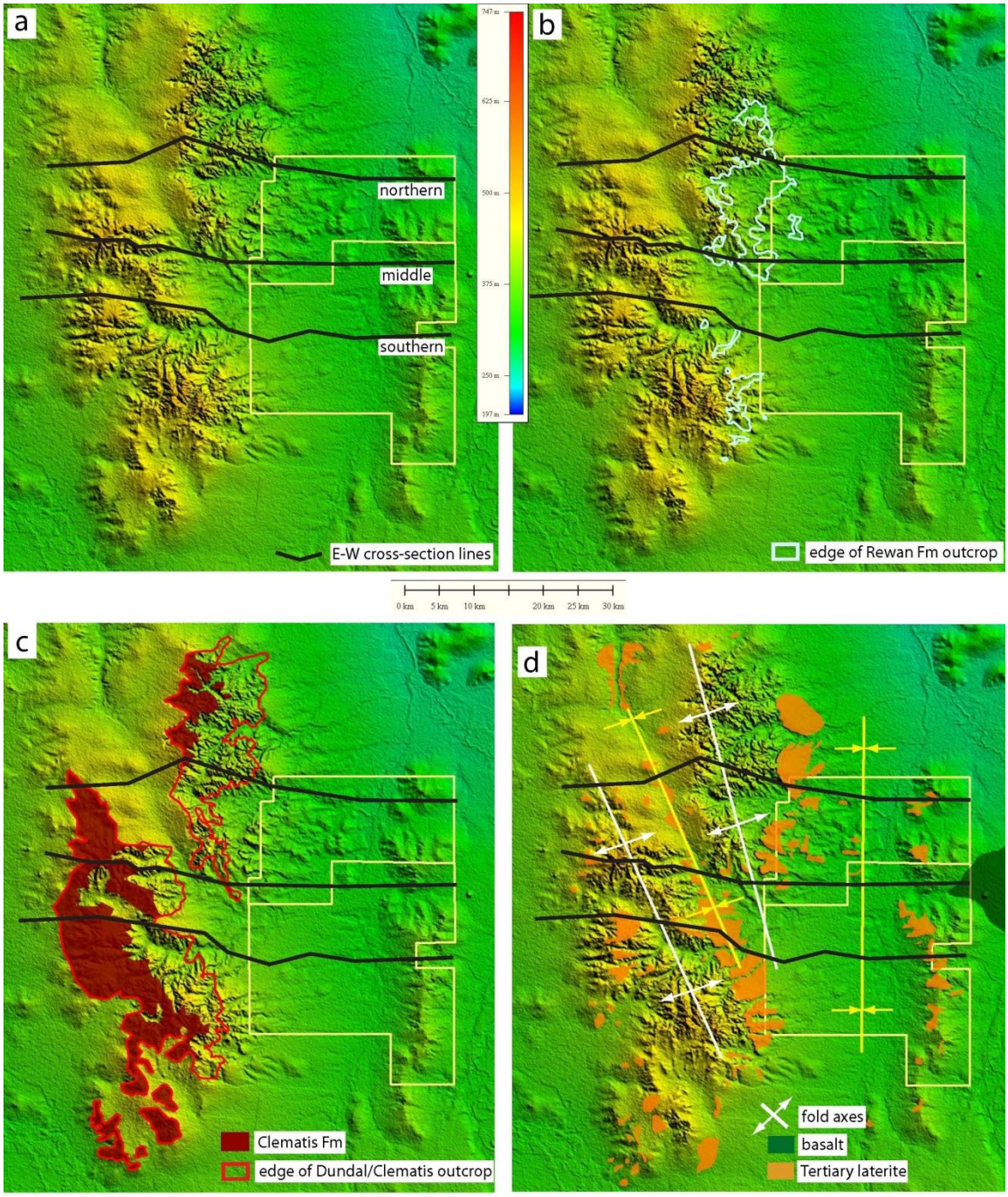


Figure 4: Geology of area around Alpha and Kevin's Corner mines

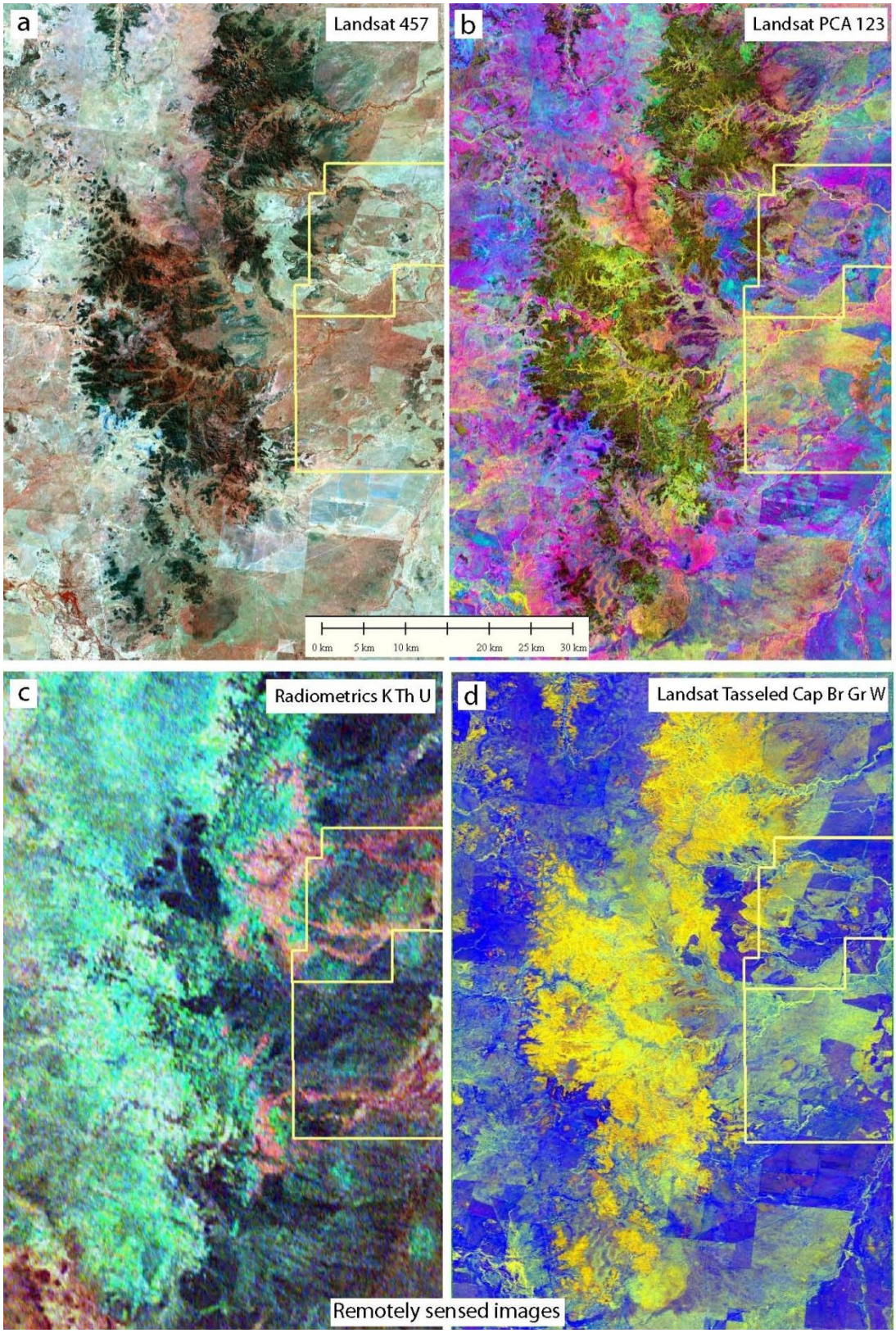


Figure 5: Remotely sensed images

14

[36] The folding of the Tertiary laterite is more or less symmetrical. However, the underlying Permian and Triassic sediments originally dipped shallowly westward, and the effect of the superimposed folding has been to create asymmetrical folds in these strata, so that the anticlines have steeper western limbs (Figure 8). As a result the Permian sediments dip westwards beneath the central part of the Lagoon Creek valley (as shown by all the cross-sections of the proposed Alpha mine), but on the eastern flanks of the Great Dividing Range they dip eastwards from the anticline axes beneath the crest of the range (Figure 5). The plunge of the folds towards the north-northwest and the convergence of the fold axes to the south means that there is a shallow northwards regional dip superimposed on the dip of the fold limbs; this is clearly evident as a shallow northwards dip of the Triassic strata north of Cudmore National Park (Figure 6).

[37] This folding is very similar to the broad open folds within the Great Artesian Basin sediments further west beyond the Great Dividing Range, as shown on the cross-section accompanying the Jericho 1:250,000 geological map published by the Bureau of Mineral Resources in 1972.

[38] The conceptual geological model proposed here resembles that in Waratah Coal's China First EIS (Volume 5, Appendix 14, Groundwater), in that the latter identified an anticline beneath the Great Dividing Range to the west of the mine. The China First model was also based on the eastwards slope of the potentiometric surface in the Colinlea Sandstone.

[39] Minor faults have been identified within the Permian strata in drill core, and recent seismic studies quoted in the reports suggest the presence of faults 2-3 km apart with throws of 10-20 m.

[40] Tertiary basalts extend onto the eastern edge of the Alpha lease (Figure 4d); the volcano from which the lavas were erupted is located adjacent to Surbiton homestead (see Figure 3). Previous EIS Reports stated that "Tertiary intrusive and extrusive rocks have not been encountered on site", but the basalts do occur within the Alpha lease.

Figure 6: Cudmore National Park, looking south; note the eastwards dip (towards the left on the photo) of the Clematis Formation outcrops in the middle left of the photo. Photo taken by J.Webb, 18/6/2013.

Figure 7: Cudmore National Park, looking southwest; note the eastwards dip (towards the left on the photo) of the Clematis Formation outcrops in the middle left of the photo, and the northwards dip of the Clematis Formation outcrops to the north (right of the photo). Photo taken by J.Webb, 18/6/2013.

4 Conceptual hydrogeological model

4.1 Aquifers

[41] The Bandanna Formation and Colinlea Sandstone can be regarded, approximately, as a single hydrogeological unit. The coal seams within the Colinlea Sandstone act as leaky aquitards, so that the lower sandstone beds (e.g. CD and DE sandstones) within the proposed mine site have storativity values characteristic of confined aquifers. The upper part of the Bandanna/Colinlea aquifer must be unconfined. The conceptual hydrogeological cross-sections within the EIS Reports show only the potentiometric surface of the CD sandstone; to the west of the proposed mine this lies within the Bandanna/Colinlea aquifer, suggesting that the potentiometric surface is close to the watertable within the Permian strata.

[42] The overlying Tertiary laterite is strongly iron-cemented and forms an aquitard, that restricts downwards infiltration of rainfall into the groundwater in the Permian and Triassic formations. The laterite lies close to the surface (generally within a few meters) throughout the proposed mine area, and forms an impermeable base to some farm dams; these tend to be the ones that hold water. Farm dams entirely within the overlying unconsolidated Quaternary sediments generally leak. Therefore the Tertiary laterite can create a perched watertable that may extend into the Quaternary sediments, particularly in the wet season; perched groundwater has been identified by drilling in the proposed mine area, e.g. for the tailings storage facility.

4.2 Groundwater quality

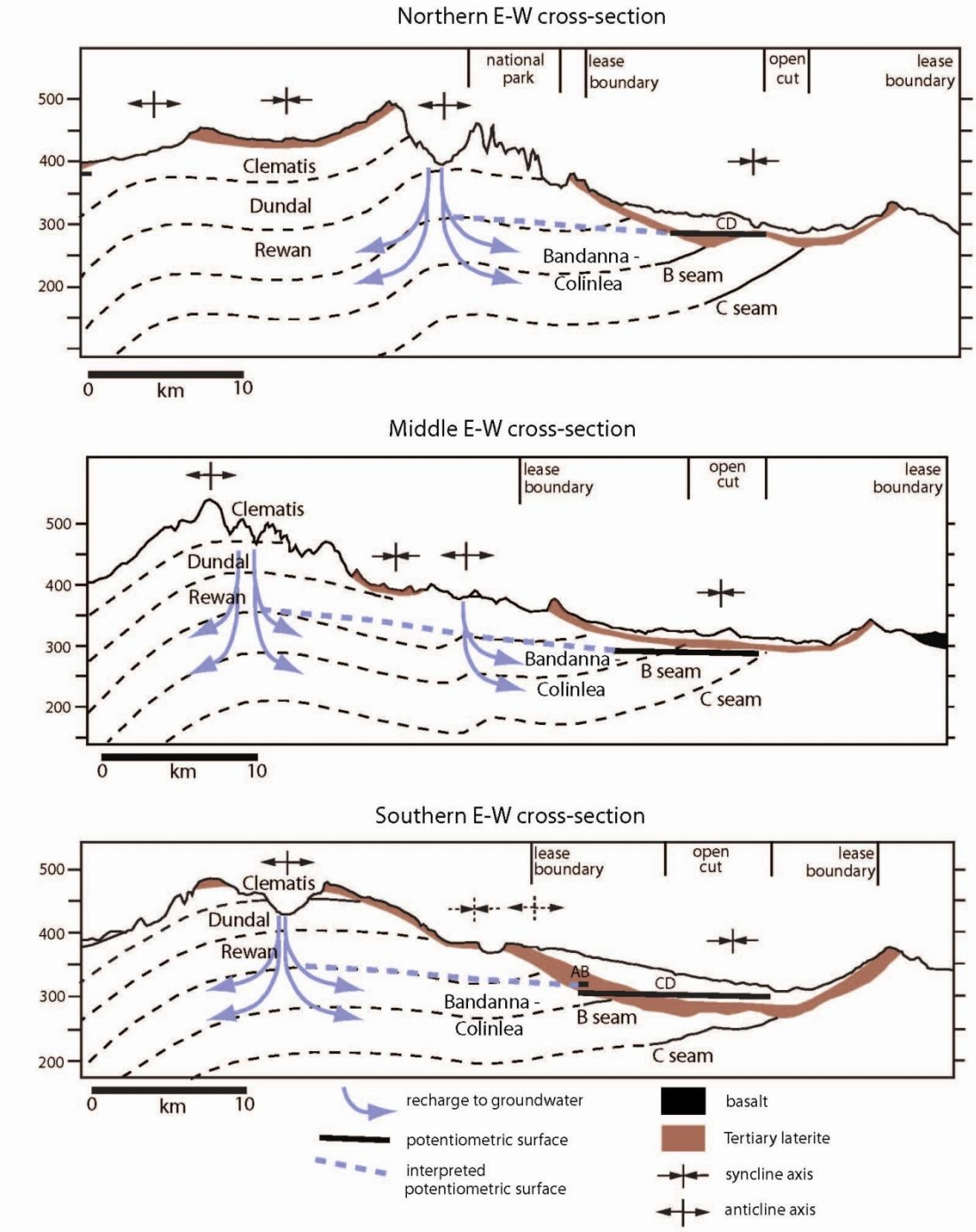
[43] The average salinity of groundwater in the area is 2000-3000 µS/cm; of 89 bores surveyed in the area for the EIS Reports, 58% have a potential beneficial use of potable supply, and only 3% are so saline that domestic or stock use is precluded. As a result the groundwater is extensively used in the area for stock watering and domestic purposes; many properties depend almost entirely on this water source.

4.3 Groundwater flow direction within the Bandanna/Colinlea aquifer

[44] The potentiometric surface of the CD sandstone within the proposed mine site dips shallowly to the east and northeast, despite the fact that the CD sandstone itself dips towards the west (Figure 8). This apparently contradictory situation is explained readily by the folding of the Permian sediments. Along the crest of the range, where the anticline axes are located, the upper surface of the Bandanna/Colinlea aquifer is topographically higher than the subcrop of the CD sandstone within the mine site in the valley of Lagoon Creek (Figure 8), and an interpreted potentiometric surface for the Bandanna/Colinlea aquifer from this high point towards the east is a continuation of the eastwards dipping potentiometric surface of the CD sandstone within the mine site.

[45] Therefore, due to the folding, the potentiometric surface of the Bandanna/Colinlea aquifer to the east of the crest of the Dividing Range in the mine area slopes to the east, and as a result groundwater flows eastwards (Figure 10a). The groundwater flow direction then swings northwards beneath the Lagoon Creek valley, following the topography as well as the low regional dip to the north.

[46] The potentiometric surface gets closer to the ground surface towards the north, until on Degulla property (Figure 3) there are artesian bores and springs.



Cross-sections; all constructed using the remotely sensed images, existing geological map, airborne radiometric data and aerial observations during site visit

Figure 8: Cross-sections

4.4 Recharge

[47] The Quaternary sediments covering much of the proposed mine area are often sandy, particularly at the surface, and absorb most rain events; there is little run-off and there are very few surface drainages that originate in this area. It is likely that the bulk of this surface recharge seeps down to the laterite layer, which probably develops a perched seasonal watertable. A portion of this recharge may seep down into the underlying Permian sediments, but it is probably not the main source of recharge for these strata.

[48] Instead the main recharge areas for the Bandanna/Colinlea aquifer in the proposed mine area are along the crest of the Great Dividing Range, where the anticline axes are located (Figure 8). Although the Bandanna/Colinlea aquifer does not outcrop in this area, there are probably extensional fractures present that have opened along the axes of the anticlinal folds; these fractures most likely initiated the erosion that formed the areas of broken topography along the anticline axes. There are a substantial number of NE-SW lineaments within the Clematis Sandstone outcrop areas that probably represent fractures that have developed along the folds. These fractures penetrate through the Rewan Formation, which would otherwise act as an aquitard. Recharge may be greater where the Rewan Formation is exposed in the core of one anticline, because the Rewan Formation is thinner there (Figure 8).

[49] Therefore the crests of the anticlines, which define the crest of the Great Dividing Range in this area, also mark the westwards limit of recharge to the mine area (Figure 10a). Because there are two anticline axes and two associated areas of broken topography, there are two separate recharge areas, one to the west of the Alpha lease, and one to the west and north of the Kevin's Corner lease.

[50] Recharge through the fractures around the anticline crests is slow, as shown by the lack of response in the potentiometric surface to seasonal variation in rainfall. Nevertheless, the potentiometric surface shows a relatively long term decreasing trend that matches the overall trend in rainfall over the same period (as demonstrated by the cumulative deviation from mean rainfall), confirming that recharge is due to local rainfall, and although low, is not negligible.

[51] The previous reports on the hydrogeology of the mine area correctly noted that there is a groundwater divide to the west of the mine site, and that the majority of recharge within the study area is derived as diffuse recharge from the Great Dividing Range, but did not specify the recharge mechanism or the recharge areas.

[52] From the average salinity of groundwater in the area (~2000-3000 µS/cm; 1200 mg/L) and the likely salinity of rainfall (~10-20 µS/cm) (Crosbie et al. 2012) recharge should average around 0.5-1% of rainfall, i.e. ~3-6 mm (mean annual rainfall is 662 mm). This compares well with previous estimates in the EIS Reports of 3-5 mm/year (0.6-1% of rainfall). The main recharge areas along the crest of the Great Dividing Range are the areas of broken topography as defined above, and these have an area of ~400 km^2 and would provide recharge of 1,200-2,500 ML/year. This recharge will be almost entirely intercepted by the dewatering at the proposed mine site; from the most recent modelling, the preferred estimate of groundwater ingress to the proposed

mine sites (both Alpha and Kevins Corner) is 176 GL over 30 years, which is equivalent to 5900 ML/yr, i.e. greater than the estimates of recharge (this is discussed further below).

[53] There are numerous statements through the various EIS hydrogeological reports that recharge is negligible/insignificant, and in the most recent modelling, "recharge was only applied to the shallow perched aquifer". Recharge to the Bandanna/Colinlea aquifer in the proposed mine area through the overlying laterite is probably small (calculated as ~20 ML/yr in the most recent modelling), but recharge to this aquifer along the crest of the Great Dividing Range is much more significant.

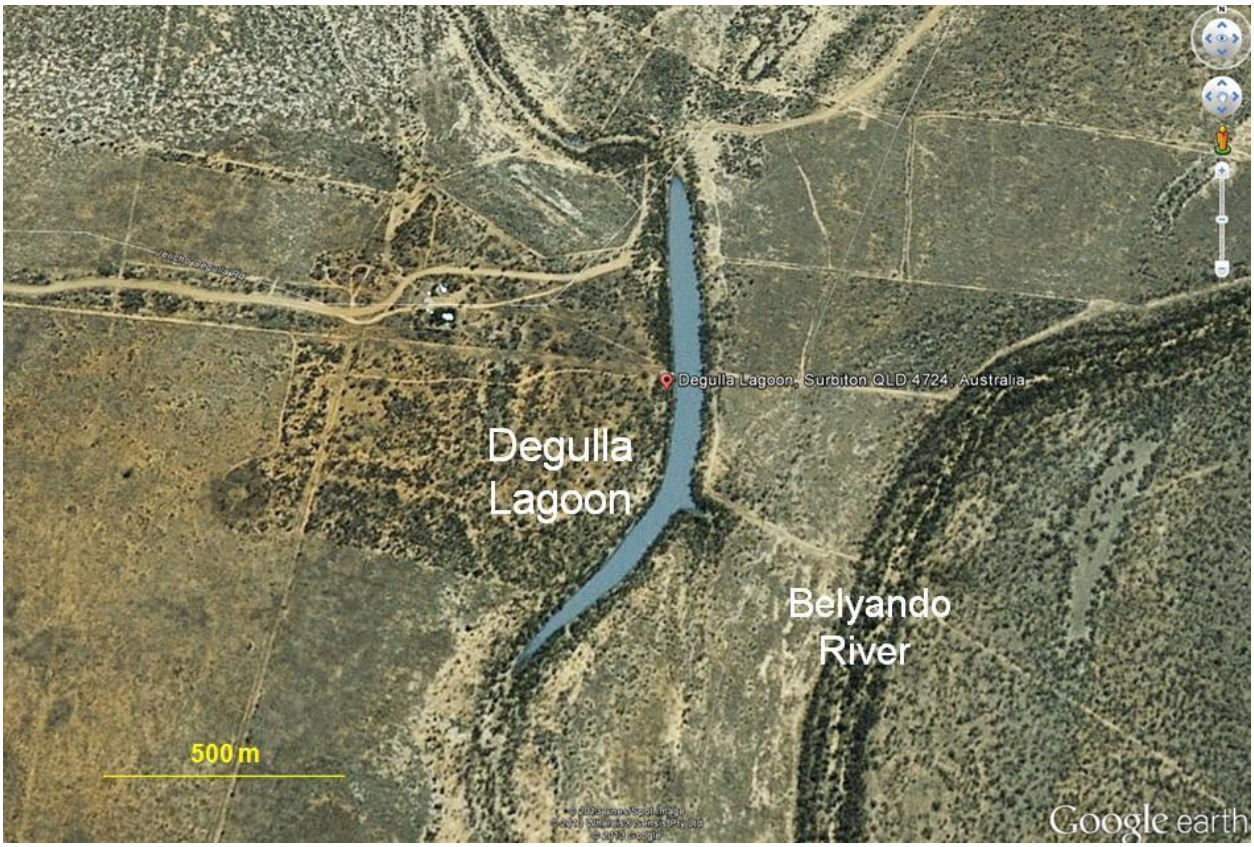


Figure 9: Google Earth image showing Degulla Lagoon and Belyando River

4.5 Discharge

[54] All creeks in the proposed mine area are ephemeral and flow only after heavy rain, when a perched seasonal watertable probably develops within the alluvium. Recharge to this watertable is probably through surface infiltration, which flows along on top of the laterite and may discharge to the creek. There is apparently little or no discharge from the Bandanna/Colinlea aquifer into Lagoon Creek in the mine area, because the potentiometric surface of the CD-DE sandstones is 12-22 m beneath the creek bed, and bores along the creek show that the water table lies at 3-9 m depth within alluvium, which is 15-20 m thick in the central area of the creek.

[55] However, the potentiometric surface in the Permian strata becomes closer to the ground surface northwards. The previous reports on the site noted that groundwater may be expected to contribute to surface water baseflow, especially to the north of the mine area, and that there is likely to be discharge to Sandy Creek.

[56] On Degulla property to the north of the proposed mine site (Figure 3) there are artesian springs, and nearby bores show that the potentiometric surface of the Permian strata lies above the ground surface. These springs are most likely fed by groundwater flow from the south, i.e. they are discharge areas for groundwater flow from the area around the proposed mine.

[57] Also on Degulla property is a permanent lagoon adjacent to Belyando River (Figure 9); this is the only permanent surface water feature in the entire region. It did not dry up during the recent drought, and continued to provide drinking water to the nearby homestead. It is plausible that this lagoon is groundwater fed. This surface water feature was not considered in any of the EIS hydrogeological reports, even though it is much closer to the proposed mines than the springs.

4.6 Relationship to Great Artesian Basin

[58] Because groundwater flow in the area around the mine site is towards the east and north, i.e. away from the Great Artesian Basin, the Alpha mine site is not hydrogeologically part of the basin. There is a major groundwater divide along the crest of the Great Dividing Range in this area, that acts as the eastern boundary of the Great Artesian Basin.

[59] The edge of the Great Artesian Basin is generally defined as the base of the Rewan Formation, but in the proposed mine area the outcrop limit of the Rewan Formation lies to the east of the groundwater divide along the crest of the range, and is therefore not the edge of the GAB in this area.

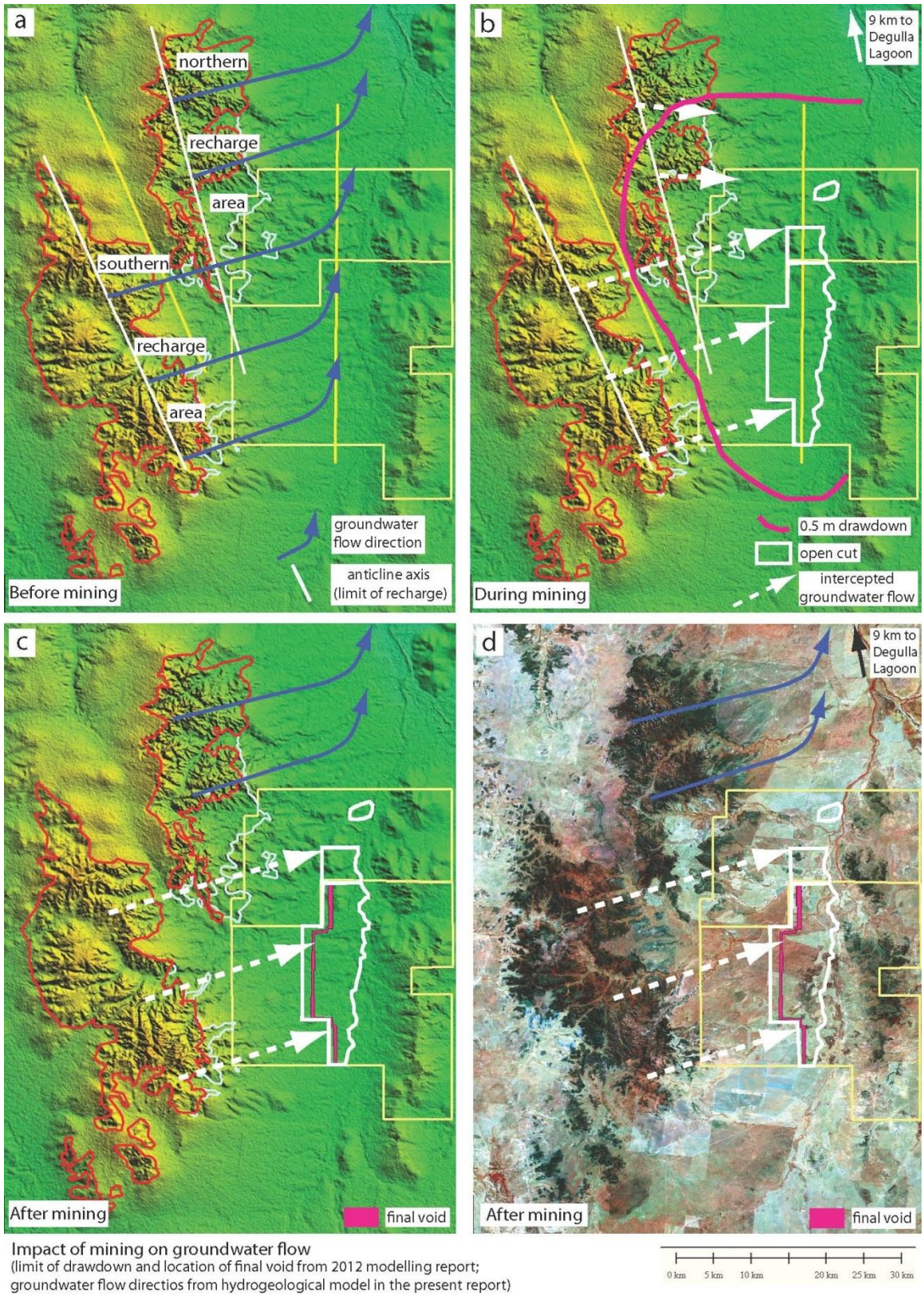


Figure 10: Impact of mining on groundwater flow

5 Impact of the proposed Alpha mine on groundwater

[60] The most recent modelling shows that drawdown of the potentiometric surface due to dewatering of the proposed Alpha mine will extend westwards to the southern recharge area (Figure 10b), diverting groundwater flow directions towards the pit and therefore intercepting all groundwater flow from this recharge area. Because dewatering in the Kevin's Corner underground mine will cause a cone of depression much lower than the floor of the Alpha open cut, drawdown due to both mines will encompass a large part of the northern recharge area, and will intercept the bulk of groundwater flow from this recharge area as well. As a result, over 90% of recharge along the Great Dividing Range in this area will be intercepted by the Alpha and Kevin's Corner mines. In the context of overall recharge to the Bandanna/Colinlea aquifer in the area, the loss of recharge attributable to the mine is very significant.

[61] The most recent EIS hydrogeological report acknowledges "that groundwater resources will be "mined" from the Galilee Basin sediments and will be permanently lost" and that "changes in groundwater levels and pressures as a result of mining will permanently alter groundwater flow patterns and levels" (URS 2012, pp151 and 162).

[62] When the mines are in operation, dewatering will greatly reduce groundwater flow northwards from the proposed mine sites. As a result, the gradient of the potentiometric surface north of the mine sites will decrease. This follows from Darcy's Law, $Q = K\,i\,A$. Because K (hydraulic conductivity) and A (cross-sectional area) are constant, any decrease in Q (groundwater flow) will cause a corresponding decrease in i (hydraulic gradient). Therefore the potentiometric surface north of the mines will drop.

[63] This decrease in the level of the potentiometric surface north of the mine is much more extensive than is presently modelled, because one of the inherent assumptions of the modelling, a constant head boundary to the north of the site, is invalid. Constant head assumes that horizontal inflow and outflow across the boundary are equal; it is a simple boundary condition to solve within a model, but in the present case it is not appropriate. To the north of the northern boundary of the proposed mines there will be continuing northwards groundwater flow, whereas to the south there will be southwards flow due to mine dewatering. This will inevitably cause the hydraulic head along the northern boundary to decrease, as argued above, and it is therefore not a constant head boundary. The modelling needs to be redone, incorporating this important change to the boundary conditions.

[64] The impact of the proposed mines on the groundwater will therefore extend much further north than presently modelled, and could easily reach the springs on Degulla property, which would most likely dry up, and could also potentially impact on surface drainages, particularly Degulla lagoon, which is only 22 km north of the northern boundary of the Kevins Corner lease. The drawdown will certainly negatively impact on the groundwater levels in the properties north of the mines (Forrester and Degulla – see Figure 3); both these properties are dependent on groundwater for stock watering.

[65] Furthermore, the assumption of a constant head boundary along the southern side of the proposed mine is probably also unjustified. The hydraulic head on this boundary would only remain constant if groundwater flow into the southern side of the mine (from recharge along the

Great Dividing Range) is equivalent to groundwater withdrawal from the mine along this boundary. However, the likely level of total recharge is 1,200-2,500 ML/year (as previously discussed); only a small part of this recharge will enter along the southern boundary (Figure 10b), so the rate of recharge is much less than the rate of dewatering along this boundary (probably one quarter of 5,900 ML/yr, the total annual rate of dewatering). Therefore the head along the southern side of the proposed mine will drop over time, i.e. it is not a constant head boundary. Taking this into account will increase the extent of drawdown due to mine dewatering to the south. The modelling needs incorporate this change to the boundary conditions.

[66] The western boundary of the model is taken as a no flow boundary along the crest of the Great Dividing Range; this is correct. However, in the modelling, "recharge was only applied to the shallow perched aquifer" (URS 2012, p82), whereas the discussion above shows clearly that there is significant recharge to the Bandanna/Colinlea aquifer along the crest of the range. The modelling needs to be revised to include this.

[67] It should be noted that all the EIS hydrogeological reports on the proposed mine site state that because the Rewan Formation is an effective hydraulic barrier, it limits the westwards propagation of the cone of depression due to mine dewatering (e.g. "the low permeability Bandana Formation and Rewan Formations constrain drawdown to the west" (URS 2012, p161)). However, although the presence of the Rewan Formation prevents upwards propagation of the dewatering effects into the units overlying this aquitard, it has no effect whatsoever on westwards propagation of the cone of depression within the Bandanna/Colinlea aquifer, as modelling of the cone of depression shows. As a result the cone of depression extends westwards to close to the groundwater divide along the crest of the Great Dividing Range.

[68] When mining of the Alpha lease is complete, a final void will remain at the western edge of the open cut (Figure 10c,d). Modelling shows that this will cause a cone of depression drawing groundwater flow almost radially toward the void (due to negative climate balance), with the surface of the lake in the void equilibrating at about 250 mAHD, always below the potentiometric surface for the CD sandstone to the east, west and south (the modelling suggests that there will be groundwater outflow to the north). Therefore the void will permanently intercept all groundwater flow from the southern recharge area, and if the mine void extends north into the Kevin's Corner open cuts, then it will permanently intercept over 70% of groundwater flow from this recharge area as well. The final mine void will therefore cause a permanent lowering of the potentiometric surface to the north of the mine, and any resulting deleterious effects on the springs, surface drainages, Degulla lagoon and local agricultural groundwater use will be permanent.

[69] Based on the approximate recharge calculations given above (less than the groundwater removal rates from the proposed mines), 1000-2000 ML/yr of groundwater flow will be intercepted and no longer flow into the groundwater system that contributes to groundwater flow beneath the Belyando River, and ultimately, the Burdekin River. The impact of the removal of this amount of groundwater flow from the regional system has not been taken into account.

[70] Furthermore, modelling indicates that the lake water in the final void will become progressively more saline over time due to evaporation, until eventually it will become too saline for cattle

watering. Northwards groundwater seepage from the lake means that this saline water will contaminate the groundwater to the north, forming a saline plume that will degrade the groundwater quality. This could have a further detrimental impact on surface drainages, Degulla lagoon and local agricultural groundwater use.

[71] The proposed monitoring regime does not contain any bores to the north of the mine site, so the impacts of the final void on groundwater levels and salinity, as detailed above, will not be identified. Therefore, the monitoring needs to be extended to the north, as proposed in section 2.1.2.

[72] The final void remaining when mining is complete will negatively and permanently impact on the groundwater and probably also the surface water, as discussed above. This can be easily overcome by filling the final void, and thereby allowing the groundwater system to re-establish (approximately) the pre-mining configuration. The ground surface over part of the open-cut area would, as a result, be several meters lower than before mining commenced, and this would have to be graded so that it did not divert Lagoon Creek, but the impact on the groundwater system would be much less than leaving a final void.

6 Confirmation

I confirm that:

(a) the factual matters stated in the report are, as far as I know, true; and
(b) I have made all enquiries considered appropriate; and
(c) the opinions stated in the report are genuinely held by myself; and
(d) the report contains reference to all matters I consider significant; and
(e) I understand the duty of an expert to the court and have complied with that duty.

Assoc Prof John Webb

27 June 2013

Attachment A - Full Curriculum vitae

Personal Details

Name: John Allan WEBB
Business address: Environmental Geoscience, La Trobe University Victoria, 3086, Australia
Phone (03) 9479 1273 Fax (03) 9479 1272
Email john.webb@latrobe.edu.au
Date of birth: 1953
Nationality: Australian

Academic Qualifications

BSc Hons First Class (Queensland) 1973. Awarded University of Queensland medal
PhD (Queensland) 1982.

Professional Appointments

2005-present *Associate Professor*, Environmental Geocience, La Trobe University
1992-2004 *Senior Lecturer*, Department of Earth Sciences, La Trobe University
1986-1991 *Lecturer*, Department of Earth Sciences, La Trobe University
1981-1985 Tutor and *Senior Tutor*, Department of Geology, University of Melbourne

Professional Organisations

1994 to present - member, International Association of Hydrogeologists (committee member, Victorian division, 2007-2013)
1974 to present - member, Geological Society of Australia
1989 to present - member, Australia / New Zealand Geomorphology Research Group

Key Experience

I have extensive experience as a hydrogeologist and hydrogeochemist, both in terms of teaching the subject at a tertiary level and as a consultant. I have supervised 25 PhD students, 4 MSc students and 86 Honours students in a variety of geological, hydrogeological and hydrogeochemical projects. On average I have supervised 3.5 honours students each year since 2007, and I am currently supervising 10 PhD students (8 of them full-time).

I have participated in a number of consulting projects, and have been an invited member of 3 expert panels to assess groundwater and contaminated site management. Over the past 12 years I have acted as an expert witness in 6 cases, including VCAT hearings.

Teaching

I have taught courses in hydrology, hydrogeology and water geochemistry at undergraduate and postraduate level since 1987, both at La Trobe University and RMIT, and teach into courses at University of Melbourne. The courses use practical exercises based on real datasets and include excursions to sites of interest.

I also teach courses on landscape and climate change, and remote sensing and GIS, as well as organising seminars and projects for undergraduate environmental science students.

Research

Hydrogeology

Groundwater management, including its influence on dryland salinity is one of the major problems facing agriculture across southern Australia. I have led a group at La Trobe University researching the hydrogeology of this topic in western and central Victoria for over 6 years, involving 6 PhD students (3 current) and 11 Honours projects (1 current). The projects have been financially supported by the Glenelg-Hopkins and Wimmera Catchment Management Authorities, Primary Industries Research Victoria, Goulburn-Murray Water and several landcare groups, as well as Australian Institute for Nuclear Science and Energy. The results have been presented at numerous national and international conferences, published in Journal of Hydrology and Hydrogeology Journal, and have been actively used in management and location of good quality groundwater resources in the area.

My hydrogeological research profile was recognised when I was invited to be a member of program 4 (Groundwater-Vegetation Interactions) within the National Centre for Groundwater Research and Teaching; this project is also supported by the Victorian Department of Primary Industries, who contributed over $250,000 to the instrumentation of the field sites. This major project is on the effect of climate and land use change on surface and groundwater resources in western and central Victoria, and has received over $250,000 in additional funding from the Groundwater Centre.

Remediation of acid mine drainage

Acid mine drainage (AMD) is generated when sulphide minerals, usually exposed by mining, are exposed to the atmosphere and oxidise, releasing acidity and dissolved heavy metals. AMD must be neutralised before it can leave a site, and this process generates a sludge which has to be disposed of. My research on AMD has concentrated on neutralisation using limestone, particularly anoxic and open limestone drains (Silvana Santomartino's PhD project), increasing the chemical stability (resistance to leaching) of neutralisation sludges (Danny McDonald's and Wendy Stanford's PhD projects). Results of these projects have been presented at international conferences and published in Environmental Science and Technology and Applied Geochemistry. We are currently researching improvements to AMD neutralisation techniques; 1 honours student and 2 PhD students are currently working on this topic.

Supervision of Postgraduate Students

1. David Cantrill, 1989 (Dept of Botany, University of Melbourne) – An Albian coniferous flora from the Otway Basin, Victoria
2. Mark Ellaway, 1990 (Dept of Geography, University of Melbourne) – Karst hydrochemistry at Buchan, eastern Victoria
3. Tom Bernecker, 1993. A sedimentation model for the Siluro-Devonian Chillagoe Formation in the Mungana area, North Queensland
4. Jon Kelly, 1999. Diagenesis and origin of glauconite in Victorian Tertiary sediments
5. Michael Martin, 2000. Heavy mineral analysis of Cretaceous sediments, northwest W.A.

6. Alan Partridge, 2000. Cretaceous and Tertiary palynology and geological history of the Gippsland Basin
7. Stan Lithco, 2003. The karst water chemistry of the cenotes and springs of the Lower Southeast of S.A.
8. Christian Ihlenfeld, 2004. Isotopic and trace element study of seasonal changes in travertine deposition, north Qld.
9. Barton Smith, 2004. Landscape evolution and geomorphology of arid zone lunettes and gypsum dunes in NW Victoria and western NSW.
10. Sue White, 2005. Karst and landscape evolution in parts of the Gambier Karst Province, southeast S.A. and western Victoria.
11. Silvana Santomartino, 2005. Use of anoxic mine drains to remediate acid mine drainage.
12. Darren Bennetts, 2006. Dryland salinity of the basalt landscape around Hamilton, western Victoria.
13. Danny McDonald, 2006. Stability of treatment sludges using synthetic acid rock drainage.
14. Gresley Wakelin-King, 2007. Landscape evolution and geomorphology of an arid zone stream near Broken Hill.
15. Matthew Edwards, 2007. Dryland salinity of Mt William Creek, upper Wimmera catchment.
16. Matthias Raiber, 2009. Dryland salinity of the basalt landscape east of Hamilton, western Victoria.
17. Yohannes Yihdego, 2012. Effect of climate and landuse change on watertables and lake levels in western Victoria.
18. Sarah Hagerty, submitted. Groundwater resources and salinity associated with granites in the Upper Wimmera catchment.
19. Alex Fink, current. Mineralogy and origin of Lightning Ridge black opal.
20. Bruce Gill, current. Application of 3D geological modelling to groundwater management
21. Fahmida Perveen, current. Affect of timber plantations on surface and groundwater resources and quality in western Victoria.
22. Fiona Glover, current. Inland acid sulphate soils in the Corangamite region, western Victoria. (80%)
23. Sanjeeva Manamperi, current. Effect of climate change on episodic groundwater recharge across the north Victorian plains. (80%)
24. Josh Dean, current. Effect of land use change on surface and groundwater resources and quality in western Victoria (80%)
25. Matej Lipar, current. Origin of solution pipes in Quaternary aeolianites of southern Australia (80%).
26. Tim Robson, current. Groundwater – surface water interactions at Lake Tutchewop, northern Victoria. (80%)
27. Farah Ali, current. Secondary mineral precipitation from acid mine drainage (70%).
28. Wendy Stanford, current. Remediation of acid mine drainage using the magnetic sludge process (80%).
29. Rakhshan Roohi, current. Use of remote sensing to estimate evapotranspiration (100%).

Publications since 2000

Refereed journal papers

1. Webb, J., Finlayson, B.L. Cochrane, G., Doelman, T. and Domanski, M., in press. Silcrete quarries and artefact manufacture in the Central Queensland Highlands, Eastern Australia. Archaeology in Oceania.
2. Burnett, S., Webb, J.A. and White, S., in press. Shallow caves and blowholes on the Nullarbor Plain, Australia - flank margin caves on a low gradient limestone platform. Geomorphology.
3. Kappen, P. and Webb, J.A., in press. An EXAFS study of arsenic bonding on amorphous aluminium hydroxide. Applied Geochemistry.
4. Doerr, S.H., Davies, R.R., Lewis, A., Pilkington, G., Webb, J.A., Ackroyd, P.J., Bodger, O., 2012. Origin and karst geomorphological significance of the enigmatic Australian Nullarbor Plain 'blowholes'. *Earth Surface Processes and Landforms*, 37, 253-261.
5. Dresel, P.E., Hekmeijer, P., Dean. J.F., Harvey, W., Webb, J.A. and Cook, P., 2012. Use of laser-scan technology to analyse topography and flow in a weir pool. *Hydrology and Earth System Sciences*, 16, 2703-2708.
6. Yihdego, Y. and Webb, J. A., 2012. Modelling of seasonal and long-term trends in lake salinity in south-western Victoria, Australia. *Journal of Environmental Management*, 112, 149-159.
7. Cochrane, G.W.G., Habgood, P.J., Doelman, T., Herries, A.I.R. and Webb, J., 2012. A progress report on research into the stone artefacts of the southern Arcadia Valley, central Queensland. *Australian Archaeology*, 75, 98-103.
8. Robson T.C. and Webb J. A., 2011. Late Neogene tectonics in northwestern Victoria: evidence from the Late Miocene-Pliocene Loxton Sand. *Australian Journal of Earth Sciences* 58, 579–586.
9. Shaqour, F., White, S. and Webb, J.A., 2011. Geotechnical characterization of geomaterial blends with zeolitic tuffs for use as landfill liners. *Bulletin of Engineering Geology and the Environment*, 70, 691-697.
10. Glover, F., Whitworth, K.., Kappen, P., Baldwin, D., Rees, G., Webb, J., Silvester, E., 2011. Acidification and buffering mechanisms in acid sulfate soil (ASS) wetlands of the Murray-Darling Basin, Australia. *Environmental Science and Technology*, 45, 2591–2597.
11. Yihdego, Y. and Webb, J. A., 2011. Modelling of bore hydrographs to determine the impact of climate and land use change in a temperate subhumid region of southeastern Australia. *Hydrogeology Journal*, 19, 877-887.
12. Webb, J.A., Gardner, T.W., Kapostasy, D., Bremar, K.A. and Fabel, D., 2011. Mountain building along a passive margin: Late Neogene tectonism in southeastern Victoria, Australia. *Geomorphology* 125, 253-262.
13. Liu, L., Field, J., Weisskopf, A., Webb, J., Jiang, L., Wang, H. and Chen, X., 2010. The exploitation of acorn and rice in Early Holocene Lower Yangzi river, China. *Acta Anthropologica Sinica*, 29, 12-32.
14. Kakuwa Y. and Webb, J., 2010. Evolution of Cambrian to Ordovician trace fossils in pelagic deep-sea chert, southeastern Australia. *Australian Journal of Earth Sciences*, 57, 615-625.
15. Holmes, W.B.K., Anderson, H. and Webb, J.A., 2010. The Middle Triassic megafossil flora of the Basin Creek Formation, Nymboida Coal Measures, New South Wales, Australia. Part

8. The genera *Nilssonia*, *Taeniopteris*, *Linguifolium*, *Gontriglossa* and *Scoresbya*. *Proceedings of the Linnean Society of New South Wales*, 131, 1-26.
16. Webb, J.A., Grimes, K.G. and Lewis, I., 2010. Volcanogenic origin of cenotes near Mt Gambier, Southeastern Australia. *Geomorphology* 119, 23–35.
17. Domanski, M., Webb, J.A., Glaisher, R., Gurba, J., Libera, J. and Zakoncielna, A., 2009. Heat treatment of Polish flints. *Journal of Archaeological Science*.
18. Edwards, M.D. and Webb, J.A., 2009. The importance of unsaturated zone biogeochemical processes in determining groundwater composition, southeastern Australia. H*ydrogeology Journal*,
19. Raiber, M., Webb, J.A. and Bennetts, D., 2009. Strontium isotopes as tracers to delineate aquifer interactions and groundwater salinisation in the basalt plains of southeastern Australia. *Journal of Hydrology*, 367, 188-199.
20. Gardner, T., Webb, J.A., Pezzia, C., Amborn, T., Tunnell, R., Flanagan, S., Kapostasy, D., Merritts, D., Marshall, J., Fabel, D and Cupper, D., 2009. Episodic intraplate deformation of stable continental margins: evidence from Late Neogene and Quaternary marine terraces, Cape Liptrap, southeastern Australia. *Quaternary Science Reviews*, 28, 39-53.
21. Parker, K.E. and Webb, J.A., 2008. Estuarine deposition of a mid Viséan tetrapod-bearing unit, Ducabrook Formation, central Queensland. *Australian Journal of Earth Sciences*, 55, 509-530.
22. Webb, J.A. and Domanski, M., 2008. The relationship between lithology, flaking properties and artefact manufacture for Australian silcretes. *Archaeometry*, 50, 555-575.
23. Raiber, M. and Webb, J.A., 2008. Development of the Streatham Deep Lead System in Western Victoria: Implications for Tertiary tectonism and landscape evolution. Australian *Journal of Earth Sciences*, 55, 493-508.
24. Webb, J.A. and Spence E., 2008. Glaciomarine Early Permian strata at Bacchus Marsh, Central Victoria – the final phase of Late Palaeozoic glaciation in Southern Australia. *Proceedings of the Royal Society of Victoria*, 120, 373-388.
25. Wakelin-King, G.A. and Webb, J.A., 2007. High-energy mud floodplains, low-energy sand channels: sediment transport and deposition in a drylands mud-aggregate river. *Journal of Sedimentary Research*, 77, 702-712.
26. Domanski, M. and Webb, J.A., 2007. A review of heat treatment research. *Lithic Technology*, 32, 153-194.
27. Santomartino, S.L. and Webb, J.A., 2007. Estimating the longevity of limestone drains in treating acid mine drainage containing high concentrations of iron. *Applied Geochemistry*, 22, 2344-2361
28. Birch, W.D., Mills, S.J., Schwendtner, K., Pring, A., Webb, J.A., Segnit, E.R., Watts, J.A., 2007. Parwanite: a new hydrated Na–Mg–Al-phosphate from a lava cave at Parwan, Victoria, Australia. *Australian Journal of Mineralogy*, 13, 23-30.
29. Webb, J.A., Ford, A. and Gorton, J., 2007. Influences on selection of lithic raw material sources at Huizui, a Neolithic/Early Bronze Age site in northern China. *Bulletin of the Indo-Pacific Prehistory Association*, 27, 76-86 http://ejournal.anu.edu.au/index.php/bippa/article/viewFile/36/31
30. Kakuwa, Y. and Webb, J., 2007. Trace fossils of a Middle-Late Ordovician pelagic deep ocean bedded chert in southeastern Australia. In Ichnology at the Crossroads: A Multidimensional Approach to the Science of Organism-Substrate Interactions, edited by

Bromley, R.G., Buatois, L.A., Mangano, M.G., Genise, J.F. and Melchor, R.N. *SEPM Special Publication* 88, 267-276.
31. Bennetts, D.A., Webb, J.A., McCaskill, M. and Zollinger, R., 2007. Dryland salinity processes within the discharge zone of a local groundwater system, *Southeastern Australia. Hydrogeology Journal*. (30%), 15, 1197-1210.
32. Wakelin-King, G.A. and Webb, J.A., 2007. Threshold-dominated fluvial styles in an arid-zone mud-aggregate river: the uplands of Fowlers Creek, Australia. *Geomorphology* 85, 114-127.
33. Tweed, S.O., Leblanc, M., Webb, J.A. and Lubczynski, M.W., 2006. Remote sensing and GIS for mapping groundwater recharge and discharge areas in salinity prone catchments, southeast Australia. *Hydrogeology Journal* 15, 75-96.
34. Webb, J.A. and Mitchell, M.M., 2006. Stratigraphy and palaeoflora of the Triassic Council Trench Formation, Central Victoria. *Proceedings of the Royal Society of Victoria*, 118, 113-127.
35. McDonald, D. M., Webb, J. A. and Taylor, J. 2006. Chemical stability of acid rock drainage treatment sludge and implications for sludge management. *Environmental Science and Technology*, 40(6), 1984-1990.
36. Webb, J.A. and James, J.M., 2006. Karst evolution of the Nullarbor Plain, Australia. In Harmon, R.S. and Wicks, C.M. (eds), Karst geomorphology, hydrology and geochemistry - a tribute volume to Derek C. Ford and William B. White. *Geological Society of America Special Paper* 404, 65-78.
37. Gardner, T.W., Webb, J.A., Davis, A.G., Cassell, E.J., Pezzia, C., Merritts, D.J. and Smith, B., 2006. Late Pleistocene landscape response to climate change: eolian and alluvial fan deposition, southeastern Victoria, Australia. *Quaternary Science Reviews*, 25, 1552-1569.
38. Bennetts, D.A., Webb, J.A., Stone, D.J.M. and Hill, D.M., 2006. Understanding the salinisation process for groundwater in an area of south-eastern Australia, using hydrochemical and isotopic evidence. *Journal of Hydrology*, 323, 178-192
39. Vos, I.M.A., Bierlein, F.P. and Webb, J.A., 2005. Geochemistry of Early-Middle Palaeozoic basalts in the Hodgkinson Province: a key to tectono-magmatic evolution of the Tasman Fold Belt System in northeastern Queensland, Australia. *International Journal of Earth Sciences*, 95, 569-585.
40. Paine, M., Bennetts, D.A., Webb, J.A., and Morand, V., 2004. Nature and extent of Pliocene strandlines in southwestern Victoria and their application to late Neogene tectonics. *Australian Journal of Earth Sciences*, 51, 407-422.
41. Nash, D. J., McLaren, S. J. and Webb, J. A., 2004. Petrology, geochemistry and environmental significance of silcrete-calcrete intergrade duricrusts in the central Kalahari, Botswana. *Earth Surface Processes and Landforms*, 29, 1559-1586.
42. Santomartino, S.L. and Webb, J.A., in review. Comparison of methods for acid sulphate soil and sediment analysis. *Australian Journal of Soil Research.*
43. Ihlenfeld, C., Norman, M.D., Gagan, M.K., Drysdale, R.N., Maas, R. and Webb, J.A., 2003. Climatic significance of seasonal trace element and stable isotope variations in a modern freshwater tufa. *Geochimica Cosmochimica Acta*, 67, 2341-2357.
44. Musgrave. R.J. and Webb, J.A., 2003. Palaeomagnetic analysis of sediments in the Buchan Caves, southeastern Australia, provides a pre-Late Pleistocene date for landscape evolution. In Sasowsky, I.D. and Mylroie, J.E. (eds), *Studies of Cave sediments*, 47-70. Kluwer.

45. Gouramanis, C., Webb, J. A. and Warren, A. A., 2003. Fluvio-deltaic sedimentology and ichnology of part of the Silurian Grampians Group, western Victoria. *Australian Journal of Earth Sciences*, 50, 811-825.
46. Kelly, J.C., Webb, J.A. and Maas, R., 2001. Isotopic constraints on the genesis and age of autochthonous glaucony in the Oligo-Miocene Torquay Group, southeastern Australia. *Sedimentology*, 48, 325-328.
47. Doelman, T., Webb, J.A. and Domanski, M., 2001. Source to Discard: Patterns of Lithic Raw Material Procurement and Use in Sturt National Park, Northwestern NSW. *Archaeology in Oceania*, 36, 15-33.
48. Webb, J.A., 2001. A new marattialean fern from the Middle Triassic of eastern Australia. *Proceedings of the Linnean Society of New South Wales*, 123, 215-224.
49. Torrence, R., Pavlides, C., Jackson, P. and Webb, J., 2000. Volcanic disasters and cultural discontinuities in Holocene time, in West New Britain, Papua New Guinea. In McGuire, W.J., Griffiths, D.R., Hancock, P.L. and Stewart, I.S. (eds). The archaeology of geological catastrophes. *Geological Society, London, Special Publications*, 171, 225-244.
50. Marshallsea, S.J., Green, P.F. and Webb, J.A., 2000. Thermal history of the Hodgkinson Province and Laura Basin, Queensland: multiple cooling episodes identified from apatite fission track analysis and vitrinite reflectance data. *Australian Journal of Earth Sciences*, 47, 779-797.
51. Domanski, M. and Webb, J.A., 2000. Flaking properties, petrology and use of Polish flint. *Antiquity*, 74, 822-832.

Refereed papers in conference proceedings

1. Webb, J.A., Jowsey, C. and McDonald, D., 2011. The maghemite sludge process: a potential new method for active neutralisation of AMD. *7th Australian Workshop on Acid and Metalliferous Drainage, 21-24 June 2011, Darwin, Proceedings*, 286-295.
2. Glover, F., Webb, J.A. and Silvester, E., 2011. Factors influencing inland acid sulphate soil formation in southeastern Australia. *7th Australian Workshop on Acid and Metalliferous Drainage, 21-24 June 2011, Darwin, Proceedings*, 364-374.
3. Yihdego, Y. and Webb, J. A., 2010. Characterising groundwater dynamics using Transfer Function-Noise and autoregressive modelling in western Victoria, Australia. *Proceedings of the 5th International Conference on Water Resources, Hydraulics and Hydrology, University of Cambridge, UK, February 23-25, 2010*, 97-101.
4. Arne, D., Nelson, A. and Webb, J., 2009. Sources of Arsenic Contamination and Remediation of Mine Water at the Historical Glen Wills Mining Area in Northeast Victoria, Australia. *Proceedings 24th International Applied Geochemistry Symposium, 1-4 June, 2009, Fredericton, Canada.*
5. McDonald, D. and Webb, J.A., 2008. Release of heavy metals from AMD treatment sludges – implications for managing sludge in perpetuity. *Proceedings 6th Australian Workshop on Acid and Metalliferous Drainage, April 2008, Burnie, Tasmania*, 321-338.
6. Yihdego, Y. and Webb, J. A., 2008. Modelling of Seasonal and Longterm Trends in Lake Salinity in Southwestern Victoria, Australia. *Proceedings of Water Down Under April 2008*, 994-1000.

7. Hagerty, S. and Webb, J.A., 2008. Aquifer Interactions and Groundwater Discharge into Streams Identified Using 87Sr/86Sr Isotope Ratios in the Upper Loddon Catchment, Central Victoria. *Proceedings of Water Down Under April 2008*, 1272-1278.
8. Raiber, M., Webb, J.A., Jacobsen, G.E., Chisari R. and Williams, A.A., 2008. Geological controls on the spatial variability of groundwater recharge and salinity in a regional-scale basalt aquifer in western Victoria. *Proceedings of Water Down Under April 2008*, 1279-1283.0406
9. Webb, J.A., Williams, B.G., Bailue, K., Walker, J. and Anderson, J.W., 2008. Short-term groundwater dynamics at a paddock scale. *Proceedings of Water Down Under April 2008*, 1493-1500.
10. Liu, L., Chen, X. and Webb, J., 2008. Production of stone spades and emergence of the first state in the Yiluo Region, China *Proceedings Stone Tools Conference, York, September 2007*
11. Raiber, M., Webb, J.A., Jacobsen, G., Chisari, R. and Neklapilova, B., 2007. Aquifer interactions and their impact on groundwater resources in the basalt plains of Western Victoria. *Twelfth International Symposium on Water-Rock Interaction, Kunming, China, August 2007; Conference Proceedings*, 985-988.
12. McDonald, D.M., Webb, J.A. and Musgrave, R.M. 2006. The effect of neutralisation method and reagent on the rate of Cu and Zn release from Acid Rock Drainage treatment sludges. *7th ICARD Conference, March 2006, St Louis, USA*.
13. McDonald, D. and Webb, J.A., 2005. Comparison of the chemical stability of ARD treatment sludges precipitated using conventional lime neutralisation and the High Density Sludge process. *Proceedings International Conference on Mining and the Environment, June 27 – July 1, 2005, Skelleftea, Sweden*, 705-715.
14. Bennetts, D.A. and Webb, J.A., 2004. Processes affecting groundwater quality in a basalt aquifer system in southern Australia. In: R.B. Wanty and R.R. Seal (Editors), *Proceedings International Symposium on Water-Rock Interaction 11, Saratoga Springs, USA*, 347-351. Balkema, Rotterdam.
15. Santomartino S. and Webb, J. 2003. An experimental study of the chemistry of iron precipitation within Anoxic Limestone Drains. *6th ICARD Conference, July 2003, Cairns*, 1117-1121.
16. Webb, J.A. and Lithco, S., 2001. Use of water chemistry to identify flow conduits in the porous Gambier Limestone, southeast Australia. *In* Mudry, J. and Zwahlen, F. (eds), *Proceedings of 7th Conference on Limestone Hydrology, Besancon, September 2001*, 333-336.

Book chapters

1. Webb J.A., and White S., 2013. Karst in Deserts. In: John F. Shroder (ed.) Treatise on Geomorphology, Volume 6, 397-406. San Diego: Academic Press.
2. Webb, J.A., Grimes, K.G. and Osborne, A., 2003. Caves in the Australian Landscape. In Finlayson, B.L. and Hamilton-Smith, E. (eds), Beneath the surface: a natural history of Australian caves, 1-52. University of New South Wales Press Ltd, Sydney.
3. Joyce, E.B., Webb, J.A., and others, 2003. Chapter 18 - Geomorphology. In Birch, W. (ed.), Geology of Victoria. Geological Society of Australia Special Publication 23, 533-561.

Consulting projects and reports since 2005

1. Webb, J.A., 2012. Review of draft report on structural control of Cenozoic aquifers in Victoria. Report for GHD Pty Ltd.
2. Webb, J.A., 2012. Review of geomorphological development and sediment age at Werribee rail crossing site. Report for Andrew Long & Assoc.
3. Webb, J.A., 2011. Extent of Pleistocene sand sheet around Dowds Lane Quarry, Gippsland. Report for Keith Heywood.
4. Webb, J.A., 2011. Hydrogeological assessment of Renmark Group aquifer, central western Campaspe catchment, prepared for Morrison and Sawers Lawyers. Expert witness statement and testimony at VCAT.
5. Webb, J.A., 2011. Wonthaggi geomorphology report. Report for Ochre Imprints.
6. Webb, J.A., 2011. Assessment of acid sulphate soils risk at Cataby Mine, Western Australia. Report for Iluka Pty Ltd.
7. Webb, J.A. and Glover, F., 2011. XRD analysis of tailings samples; prepared for Lane Piper Pty Ltd.
8. Webb, J.A., 2010. Bemm River geomorphology report. Report for Ochre Imprints.
9. Webb, J.A., 2010. Groundwater-surface water interaction at Anglesea Borefield. Report for GHD.
10. Webb, J.A., 2009-2011 – invited member, review panel of Lake Tutchewop Sustainability Project (consultant for Goulburn Murray Water).
11. Webb, J.A., 2009. Expert witness statement and testimony at VCAT; Application for groundwater extraction licence by Alanvale Pty Ltd.
12. Webb, J.A., 2009. Literature survey of Cr VI in cement for rehabilitation of Fyansford Cement Works; prepared for Lane Piper Pty Ltd.
13. Webb, J.A. and Glover, F., 2009. Salinity risk assessment for Pyrenees Shire. Maps and report prepared for Pyrenees Shire Council.
14. Webb, J.A. 2008. Assessment of stable isotope results to determine extent of groundwater leakage from evaporation ponds, central Victoria. Report prepared for GHD Pty Ltd, 5 pp.
15. Webb, J.A., 2008. Consultant for Earth Systems, providing independent review of new subsurface barrier technology.
16. Webb, J.A., 2008. Consultant for SKM groundwater mapping project across southern Victoria.
17. Webb, J.A., 2008. Invited member, panel for development of Index of Groundwater Condition in Victoria (consultant for Hyder Consulting).
18. Webb, J.A., 2008-2009. Invited member, review panel of Lake Tutchewop Sustainability Project (consultant for Goulburn Murray Water).
19. Webb, J.A., 2007. Review of remediation options at Tioxide site, northern Tasmania. Report prepared for Lane Piper Pty Ltd, 6 pp.
20. Webb, J.A. 2007. Assessment of hydrogeochemistry at Zinifex smelter site, Tasmania. Report prepared for GHD Pty Ltd, 10 pp.
21. Webb, J.A. 2007. National Heritage List nominations for 4 sites with pseudokarst values (Natural Bridge, Cape Bridgewater sea caves, Girraween granite caves, Holy Jump lava cave). Commonwealth Department of the Environment and Water Resources, 12 pp.
22. Webb, J.A., 2006. Assessment ofbackground levels of contaminants near Tullamarine waste disposal site. Report prepared for Anthony Lane and Associates, 2 pp.
23. Webb, J.A., 2006. Assessment of Cr contamination at Montague Street, South Melbourne. Report prepared for Anthony Lane and Associates, 17 pp.

24. Webb, J.A., 2006. Preliminary hydrogeological assessment of Warrnambool Cheese and Butter Factory. Report prepared for Rock Solid Pty Ltd, 2 pp.
25. Webb, J.A., 2005. Geological opinion for King Valley Vignerons, 5 pp. Followed by expert witness testimony at VCAT.
26. Webb, J.A., 2005. Application for an abattoir and saleyards near Learmonth – hydrological and hydrogeological assessment. 3 pp. Followed by expert witness testimony at VCAT.

Attachment B – Letter of instructions

36

EDO Qld.
Environmental Defenders Office
Using the law to protect our environment.
30 Hardgrave Rd WEST END, QLD 4101
tel +61 7 3211 4466 ***fax*** +61 7 3211 4655
edoqld@edo.org.au www.edo.org.au/edoqld

16 April 2013

Assoc Prof John Webb
Environmental Geoscience
Department of Agricultural Sciences
La Trobe University
Victoria 3086

Sent by email: John.Webb@latrobe.edu.au

Dear Dr Webb

Coast and Country Association of Queensland Inc. & Ors ats Hancock Coal Pty Ltd, Land Court of Queensland Proceeding MRA082-13 & EPA083-13

Objection to Mining lease and Environmental Authority for Alpha Coal Mine

We refer to your telephone conversation with Sean Ryan on 15 April 2013. We confirm that we act for Coast and Country Association of Queensland Inc. (**CCAQ**) as an objector in the Queensland Land Court proceedings MRA082-13 & EPA083-13 (**Proceedings**).

1. **Engagement**

1.1 On behalf of CCAQ, we wish to engage you to act as an independent expert witness in relation to the groundwater issues in the Proceedings.

1.2 You have estimated that 10 hours' work will be necessary to provide us your preliminary oral opinion in this matter, to be charged at $180/hour excluding GST. Our client has accepted this estimate.

1.3 Please provide us your preliminary oral opinion and a fee estimate for the remainder of the work as soon as possible.

2. **Instructions**

2.1 You are instructed to review this letter and accompanying documents.

2.2 Your attention is drawn to the advice of the Interim Independent Expert Scientific Committee on Coal Seam Gas and Coal Mining to the Department of Sustainability, Environment, Water, Population and Communities (**IIESC Advice**), which is enclosed as **Annexure C**.

2.3 You are further instructed to prepare a report setting out your opinion as to:

(1) whether there is sufficient information to form an adequate scientific basis for approval of the mine having regard in particular to potential groundwater impacts and the reasons for your view;

(2) whether, having reviewed all of the EIS documents, you agree with the conclusion of Coordinator-General's assessment in relation to groundwater and the reasons for your view;

(3) whether, having regard to all of the available material, there are issues that should be examined in more detail or additional lines of inquiry in relation to groundwater that should be explored before approval is granted and the reasons for your view.

3. Background information

3.1 The Alpha Coal Mine (**the Project**) is a proposed open-cut coal mine north of the township of Alpha, approximately 360km south west of Mackay in the Galilee Basin, Queensland. The mining lease application is for 40 years with an annual extraction rate of around 45 million tonnes per annum Run of Mine (**ROM**) coal.

3.2 The Project is situated in the Galilee Basin in the catchment of the Burdekin River which flows into wetlands and the Great Barrier Reef, and the area of the Project and its surroundings is predominantly used for agriculture, particularly grazing.

3.3 The thermal coal deposits for the Project are estimated to be 2.6 billion tonnes, and are located within Mining Lease Application 70426 (**MLA**), which comprises approximately 64,769 hectares. Approximately 22,500 hectares of the mining lease area is proposed to be disturbed by mining operations using dragline, truck and shovel equipment.

3.4 Hancock Coal Pty Ltd (**Applicant**) applied for an environmental authority (mining lease) (**EA**) under the *Environmental Protection Act 1994* (Qld) (**EP Act**) and a mining lease (**ML**) under the *Mineral Resources Act 1989* (Qld) (**MR Act**) for the Project on or about 17 December 2009.

3.5 The Coordinator-General declared the Project a significant project for which an environmental impact state (**EIS**) was required under the *State Development and Public Works Organisation Act 1971* (Qld) (**SDPWO Act**) on 24 October 2008.

3.6 The Applicant submitted an EIS in November 2010, a supplementary EIS in August 2011, an addendum to the supplementary EIS in November 2011 and additional supplementary documentation for the Project released with the Coordinator-General's report in May 2012, for approval under the SDPWO Act (**EIS documents**).

3.7 The Coordinator-General's report on the mine under the SDPWO Act was delivered on 29 May 2012. The Coordinator-General recommended that the mine be approved subject to conditions.

3.8 The Certificate of Public Notice for the application for the Mining Lease and Environmental Authority was issued on 19 December 2012.

3.9 We submitted on behalf of CCAQ an objection to the applications for a mining lease and an environmental authority on 20 February 2013.

4. **Enclosed Material**

4.1 We enclose the following documents, which are of general relevance to the Project:

(1) Initial Advice Statement to the Coordinator General (Application) (18/09/2008)

(2) Final Terms of Reference for EIS (01/06/2009)

(3) EIS Volume 1 (20/12/2010)

- Section 00 Executive Summary
- Section 01 Introduction
- Section 02 Description of the Project

(4) EIS Volume 2 (20/12/2010)

- Section 01 Introduction
- Section 02 Description of the Project

(5) EIS Volume 5 (20/12/2010)

- Appendix P Environmental Management Plan

(6) Coordinator General's Assessment Report (24/05/2012).

4.2 Additionally, We enclose the following documents, which are relevant to surface water and groundwater:

(1) EIS Volume 2 (05/11/2010)

- Section 4 Geology
- Section 10 Aquatic Ecology and Stygofauna
- Section 11 Surface Water
- Section 12 Groundwater
- Section 16 Waste
- Section 24 Hazard and Risk
- Section 25 Decommissioning and Rehabilitation

(2) EIS Volume 4 Appendix G Cumulative Impacts (05/11/2010)

(3) EIS Volume 5

- Appendix E2 Aquatic Ecology Assessment (09/09/2010)
- Appendix E3 Stygofauna Survey (07/09/2010)
- Appendix F1 Geomorphology Technical Report (09/2010)

- Appendix F2 Flooding Technical Report (15/09/2010)
- Appendix F3 Site Water Management System and Water Balance Technical Report (14/09/2010)
- Appendix F4 Surface Water Quality Technical Report (09/2010)
- Appendix G Groundwater (14/09/2010)
- Appendix J1 Geochemical Report (30/09/2010)
- Appendix J2 Alpha Coal Tailings Storage Facility-Concept Design Report (09/2010)

(4) Supplementary EIS Volume 2

- Appendix I Coal Mine-Surface Water Summary (05/09/2011)
- Appendix J Coal Mine-Geomorphology Technical Report (06/2011)
- Appendix K Coal Mine-Flooding Technical Report (04/2011)
- Appendix L Coal Mine-Site Water Management System and Water Balance Technical Report (11/04/2011)
- Appendix M Coal Mine-Surface Water Quality Technical Report (13/04/2011)
- Appendix N Coal Mine-Groundwater and Final Void Report (05/09/2011)
- Appendix O Coal Mine-Groundwater Bore Survey Report (28/07/2011)
- Appendix S Coal Mine-Interim Geochemical Report (14/03/2011)
- Appendix T Coal Mine-Tailings Storage Facility Update 04/2011

(5) Addendum to the Supplementary EIS Volume 1

- Appendix C Out-of-Pit Tailings Storage Facility-Hydrogeological Assessment (30/09/2011)
- Appendix D Out-of-Pit Tailings Storage Facility-Geotechnical Assessment (14/10/2011)
- Appendix E Stream Morphology Technical Report (09/2011)

(6) Additional Supplementary Documentation

- Groundwater Modelling Report (28/03/2012)
- Mine Water Structures Bridging Report (10/07/2012)

4.3 These documents are indexed and included in an electronic expert brief, however we can provide hard copies if necessary.

4.4 We have included all EIS Documents relevant to surface water and groundwater, as we are uncertain of the extent to which surface water may be relevant to groundwater issues. We do not assume that all documents included in the index will be relevant to your report, but have included them for the sake of completeness, and we would appreciate it if you could consider the documentation enclosed with a view to identifying any additional documentation or other expert opinions you may require.

5. **Timing**

5.1 Please prepare a draft report by 27 May 2013, marked "Privileged and Confidential: prepared for the purpose of the Queensland Land Court objection hearing to the Alpha Coal Mine". This will enable us to ensure that there has not been any misunderstanding of our instructions or any factual assumptions.

5.2 Your final report is required to be provided to the Court and other parties by 17 June 2013.

5.3 You will be required to meet with any corresponding expert from the other parties by 8 July 2013 and produce any joint report by 22 July 2013.

5.4 You may be required to give oral evidence, or be cross examined on your evidence, on a day within the two weeks of hearing commencing on 2 September 2013.

5.5 Please let us know if you have any difficulties with these dates.

6. **Your duty to the Land Court**

6.1 We enclose as **Annexure A** rule 23 of the *Land Court Rules 2000* and rules 426, 428 and 429B of the *Uniform Civil Procedure Rules 1999* which govern experts in the Land Court.

6.2 In particular we note that rule 426 of the *Uniform Civil Procedure Rules 1999* provides that you have a duty to assist the Land Court which overrides any obligations you may have to CCAQ as your client.

6.3 We also emphasise that we and our client don't seek to influence your views in any way and we ask for your independent opinion to assist the Land Court. Consequently, please note that any statements of fact or opinion in this letter of instructions, the above documents, or anything given or said to you by us relevant to the issues in your report do not constrain you in any way and are not intended to influence your views. We ask you to form your own opinion about the relevant facts and circumstances for the purposes of your report.

6.4 We recommend that any joint report or separate expert report you prepare should contain:

(1) an acknowledgement of having been instructed on an expert's duty in accordance with rule 426 of the *Uniform Civil Procedure Rules 1999* and having understood and discharged that duty; and

(2) a statement verifying that no instructions were given or accepted to adopt, or reject, any particular opinion in preparing the report.

7. **Format of your report**

7.1 Suggestions for the format of your report are set out in **Annexure B**, "Format of your report".

7.2 Your report must include:

(1) your qualifications;

(2) all material facts, whether written or oral, on which your report is based;

(3) references to any literature or other material you relied on to prepare the report;

(4) for any inspection, examination or experiment you conducted, initiated, or relied on to prepare your report—

i. a description of what was done; and

ii. whether the inspection, examination or experiment was done by the expert or under the expert's supervision; and

iii. the name and qualifications of any other person involved; and

iv. the result;

(5) if there is a range of opinion on matters dealt with in your report, a summary of the range of opinion, and the reasons why you adopted a particular opinion;

(6) a summary of the conclusions you reached; and

(7) a statement about whether access to any readily ascertainable additional facts would assist you in reaching a more reliable conclusion.

7.3 You should attach to the report:

(1) a copy of your Curriculum Vitae; and

(2) a copy of this letter.

7.4 Please number all pages and paragraphs of your report. You may wish to include an index.

7.5 If your report includes any photographs, measurements, graphs or illustrations these should be firmly attached to the report, and clearly identified and numbered.

7.6 You are required to include a summary of your opinion.

7.7 Your report should contain:

(1) an acknowledgement of having been instructed on an expert's duty in accordance with rule 426 of the *Uniform Civil Procedure Rules 1999* and having understood and discharged that duty; and

(2) a statement verifying that no instructions were given or accepted to adopt, or reject, any particular opinion in preparing the report.

8. **Change of opinion**

8.1 If for some reason, you change your opinion after delivering your report, please advise us as soon as possible. If that change is material, a supplementary report will need to be prepared, which explains the reasons for the change in your opinion.

9. Confidentiality and privilege

9.1 In accepting this engagement, you agree that:

(1) this letter and all future communications (whether electronically maintained or not) between us are confidential. These communications may be subject to client legal privilege;

(2) you must take **all** steps necessary to preserve the confidentiality of our communications and of any material or documents created or obtained by you in the course of preparing your report;

(3) you must not disclose the information contained in our communications or obtained or prepared by you in the course of preparing your report without obtaining consent from us;

(4) you must not provide any other person with documents which come into your possession during the course of preparing this report, whether created by you or provided to you by us or our clients, without obtaining consent from us.

9.2 The duty of confidentiality continues beyond the conclusion of your instructions.

9.3 If you are ever obliged by law to produce documents containing any of this confidential information (whether by subpoena, notice of non-party discovery or otherwise) please contact us immediately so that we may take steps to claim client legal privilege.

9.4 You should ensure that you retain copies of all drafts of your report together with all documents that you rely on in preparing your report. We will inform you when you are no longer required to retain them.

9.5 If requested, you must return to us all documents and other material (including copies) containing confidential information. Where any confidential information is in electronic form, we may require you to delete this information instead.

9.6 Any internal working documents and draft reports prepared by you may not be privileged from disclosure and may be required to be produced to the opposing parties in the litigation, and to the Court.

9.7 You may be cross-examined about any changes between your working documents and your report. The Court will be interested to understand the reason or reasons for any changes, and you should be prepared to, and able to, explain them.

10. Document management

10.1 Please ensure that all documents created pursuant to this retainer are marked "Privileged and Confidential: prepared for the purpose of the Queensland Land Court objection hearing to the Alpha Coal Mine".

11. Court appearance

11.1 At the hearing of this objection, you may be required to attend Court and give evidence. You must be personally involved and knowledgeable in all aspects of the preparation of the report.

11.2 If you are required to attend Court to give evidence, we will contact you to discuss your availability and make the necessary arrangements.

If you have any questions regarding your engagement or require further information, please do not hesitate to call us on 3211 4466.

Yours faithfully

Environmental Defenders Office (Qld) Inc

Sean Ryan

Senior Solicitor

To provide feedback on EDO services, write to us at the above address.

ANNEXURE A

Land Court Rules 2000 **(Qld)**

23 Expert evidence

(1) A party who intends to call a person to give evidence as an expert witness must file and serve on each other party a statement—

(a) giving the name and address of the witness; and

(b) describing the witness' qualifications to give evidence as an expert; and

(c) containing the witness' evidence for the hearing.

(2) A party must comply with subrule (1) at least 21 days before the date set for the hearing or, if the court directs a different time, within the time directed by the court.

(3) A party may not, except with the leave of the court or with the consent of each other party, call evidence from a witness as an expert unless the party has complied with subrules (1) and (2).

(4) An expert witness, in examination in chief, must not, except with the leave of the court, expand on matters contained in the witness' statement of evidence or introduce fresh material.

(5) The court may order expert witnesses to confer and prepare and file a document setting out areas of agreement and disagreement and the reasons for any disagreement.

(6) The court may make the order it considers appropriate about the cost of preparing the document.

Uniform Civil Procedure Rules 1999 **(Qld)**

Part 5 Division 2 Evidence given by an expert

426 Duty of expert

(1) A witness giving evidence in a proceeding as an expert has a duty to assist the court.

(2) The duty overrides any obligation the witness may have to any party to the proceeding or to any person who is liable for the expert's fee or expenses.

428 Requirements for report

(1) An expert's report must be addressed to the court and signed by the expert.

(2) The report must include the following information—

(a) the expert's qualifications;

(b) all material facts, whether written or oral, on which the report is based;

(c) references to any literature or other material relied on by the expert to prepare the report;

(d) for any inspection, examination or experiment conducted, initiated, or relied on by the expert to prepare the report—

(i) a description of what was done; and

(ii) whether the inspection, examination or experiment was done by the expert or under the expert's supervision; and

(iii) the name and qualifications of any other person involved; and

(iv) the result;

(e) if there is a range of opinion on matters dealt with in the report, a summary of the range of opinion, and the reasons why the expert adopted a particular opinion;

(f) a summary of the conclusions reached by the expert;

(g) a statement about whether access to any readily ascertainable additional facts would assist the expert in reaching a more reliable conclusion.

(3) The expert must confirm, at the end of the report—

(a) the factual matters stated in the report are, as far as the expert knows, true; and

(b) the expert has made all enquiries considered appropriate; and

(c) the opinions stated in the report are genuinely held by the expert; and

(d) the report contains reference to all matters the expert considers significant; and

(e) the expert understands the expert's duty to the court and has complied with the duty.

429B Court may direct experts to meet

(1) The court may, at any stage of a proceeding, direct experts to meet and—

(a) identify the matters on which they agree; and

(b) identify the matters on which they disagree and the reasons why; and

(c) attempt to resolve any disagreement.

(2) The court may, for the meeting—

(a) set the agenda; and

(b) specify the matters the experts must discuss; and

(c) direct whether or not legal representatives may be present; and

(d) give directions about the form of any report to be made to the court about the meeting; and

(e) give any other directions the court considers appropriate.

(3) Evidence of anything done or said, or an admission made, at the meeting is admissible at a trial of the proceeding only if all parties to the proceeding agree.

(4) However, subrule (3) does not apply to a report made to the court about the meeting identifying the matters mentioned in subrule (1)(a) or (1)(b).

ANNEXURE B

Court Rules

1 A copy of the relevant sections of the *Land Court Rules 2000* and the *Uniform Civil Procedure Rules 1999* is provided at Annexure A.

2 While the format of your report is discretionary, you should ensure that your report complies with the above requirements, and that compliance with these requirements is readily apparent.

Format

3 We make the following suggestions regarding the layout of your report.

4 Ensure that your report contains your full name and address.

5 Please number all pages and paragraphs of your report. You may wish to include an index. If your report includes any photographs, measurements, graphs or illustrations these should be firmly attached to the report, and clearly identified and numbered.

6 Your report may include the following sections and headings:

6.1 **"Introduction"**

This section should:

- refer to, and annex, the letter of instructions received from me;
- refer to, and disclose, the substance of any conversations that you have had **and** to which you have had regard in preparing the report;
- specifically identify and refer to any literature or other source materials (eg text books, industry guidelines and handbooks) used in support of your opinion. This will include the documents supplied by me, as well as any other documents to which you have referred. If lengthy, it may be practical to list this material in an annexure to the report. If for some reason, you do not refer to certain material when preparing your report, please specifically identify this material and outline the reasons it was not referred to; and
- refer to any methodology you have adopted in preparing the report, including a detailed description of any test or examinations, who carried them out, their qualifications and the results.

6.2 **"My qualifications"**

In this section of your report, you need to qualify yourself as an expert in the areas in which you have been asked to provide an opinion. You should describe how your specialist knowledge (whether obtained through training, study or experience), your experience and qualifications qualify you as an expert in these areas.

Your curriculum vitae should also be annexed to your report and referred to under this heading.

6.3 **"Summary of my opinion"**

You are required to include a summary of your opinion.

6.4 **"Background facts and assumptions"**

The Court Rules require you to list all "facts, matters and assumptions on which each opinion expressed in the report is based".

The facts and assumptions you rely on need to be linked to their sources and clearly stated and verifiable. These may be sufficiently set out in our letter of instructions.

If you are called as a witness, you may be required to give evidence in relation to your assumptions.

6.5 **"My opinion"**

This part of your report should contain your detailed reasons for your opinions on the questions put to you. This will be the most substantial part of your report.

When drafting your report, you should make it clear that the opinion is wholly or substantially based on your expert knowledge. Your opinions must be confined to areas within your expert knowledge.

You must set out the process of reasoning that you followed in coming to your opinion and identify the facts and assumptions upon which you rely for the opinion. Where there are alternative views available, you should explain why you have chosen a particular alternative.

6.6 **"Qualification of the opinion"**

If appropriate, you should set out any qualification of your opinion, without which the report would be incomplete or inaccurate. If applicable, you should state that a particular question or issue falls outside your relevant field of expertise.

You should also state if your opinion is not concluded because of insufficient research or data or for any other reason.

6.7 **"Confirmation"**

You must confirm, at the end of the report—

(a) the factual matters stated in the report are, as far as the expert knows, true; and

(b) the expert has made all enquiries considered appropriate; and

(c) the opinions stated in the report are genuinely held by the expert; and

(d) the report contains reference to all matters the expert considers significant; and

(e) the expert understands the expert's duty to the court and has complied with the duty.

Please ensure that you make all necessary inquiries in a timely fashion to enable you to confirm these matters.

6.8 **"Signature"**

The final page of your report must be signed by you.

ANNEXURE C

Interim Independent Expert Scientific Committee on Coal Seam Gas and Coal Mining: Advice to decision maker on coal mining project

iiesc
Interim Independent Expert Scientific Committee on Coal Seam Gas and Coal Mining

Advice to decision maker on coal mining project

Proposed action: Coal Mine

Requesting agency	Department of Sustainability, Environment, Water, Population and Communities
Date of request	20 June 2012
Project title	**Alpha Coal Mine, QLD** (EPBC 2008/4648)
Summary of request	The Department of Sustainability, Environment, Water, Population and Communities (the department) is currently assessing the Alpha Coal Mine and Rail Infrastructure Project (2008/4648) in accordance with the provisions of the *Environment Protection and Biodiversity Conservation Act 1999*. The department seeks the advice of the Interim Independent Expert Scientific Committee on Coal Seam Gas and Coal Mining (the committee), regarding whether the proposed conditions in the Queensland Coordinator-General's Assessment Evaluation Report are sufficient to mitigate the water related impacts to: 1. the Great Artesian Basin; 2. regional surface water resources of the Galilee Basin; 3. the Caley Valley Wetland, including potential acid sulphate soil issues; and 4. habitat for listed species, through water course alterations.

Advice

1) The committee notes that developments in the Galilee Basin are going to be large in scale, where significant tributaries to the Burdekin Catchment will be dissected by mines along a strike of over approximately 300 km. The Alpha proposal could be a significant part of this, being approximately 30 million tonnes per year over 30 years. This would be one of the largest coal mines in Australia. The committee considers that information relating to the potential impacts of this project should be commensurate with its scale.

2) The committee notes that substantial information has been provided by the proponent to address impacts of the proposed project in the Galilee Basin. However, in relation to relevant water matters, the committee advises that information presented could be improved by providing:
   a) further details of the measured hydrogeological data, and groundwater model parameters, uncertainties, confidence and transparency
   b) a site and regional water balance
   c) surface water quantity and quality impacts
   d) associated risk assessments; and
   e) mitigation measures to appropriately address risks.

   Such information would be expected for a project of this scale and is integral to allowing an

informed and robust scientific consideration of the project.

3) Given the pending development scenarios, the committee advises that the cumulative surface and groundwater impacts in the region have not been assessed. Based on the limited information presented, in particular, on cumulative impacts, the committee has considerable concerns relating to the scale and extent of impacts associated with the project. A regional cumulative impact assessment should be undertaken as a matter of priority.

4) The committee notes that an independent due diligence assessment has been undertaken on the proponent's initial groundwater model report. The groundwater model report was revised based on this assessment. However, a regional water balance has not been provided to place the project in context.

5) The committee further recommends that the regional cumulative impacts (covering surface water, groundwater, geomorphological, hydrological and ecological impacts) be adequately assessed and appropriately influence the conditioning and management of the project development phases.

6) In terms of the specific advice requested, the committee notes that based on the information provided that:
   a) the proposed mine is in close proximity to the eastern margin of the Great Artesian Basin. The committee notes that there was not enough information to make an assessment as to the integrity of the Rewan Formation as an aquitard in this area to restrict connection with the Great Artesian Basin. In the absence of this assurance, it would be necessary to highlight the risks posed to the Great Artesian Basin from the current proposal, as well as future proposals.

   b) the region's hydrology and water quality may be affected by the scale of the proposed projects significantly reducing the quantity of surface water in the region; acid water drainage, especially after water quality in the final void deteriorates; the diversion of Lagoon Creek; emergency discharges of contaminated water; leachate from the onsite landfill; and the use of overburden to backfill open-cut pits. As specific risks cannot be quantified without an adequate water balance, surface water cumulative impact study, or solute balance, it is difficult to assess the adequacy of mitigation measures to reduce impacts to an acceptable level, including acid water drainage which may impact on the water quality of the Burdekin Catchment.

   c) habitat for listed species will primarily be affected by the cumulative quantity of water intercepted in the catchment; acid water drainage; the diversion of Lagoon Creek; and the rail loop which intersects the Caley Valley Wetland.

   d) the proposed railway loop intersects a substantial portion of the Caley Valley Wetland. This has potential to significantly impact on the values of the wetland both directly through its location, and indirectly through changes to water quality resulting from changes in freshwater and tidal hydrology, and release of contaminants and oxidation of potential acid sulphate soils to the Wetland during and after construction. However, the proponent intends to offset their impact to the Wetland via land and financial (in-kind) contributions. The committee is not confident that the proposed offsets are sufficient, especially regarding the quality of offsets compared to cumulative impacts and outcomes sought.

7) In summary, the committee recommends that the Galilee Basin component of the wider Lake Eyre Basin bioregional assessment be conducted as a matter of priority, in order to assess regional cumulative impacts. Specifically, the bioregional assessment should include an assessment of groundwater impacts associated with the Galilee Basin (which may affect the Great Artesian Basin to the west), and surface water impacts associated with the Burdekin Catchment (which may be impacted to the east). Further, a regional and site water balance should be provided as baseline information, and a regional risk-based approach should be developed to examine local and regional impacts. Any proposed models should be peer reviewed and publicly released.

Date of advice	20 July 2012