ASSESSMENT REPORT

NRE No. 1 Mine – Preliminary Works Project
Modification 1 – Longwalls 4 and 5, and Gateroads 6, 7 and 8

1. BACKGROUND

1.1 Project Location

Gujarat NRE Coking Coal Ltd (Gujarat) owns and operates the NRE No. 1 Colliery (NRE No. 1), located in the Illawarra region, approximately eight kilometres (km) north of Wollongong and 70 km south of Sydney (refer to **Figure 1**).

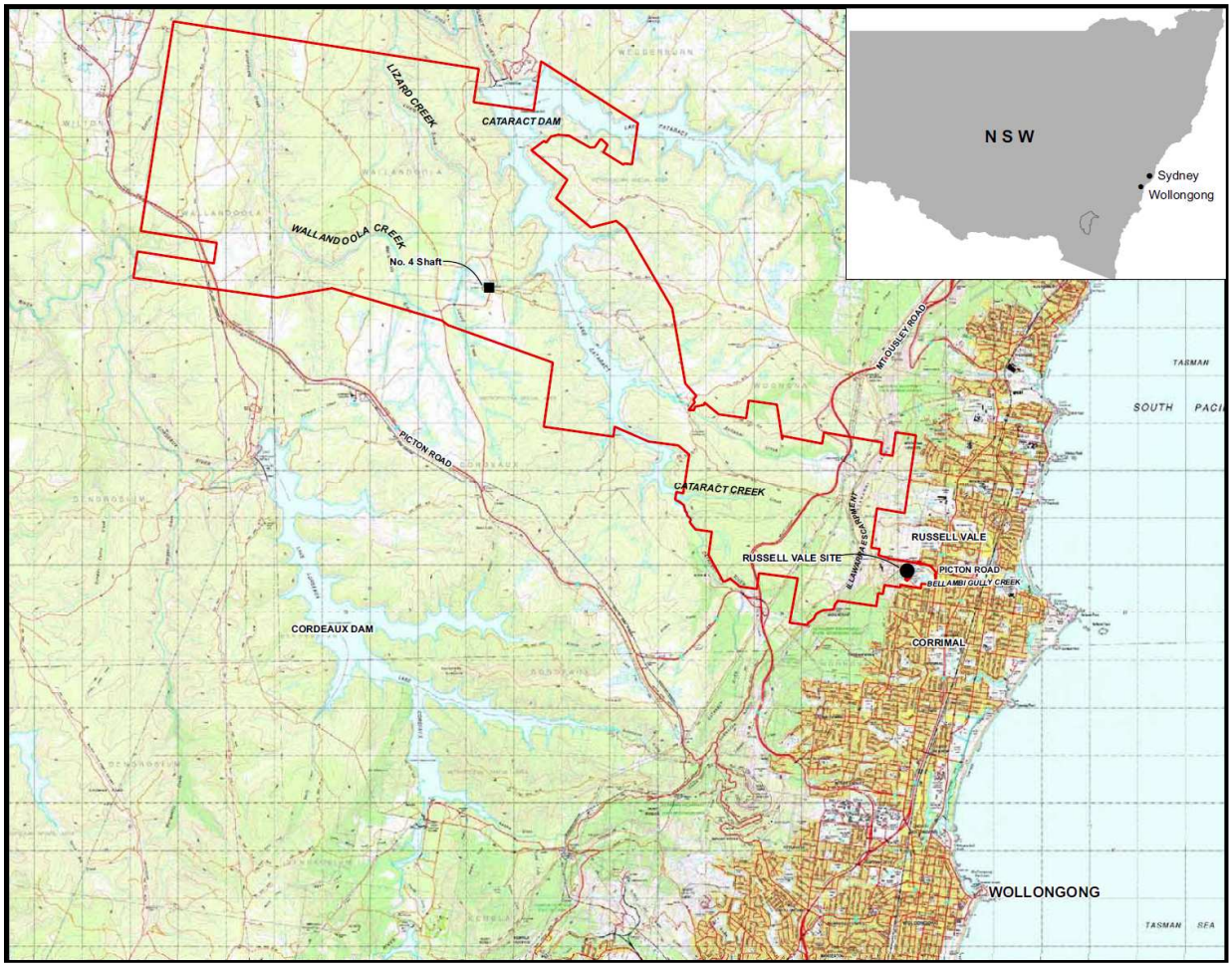

Figure 1 – *Regional Location and Project Application Area (project area marked in red)*

1.2 History of Mining

Mining at NRE No. 1 has been undertaken since 1887 through a range of mining techniques including bord and pillar mining, pillar extraction and longwall mining. The Bulli Seam was previously mined using pillar extraction techniques (early to mid 1900s) and the Balgownie Seam was extracted using longwall mining techniques (between 1970 and 1982).

1.3 Existing Project Approval

On 13 October 2011, the Planning Assessment Commission (PAC) approved the Preliminary Works Project (MP 10_0046) at NRE No 1 under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The existing project involves:

- extracting up to 1 million tonnes per annum (Mtpa) of run-of-mine (ROM) coking coal through first workings and pillar extraction from the Bulli and Wongawilli Seams for a period of three years;
- upgrading the existing mining infrastructure at the surface facilities site; and
- trucking ROM coal from NRE No. 1 to Port Kembla Coal Terminal (PKCT).

1.4 Other Related Approvals

The existing Preliminary Works Project approval does not allow for longwall mining. However, Gujarat has recently extracted coal using longwall mining techniques from one panel (Longwall 4) under a Subsidence Management Plan (SMP) approved by the Division of Resources and Energy (DRE) within the Department of Trade and Investment, Regional Infrastructure and Services (DTIRIS). Gujarat was able to undertake longwall mining operations under an approved SMP because a transitional provision relating to existing mining leases (clause 8K of the *Environmental Planning and Assessment Regulation 2000*) had the effect that development consent was not required for mining undertaken up until 30 September 2012, providing that Director-General's requirements had been issued for a project application prior to 16 December 2010.

DRE granted SMP approval for the first half of Longwall 4 on 26 March 2012, and the second half of this same longwall on 30 July 2012. The extraction of Longwall 4 was completed under the approved SMP. Gujarat also sought SMP approval from DRE for Longwall 5 but this element of its application was not determined.

Gujarat has also submitted a separate Part 3A project application for the Underground Expansion Project (MP 09_0013). This project would involve a significant expansion of the mine into the western section of the existing project area (see **Figure 1**) over a project life of 18 years and would involve extensive longwall mining. The environmental assessment (EA) for this project has not yet been completed or publicly exhibited.

1.5 Southern Coalfield Inquiry and Previous PAC Approvals

In July 2008, the NSW Government released a report of the independent *Strategic Review of Impacts of Underground Coal Mining on Natural Features in the Southern Coalfield*. The Southern Coalfield Inquiry was established because of concerns held within both Government and the community over existing and potential impacts of mine subsidence on significant natural features such as rivers, significant streams, swamps and cliff lines.

The report included a total of 22 recommendations to guide environmental assessment of mining projects in the Southern Coalfield. These recommendations have been considered and refined during the PAC's later merit reviews of the Metropolitan Coal Project in 2009 and the Bulli Seam Operations Project in 2011. Key recommendations included:

- a precautionary approach should be applied to any new mining proposal that may have unacceptable impacts on significant natural features;
- putting an onus on industry to demonstrate that its proposals would not result in unacceptable impacts on significant natural features;
- EAs for project applications should address subsidence effects, subsidence impacts and environmental consequences by providing:
  - a minimum of 2 years baseline data, collected at appropriate frequency and scale, for significant natural features;
  - identification and assessment of the significance of all natural features within 600 metres (m) of the edge of longwalls; and
  - for risk management zones to minimise impacts on key natural features; and
- further research should be conducted into certain areas such as the prediction of non-conventional subsidence, impacts of mining on swamps, and remediation of streams.

These principles were again applied in the Department's assessment and the PAC's determination of the NRE No 1 Preliminary Works Project. The Department notes that the EA and other supporting documentation for the project included consideration of the Inquiry's recommendations and the PAC's merit reviews of the Metropolitan and Bulli Seam Operations Projects.

2. PROPOSED MODIFICATION

On 14 May 2012, Gujarat lodged an application and supporting EA (see **Appendix B**) to modify the project approval for its Preliminary Works Project under section 75W of the EP&A Act. The proposed modification involves:

- obtaining consent to extract coal using longwall mining techniques in the Wongawilli Seam for Longwalls 4 and 5; and
- developing the main gate roads for Longwalls 6, 7 and 8 (refer to **Figure 2**).

Since the application for the proposed modification was made, the extraction of Longwall 4 has been completed under DRE's approved SMP. Therefore, the only longwall mining that would be undertaken under this approval is for Longwall 5.

The proposed modification would have a capital investment value of $20 million and continued employment of 330 workers at the mine. The extraction rate would remain within the current limit of 1 million tonnes per calendar year, as Gujarat has predicted that in 2013 it would extract 530,240 tonnes from the proposed Longwall 5 and 346,980 tonnes from the development of gateroads. In 2012, 387,515 tonnes was extracted from the now completed Longwall 4. The proposed extraction area is entirely within the existing approved project area. The proposed modification would make use of existing facilities and would not involve any vegetation clearing nor increased trucking.

Gujarat has informed the Department that, if the modification application is approved, it would immediately submit a draft Extraction Plan to the Department and a revised SMP application to DRE. Both the Extraction Plan and SMP would need to be approved prior to any extraction of Longwall 5.

3. STATUTORY CONTEXT

3.1 Section 75W Modification

The proposed modification would not change the nature of the development subject to the existing project approval, ie an underground coal mine. It proposes a change in the nature of coal mining, ie from bord and pillar mining of three remnant coal pillar areas and to also include two small longwalls. The Department considers that this is a relatively minor expansion of the existing coal mining.

The proposed modification would not increase the currently approved extraction rate; it would use existing surface facilities and lead to no change or increase to the approved trucking of coal. The additional mining would be completed well within the 3-year period approved for the original project. The Department is satisfied that the proposed modification is a relatively minor change to the approved project, and can be characterised as a modification to the original approval rather than a new development proposal in its own right. Consequently, the Department is satisfied that the proposed modification may be determined under section 75W of the EP&A Act.

By comparison, the separate project application that Gujarat has lodged (MP 09_0013) proposes a substantial increase in the mining area, a substantial increase in extraction rate (up to a total of 3 Mtpa), extensive upgrading of surface facilities and increased levels of product coal trucking.

3.2 Approval Authority

The Minister for Planning and Infrastructure is the approval authority for the modification application. However, the PAC must determine the application under the Minister's delegations of 14 September 2011, because Gujarat has declared reportable political donations and over 25 submissions in the nature of objections were received.

3.2 Permissibility

The land subject to the modification application is zoned as E2 Environmental Conservation under the *Wollongong Local Environmental Plan 2009*. Under this plan, mining is prohibited. However clause 7(1)(a) of the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* makes underground mining permissible with consent on any land. Consequently all aspects of the modification proposal are permissible with development consent.

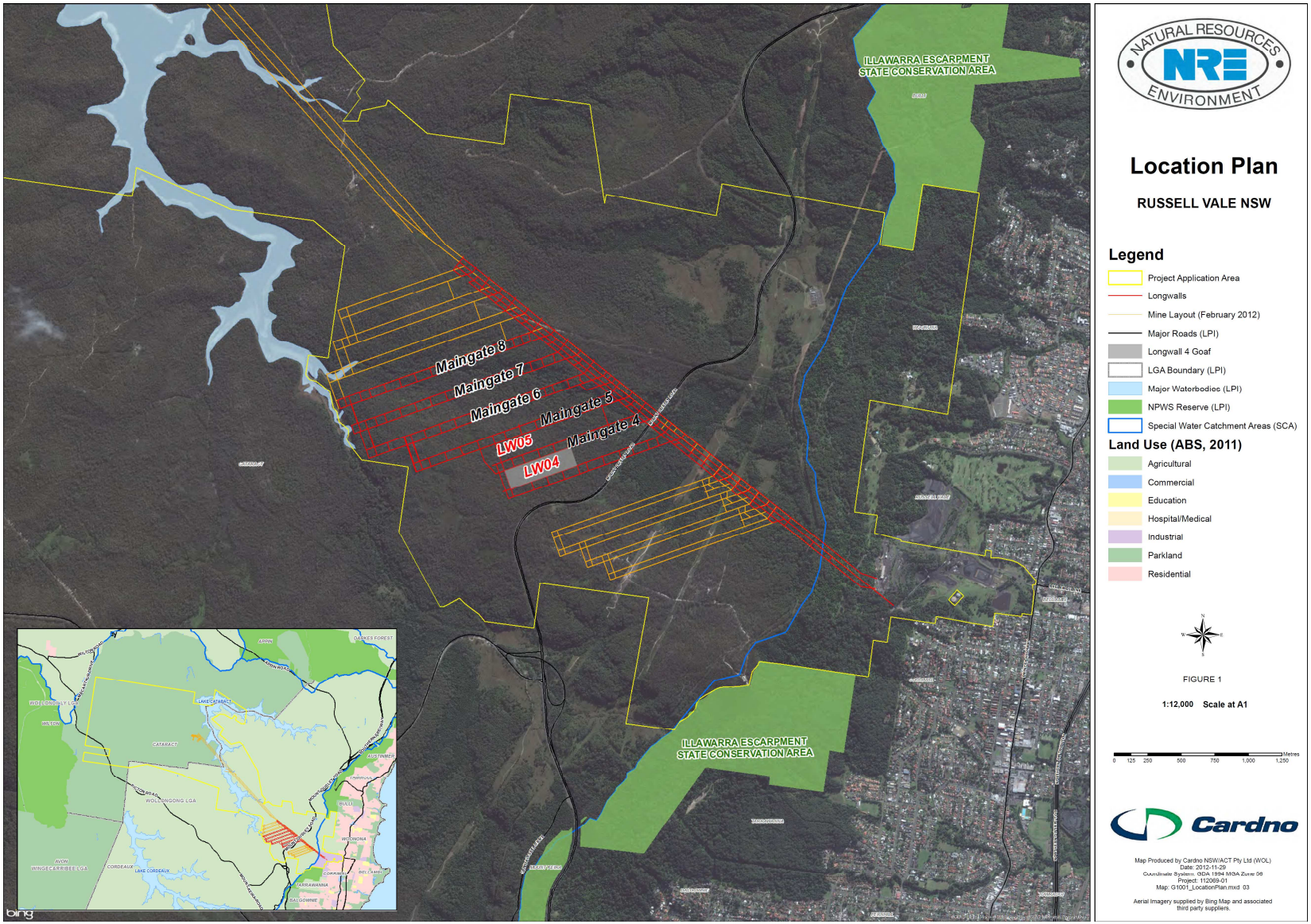

Figure 2: *Proposed Modification*

4. CONSULTATION

In accordance with Section 75H(3) of the EP&A Act, the Department:

- made the EA publicly available from 13 August 2012 until 3 September 2012:
  - on the Department's website,
  - at the Department's Information Centre and the offices of Wollongong City Council, and
  - at the offices of the Nature Conservation Council;
- notified relevant State government agencies and Wollongong City Council by letter; and
- advertised the exhibition of the EA in the Illawarra Mercury.

During and following the exhibition period, the Department received 43 submissions, comprising:

- 9 from public authorities;
- 3 from special interest groups; and
- 34 from the general public.

Of the 37 submissions from special interest groups and the general public, 35 objected to the modification, one raised concerns about the modification and one supported the modification. A full copy of these submissions is attached in **Appendix C**.

4.1 Key Areas of Concern

Environmental Issues

The key environmental issues raised in submissions were potential subsidence impacts on natural features (including surface water, groundwater, upland swamps and biodiversity) and built features (including water storages and roads). These concerns are addressed in detail in Section 5 of this report, with a particular focus on Cataract Creek, upland swamp CCUS4 and the Cataract Reservoir. Other environmental concerns raised in submissions include potential impacts on greenhouse gases and air quality, noise and Aboriginal heritage. These latter issues are discussed in **Table 1**.

Other regulatory and technical issues (including a perceived piecemeal approach to project development, non-compliances at the mine, concerns over the subsidence modelling and multi-seam mining) were also raised. Where these matters are not directly related to subsidence and/or the environmental impacts of the modification application, they are addressed below.

The number of times that each issue was raised is shown in **Figure 3**, below.

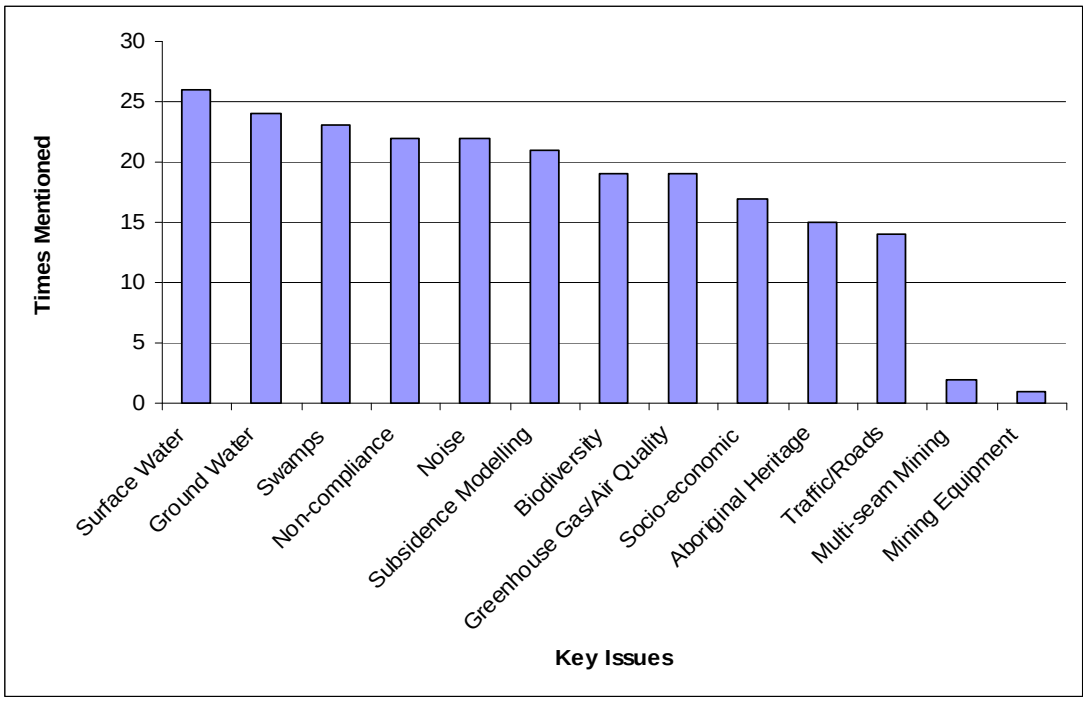

Figure 3: *Key Issues Raised in Submissions*

Piecemeal Approach
Some submissions raised concerns about a perceived 'piecemeal' approach by Gujarat to the development of projects and modifications at NRE No. 1. The PAC also made comments to the same effect in its determination report for the Preliminary Works Project. The Department agrees that Gujarat's recent and current approach is not best practice, but notes that it is bound to consider all applications on their merits.

The Department is also aware that the current modification application is essential for mine continuity, and ultimately the economic future of the whole mine and the company. Although the Department would prefer to assess broader, long-term proposals (such as Gujarat's Underground Expansion Project), it also recognises that this application would in fact provide an ideal opportunity for gathering important information to assist in assessing the larger project application.

Gujarat's Non-Compliances
A number of submissions also raised concerns about Gujarat's recent history of non-compliances at NRE No. 1. There have been a number of non-compliances with the existing project approval, relating to the submission of management plans, establishment of a Community Consultative Committee (CCC) and availability of information on the mine's website.

While these non-compliances have not had any direct environmental impact or fall within the highest categories of concern, the Department takes all non-compliances seriously. These issues have been investigated by the Department's Compliance Branch and no action was taken as Gujarat has since addressed each of these issues. All required management plans have now been approved, the CCC is now operating and all relevant information is available on the mine's website.

The Department is also aware that Gujarat has been penalised for other non-compliances relating to its Environmental Protection Licence (EPL), Mining Lease (CCL745) and Sydney Catchment Authority approvals. These penalties are levied by other Government agencies under separate legislation.

Submission in Support
The **Construction, Forestry, Mining and Energy Union** (CFMEU) lodged a submission in support of the proposed modification. CFMEU emphasised that Gujarat needs to mine Longwall 5 to ensure the long-term viability of both the NRE No. 1 Colliery and the NRE Wongawilli Colliery. This submission stated that, if the modification application is not approved, then employment within the Illawarra region would be adversely affected both directly (Gujarat employees) and indirectly (eg rail operators at the Port Kembla Coal Terminal).

4.2 Response to Submissions
Gujarat provided a formal Response Submissions (RTS) to the Department on 8 October 2012 (see **Appendix D**). The RTS addresses the issues raised in submissions, and includes a significant amount of information additional to that provided in the EA. In particular, the RTS includes an additional subsidence impact assessment by SCT Operations Pty Ltd (the SCT SIA) that specifically addresses concerns raised in submissions about the potential subsidence modelling and predictions, and associated impacts on key surface features.

The SCT SIA included additional groundwater and geotechnical monitoring information gathered after the extraction of Longwall 4. As a result of the additional monitoring, and its predictions Gujarat has reduced the proposed length of Longwall 5 from 1,145 m to approximately 845 m in order to reduce potential impacts on surface features, particularly on one upland swamp (CCUS4).

The RTS also includes an entirely new swamp impact assessment, prepared by Biosis Pty Ltd, that identifies the significance of all swamps within the existing, proposed and future mining areas and assesses the potential impacts of the proposed mining.

The Department forwarded the RTS to all affected Government agencies and invited further comments. The **Office of Environment and Heritage** (OEH), **Sydney Catchment Authority** (SCA), **Dams Safety Committee** (DSC), **NSW Office of Water** (NOW) and DRE provided further comments which outlined their residual concerns, while the **Environmental Protection Authority** (EPA) and **Roads and Maritime Services** (RMS) chose not to make any further comments. **Wollongong City**

Council (Council) has not yet provided further comments to the Department. A full copy of agency comments on the RTS is included in **Appendix E**.

On 7 November 2012, at the request of the Department, Gujarat provided an Addendum to its RTS (see **Appendix F**), which addressed the key residual issues raised by the agencies. The Addendum provided further subsidence monitoring data collected at Longwall 4 since the RTS was prepared. It also briefly discussed some of the proposed content of the Extraction Plan/SMP required to support potential extraction of Longwall 5 and a related Trigger Action Response Plan (TARP). On 18 November 2012, again at the request of the Department, Gujarat provided a revised SIA report from SCT that addressed minor inaccuracies in SCT's original report and incorporated all subsidence monitoring data gathered since the completion of Longwall 4 (see **Appendix G**).

4.3 Residual Concerns in Agency Submissions[1]

OEH and **SCA** retain concerns about the quality and detail of the subsidence modelling and the accuracy of predictions for Longwall 5. OEH also raised concerns about the potential impacts of Longwall 5 on an upland swamp (CCUS4) and doubts as to whether Gujarat could meet a negligible environmental consequences criterion for impacts on this swamp. However, OEH appears to have not fully taken into account the RTS's revised mine layout, which significantly shortened Longwall 5 to avoid undermining CCUS4.

SCA noted the revised mine layout and the fact that CCUS4 is now outside the predicted limits of subsidence, but still requested further specific subsidence and groundwater information to support the predicted negligible impacts on both CCUS4 and Cataract Creek. SCA also retains concerns over the development of Maingates 6, 7 and 8, as it believes that future longwall mining in this area may cause significant subsidence impacts.

The Department notes that the subsidence data gathered from the already extracted Longwall 4 is the most relevant information for subsidence modelling of Longwall 5 and the prediction of potential impacts to surface features. Gujarat provided preliminary subsidence and groundwater information in the RTS based on Longwall 4 and has since provided further information in the Addendum to the RTS, as well as an amended report by SCT, which are discussed in detail in Section 5.1. Further subsidence information must also be included in the Extraction Plan and SMP and both require approval prior to the commencement of any longwall mining.

NOW also retains concern about the level of groundwater monitoring and noted that monitoring within the Longwall 4 goaf would provide further evidence that the vertical flow of groundwater is slow. NOW has not identified any specific concerns about the potential impacts of the proposed Longwall 5. The groundwater monitoring information that it has requested is unlikely to be available for at least another 3 months and the Department believes it is not critical to the determination of the application, provided the predicted impacts on surface features are of an appropriately limited significance.

DSC initially raised concern about the impact of Longwall 5 on the water security of Cataract Dam. Longwall 5 is not within the DSC's notification area for the water storage and only first workings (ie Maingates 6, 7 and 8) are proposed within the notification area. DSC subsequently clarified its position that the proposed modification may go ahead since no longwalls are currently proposed in the notification area. Gujarat is currently seeking formal endorsement from DSC.

DRE initially requested further information about natural surface features, particularly swamps, which has since been provided in the RTS and Addendum to the RTS. DRE also recommended a number of conditions of approval in reference to rehabilitation and reporting which have been taken into account in drafting the recommended conditions of approval.

RMS raised no concerns, and noted that Gujarat RMS had established a Technical Committee to deal with potential impacts on Mount Ousley Road and its culvert over Cataract Creek. RMS requested that conditions of approval provide that the implementation of the proposed modifications (ie the extraction of the longwalls) should be subject to the satisfaction of this Committee.

[1] This section only describes residual agency concerns held after consideration of Gujarat's RTS, rather than the history of each agency's concerns and how they have been addressed by Gujarat in the RTS.

EPA and OEH's **Heritage Branch** raised no concerns.

Council did not object to the proposal and raised no significant concerns. Council recommended conditions of approval concerning environmental monitoring, auditing and the public availability of information on the mine's website.

5. ASSESSMENT

5.1 Mining Subsidence

Underground Mining Environment

It is important first to note that the proposed modification involves longwall extraction in the Wongawilli Coal Seam. Longwall extraction has previously taken place in the overlying Balgownie Seam, and bord and pillar and pillar extraction mining has also taken place in the uppermost Bulli Seam. Thus the proposed modification represents 'multi-seam' mining, where subsidence impacts from the lowermost mining will add to (and possibly even re-activate) the subsidence impacts which previously took place as a result of mining in the higher seams. Accurate prediction of subsidence effects and subsidence impacts in this complex engineering environment is more difficult than with single-seam extraction. This is particularly the case because the extent of pillar extraction in the Bulli Seam (which took place up to 100 years ago) is not always accurately recorded on the available maps of coal mine workings. It cannot therefore be certain that the roof of the Bulli Seam workings has fully collapsed (ie subsided) at all locations. Remnant pillars may continue to be present in the Bulli Seam workings, but possibly do not retain a high level of inherent strength or stability.

DRE, when considering Gujarat's earlier SMP application for both Longwalls 4 and 5, raised concerns over the risk of subsidence causing some of these overlying remnant pillars to collapse, which could in turn lead to rapid successive failures of weakened adjoining pillars. This unpredictable phenomenon of a large-scale progressive collapse of coal pillars in a short period of time is called 'pillar run'. The potential consequences of pillar run are impacts to a range of surface features outside what would otherwise be the predicted area for subsidence impacts.

Given the inherent uncertainties, and the difficulty of fully eliminating those uncertainties, it is appropriate that subsidence predictions and management errs towards conservatism, as an appropriate application of the precautionary principle.

Surface Features

Longwall 4 and the proposed Longwall 5 are located west of the Illawarra Escarpment, in an area dominated by native bushland with few built features. The area affected by the modification application is part of Metropolitan Sydney's potable water supply catchment and is managed by the SCA with the aim of protecting water quality.

The topography is generally undulating, marked with occasional rocky outcrops, with altitude varying from a high point of 398 m AHD south of Longwall 4, to a low point of 300 m AHD north of Longwall 5, resulting in a slope of approximately 7%. Watercourses include Cataract Creek and three associated minor tributaries. The tributaries are ephemeral but Cataract Creek has permanent flows and in this area is a 4th order stream (using the Strahler classification system).

Built features within the vicinity of the proposed longwalls are relatively few, and include:

- the nearby Mount Ousley Road, including a culvert over Cataract Creek;
- a 330 kV Transmission Line (owned and maintained by Transgrid);
- 132 kV and 33 kV Transmission Lines (owned and maintained by Endeavour Energy).
- unsealed 4WD tracks and fire trails; and
- one known Aboriginal heritage site (52-3-032, an axe grinding groove site).

Subsidence Effects

Subsidence effects refer to deformation of the ground mass due to mining including all mining-induced ground movements. 'Conventional subsidence' includes vertical displacement, tilt, and tensile and compressive strain. Additional 'non-conventional subsidence' components can arise in steep or incised topography, and includes valley closure, upsidence and far-field horizontal movements.

The key conventional subsidence impact that may result from the proposed modification is fracturing of the surface zone due to tensile and compressive strains, resulting in curvature of the ground surface. Curvature in an outwards direction results in the ground swelling or 'hogging', which occurs when the ground is subjected to tensile strain. Curvature in an inwards direction results in the ground 'sagging', which occurs when the ground is subjected to compressive strain.

Proposed Mining Geometry

Longwall 4 and the proposed Longwall 5 have a depth of cover of 340 m, a seam thickness of 2.7 - 3.2 m and a cutting height of 2.9 m. Both longwalls were designed to minimise the surface and other environmental impacts from subsidence with a narrow panel width (145 m wide) and large chain pillars (59.5 m wide). The overall post-mining void (ie counting the adjacent roadways) would be 156 m in width.

In response to concerns raised in submissions, the proposed Longwall 5 has also been significantly reduced in length from an initial 1,145 m to approximately 845 m.

Conventional Subsidence Effects and Impacts

Original Subsidence Predictions

The EA includes a subsidence impact assessment prepared by Seedsman Geotechnics (the Seedsman SIA), which provided predictions of maximum subsidence, tilt and strain for Longwalls 4 and 5.

The Seedsman SIA advised that the proposed pillar-width to maximum seam-extraction-height ratio of 18.6 would mean that the chains pillars would be long term stable and allow minimal subsidence above them. Seedsman noted that there is no Australian or International database evidence of pillar failure where the pillar width to height ratio is greater than 5.0. The Seedsman report concluded that the maximum anticipated vertical subsidence associated with Longwalls 4 and 5 would be 1.15 m, with maximum tilts, compressive strains and tensile strains of 17 millimetres/metre (mm/m), 12 mm/m and 10 mm/m respectively.

Many submissions from agencies and the general public raised concerns about the subsidence modelling and subsidence impact predictions in the EA, particularly the Seedsman SIA. Gujarat has since submitted a further subsidence impact assessment undertaken by SCT Consulting (the SCT SIA) as part of its RTS.

Recent Subsidence Monitoring from Longwall 4

The SCT SIA utilised more-recent monitoring data obtained from the mining of the now-completed Longwall 4 and responded to the various concerns raised in submissions. The most recent monitoring data indicates that maximum measured vertical subsidence is 1.38 m, maximum tilt is approximately 25 mm/m at the start of the panel and 15 mm/m over the longwall face, and maximum strain is 3 mm/m. While vertical subsidence is some 16% greater than earlier predicted, tilts and strains are largely within predictions.

The SCT SIA concludes that the higher level of vertical subsidence was due to the overlying mining in the Bulli Seam and Balgownie Seam, which had reduced the bridging characteristics of the overburden strata so that the overburden strata is more compliant and less able to span across a single panel, even one as small as Longwall 4.

Although the amount of vertical subsidence is significantly greater for mining a panel of this limited size in the third seam than would be expected if it was located in a single seam mining environment, the lateral extent of subsidence is not significantly greater than for single seam mining. That is, the surface subsidence profile is quite steep over the extracted longwall, but does not extend greatly over the adjoining pillars (see **Figures 4** and **5**). This is the key outcome of the monitoring data – subsidence is predominantly constrained to within the limits of the surface expression of the longwall panel itself. Gujarat has undertaken subsidence monitoring beside the northbound slow lane of Mount Ousley Road to provide an indication of subsidence movements beyond the goaf edge. A maximum of 30 mm of vertical subsidence has been measured at 180 m from the goaf edge.

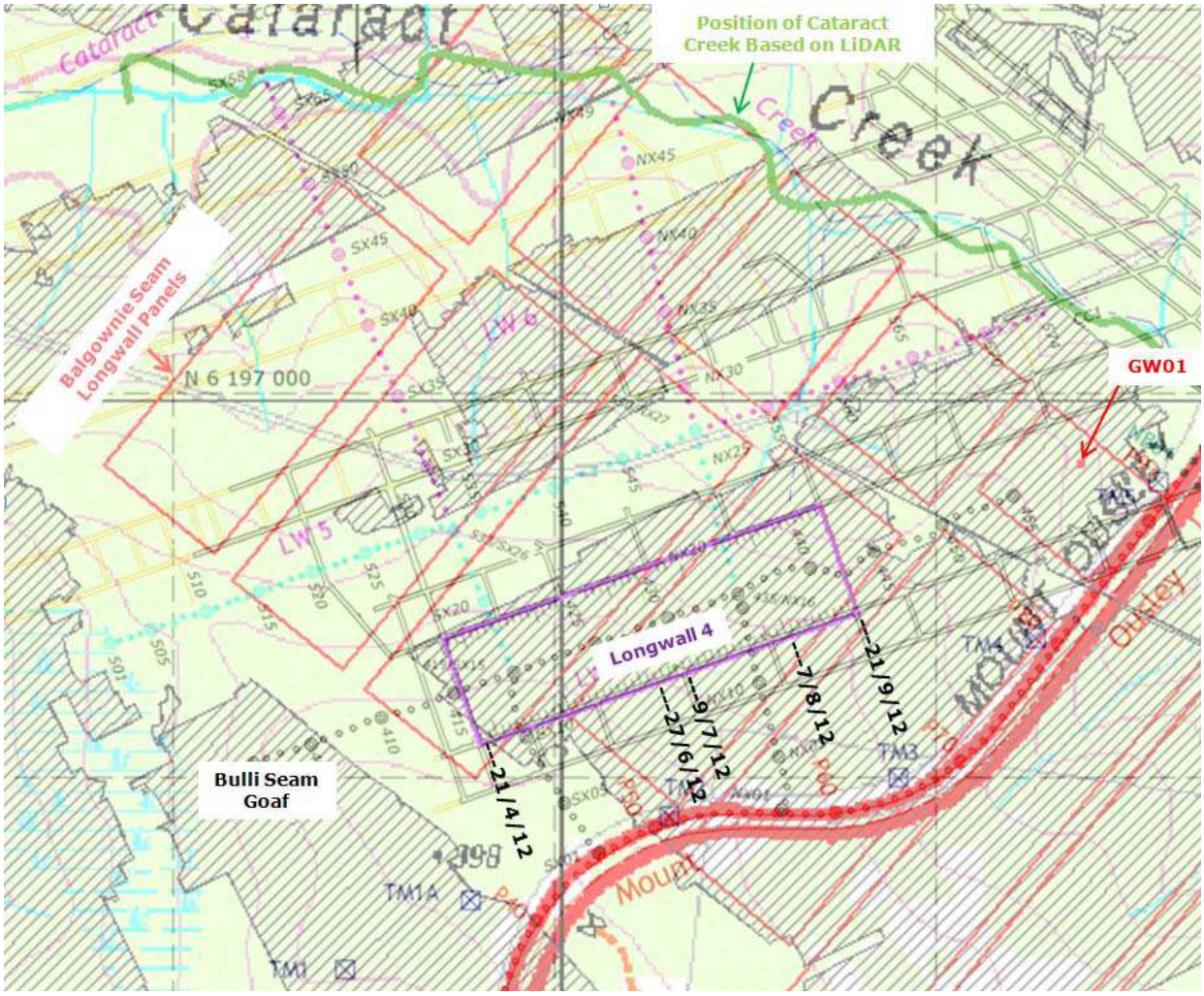

Figure 4 – *Site Plan Showing Location of Subsidence Lines and Previous Mine Workings*

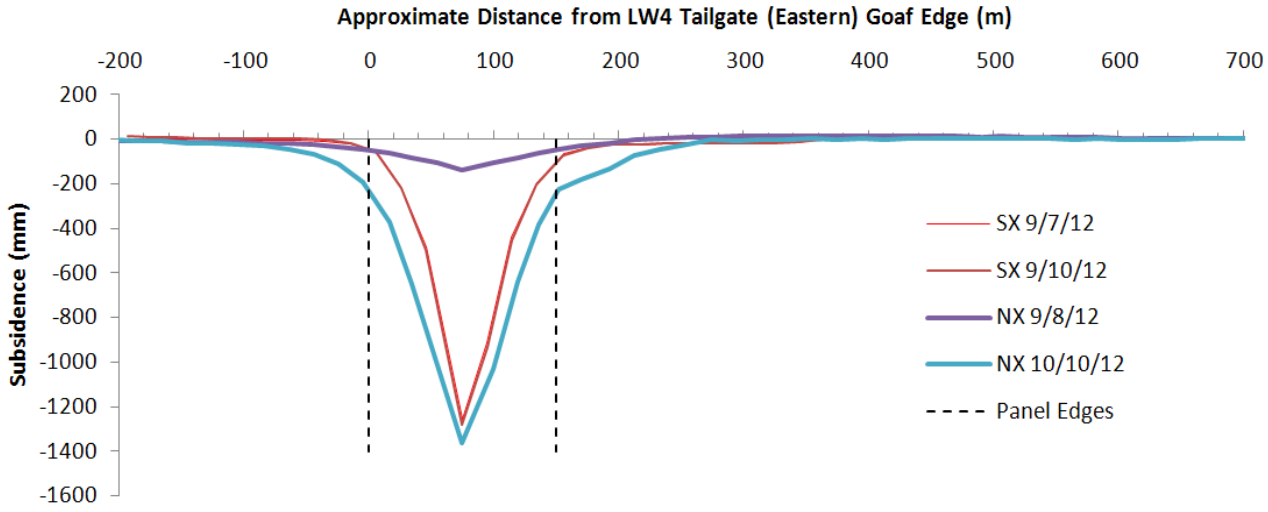

Figure 5 – *Subsidence Measured on South and North Cross Sections above Longwall 4*

The monitoring data from Longwall 4 also shows that strains are largely confined to the inside edge of the chain pillars and the centre of the longwall as shown in **Figure 5**. The maximum observed tensile strain over the chain pillars of Longwall 4 was 4.68 mm/m and the maximum observed compressive strain was 5.03 mm/m.

Minor tensile surface cracking has been observed at the top of the hill on Mount Ousley Road and over the panel during mining of Longwall 4. This observation is consistent with general experience of coal mining below steep terrain and is likely to be associated with an equal amount of compression across Cataract Creek, with the movement likely to have been taken up on a horizontal shear plane at or just below the base of the valley. Potential cracking of Cataract Creek is discussed in detail in section 5.3.

The Department is satisfied that these subsidence effects are relatively small, and are generally within predictions, or else do not substantially exceed predictions (including the original predictions). They are not, in themselves, of concern.

Potential Impacts of Multi-Seam Mining

As has been noted above, in the area affected by the modification application, the Bulli Seam was previously mined using pillar extraction techniques (early to mid-1900's) and the Balgownie Seam was extracted using longwall mining techniques (between 1970 and 1982). Subsidence data was not collected for mining in the Bulli Seam, although likely subsidence can be estimated based on experience at other similar sites. Accurate data is available for longwall mining in the Balgownie Seam. Total previous cumulative subsidence in the centre of Longwalls 4 and 5 from mining the Bulli and Balgownie seams is estimated to be about 1m and 1.4 m, and 0.5-1.3 m and 1.4 m, respectively.

The EA contained multiple risk assessments addressing the risk of pillar failure and pillar run in the overlying Bulli Seam, including reports by KNJ Consulting, Strata Engineering (Australia) Pty Ltd and Stable Strata Consulting. The risk assessment by KNJ Consulting concluded that the chance of pillar run impacting on surface features outside the predicted conventional subsidence zone was 'practically impossible'. The Stable Strata Consulting report deemed the risk of pillar run to be "exceedingly low to negligible", while the Strata Engineering report concluded that the proposed longwall is "unlikely to induce a pillar run".

SCT is not aware of any area in the Southern Coalfield where three seams have been mined directly above one another, except the recent extraction of Longwall 4. There has been previous mining in three seams in the Newcastle Coalfield at both the Wyee and Myuna Collieries (Wallarah, Great Northern, and Fassifern Seam) and there may have been other sites in some of the older mines in the Newcastle Coalfield. The practice of multi-seam mining is more common in the United Kingdom where SCT is aware of at least one site where up to nine seams were mined at the same colliery. Multi-seam mining is also common in other countries such as China, Poland, Russia, and Germany.

The SCT SIA notes that the subsidence monitoring of Longwall 4 was two rather than three dimensional. Consequently, the data is not suitable to determine far-field horizontal movements or movements in a downslope direction associated with valley closure. Notwithstanding, the Department considers that other information, including measured strains and geological profiles, can be used to generally assess the likelihood of any potential far-field movements. Gujarat has also committed to three dimensional surveying for the proposed Longwall 5 to assist in providing a more holistic picture of ground movement associated with mining.

The monitoring results contain no evidence of pillar run. The tight correlation of subsidence within the surface expression of the new void formed by Longwall 4 in the Wongawilli Seam is of considerable comfort in this respect. SCT suggests that this is also evidence that the pillar extraction areas in the Bulli Seam are already fully subsided.

The Department accepts that the expert reports, including those by KNJ Consulting, Strata Engineering (Australia) Pty Ltd and Stable Strata Consulting, conclude that the risk of pillar run in the overlying Bulli Seam is acceptably low. It is comforted by the narrow subsidence profile developed above the extracted void of Longwall 4. It can see no evidence to prevent or limit the extraction of Longwall 5 based solely on the unquantifiable (but low) risk of a pillar run.

Maingates 6, 7, and 8
Maingates 6, 7 and 8 are three sets of twinned underground development headings located to the northwest of Longwalls 4 and 5 which have the primary purpose of forming 'gateroads' to outline the next three proposed longwall blocks, ie Longwalls 6, 7 and 8 (see **Figure 2**).

The proposed extraction of Longwall 5 would take approximately 4 to 5 months to complete, and the development of the proposed maingates would take a similar amount of time. The development of the maingates is necessary for the future continuity of longwall mining at NRE No. 1. If the maingates are not developed simultaneously to the proposed Longwall 5 extraction, then at the completion of Longwall 5, the longwall machine would have no work to do (at a significant cost to the mine) and there would be no other commercially viable source of coal to extract. Given the fact that the EA for the expansion of the mine has not been lodged yet, and that it is likely to take between 6-12 months to assess the results of the application, there is a distinct possibility that Gujarat will lodge another modification application in due course seeking to extract these 3 additional longwalls. The additional monitoring associated with the extraction of Longwall 5 will be critical input in assessing the likely environmental impacts of such extraction.

The Department is aware that each of the proposed Maingates 6, 7 and 8 is within the Cataract Notification Area, however DSC has informed the Department that is does not object to the gateroads due to the negligible subsidence involved. Gujarat is currently seeking formal endorsement from DSC.

The proposed first workings for Maingates 6, 7, and 8 are designed to leave the coal pillars intact, the roadways open and the overlying strata supported. The Department is satisfied that first workings would cause less than 20 mm of vertical subsidence, which is defined by DRE as 'zero subsidence'. The Department is satisfied that there is no significant environmental impact associated with development of the gateroads. The critical issue is the potential impacts of longwall extraction.

SCA has residual concerns about the proposed development of the maingates as it believes that significant impacts may result from future longwall mining in this area. The Department understands that there are features of special significance located over these gateroads, including Cataract Creek and upland swamps CCUS4 and CCUS5. A future proposal to conduct longwall mining in this area may have adverse impacts on these features. However, no detailed information (for example a subsidence impact assessment) is before the Department to enable it to come to a firm, substantive and reasonable position on whether on not extraction of these longwalls can be undertaken with acceptable environmental impacts, or not. Any future application would be subject to a separate, rigorous assessment and would be informed by the experience of mining Longwall 5. Gujarat has also made it clear to the Department that the development of these gateroads would be at its own financial risk.

The application before the Department is for the development of the gateroads, and there is no reasonable basis on which to recommend refusal of this application.

5.2 Upland Swamps
The EA does not include a full swamp impact assessment specific to Longwalls 4 and 5, but relies on a combination of other documents and information including a previous ecological assessment undertaken by ERM and mapping by Biosis. It also includes a short swamp impact assessment of one affected upland swamp (CRUS1) by GeoTerra. A number of submissions raised concerns about the lack of a site-specific swamp impact assessment and requested that further information be provided about the identification of upland swamps in the vicinity of Longwalls 4 and 5 and an assessment of potential subsidence impacts on these swamps.

The RTS includes a comprehensive swamp impact assessment undertaken by Biosis for all upland swamps within Gujarat's larger Underground Expansion Project area, including specific consideration of the upland swamps located above Longwalls 4 and 5. This report involved the use of LIDAR (Light Detection and Ranging) data to identify upland swamps and detailed ground-truthing and mapping of all vegetation sub-communities within the upland swamps. The Biosis report also draws on baseline monitoring of one upland swamp (CRUS1) undertaken since Autumn 2011 and monitoring of two other swamps (CCUS3 and CCUS4) undertaken since Autumn 2012. OEH and SCA have commented on the good quality of the Biosis report, and the Department considers it to be the most comprehensive swamp impact assessment yet undertaken in the Southern Coalfield.

Swamps of Special Significance

The PAC has previously recommended that upland swamps (as well as cliff lines and watercourses) in the Southern Coalfield should be categorised against clearly quantifiable criteria to establish whether or not they are of 'special significance'. OEH has recently prepared draft *Upland Swamp Environmental Impact Assessment Guidelines* which seek to identify relevant thresholds for swamps of special significance. The draft guidelines propose that special significance is established if a swamp fulfils at least three of the following five criteria:

- statutory thresholds (ie Endangered Ecological Community, or EEC);
- substantial size (ie greater than 7.4 hectares (ha));
- unusual complexity (ie comprising all sub-communities within a vegetation community);
- closely proximal habitat (ie swamp cluster); and
- scientific research importance (mapped by OEH).

It is understood that application of the draft guidelines would result in some 166 of the 1000 swamps (but 66% of all swamps by area) in the Southern Coalfield being judged to have 'special' significance. These draft guidelines have not yet been discussed in detail between agencies or agreed across Government. However, Biosis has used them in its assessment, a decision which is endorsed by the Department.

The Biosis assessment identified that CRUS1 and CCUS4 meet the statutory threshold as an EEC (as would any upland swamp), from part of a swamp cluster and contain all vegetation sub-communities (see **Figure 6** below). However, CCUS3, previously mapped as a single swamp, was found to consist of two separate swamps reliant on divergent flow pathways and contained within different catchments. Detailed assessment of these two swamps then identified that neither meet OEH's proposed criteria for special significance. CCUS3 is shallow in nature, with little peat development or organic material, while CRUS1 and CCUS4 have deeper soils with increased organic content. Based on the monitoring data collected so far, CCUS3 is not considered to be groundwater dependent, as it is predominantly reliant on surface flow recharge.

Potential Swamp Impacts

The SCT SIA acknowledged that, based on the experience of mining in areas of swamps in the Southern Coalfield, there is a high potential for subsidence impacts on a swamp if longwall mining occurs directly beneath it. However, none of the swamps of special significance in the vicinity of the proposed Longwall 5 would be directly undermined due to the shortening of the longwall panel in the revised mine layout. CRUS1 and CCUS4 are approximately 360 m and 80 m, respectively, from the proposed Longwall 5 extraction void at their closest points.

If longwall mining occurs beneath slopes leading to a swamp, then there is a higher likelihood of non-conventional subsidence effects in the form of valley closure due to strains. These impacts may not necessarily occur immediately but can occur over time as a result of changes to the balance between recharge and infiltration from the surface through newly created fractures. Given the low level of strains recorded over the chain pillars of Longwall 4 and the distance between the proposed Longwall 5 and the swamps of special significance, SCT concludes that the likelihood of non-conventional effects would be low. However, the Department notes that the predictions of subsidence effects on CRUS1 and CCUS4 are based on the assumption that subsidence from the proposed Longwall 5 would be largely constrained within its chain pillars as has been monitored at Longwall 4 (see **Figure 5** above).

Biosis predicts that CRUS1 would not experience any subsidence impacts since the controlling rockbar associated with this swamp is outside the predicted limits of subsidence. The RTS also predicts that there would be negligible impacts on CCUS4 as the swamp is now located behind the proposed start line for Longwall 5. In its latest submission, OEH expressed continuing concerns that there may be 'low-level' impacts on CCUS4 and refers to statements to that effect in the Biosis report. However, the Department understands that the quoted low-level impacts do not relate to the shortened Longwall 5 but to the proposed Longwall 6, which is part of the separate Underground Expansion Project application. The Biosis report acknowledges that CCUS3 may be affected by tensile and compressive strains resulting from the proposed Longwall 5. However, as it is not considered to be a groundwater dependent swamp, no significant impacts are expected on groundwater supply or storage capacity. Any potential impacts to the biodiversity within this swamp are addressed in section 5.4.

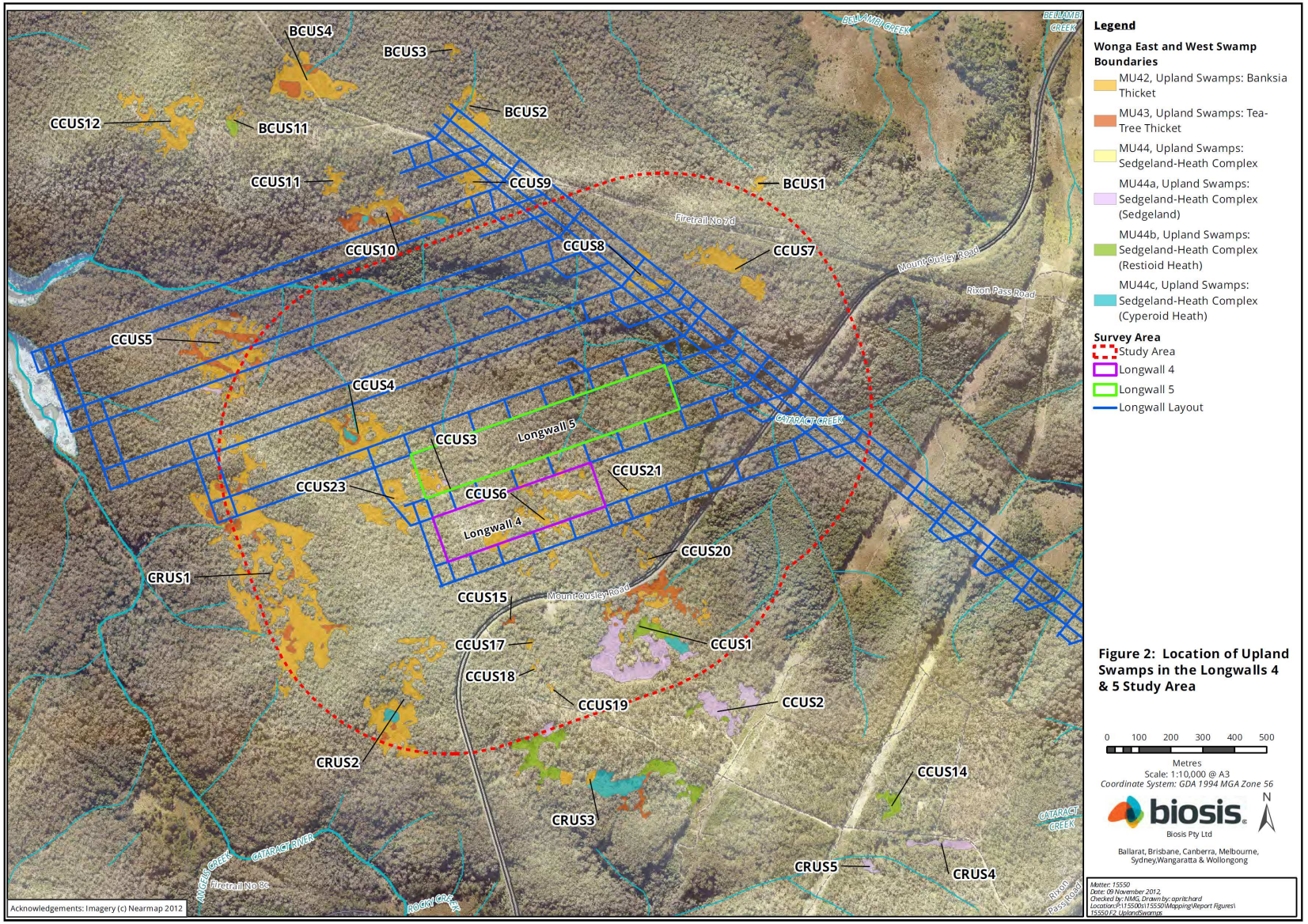

Figure 6 – *Site plan showing all upland swamps in the vicinity of Longwalls 4 and 5*

Mitigation and Management
OEH has suggested that, if any impacts occur in any swamp of special significance, then remediation or offsetting should be required and implemented through an appropriate Trigger Action Response Plan (TARP).

The Department notes that neither Biosis nor SCT expects there to be any impacts on swamps of special significance. However, the SCT SIA also notes that, if there are any such impacts, then they are unlikely to become apparent until well after mining is complete and well after there is any capacity for Gujarat to make any significant change to the mining process.

The Department agrees that environmental consequences in swamps may take time to become apparent, and believes that a negligible environmental consequences performance criterion in the approval is the most important approach to preventing impacts. That is, prevention is better than cure. However, a rigorous monitoring regime and associated TARP is also necessary to provide for an agreed management regime in the event that performance criteria are not met. The existing approval already requires that the Water Management Plan contain a TARP, which is termed a 'Surface and Ground Water Response Plan'. This TARP must provide for responses to exceedances, mitigation and/or offset of impacts, and reductions in ongoing impacts to below the relevant impact assessment criteria.

The Department has therefore recommended conditions of approval requiring negligible environmental consequences within CRUS1 and CCUS4, and the review of the existing Water Management and Biodiversity Management Plans, which must be approved as part of the Extraction Plan process prior to the commencement of any future longwall mining.

5.3 Surface Water
The EA did not include a separate surface water impact assessment, and did not provide specific subsidence predictions for surface water features within the vicinity of Longwalls 4 and 5. OEH, SCA and a number of public submissions specifically raised concerns about this and also noted that a consideration of special significance was necessary. The RTS sought to address these deficiencies.

The RTS identifies Cataract Creek as a stream of special significance, and includes the SCT SIA, which considers potential surface water impacts from subsidence. The Addendum to the RTS also includes details of inspections of streams undertaken by Gujarat in May and October 2012 (ie before and after the extraction of Longwall 4). The streams within the vicinity of Longwall 4 and the proposed Longwall 5 are shown on **Figure 6** above.

Special Significance of Cataract Creek
Cataract Creek has permanent flows and drains directly to the Cataract Reservoir. Its headwaters are located immediately west of the Illawarra Escarpment and it is classified as a 4th order stream west of Mount Ousley Road. As a stream of 3rd or higher order, Cataract Creek fits the categories of special significance for watercourses recommended by the PAC in its assessment of the Bulli Seam Operations Project, and as earlier proposed by the Southern Coalfield Inquiry.

Potential Impacts on Cataract Creek
Cataract Creek is a relatively steep watercourse, particularly in its headwaters, and flows to the Reservoir through a series of short pools, rock bars and boulder fields. While the creek lies within a plateau of Hawkesbury Sandstone (which overlies Longwall 4 and the majority of Longwall 5), the stream itself does not have a bed of Hawkesbury Sandstone. Gujarat reports that its surface geological mapping indicates that the section of the creek closest to Longwall 5 has eroded through the Hawkesbury Sandstone and sequentially through a number of underlying geological strata (the Newport and Garie Formations and the Bald Hill Claystone) and into the uppermost layers of the Bulgo Sandstone. Downstream of these outcrops, a large volume of colluvium and alluvium blankets the lower section of the creek, which has a much lower gradient immediately upstream of the reservoir. These recent sediments would also be expected to be underlain by the Bulgo Sandstone.

The creek does not have steep to vertical incised valley sides due to the absence of Hawkesbury Sandstone. Because the channels and pools have developed in more erosive rock strata, the pools are not as deep or long as those which commonly develop within the Hawkesbury Sandstone (such as at Metropolitan Colliery or in the creeks west of Cataract Reservoir).

Longwall mining beneath or close to streams in the Southern Coalfield commonly causes streambed cracking and potential environmental consequences such as the draining of pools, loss of surface flows through the bed of the stream, iron staining, opacity and water quality deterioration.

While Cataract Creek has also previously been partially undermined by longwall mining in the Balgownie seam and bord and pillar and pillar extraction workings in the Bulli Seam, no evidence has been found of existing stream bed cracking, flow loss or adverse effects on pool levels. However, some iron staining has been observed in the creek prior to extraction of Longwall 4.

Cataract Creek does not appear to have been impacted by previous mining in the same way as rock strata in the beds of other watercourses located on Hawkesbury Sandstone. Detailed observations by Gujarat and its consultants have also revealed no evidence that the extraction of Longwall 4 has caused any subsidence impacts on the creek. Gujarat's October inspection, when compared against its May inspection, concluded that there was less iron staining, no change in pool holding levels, no new cracks, and only a minor reduction in creek flow, which is most likely due to less rainfall and runoff in the catchment as a whole.

SCT believes that the Bulgo Sandstone in the floor of Cataract Creek does not react to compressive strains in the way that gives rise to fracturing in watercourses located in the Hawkesbury Sandstone. The SCT SIA states that valley closure (or horizontal movement in a downslope direction) appears to be concentrated on a horizon at the bottom of the overlying Hawkesbury Sandstone, which in this case, is above the level of the river channel. The Department accepts that this is the most likely explanation of the limited subsidence impacts on Cataract Creek.

The great majority of Cataract Creek is located more than 200 m from any point above the proposed Longwall 5 extraction void. However, the proposed finishing line of the longwall is only about 40 m distant from the Creek. Given this relative proximity, the Department acknowledges that there is some risk of subsidence impacts, particularly from tensile strains. However, vertical subsidence in Longwall 4 was predominantly constrained to within the limits of the longwall void and the strains were largely confined to the inside edge of the chain pillars as shown in **Figure 5** above.

Surface water flow in Cataract Creek may be slightly reduced due to predicted minor increases in groundwater infiltration (see section 5.4). However, such minor surface water losses are expected to report to the surface either further downstream in Cataract Creek, or else directly to the reservoir.

Both SCA and OEH hold residual concerns that Gujarat has not provided specific subsidence predictions for Cataract Creek. While the Department has requested that Gujarat provide these figures, its subsidence experts are not able to do so with a sufficient measure of reliability. Gujarat has accepted these deficiencies in its subsidence predictions and has instead proposed an adaptive management approach. For example, the panel's finishing line may be adjusted during extraction and set back to provide a greater separation distance and limit adverse impacts. Although the Department considers that it would be preferable to consider specific subsidence predictions, it accepts that such predictions would not be entirely reliable or accurate. It considers that the information provided is sufficient to provide a clear indication of likely impacts, while nonetheless providing for an adaptive management which can be used to ensure acceptable environmental outcomes.

Impacts on Tributaries of Cataract Creek

There are three minor tributaries of Cataract Creek within the vicinity of Longwalls 4 and 5, however since they are ephemeral and do not flow directly from upland swamps, they do not fit the PAC's proposed criteria for watercourses of special significance.

The RTS states that there may be some minor impacts on the water quality of tributaries to Cataract Creek, such as iron staining. Iron staining already occurs in some of these tributaries (eg CT1), as was confirmed by both Gujarat's May and October inspections). However, since these tributaries are ephemeral and not of special significance, the Department is satisfied that these impacts are acceptable and would not have any significant impacts on the water quantity or quality of either Cataract Creek or Cataract Reservoir.

Impacts on Cataract Reservoir

Longwall 4 and the proposed Longwall 5 are relatively remote from the stored waters of Cataract Reservoir. Longwall 5 is a little over one km from the reservoir at the closest point. As neither longwall is located within its Cataract Reservoir Notification Area, DSC has not raised any concerns over them.

There is no potential for significant flow from the stored waters into the mine. An increase in vertical hydraulic conductivity is expected in areas that have been directly undermined, as evidenced by the piezometric profile shown in **Figure 7** below, but the magnitude of flow is likely to be insignificant by comparison with the volume of rainfall recharge and other natural effects such as evaporation from the surface of the reservoir.

Conclusion and Recommendations

Neither Longwall 4 nor the proposed Longwall 5 underlies either Cataract Creek or Cataract Reservoir. Based on the information available, the Department does not expect any significant subsidence impacts or environmental consequences on these important surface water features.

The existing conditions of approval include performance measures requiring negligible leakage from Cataract Reservoir and negligible reduction in its water quality. The Department considers these criteria are sufficient to manage the potential impacts on the reservoir from the extraction of Longwalls 4 and 5. However, the Department has recommended that an existing performance measure, applying to certain watercourses in the west of the existing project area, is also extended to Cataract Creek. This performance measure would require that impacts in Cataract Creek are limited to:

- negligible diversion of flows or changes in the natural drainage behaviour of pools;
- negligible gas releases and iron staining; and
- negligible increase in water cloudiness.

In its RTS, Gujarat has committed to:

- establishing stream flow monitoring sites along Cataract Creek, which would be designed to monitor changes in stream flow;
- increasing the intensity of monitoring as Longwall 5 approaches Cataract Creek; and
- developing triggers based on survey, ecological, water quality and visual data to provide early indications of potential impacts, which are linked to slowing the longwall progress.

The Department has also recommended conditions requiring NRE to update its Water Management Plan (including its Surface and Ground Water Impact Response Plan). The Department is satisfied that an updated Water Management Plan approved prior to the commencement of longwall mining, would be able to provide an appropriate adaptive management approach to prevent any adverse impacts on Cataract Creek.

5.4 Biodiversity

The EA includes an Ecological Assessment undertaken by ERM, which specifically assesses the ecological impacts of the proposed mining of Longwalls 4 and 5. The EA also incorporates other information from previous ecological assessments for the Preliminary Works Project and vegetation mapping undertaken by Biosis. The RTS also includes Biosis's new swamp impact assessment for all swamps potentially affected by Gujarat's Underground Expansion Project, including the upland swamps in the vicinity of Longwalls 4 and 5.

The proposed modification does not require the direct removal of native vegetation or fauna habitat. Notwithstanding, the Department is aware that, during the establishment of subsidence monitoring lines over Longwall 4 as required under DRE's SMP approval, Gujarat inadvertently damaged approximately 50 individuals of the *Pultenaea aristata* flora species, which is listed as vulnerable under the *Threatened Species Conservation Act 1995* (TSC Act). According to the RTS, SCA was notified of this incident immediately and the plants are expected to regenerate over time as the clearing did not disturb the ground. SCA has also issued Gujarat with a Penalty Infringement Notice.

The key concern relating to biodiversity impacts from the proposed modification is the potential for habitat alteration due to subsidence from longwall mining, which is listed as a Key Threatening Process under the TSC Act.

The upland swamps in the vicinity of the proposed Longwall 5 are listed as an EEC under the TSC Act. As a result of the revised mine layout, the only swamp that sits above Longwall 5 is CCUS3, which covers an area of approximately 0.55 ha. As discussed in section 5.2 above, the other two swamps (CRUS1 and CCUS4) are expected to experience not greater than negligible environmental consequences from subsidence due to their distance from the proposed Longwall 5.

Apart from flora within the upland swamps, there are no threatened flora or fauna species that have been surveyed as present within the proposed modification area. However, the EA found that there is *potential* habitat for 24 threatened fauna species within the proposed modification area, including the Giant Burrowing Frog, Littlejohn's Tree Frog, Red-crowned Toadlet and Stuttering Barred Frog.

The EA and RTS both concluded that there would be no significant subsidence-related impacts to threatened flora or fauna species, including swamp vegetation in CCUS3 or other potential fauna habitat. In relation to CCUS3, the RTS refers to information gathered on swamps that have been undermined at the Dendrobium Mine. In particular, the end-of-panel reports for Dendrobium Area 3A have revealed that there had been no observable impacts to vegetation or fauna habitat within swamps and streams that had been undermined, even those swamps and streams that had experienced fracturing of bedrock.

The Department notes that some changes may take some considerable time to manifest, particularly if wet weather has provided a regular source of soil moisture, and in the absence of critical impacts such as a hot bushfire. Nonetheless, the Department is satisfied that it is unlikely that there would be any significant impacts to biodiversity as a result of the proposed modification, and notes that Gujarat is bound by an existing condition of approval that requires no more than negligible environmental consequences to threatened species, populations or their habitats, and EECs.

The Department has recommended conditions of approval requiring no more than negligible environmental consequences within CRUS1 and CCUS4, and the review of the existing Biodiversity Management Plan, which must be approved as part of the Extraction Plan process prior to the commencement of any future longwall mining.

5.5 Groundwater

The EA does not include a groundwater impact assessment specific to proposed Longwalls 4 and 5. Instead, it relies largely on a groundwater assessment prepared by GeoTerra for the Preliminary Works Project that considered the whole Wonga East mining area, including Longwalls 4 and 5. Although the model in the GeoTerra report was used to assess a larger area, the EA extrapolates certain predictions and parameters for the area of Longwalls 4 and 5. The EA also draws on monitoring of surface water and groundwater systems across the Southern Coalfield.

Many submissions raised concerns about the lack of groundwater monitoring data specific to Longwalls 4 and 5. In response to recommendations from OEH, SCA, NOW and DRE, Gujarat installed two piezometer boreholes (GW01 and GW01a) east of Longwall 4, with the aim of assessing the characteristics, particularly in relation to significant natural features including upland swamps and Cataract Creek.

GW01 was drilled approximately 220 m southwest of where Mount Ousley Road crosses Cataract Creek. A string of eight vibrating wire piezometers was installed in GW01. The hole is located in an area where the Bulli Seam has previously been mined and above a 150 m long by 190 m wide longwall goaf in the Balgownie Seam. Numerous fractures were observed within the overburden strata during drilling and through down-hole camera inspection.

The RTS and Addendum to the RTS include consideration of the additional subsidence monitoring data and deep groundwater monitoring data from GW01 and GW01a that became available during and after mining of Longwall 4. These documents concluded that the additional data does not invalidate the original assumptions and parameters set out in the EA.

Groundwater Systems

Groundwater systems within the vicinity of Longwalls 4 and 5 can be broadly defined as either shallow or deep. Shallow systems include soils and the underlying weathered bedrock on hill slopes, plateaus, swamps and the minor alluvial deposits associated primarily with Cataract Creek. Deep

systems involve consolidated rocks, comprising rock strata with a porous matrix (commonly sandstone units) sometimes enhanced by fracturing. These two types of groundwater systems are recharged by rainfall and runoff over geological time.

Shallow groundwater systems may be impacted by reservoir bed or surface cracking which can allow leakage into the mine goaf, as well as subsurface creek flow diversion and swamp impacts. This is important to consider since Longwalls 4 and 5 are located within a water catchment Special Area aimed at protecting Sydney's drinking water supplies. Where shallow groundwater systems constitute upland swamps, they are separately considered in detail in section 5.2.

Deep systems may be impacted by aquifer depressurisation and groundwater connectivity to mined goaves and to springs on the Illawarra Escarpment to the east. However, the deeper groundwater aquifers in the Southern Coalfield generally have high levels of salinity and are not very productive.

There are no registered bores within the Gujarat mining lease and no groundwater extraction is conducted from the private bores or wells in the vicinity of Longwall 4 or the proposed Longwall 5. The nearest private registered bore on the Woronora Plateau is a test bore at Appin Colliery, which is located approximately 4.9 km to the north. There are very minor productive supplies of groundwater within the Narrabeen Group lithologies, including the Bulgo Sandstone, which have significantly lower yielding aquifers when compared to the Hawkesbury Sandstone. The Bulgo Sandstone aquifers can contain salinities of up to 1500 mg/L.

Groundwater Predictions

The GeoTerra model predicts that groundwater inflow to NRE No 1's Wongawilli Seam workings would rise from 0.2 megalitres/day (ML/day) to 1.4 ML/day, if all longwalls in Wonga East (which includes Longwalls 1 to 11) were extracted. Gujarat has advised the Department that the volume of groundwater inflow to Longwall 4 did not vary significantly during extraction (ie there was no observable increase in groundwater make as a result of roof fracturing and collapse). The Bulgo Sandstone in the vicinity of Longwalls 4 and 5 has been previously subsided and fractured due to past workings and there may be a further depressurisation of groundwater in this unit of 10-20 m near the surface.

The model also predicts that flow in Cataract Creek will decline by approximately 0.07 ML/day, if these 11 longwalls in Wonga East were extracted. Although surface water flow would be slightly reduced due to increases in groundwater inflow, it would likely flow through subsurface fractures and emerge downslope as discharge into Cataract Creek or Cataract Reservoir. In this scenario, any water loss from Cataract Creek would be only temporary.

Groundwater Monitoring

SCT reports that monitoring results from GW01 indicate that there is a restriction to downward flow at a horizon between about 25 m and 45 m below the surface, within the top part of the Bulgo Sandstone. SCT believes that this is sufficient to restrict vertical groundwater flow to less than the recharge available. The SCT SIA also concludes that the vertical flow rate is likely to be relatively insignificant by comparison with rainfall recharge, but the magnitude of downward flow indicated by this profile depends on the hydraulic conductivity of the overburden strata.

Using data obtained from GW01, SCT has plotted a hydrostatic pressure gradient from 24 m below the surface, the elevation of the current standing water level in the bore (see **Figure 7** below). A hydrostatic pressure gradient represents the rate of increase in water pressure that would be expected in a connected body of water where there is no vertical flow, such as might be observed in the ocean for instance.

The SCT SIA also includes results from packer testing that indicates that the hydraulic conductivity of the Bulgo Sandstone in a horizontal direction, including the restricted flow horizon, ranges from about 1.2×10^{-8} metres/second (m/s) to 4×10^{-6} m/s. The hydraulic conductivity of the Stanwell Park Claystone in a horizontal direction is measured as being between 3×10^{-8} m/s and 5×10^{-9} m/s. These numbers are indicative, rather than definitive, but they do provide evidence of slow vertical groundwater flow within the Bulgo Sandstone.

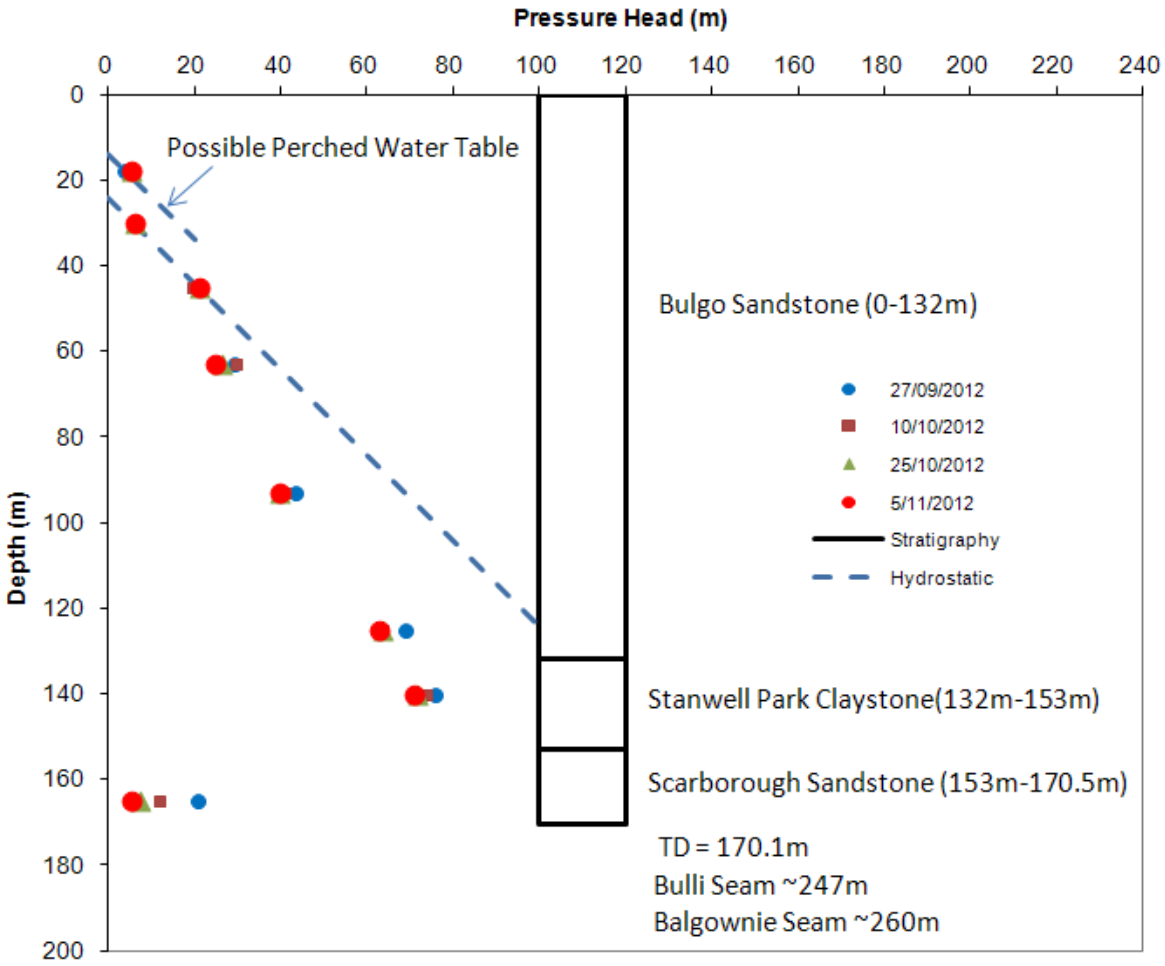

Figure 7 – *Pressure Profile Measured in Longwall 4 Borehole (GW01)*

Groundwater Management

The Department is satisfied that the proposed mining of Longwall 5 can be managed such that it would not result in any significant impacts on groundwater resources, and that existing conditions of approval are generally adequate to mange the risk of groundwater impacts.

Under the existing conditions of approval, Gujarat is also required to:

- obtain appropriate water licences from NOW for groundwater inflows to the mine;
- offset the loss of any baseflow to watercourses caused by the project;
- provide a compensatory water supply to any owner of privately-owned land whose water supply is adversely impacted as a result of the project; and
- develop a comprehensive Water Management Plan (WMP) for the project in consultation with relevant authorities, that includes an agreed:
  - groundwater monitoring program;
  - impact assessment criteria or trigger values; and
  - Surface and Ground Water Impact Response Plan.

Gujarat's recently-approved WMP does not address Longwalls 4 and 5. However, the Department has recommended conditions of approval that would require Gujarat to update its WMP to address the potential impacts of Longwalls 4 and 5, prior to mining Longwall 5. Other details of the WMP are discussed in sections 5.2 and 5.3. The Department notes that its recommended conditions require Gujarat to ensure the project has no more than negligible environmental consequences on key surface water resources, including Cataract Creek, Cataract Reservoir and upland swamps of special significance (such as CCUS4 and CRUS1). This is discussed in greater detail in sections 5.3 and 5.2.

5.6 Traffic and Transport

Mount Ousley Road Cracking

The Addendum to the RTS includes information concerning recent minor, subsidence-related, surface cracking which has occurred in the pavement of Mount Ousley Road, following the extraction of Longwall 4 (see **Figure 8**). Minor surface cracking has taken place at 4 locations near the top of the hill on Mount Ousley Road, up to approximately 700 m away from Longwall 4.

Routine visual inspections undertaken by Comms Network Solutions on behalf of Gujarat initially revealed the minor cracking on 9 October 2012. SCT then inspected the surface of Mount Ousley Road from south of Picton Road to Bellambi Creek in the north (see **Figure 9**). SCT correlated the results with subsidence monitoring undertaken at the recently completed Longwall 4.

The impacts on Mount Ousley Road are very minor and involve a minor amount of vertical subsidence (maximum 30 mm at a distance of 180 m from the edge of the Longwall 4 goaf, which is the closest approach of the road to the goaf). SCT considers that the cracking results from compressive strains caused by reactivation of the overlying goafs in the Bulli and Balgownie Seams following the extraction of Longwall 4. Gujarat has stated in its RTS that the surface cracking appears to be consistent with pre-existing goaf edges and geological structures. These points are locations at which variations in the imposed strain regime (as a result of the additional extraction) are most likely to be expressed.

As noted above, subsidence monitoring of Longwall 4 was two rather than three dimensional. The resulting data are not sufficient to determine whether the cracks also reflect far-field horizontal movements (ie the surface rocks have moved southwards towards the subsidence profile immediately above the extracted Longwall 4).

Figure 8 – *Photos of subsidence related surface cracking from Mount Ousley Road inspection*

The surface cracks observed are of a low magnitude (from 2-10 millimetres in width) and are considered to be not significant in the context of general wear and tear on the road surface. The Addendum to the RTS notes that there are much larger cracks evident along the edge of the road that are clearly associated with other factors including the settlement of the earth embankment above Cataract Creek. Gujarat has informed the RMS over the impacts, and RMS has reviewed the inspection reports. It accepts that the cracking is minor in scale and effect, and will repair them as part of its ongoing road maintenance program, at cost to either Gujarat or the Mine Subsidence Board.

The Department is satisfied that the cracking of Mount Ousley Road is very minor, does not affect the safety or serviceability of the road, and has been appropriately managed by Gujarat in accordance with the conditions of its existing approval. There is no reason to assume that more significant cracking may arise from extracting Longwall 5, since it is located further away from the road than is Longwall 4. However, it is not unlikely that additional cracks of a similar scale (or some minor re-activation of the recent cracks) may result from extraction of Longwall 5.

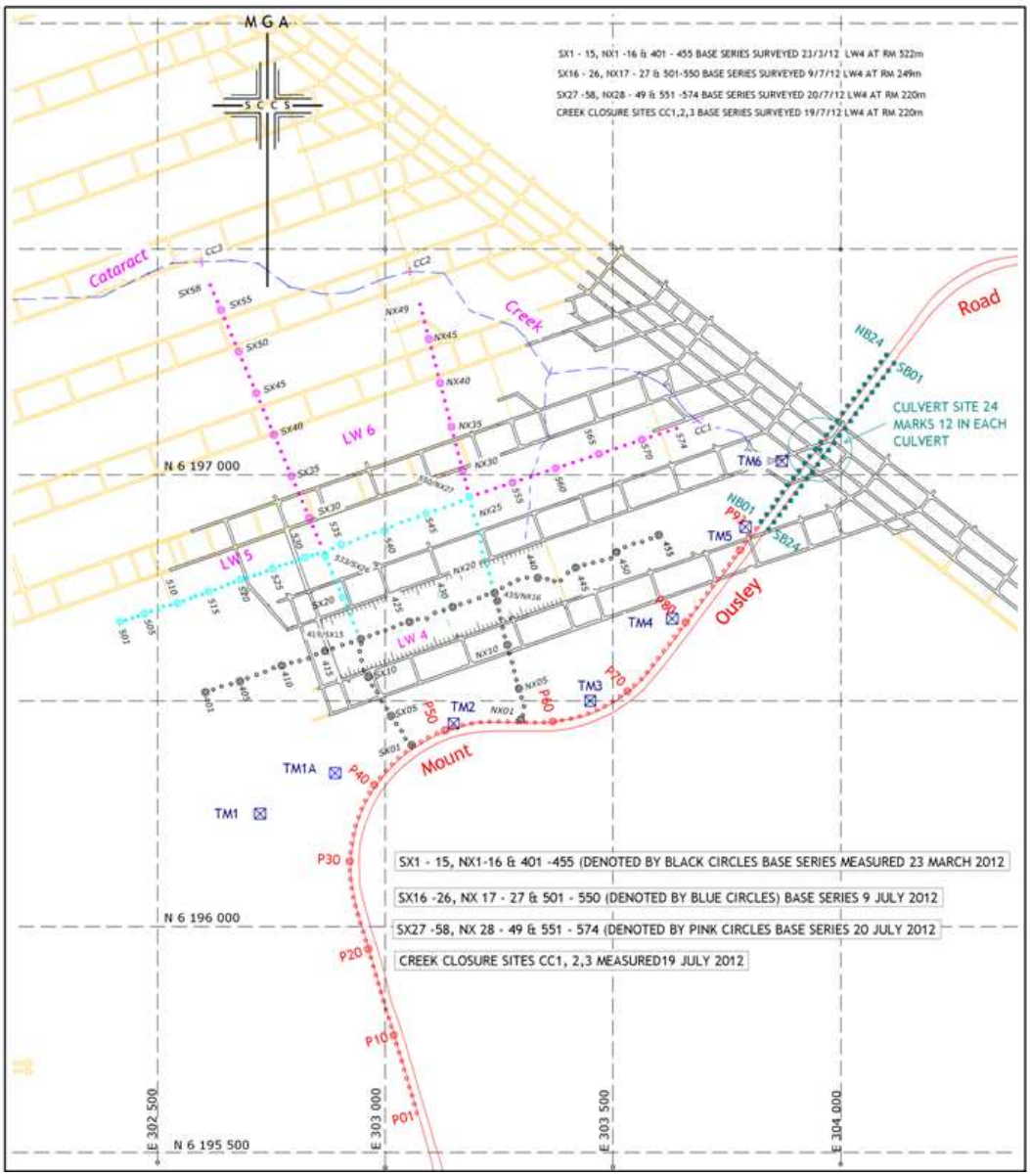

Figure 9 – *Site Plan Showing Location of Survey Monitoring Pegs along Mount Ousley Road*

Coal Trucking

A number of submissions raised concerns over the impacts of traffic associated with the operation of the surface facilities at NRE No. 1 and the delivery of coal for export from Port Kembla Coal Terminal. The Department notes that the proposed level of coal trucking would remain as per the approved project. Gujarat has also committed to continue to implement its approved Traffic Management Plan.

5.7 Other Minor Changes

Gujarat has sought a modification to its existing conditions of approval to delay the date by which its existing Bulli Conveyor must be decommissioned, which is currently by the end of 2012. The Department notes that Gujarat is currently experiencing financial difficulties and is satisfied that the noise criteria in the approval conditions can be met without decommissioning the conveyor by this date. For that reason, the Department has recommended conditions of approval requiring the decommissioning of the existing conveyor by the end of 2016.

Gujarat has also requested that the approval is modified to reflect three minor proposed changes to its 2010 Statement of Commitments, which form part of the existing conditions of approval.

Firstly, Gujarat has requested to delay the construction of its proposed Bellambi Creek diversion at its surface facilities site from October 2012 until the end of 2014, again due to the company's current

financial difficulties. The Department notes that the existing Bellambi Gully underground culvert is designed to carry up to a 100 year ARI (average recurrence interval) flood event. Gujarat has also informed the Department that is willing to carry the liability of clean-up costs associated with any rainfall event that leads to overtopping of the culvert and subsequent flooding and surface erosion. Given the relatively low risk of occurrence of such an event over the next 2 years, and Gujarat's admission of its liability, the Department accepts Gujarat's proposed change to the commitment to require the construction of the Creek diversion by the end of December 2014.

Secondly, Gujarat has requested to remove the commitment to construct two noise barriers that were part of its original application for the Preliminary Works Project. The Department notes that its acoustic specialist assessed these proposed barriers and considered them to be of little to no value in reducing actual or potential noise impacts. The Department accepts Gujarat's proposal to delete the construction of these barriers from its Statement of Commitments.

Thirdly, Gujarat has requested that its commitment to 'self-impose' a speed limit of 50 km/hour along Bellambi Lane be reframed to expressly apply only to coal transport trucks. The Department accepts that this commitment was never intended to be applied to cars and light vehicles driven by mine staff and that there may be some confusion about the application of this limit. The Department supports the proposed clarification of this commitment.

5.8 Socio-economic

The proposed modification would have a capital investment value of $20 million and would help retain approximately 330 jobs at the NRE No 1 mine. Gujarat has informed the Department that it needs to mine Longwall 5 to ensure the long-term viability of both NRE No. 1 and the NRE Wongawilli Colliery. Consequently, the continuity of employment of an additional 300 workers at the NRE Wongawilli Colliery may also be affected, if the modification is not approved. The vast majority of employees reside within the region, and the majority of payments to employees, suppliers and contractors are paid into the regional economy. The Department understands that if the modification application is not approved, there is a strong possibility that many, if not all of the current employees at both Gujarat mines may be left without work. This would have serious ramifications for employment within the Illawarra region both directly and indirectly.

5.9 Other Issues

Other environmental issues associated with the proposed modification are considered in **Table 1**.

Table 1: Other Issues

Issue	Potential impact and consideration	Conclusion and recommendation
Aboriginal and non-Aboriginal Heritage	• The EA includes an Aboriginal and Historic Heritage Assessment undertaken in 2010 by ERM for Gujarat's Underground Expansion Project. Biosis undertook ground-truthing and mapping in 2012 to specifically locate heritage sites near to Longwalls 4 and 5. • The assessment indicated that there are 8 heritage sites in close proximity to the proposed longwalls, of which one (Aboriginal axe grinding groove 52-3-0320) may be impacted as it is located directly above Longwalls 4 and 5. • However, the risk of impacts (eg cracking of sandstone platforms or tree falls) to this site is considered to be low, since the maximum predicted tensile strains are predicted to be low. • The EA also includes a Heritage Management Plan (HMP) that was submitted as part of the original SMP application for Longwalls 4 and 5. The HMP contains a TARP that provides management and mitigation measures relating specifically to site 52-3-0320, including archival recording and comparative photograph monitoring.	• The Department is satisfied with the level of assessment undertaken in relation to cultural heritage and the management and archival recording measures included in the TARP in the HMP. • The Department is satisfied that the project can be managed to avoid impacts to site 52-3-0320. • Nevertheless, the Department has recommended a condition of approval requiring a performance criterion of negligible impact at this site.

Air Quality and Greenhouse Gas Emissions	• Coal production volumes and associated numbers of truck transports would not be increased under the proposed modification.	• Gujarat has committed to continued implementation of its Air Quality and Greenhouse Gas Management Plan.
Waste	• The annual rate of production is as per the approved project.	• Waste mitigation would continue in accordance with existing conditions of the project approval.
Noise	• Production volumes, coal processing, surface activities and associated coal transport are as per approved project.	• Gujarat would continue to apply mitigation measures in accordance with the existing conditions of the project approval.

6 RECOMMENDED CONDITIONS

The Department has prepared recommended conditions of approval for the project (refer to **Appendix A**). These conditions are required to:

- prevent, minimise, and/or offset adverse impacts of the project;
- set standards and performance measures for acceptable environmental performance;
- ensure regular monitoring and reporting; and
- provide for the ongoing environmental management of the project.

A consolidated version of the conditions of approval is also attached in **Appendix H**.

Gujarat has reviewed and accepted the recommended conditions. The Department believes the conditions reflect current best practice for the regulation of underground coal mines in NSW. They appropriately reflect the concerns and proposals of other agencies, in accordance with the Department's policy.

7 CONCLUSION

In assessing this modification application, the Department recognises that there are some limitations in the information provided by Gujarat in support of its proposed extraction of Longwalls 4 and 5. There are also inherent uncertainties in the multi-seam mining environment proposed at NRE No. 1. Given these factors, the Department has given additional weight to the precautionary principle, risk minimisation and the potential for adaptive management. Notwithstanding these critical factors, it is important to note that the application would only lead to subsidence from a single, relatively short longwall panel, which was specifically designed with a narrow panel width and large chain pillars, and has also been significantly shortened to minimise potential impacts on key surface features. In that respect, Gujarat has adopted a very conservative mine design in order to substantially limit the potential for unpredicted environmental impacts on key surface features.

The Department considers that it is unlikely that there will be any significant subsidence-related impacts on the key surface features, including Cataract Creek, upland swamp CCUS4, one heritage site (52-3-0320) and biodiversity. The Department has included performance criteria in the recommended conditions of approval requiring no greater than negligible environmental consequences and/or subsidence impacts on these features.

The Department has also recommended conditions requiring the development of an Extraction Plan and review of the Water, Biodiversity and Heritage Management Plans, to both fully integrate them with the Extraction Plan and also to ensure inclusion of appropriate adaptive management and contingency measures. Each of these plans must be approved prior to commencing longwall mining.

The Department is also aware that Gujarat considers the current modification application to be essential for mine continuity, and ultimately the economic future of the mine and the company.

The Department has assessed the proposed modification in accordance with the relevant requirements of the EP&A Act, including the objects of the Act and the principles of ecologically sustainable development, and is satisfied that it is in the public interest and should be approved.

8 RECOMMENDATION

It is RECOMMENDED that the Planning Assessment Commission exercise the powers and functions delegated to it in the Minister for Planning and Infrastructure's Instrument of Delegation, dated 14 September 2011, and:

- **consider** the findings and recommendations of this report;
- **determine** that the proposed modification is within the scope of section 75W of the EP&A Act;
- **approve** the modification application, subject to conditions, under section 75W of the EP&A Act; and
- **sign** the attached notice of modification (Tagged A).

3/12/12

David Kitto
Director
Mining and Industry Projects

3/12/12

Richard Pearson
Deputy Director-General
Development Assessment and Systems Performance

APPENDIX A – Notice of Modification

APPENDIX B – Environmental Assessment (see attached CD)
APPENDIX C – Full Copy of Submissions (see attached CD)
APPENDIX D – Response to Submissions (see attached CD)
APPENDIX E – Agency Comments on Response to Submissions (see attached CD)
APPENDIX F – Addendum to Response to Submissions (see attached CD)
APPENDIX G – Amended SCT Report (see attached CD)

APPENDIX H – Consolidated Conditions of Approval