Dendrobium Mine

Environmental Management System

SCA Asset Protection Plan Revision 5 - Area 3B

(Longwalls 9 & 10 only)

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Review History

Revision	Description of Changes	Date
4-Draft 1	Updated to cover changes in the APP associated with Area 3A and the modified Development Consent. This revision now only covers SCA Assets	30 July 09
4-Draft 2	Updated to incorporate SCA comments and updated MSEC predictions	23 Oct 09
4-Draft 3	Updated to incorporate SCA comments	19 Feb 10
4-Draft 4	Updated with new Area 3A layout and incorporated SCA comments on Draft 3	7 April 10
4	Final Plan agreed to by SCA	14 April 10
5-Draft 1	Updated to cover changes in the APP associated with the inclusion of Area 3B (Longwalls 9 & 10 only)	8 August 2012

Document Approval

Authorising Officer (BHP Billiton Illawarra Coal)	Acceptance of APP (Sydney Catchment Authority)
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1 INTRODUCTION

Under section 75W of the Environmental Planning and Assessment Act 1979, the Minister for Planning modified the original consent for Dendrobium Mine on 8th December 2008. Within Schedule 3 of the modified Consent there is "Specific Environmental Conditions-Mining Area". These requirements require Subsidence Management Plans be prepared, as described in Condition 7; which supersedes original consent.

"Prior to carrying out any underground mining operations that could cause subsidence in either Area 3A, 3B or 3C, the Applicant shall prepare a Subsidence Management Plan (SMP) to the satisfaction of the Director-General and the Director-General of DPI. Each such SMP must:

(a) integrate ongoing management of Areas 1 and 2;
(b) integrate the Watercourse and Swamp Impact Monitoring, Management and Contingency Plans required under conditions 4 and 6;
(c) include monitoring of subsidence effects;
(d) include a SCA Assets Protection Plan;
(e) include monitoring, management, and contingency plans for all other significant natural features and all significant man made features which may be impacted by subsidence, including:

- *landscape (including cliffs and steep slopes);*
- *groundwater (see condition 13);*
- *terrestrial flora and fauna and ecology (including all threatened species assessed as being likely to be significantly affected by the development and their habitats);*
- *Aboriginal and other cultural heritage (see condition 12); and*
- *electrical, communications and other infrastructure;*

(f) be prepared in consultation with DECC, SCA and DPI;
(g) be approved prior to the carrying out of any underground mining operations that could cause subsidence in the relevant Area; and
(h) be implemented to the satisfaction of the Director-General and the Director-General of DPI.

Notes:
The SCA Assets Protection Plan required under this condition must also be prepared and implemented to the satisfaction of the SCA.
The contingency plans required under paragraph (e) must address remediation (as appropriate) and be based on a TARP structure."

1.1 PURPOSE

This plan aims to identify and minimise impacts on surface infrastructure caused by longwall mining in Areas 1, 2, (complete) 3A and 3B and where necessary, undertake remedial measures. The Plan has been developed to the satisfaction of the SCA, and in consultation with the SCA and relevant regulatory authorities.

Subsidence associated with longwall extraction has been identified as the most likely potential cause of adverse affects on surface structures. Most of the items of infrastructure lie outside the subsidence zone associated with the layout of

Longwalls 9 to 18 in Area 3B as described in Section 1.4. Some mining induced regional horizontal movements and valley closure may be expected, but the impacts from this have been assessed as being minimal.

Whilst the Plan Revision 5 has been developed for the subsidence effects associated with the Area 3B Longwalls, the Plan is still applicable for Areas 1, 2 and 3A. The Plan (and the associated Management Plans) will remain in effect for the life of Dendrobium Mine and until impacts after mining in Areas 1, 2, 3A and 3B are assessed as completed and impacts are rehabilitated to the satisfaction of the SCA, Dams Safety Committee (DSC), and the Department of Trade and Investment.

1.2 SCOPE

This Asset Protection Plan Revision 5 addresses mining-related subsidence impacts in relation to Dendrobium Area 3B,(for Longwalls 9 & 10 only) over and above the impacts due to Area 1, 2 and 3A , on items of man-made infrastructure as listed in Section 2. It is confined to surface infrastructure owned or controlled by SCA. The Plan includes consideration of dam walls and extends to the management of potential leakages of water contained in those reservoirs. The APP is still applicable for Areas 1, 2 & 3A and the Management Plan for those Areas is included as Appendix A, B, C and D of this Document.

It is ***not*** the objective of this Plan to address other potential sources of impact on man-made assets such as exploration, construction of surface facilities etc as these will follow existing approval processes and requirements.

It is ***not*** the objective of this plan to identify natural features such as creeks, steep slopes and flora and fauna as assets, nor to propose mitigation and remediation measures with regard to such features. These aspects are addressed in the other Dendrobium Management Plans, required by conditions of Schedule 3 of the modified development consent and are developed separately to this Asset Protection Plan.

1.3 DEFINITIONS

Assets	In relation to this Plan, "Assets" are items of Built Infrastructure, including dammed water bodies in the SCA Catchment Area, but excluding natural features and items of Archaeological significance.
CMH&SA	Coal Mine Health and Safety Act 2002
CMH&SR	Coal Mine Health and Safety Regulation 2006
DII	Department of Industry & Investment now referred to as T & I
DoP	Department of Planning
DPI-MR	Department of Primary Industries - Mineral Resources Division referred to DPI, DII and now referred to as T & I
DPI	Department of Primary Industries now referred to as T & I
DSC	Dams Safety Committee
T & I	Department of Trade and Investment.
SCA	Sydney Catchment Authority
Section 88 Application	An application made under Section 88 of the CMH&SR 2006 to mine a block of coal by methods other than the Bord and Pillar method.
SMP	Subsidence Management Plan (requirement of 2008 Development Consent conditions)
FSL	Dam Full Supply Level

It is understood that, for the purposes of defining the extraction zone of a longwall block(s) and the proximity of such a zone to the vertical projection of the FSL of a Reservoir that, for Dendrobium Mine, a 35^{o} angle of draw plus half the depth of cover represents 1.2 x depth of cover.

1.4 THE MINING AREA

The Dendrobium Mine will extract coal from the Wongawilli Seam using longwall mining techniques. Three separate groups of longwalls will be mined consecutively and these areas are referred to as mining Areas 1, 2 and 3 as indicated in Figure 2. Areas 1 and 2 have been mined. Area 3 consists of Area 3A, 3B and 3C. This Asset Protection Plan, Revision 5 extends the Plan to address issues related to Area 3B (for Longwalls 9 & 10 only).

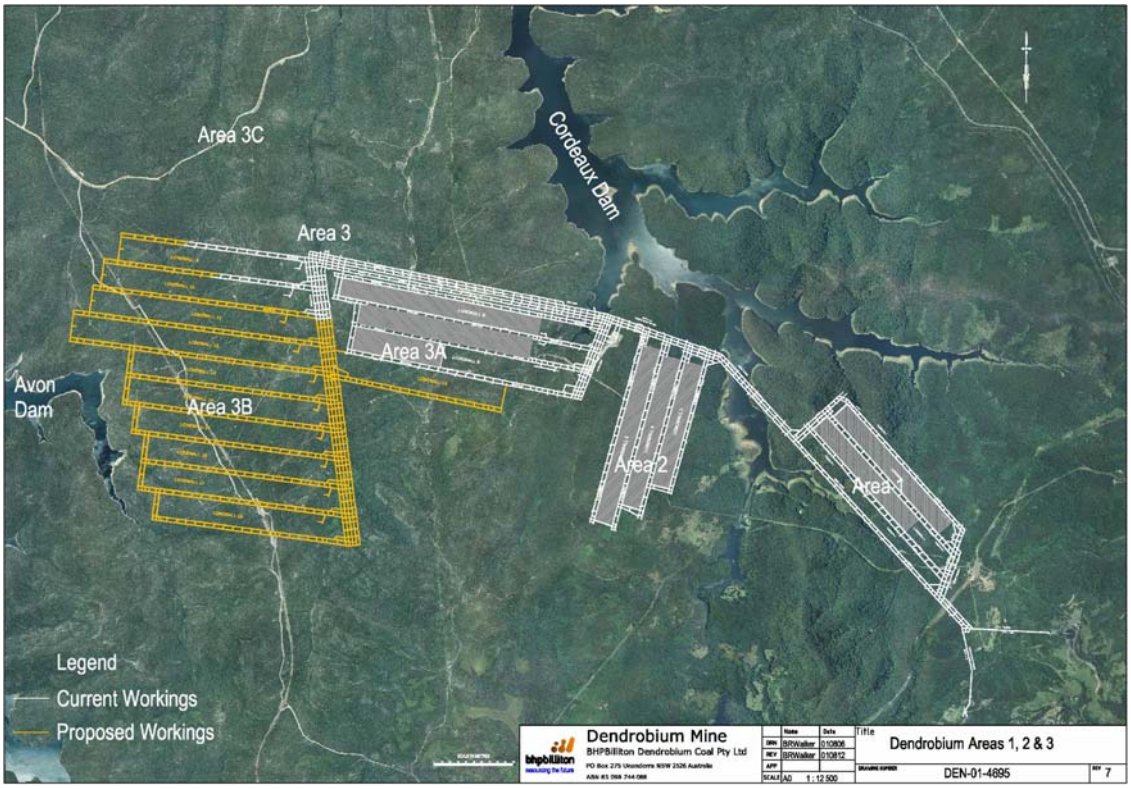
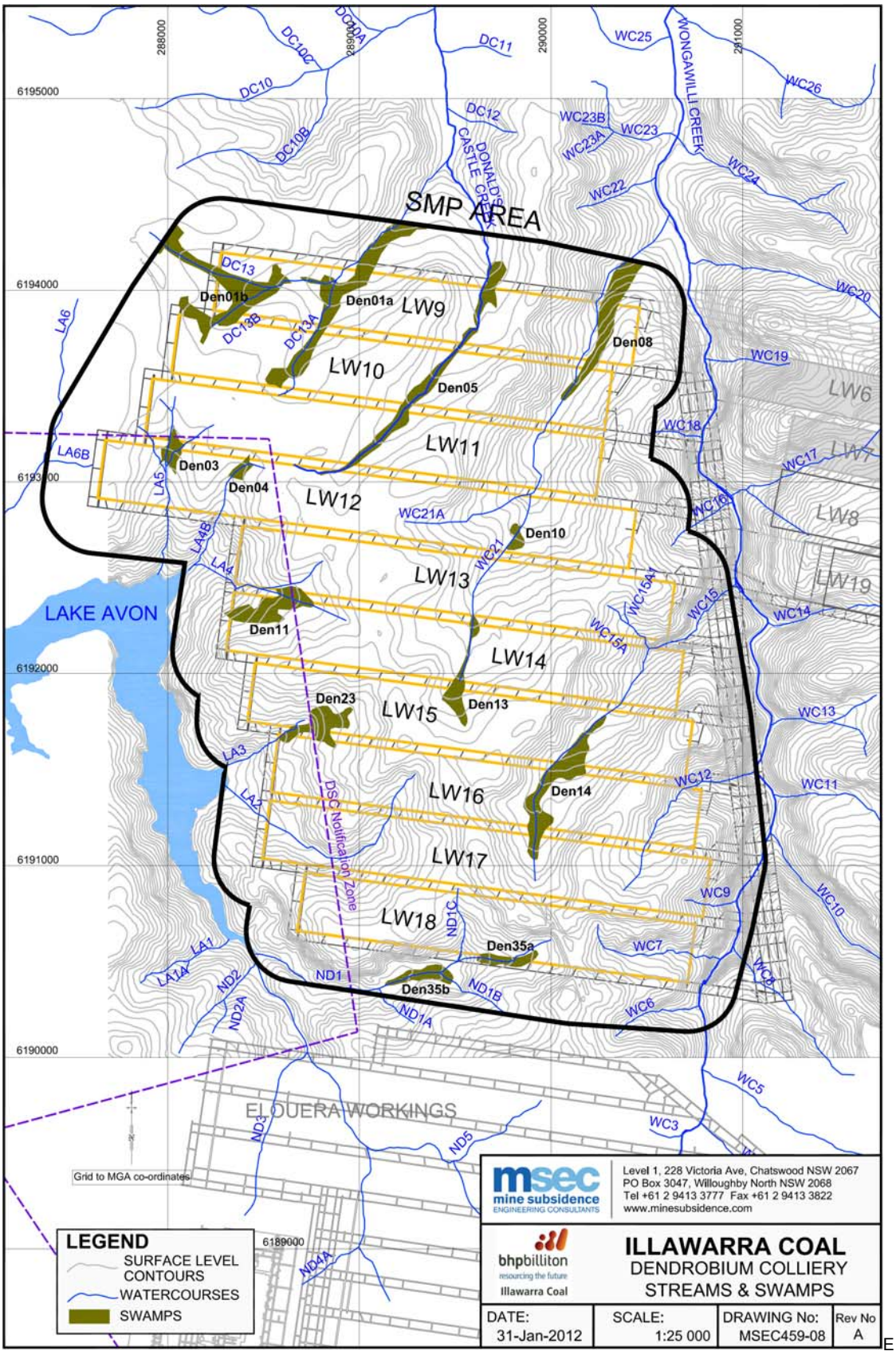


Figure 1: Dendrobium Mine Plan (August 2012)

Area 3B is located between the eastern side of Lake Avon and Wongawilli Creek with some of the area within the DSC Notification Area (Figure 2). The longwalls have been arranged to avoid longwall extraction under the Wongawilli Creek.

The mine plan shown in Figures 1 & 2 are consistent with the extraction areas for which the application has been made through the SMP process. At the appropriate time application will be made to the Dams Safety Committee for mining in the Lake Avon Notification Area. Figure 4 shows the location of the major infrastructure that will be affected by the mining in Area 3B.



Extract from drawing MSEC459-02

Figure 2: Layout of Longwalls 9 to 18 in Area 3B

The proposed layout of Longwalls 9 to 18 within the Wongawilli Seam in Area 3B is shown in Figure 2. A summary of the proposed dimensions of these longwalls are provided in Table 1.

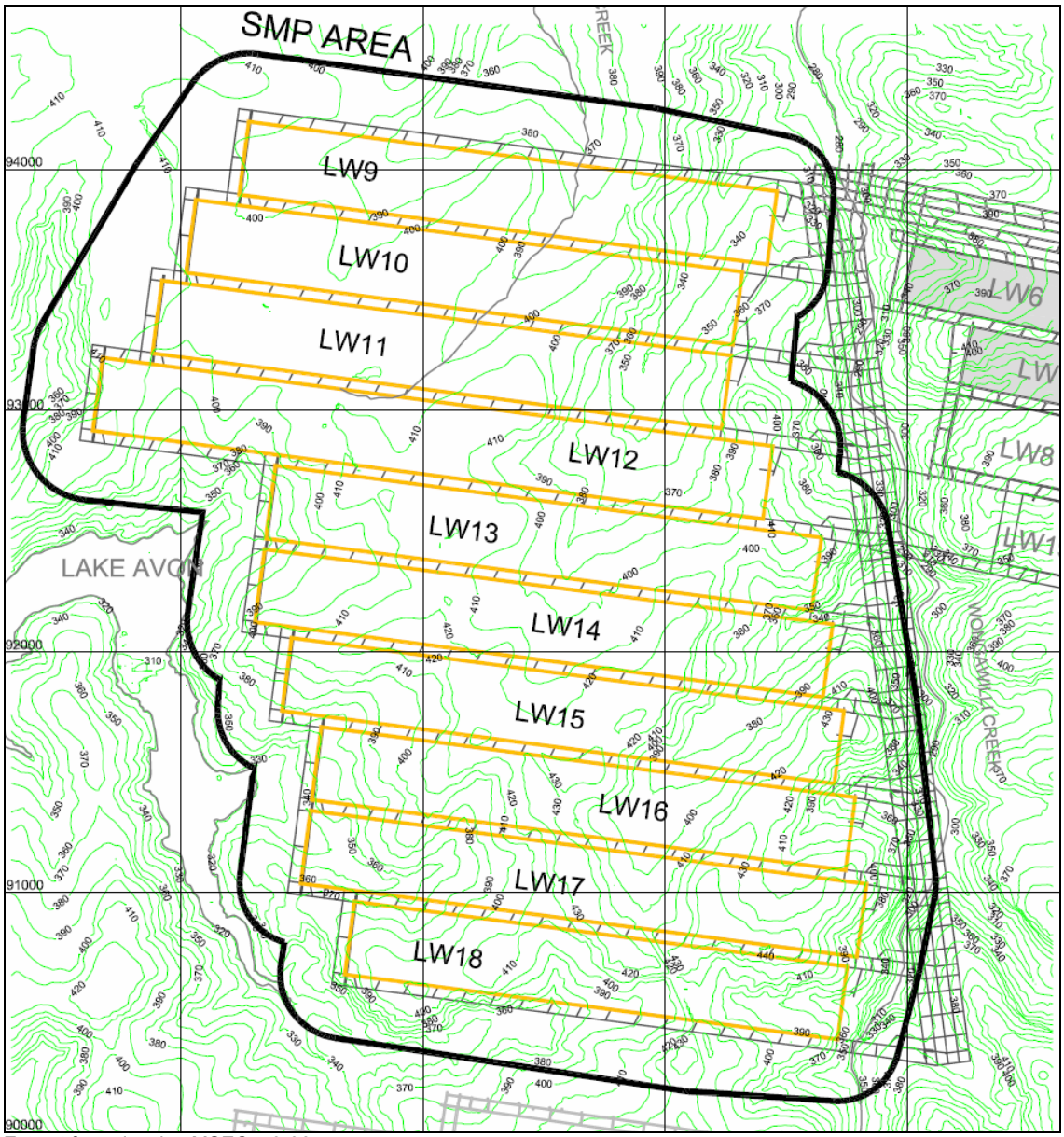
Longwall	Overall Length	Void Width including Headings (m)	Solid Chain Pillar Width (m)
Longwall 9	2200	305	-
Longwall 10	2280	305	45
Longwall 11	2370	305	45
Longwall 12	2790	305	45
Longwall 13	2275	305	45
Longwall 14	2365	305	45
Longwall 15	2300	305	45
Longwall 16	2225	305	45
Longwall 17	2315	305	45
Longwall 18	2055	305	45

Table 1 Proposed Dimensions of Longwalls 9 to 18 in Area 3B

The longwalls in Area 3B are proposed to be extracted from the Wongawilli Seam, which underlies the Bulli Seam by approximately 20 metres. The Bulli Seam is not proposed to be extracted in Area 3B. Accordingly, all the predicted systematic subsidence parameters provided in the report were made using single-seam conditions, rather than multi-seam conditions as was undertaken for parts of Area 1.

The depth of cover to the Wongawilli Seam within the General Study Area, referred to in report MSEC459 varies between a minimum of 310 metres, above the eastern end of Longwall 9 and a maximum of 450 metres above the eastern ends of Longwalls 17 and 18. The seam floor within the mining area generally dips from the south to the north, having an average dip of around 2%, or 1 in 50. The maximum seam dip is 10% or 1 in 10 which occurs locally in the south east corner of the mining area. Depth of cover contours are shown on Figure 3.

The Wongawilli Seam in Area 3B is nominally 10 metres thick and contains numerous bands of non-coal material. The economic section of the Wongawilli Seam is the basal 3 metres to 5 metres. IC has reviewed the nature of the banding in Area 3B and has proposed to extract a maximum height of 3.9 metres for Longwall 9 and a maximum height of 4.5 metres for Longwalls 10 to 18. To ensure roof and floor conditions are suitable for longwall mining operations, various bands within the coal seam are proposed to be targeted to achieve the overall extraction height.



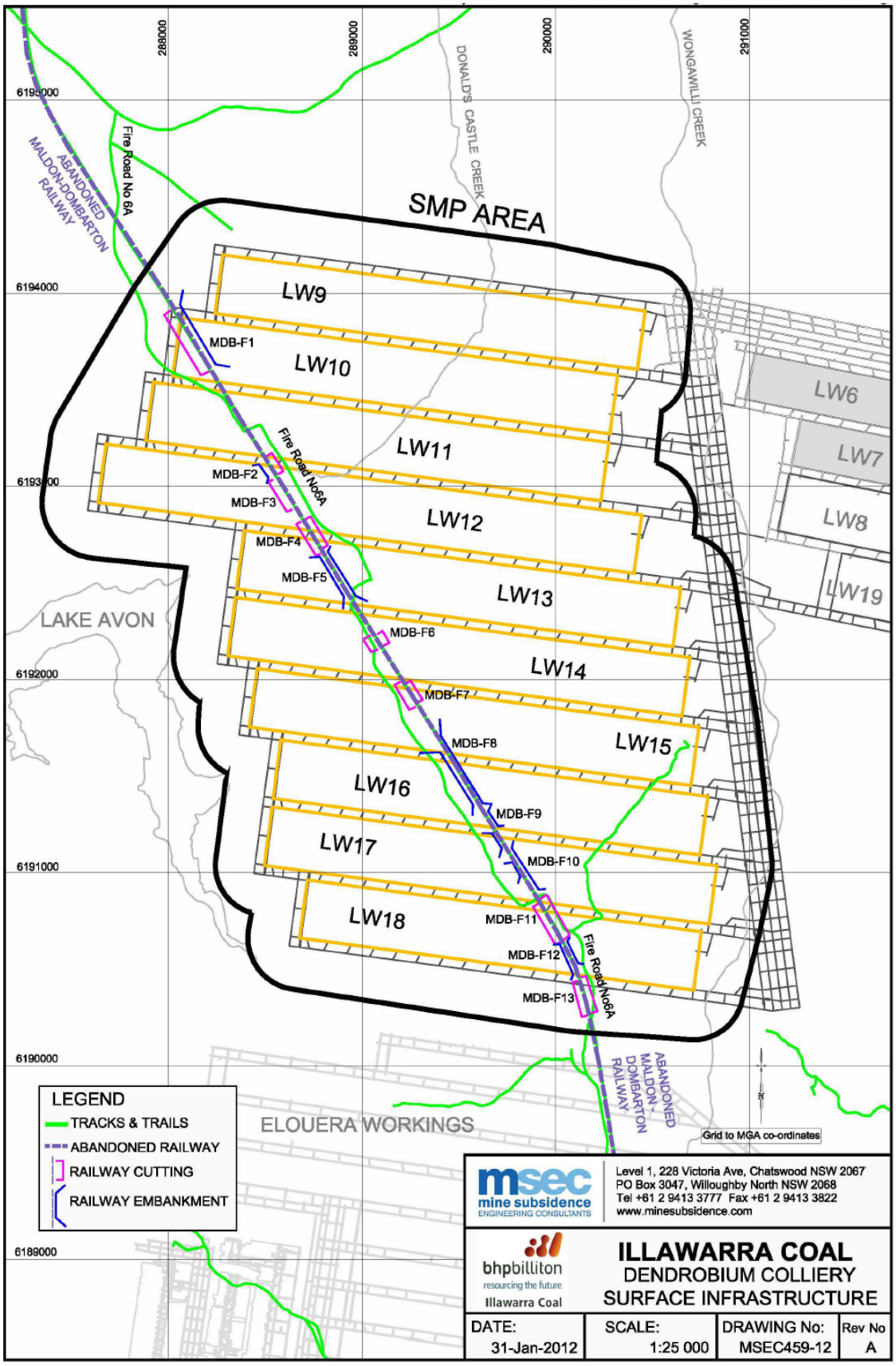
Extract from drawing MSEC459-06

Figure 3: Depth of Cover over Longwalls 9 to 18

Dendrobium Mine submitted a draft Subsidence Management Plan Application, in June 2012, for Area 3B, which is currently being reviewed by the regulators. The final SMP will be submitted later in 2012.

Dendrobium will submit an application to the Dams Safety Committee (DSC) in 2012 for the endorsement of the first workings and the extraction of Longwalls 11 to 18 within the Notification Area of Avon Dam.

The Dendrobium Mine underground workings lie underneath Sydney Catchment Authority land known as the Metropolitan Special Area which is zoned 7(a) Environmental Protection Special (Water Catchment). The infrastructure that is affected by the mining of Area 3B is shown on Figure 4.

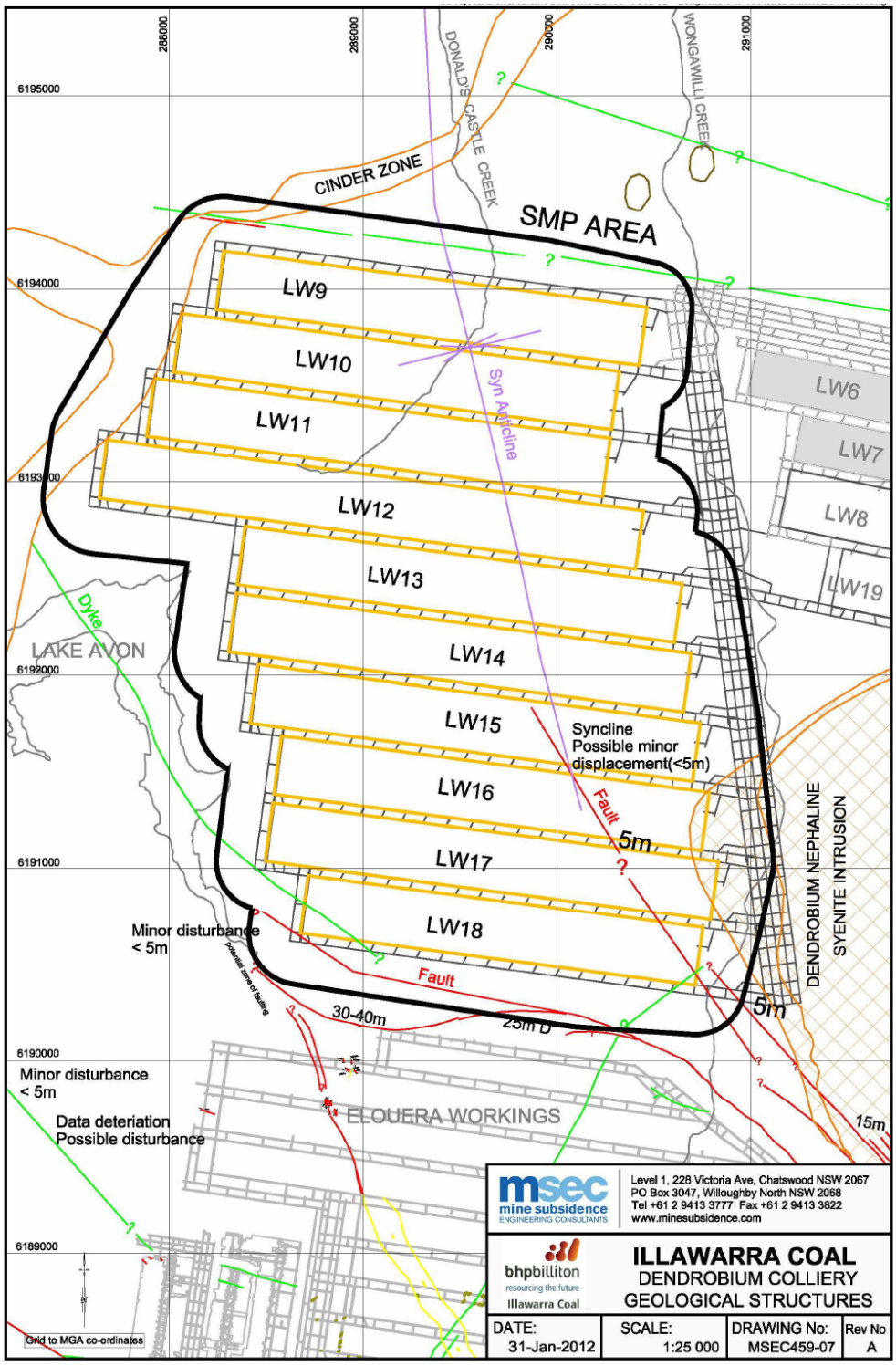


Drawing MSEC459-12

Figure 4: Items of Infrastructure in the Vicinity of Area 3B Longwalls

1.5 GEOLOGY

The geology of the Dendrobium Area was outlined in Chapter 1 of Report No. WKA77, which was included as Volume 2 of the EIS for the Dendrobium Mine Project. The geology mainly comprises sedimentary sandstones, shales and claystone of the Permian and Triassic Periods, which have been intruded by igneous sills. The major geological features in Area 3B are shown in Figure 5.



Drawing MSEC459-07

Figure 5: Geological Features in Area 3B

A generalised sedimentary stratigraphic section is shown in Figure 6. The sandstone units vary in thickness from a few metres to as much as 120 metres. The major sandstone units are interbedded with other rocks and, though shales and claystone are quite extensive in places, the sandstone predominates.

The major sedimentary units in the Dendrobium Area are, from the top down:-

- The Hawkesbury Sandstone,
- The Narrabeen Group, and
- The Illawarra Coal Measures.

The Narrabeen Group contains the Newport Formation (sometimes referred to as the Gosford Formation), the Bald Hill Claystone, the Bulgo Sandstone, the Stanwell Park Claystone, the Scarborough Sandstone, the Wombarra Shale and the Coalcliff Sandstone.

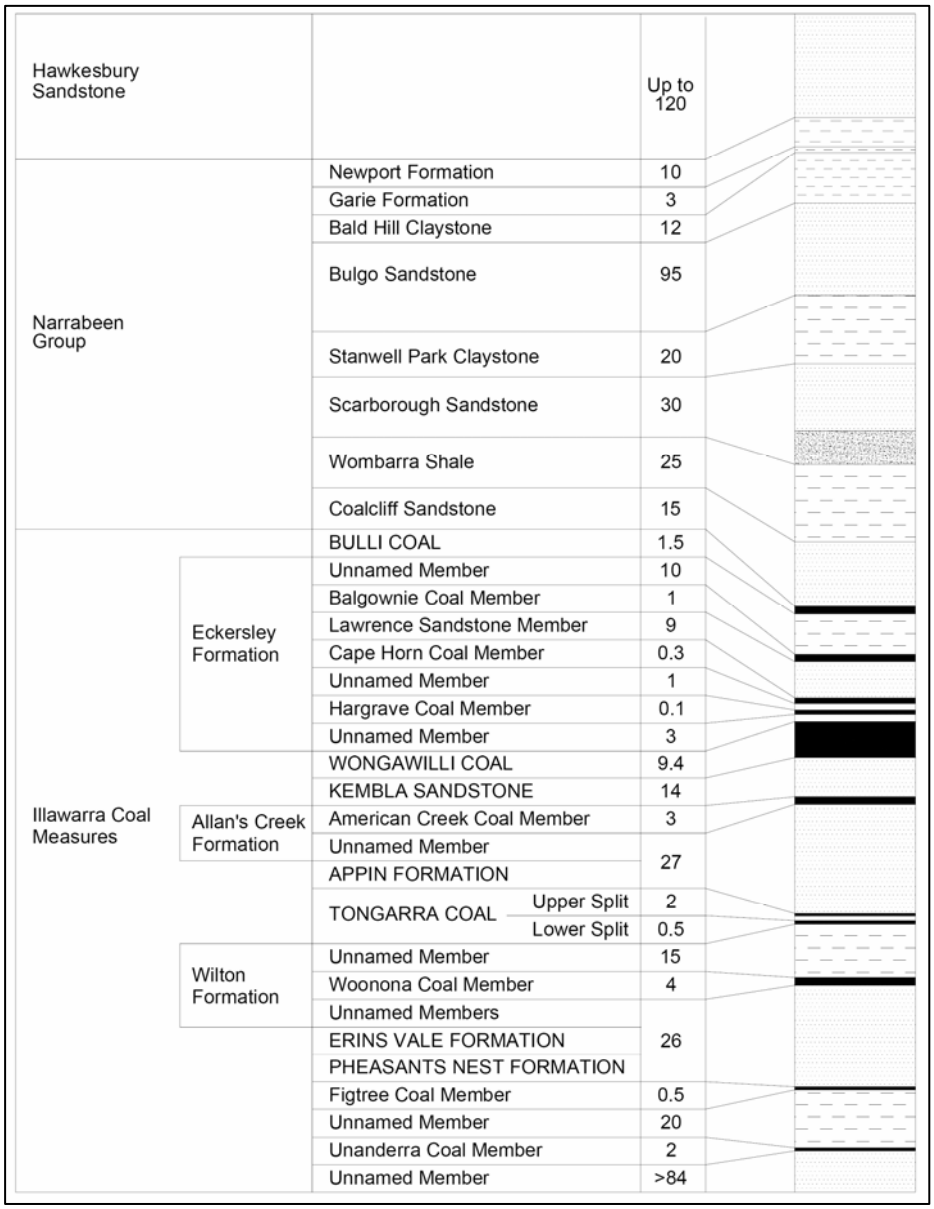


Figure 6: Generalised Stratigraphic Column (after Williams, 1979)

The Bulli Seam is the top unit in the Illawarra Coal Measures. The interval between the Bulli Seam and the Wongawilli Seam is known as the Eckersley Formation which consists of sandstones, shales and minor coal seams. The longwalls are proposed to be extracted from the Wongawilli Seam, which is located directly below the Eckersley Formation.

The major claystone units are the Bald Hill and Stanwell Park Claystones, which lie above and below the Bulgo Sandstone at the base of the Hawkesbury Sandstone. Due to the nature of the claystones, which swell when wetted, they tend to act as aquicludes or aquitards. The Wombarra Shale lies within the collapsed zone above the proposed longwalls and will be less effective in reducing vertical permeability.

There are several igneous structures within Area 3B with the most noteworthy igneous sill being the Nepheline Syenite intrusion, in the south-eastern part of the mining area, with the approximate location shown in Figure 5 Mapping of the sill will be refined as further geological investigations are undertaken using in-seam drilling. The extent of sill cannot be mapped using surface geophysical techniques and drilling from the surface has provided the present definition of the margin. Another sill and cindered zone have been identified north-west of the proposed longwalls.

Several geological structures have been identified at seam level in the vicinity of the proposed longwalls in Area 3B. A series of faults have been identified south of Longwall 18, between the proposed longwalls and the existing Elouera workings, having throws between 25 metres and 40 metres. Dykes have also been identified north, south-west and south-east of the proposed longwalls.

In common with the rest of the Southern Coalfield, the in-situ horizontal stresses at the Dendrobium Mine are relatively high. SCT Operations has reported that the maximum horizontal stress (σH max) is 14 MPa to 16 MPa at 200 metres depth of cover and 20 MPa to 24 MPa at 450 metres depth of cover. The maximum principal stress direction, based on borehole breakout data, is NE to SW (032° – 65° TN).

The rocks of the Hawkesbury Sandstone and the Narrabeen Group are of relatively low permeability and have a limited capacity to facilitate migration of water from the surface into the proposed mine workings. This capacity is further reduced by the relatively high level of in situ horizontal stress that is a feature of the Southern Coalfield. As mining occurs, the subsidence of the strata above the goaf areas can lead to some fracturing of the strata, which in turn can increase vertical permeability. This increased permeability is referred to as the fracture permeability. The fracture permeability decreases above the goaf due to confinement in the overlying strata.

The vertical permeability is reduced by the claystone layers, which, on exposure to water, tend to swell and seal any fractures, inhibiting the passage of water. Such layers are referred to as aquicludes or aquitards. If the claystone

layers are in the collapsed or fractured zones above the proposed longwalls, the fractures could be too large to be sealed by this process.

The Bald Hill Claystone is generally considered to be the most impervious aquiclude and any cracking that occurs in the strata above this layer will generally have little impact on the quantity of water migrating from the surface to the seam. The Bald Hill Claystone is present over virtually all of the proposed mining area and is located below the Lake Avon FSL.

Normally, in the Southern Coalfield, where the depth of cover to the seam is reasonably high and where the seam extraction height varies up to 4.5 metres, the fracturing of the strata does not form continuous paths from the surface to the seam and any cracks that might form tend to re-seal within the aquicludes.

1.6 SUBSIDENCE PREDICTIONS

Subsidence predictions for Dendrobium mining Area 3B were carried out by Mine Subsidence Engineering Consultants and reported in MSEC459 Revision A dated January 2012 which was included in the SMP application for Area 3B.

Extracts from that report state:
"The following paragraphs provide the maximum predicted conventional subsidence parameters resulting from the extraction of the proposed Longwalls 9 to 18. The predicted subsidence parameters and the impact assessments for the natural features and items of surface infrastructure are provided in Chapters 5 and 6.

The predicted subsidence, tilt and curvature have been obtained using the Incremental Profile Method, which has been calibrated for Dendrobium Mine, as described in Section 3.6, of the report. The predicted strains have been determined by analysing the strains measured at other NSW Collieries, where the longwall width-to-depth ratios and extraction heights are similar to those for the proposed longwalls.

The maximum predicted subsidence parameters and the predicted subsidence contours provided in this report describe and show the conventional movements and do not include the valley related upsidence and closure movements, nor the effects of faults and other geological structures. Such effects have been addressed separately in the impact assessments for each feature provided in Chapters 5 and 6 of the report.

1.6.1 Maximum Predicted Conventional Subsidence Tilt and Curvature.

The maximum predicted conventional subsidence parameters resulting from the extraction of the proposed longwalls were determined using the calibrated Incremental Profile Method, which was described in Chapter 3 of report

MSEC459. A summary of the maximum predicted values of incremental conventional subsidence, tilt and curvature, due to the extraction of each of the proposed longwalls, is provided." Refer Table 2

Longwall	Maximum Predicted Incremental Conventional Subsidence (mm)	Maximum Predicted Incremental Conventional Tilt (mm/m)	Maximum Predicted Incremental Conventional Hogging Curvature (km^{-1})	Maximum Predicted Incremental Conventional Sagging Curvature (km^{-1})
LW9	2050	25	0.5	0.6
LW10	2450	30	0.5	0.7
LW11	2500	30	0.6	0.7
LW12	2450	30	0.5	0.7
LW13	2250	30	0.5	0.7
LW14	2550	35	0.8	0.7
LW15	2450	30	0.5	0.7
LW16	2450	30	0.7	0.7
LW17	2700	40	0.9	1.0
LW18	2550	35	0.8	0.8

Table 2: Maximum Predicted Incremental Conventional Subsidence, Tilt and Curvature Resulting from the Extraction of Each of the Proposed Longwalls ***(Table 4.1 in report MSEC459)***

"The predicted total conventional subsidence contours, resulting from the extraction of Longwalls 9 to 18 are shown in Drawing No. MSEC459-14. A summary of the maximum predicted values of total conventional subsidence, tilt and curvature, after the extraction of each of the proposed longwalls, is provided" Refer Table 3.

Longwalls	Maximum Predicted Total Conventional Subsidence (mm)	Maximum Predicted Total Conventional Tilt (mm/m)	Maximum Predicted Total Conventional Hogging Curvature (km^{-1})	Maximum Predicted Total Conventional Sagging Curvature (km^{-1})
LW9	2050	25	0.5	0.6
LW10	2450	30	0.5	0.7
LW11	2550	30	0.6	0.7
LW12	2550	30	0.6	0.7
LW13	2550	30	0.6	0.7
LW14	2550	35	0.8	0.7
LW15	2600	35	0.8	0.7
LW16	2600	35	0.8	0.7
LW17	2700	40	0.9	1.0
LW18	2800	40	1.0	1.0

Table 3: Maximum Predicted Total Conventional Subsidence, Tilt and Curvature after the Extraction of Each of the Proposed Longwalls
(Table 4.2 in report MSEC459)

"The predicted tilts provided in the above table are the maxima after the completion of each of the proposed longwalls. The predicted curvatures provided in the above table are the maxima at any time during or after the extraction of each of the proposed longwalls.

The maximum predicted subsidence, after the completion of the proposed longwalls, is 2800 mm which represents around 61 % of the extraction height. The maximum predicted conventional tilt is 40 mm/m (i.e. 4 %), which represents a change in grade of 1 in 25. The maximum predicted conventional hogging and sagging curvatures are both 1.0 km-1, which represent minimum radius of curvature of 1 kilometre.

The predicted conventional subsidence parameters vary across the SMP Area as the result of, amongst other factors, variations in the longwall geometry and the depths of cover." Further details can be found in report MSEC459.

1.6.2 Predicted Strains.

"The maximum predicted conventional strains resulting from the extraction of Longwalls 9 to 18, based on applying a factor of 15 to the maximum predicted curvatures, are both 15 mm/m tensile and compressive.

At a point, however, there can be considerable variation from the linear relationship, resulting from non-conventional movements or from the normal scatters which are observed in strain profiles. When expressed as a percentage, observed strains can be many times greater than the predicted conventional strain for low magnitudes of curvature. In this report, therefore, we have provided a statistical approach to account for the variability, instead of just providing a single predicted conventional strain.

The range of potential strains above Longwalls 9 to 18 has been determined using monitoring data from Dendrobium Area 3A, as well as previously extracted longwalls in the NSW Coalfields where the mine geometries were reasonably similar to that for Dendrobium Area 3B. Two monitoring lines was adopted from Dendrobium Area 3A (SCW North and South Lines) and a total of 34 monitoring lines were adopted from the Hunter and Newcastle Coalfields. Comparisons of the longwall void widths, depths of cover, longwall width-to-depth ratios and extraction heights are provided." Refer Table 4*.*

It can be seen from the table, that the range of the longwall width-to-depth ratios used in the strain analysis was similar to but slightly higher, on average, than the width-to-depth ratios of the proposed Dendrobium Longwalls 9 to 18. The average extraction height for the longwalls used in the strain analysis was also similar to the extraction height for the proposed longwalls. The strain analysis, therefore, should provide a reasonable indication of the range of potential strains resulting from the extraction of Dendrobium Longwalls 9 to 18"

Parameter	Dendrobium Longwalls 9 to 18		Longwalls Used in Strain Analysis	
	Range	Average	Range	Average
Longwall Width	305	305	160 ~ 200	175
Depth of Cover	310 ~ 450	370	150 ~ 250	175
W/H Ratio	0.7 ~ 1.0	0.82	0.8 ~ 1.2	1.03
Extraction Height	4.6	4.6	3.8 ~ 4.8	4.5

Table 4: Comparison of the Mine Geometry for Dendrobium Longwalls 9 to 18 with the Longwalls from the NSW Coalfields used in the Strain Analysis.*(Table 4.3 in report MSEC459)*

1.6.3 Predicted Conventional Horizontal Movements.

The report MSEC459 explains this in more detail however notes "*The maximum predicted conventional tilt within the SMP Area, at any time during or after the extraction of the proposed longwalls, is 40 mm/m, which occurs adjacent to the maingate of the proposed Longwall 18. The maximum predicted conventional horizontal movement is, therefore, approximately 600 mm, i.e. 40 mm/m multiplied by a factor of 15".*

1.6.4 Predicted Far Field Horizontal Movements.

The report provides a lot of detail and concludes *"The predicted far-field horizontal movements resulting from the extraction of the proposed longwalls are very small and could only be detected by precise surveys. Such movements tend to be bodily movements towards the extracted goaf area, and are accompanied by very low levels of strain, which are generally less than survey tolerance. The impacts of far-field horizontal movements on the natural features and items of surface infrastructure within the vicinity of the SMP Area is not expected to be significant, except where they occur at large structures which are sensitive to small differential movements."*

2 MAJOR ITEMS OF INFRASTRUCTURE

Report MSEC459 notes the surface features, including man-made assets of interest to SCA that could be affected by the mining of Longwalls 9 to 18 in Area 3B. The scope of this Asset Protection Plan is confined to the following SCA items listed in that report, along with the stored water contained by the Avon and Cordeaux Reservoirs.

- Unsealed Roads
- Drainage Culverts.

Descriptions of these items are extracted from report MSEC459 and are presented in sections 2.1 to 2.2. The stored waters in Avon and Cordeaux Reservoirs are addressed in section 2.3.

2.1 UNSEALED ROADS

There are no public roads within the SMP Area. There are, however, unsealed fire trails and four wheel drive tracks within the SMP Area, which are used by the Sydney Catchment Authority (SCA) and other groups for fire fighting and other activities. The locations of the unsealed roads are shown in Figure 4.

2.2 DRAINAGE CULVERTS

There are small drainage culverts located across the SMP Area associated with the unsealed fire trails and four wheel drive tracks. The culverts comprise small concrete pipes which are located at the drainage line crossings. The drainage culverts could experience the full range of predicted subsidence movements.

2.3 STORED WATERS IN THE AVON AND CORDEAUX RESERVOIRS

There are two reservoirs partially located within the Study Area, being Lake Cordeaux and Lake Avon, the locations of which are shown in Figure 1. The Dams Safety Committee (DSC) Notification Areas for Lake Avon are also located within the Study Area, which is also shown in Figure 2.

Lake Avon, also known as the Avon Reservoir, is located to the west of the proposed Longwalls. The commencing ends of Longwalls 11 to 18 are located within the Dams Safety Committee (DSC) Notification Area for Lake Avon. A summary of the minimum distance of the perimeter of the reservoir from each of the proposed longwalls is provided in Table 5.

Longwall	Minimum Distance from the Full Supply Level of the Reservoir (m)
LW12	310
LW13	250
LW14	260
LW15	270
LW16	230
LW17	240
LW18	240

Table 5: Minimum Distances of the Proposed Longwalls from Lake Avon.*(Table 6.5 in report MSEC459)*

The setback of the proposed longwalls from the lake will be based on the outcomes of the groundwater model undertaken by Coffey Geotechnics. Lake Avon is fed by the Avon River and its many tributaries and has a length of approximately 19 kilometres. The Lake Avon water storage has a total operating capacity of approximately 147,000 ML.

Lake Cordeaux is located approximately 3 kilometres east of the proposed longwalls. At this distance, the lake is not predicted to experience any measurable mine subsidence movements. It is not expected, therefore, that the lake would experience any impacts resulting from the extraction of the proposed longwalls.

There are no dam structures or associated works within the SMP Area. The closest dam walls are the Cordeaux Dam Wall and the Upper Cordeaux No. 2 Dam Wall which are located approximately 5 kilometres north and 5 kilometres east, respectively, from the proposed longwalls. At these distances, the dam walls are not predicted to experience any measurable mine subsidence movements. It is not expected, therefore, that the dam walls would experience any impacts resulting from the extraction of the proposed longwalls.

3 SUBSIDENCE IMPACT ASSESSMENTS

Assessments 3.1 to 3.3 in this section have been extracted from subsidence report MSEC459 Revision A, dated January 2012, and provide the predicted subsidence parameters for items of surface infrastructure within the Study Area. Impact assessments have been made for items of surface infrastructure based on the predicted subsidence parameters. All significant items of surface infrastructure located outside the general Study Area, which may be subjected to far-field movements and may be sensitive to these movements, have also been included as part of these assessments.

It is possible for the actual subsidence parameters to be greater or less than those predicted for isolated features, depending on their relative position within the subsidence trough, so an additional factor of safety has been applied by taking the predicted maximum values of subsidence, tilt, curvature and strain within 20 metres of the perimeter of each feature. The predictions should, therefore, provide the best available indication of the overall subsidence parameters that are likely to be experienced by each feature.

3.1 UNSEALED ROADS

3.1.1 Predictions for Unsealed Roads

The unsealed roads are located across the SMP Area and, therefore, are expected to experience the full range of predicted subsidence movements. A summary of the maximum predicted values of total conventional subsidence, tilt and curvature for the unsealed roads, resulting from the extraction of the proposed longwalls, is provided in Table 6.

Location	Maximum Predicted Total Conventional Subsidence (mm)	Maximum Predicted Total Conventional Tilt (mm/m)	Maximum Predicted Total Conventional Hogging Curvature (km^{-1})	Maximum Predicted Total Conventional Sagging Curvature (km^{-1})
Unsealed Roads	2800	40	1.0	1.0

Table 6: Maximum Predicted Total Conventional Subsidence, Tilt and Curvature for the Unsealed Roads Resulting from the Extraction of the Proposed Longwalls 9 to 18. ***(Table 6.4 in report MSEC459)***

The predicted tilts provided in the above table are the maxima after the completion of any or all of the proposed longwalls. The predicted curvatures provided in the above table are the maxima at any time during or after the extraction of each of the proposed longwalls.

The maximum predicted conventional hogging and sagging curvatures for the unsealed roads and tracks, resulting from the extraction of the proposed longwalls, are both 1 km-1, which represents a minimum radius of curvature of 1 kilometre.

The maximum predicted conventional strains for the unsealed roads, based on applying a factor of 15 to the maximum predicted conventional curvatures, are both 15 mm/m tensile and compressive. The analysis of strains measured in the NSW Coalfields, for previously extracted longwalls having similar width-to-depth ratios and extraction heights as the proposed longwalls, is provided in MSEC459 Section 4.3.

Non-conventional movements can also occur and have occurred in the NSW Coalfields as a result of, amongst other things, anomalous movements and downslope movements.

3.1.2 Impact Assessments for Unsealed Roads

The maximum predicted conventional tilt for the unsealed roads, resulting from the extraction of the proposed longwalls, is 40 mm/m (i.e. 4 %), which represents a change in grade of 1 in 25. The predicted maximum tilt could result in some changes in the surface water drainage for the unsealed roads and tracks. Any changes would be localised and it would be expected that any adverse impacts could be remediated by locally regrading the affected sections of road or track. It is expected, at the magnitudes of predicted curvatures and strains, that cracking and heaving of the unsealed road surfaces would occur as a result of the extraction of the proposed longwalls. Examples of surface cracking and heaving along the fire roads above the previously extracted longwalls at Dendrobium Mine are provided report MSEC459 in Section 4.7. The unsealed roads in Dendrobium Areas 1, 2 and 3A were maintained in safe and serviceable conditions during mining using normal road maintenance techniques. It is expected, therefore, that the unsealed roads in Area 3B could also be maintained using similar remediation measures, including regrading and recompacting the unsealed road surfaces during mining.

3.1.3 Impact Assessment for the Unsealed Roads on Increased Predictions

If the actual tilts exceeded those predicted by a factor of 2 times, the maximum changes in grade at the unsealed roads would be 80 mm/m (i.e. 8 %), which represents a change in grade of 1 in 13. It would still be expected that the unsealed roads could be maintained in safe and serviceable conditions by remediating during mining using normal road maintenance techniques. If the actual curvatures or ground strains exceeded those predicted by a factor of 2 times, the likelihood and extent of cracking and heaving of the unsealed road surfaces would increase directly above the proposed longwalls. It would still be expected that any impacts could be managed and repaired using normal road maintenance techniques.

3.1.4 Recommendations

The unsealed roads will be visually monitored as the proposed longwalls mine beneath them, so that any impacts can be identified and rectified accordingly. IC will develop in consultation with the SCA, management strategies for the unsealed roads if impacts are observed. With these strategies in place, it is likely that the unsealed roads can be maintained in a safe and serviceable condition throughout the mining period.

3.2 DRAINAGE CULVERTS

There are small drainage culverts located across the SMP Area associated with the unsealed fire trails and four wheel drive tracks. The culverts comprise small concrete pipes which are located at the drainage line crossings. The drainage culverts could experience the full range of predicted subsidence movements, which are summarised in the report MSEC459 Chapter 4.

The maximum predicted tilt within the SMP Area of 40 mm/m (i.e. 4 %) represents a change in grade of 1 in 25. The predicted changes in grade could be of sufficient magnitude to affect the flow of water through the culverts in the location of maximum tilt. If the serviceability of any culverts were to be adversely affected, as a result of the extraction of the proposed longwalls, this could be easily remediated by relevelling the affected culverts.

The maximum predicted conventional strains for the drainage culverts, based on applying a factor of 15 to the maximum predicted conventional curvatures, are both 15 mm/m tensile and compressive. The predicted strains could be of sufficient magnitude to result in cracking in the concrete culverts. Any impacted culverts could be readily repaired or, where required, the culverts can be replaced.

3.3 LAKE CORDEAUX AND LAKE AVON

The locations of Lake Cordeaux and Lake Avon are shown in Figure 1. The predictions and impact assessments for the lakes are provided in the following sections.

Lake Cordeaux is located approximately 3 kilometres east of the proposed longwalls. At this distance, the lake is not predicted to experience any measurable mine subsidence movements. It is not expected, therefore, that the lake would experience any impacts resulting from the extraction of the proposed longwalls.

3.3.1 Predictions and Impact Assessments for the Avon Reservoir

Lake Avon is located at a distance of 230 metres from Longwall 16, at its closest point to the proposed longwalls. At this distance, the lake is predicted to experience conventional subsidence of less than 20 mm as the result of mining. While it is possible that the lake could experience subsidence slightly greater than 20 mm, it would not be expected to experience any significant conventional tilts, curvatures or strain.

The maximum predicted total upsidence and closure at Lake Avon, resulting from the extraction of proposed longwalls, are 50 mm and 100 mm, respectively, which occur where the lake is closest to the proposed longwalls. Whilst the predicted movements are small, it is possible that minor isolated cracking could occur in the bedrock, as has been observed in the Southern Coalfield up to 400 metres from previously extracted longwalls.

It is unlikely that any minor isolated cracking that occurs in the bedrock beneath the lake would result in any loss of water, as the depths of cracking resulting from valley related movements have been observed to be generally less than 10 metres to 15 metres (SCT, 2003 and Mills and Huuskes, 2004). Any minor isolated cracking in the bedrock beneath the lake is likely to be filled by the alluvial materials and not result in any water loss from the system. Furthermore, there is unlikely to be an impact on water quality in the lake, as a result of fracturing in the bedrock, as there would be no continuous flow paths through these fractures.

A cross-section through Lake Avon and Longwall 16, where the lake is located closest to the proposed longwalls, is shown in Figure 7. It can be seen from this figure that the stored water in the lake is located outside the 35 degree angle of draw line from the proposed longwalls.

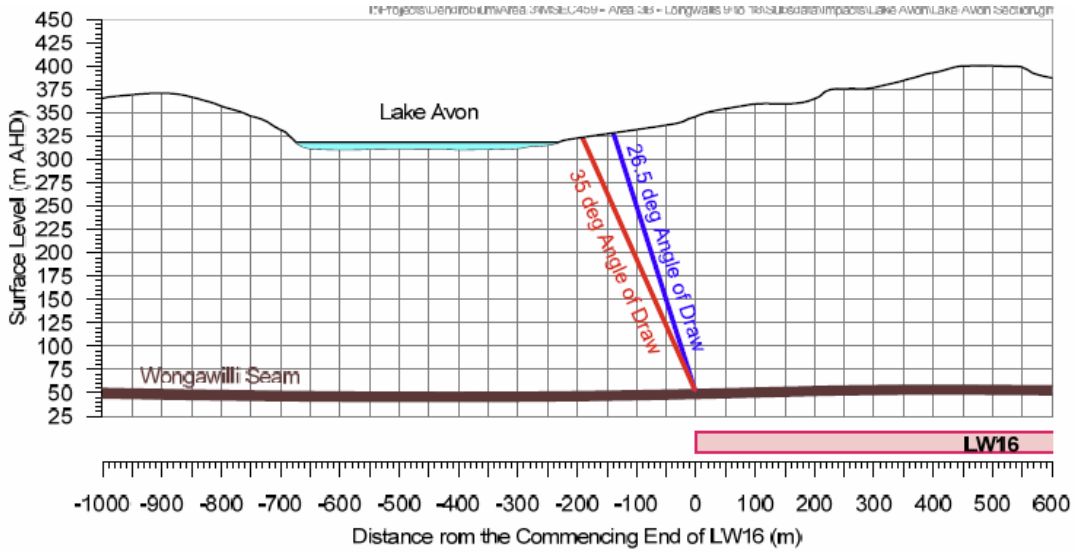


Figure 7: Cross-Section through the Lake Avon and the Proposed Longwall 16. ***(Figure 6.6 in report MSEC459)***

Directly above the proposed longwalls, there is likely to be a significant increase in the conductivity of subsurface water in the strata within the collapsed zone and, to a lesser extent, within the fractured zone. These zones are located well inside the 26½ degree angle of draw lines from the goaf edges of the longwalls.

Outside the collapsed and fractured zones, there is unlikely to be a significant increase in the conductivity of subsurface water in the strata. A detailed assessment of the potential impact of the proposed mining on the conductivity of subsurface water has been undertaken by Coffey Geotechnics.

3.3.2 Impact Assessment for the Reservoir based on Increased Predictions

If the actual subsidence at Lake Avon exceeded the prediction by a factor of 5 times, the maximum predicted subsidence would still be less than 20 mm and, therefore, would still not be significant.

If the actual upsidence and closure movements exceeded the predictions by factors of 2 times, it is possible that more significant cracking could occur in the bedrock beneath Lake Avon, within 400 metres of the proposed longwalls. Any cracking resulting from the valley related movements would still be expected to be less than 15 metres in depth and unlikely, therefore, to result in loss of water from the lake. A detailed assessment of the potential impact of the proposed mining on the conductivity of subsurface water has been undertaken by Coffey Geotechnics.

3.3.3 Recommendations for the Reservoir

IC will consult with the SCA and DSC in relation to management of any potential impacts on Lake Avon. In addition, appropriate management strategies will be developed and implemented to ensure that there is no unacceptable water loss from the lake. With these management strategies in place, it is unlikely that there would be any significant impacts on the lake resulting from the proposed mining.

Monitoring, Contingency and Closure Management Plans have been developed and endorsed by the Dams Safety Committee for the Cordeaux Reservoir and have been and are being used for Areas 1, Area 2 and Area 3A. Discussions are taking place with the Dams Safety Committee in relation to updating the Management Plans, to mainly revise the Contingency TARP levels, and reflect Area 3B operations. These plans will form the foundation of the documents that will be developed for the Avon Reservoir.

3.3.4 Risk Assessments and Management Plans

There have been risk assessments carried out for mining in Area 1 and 2 by HMS Consultants and for Area 3A SMP by AXYS Consulting in August 2007 (Refer Attachment H of the SMP Application for Area 3 dated October 2007) During these assessments inflow mechanisms and initiators were identified for the primary risk issues, being water storage loss from the reservoir.

Potential failure mechanisms assessed as being credible, which may lead to such a loss of water were identified. Controls were identified for each potential hazard and these formed the basis of the Management and Action Response Plans that direct operations within Area 1, Area 2 and Area 3A to limit losses from the Cordeaux Reservoir to within limits imposed by the DSC. These are described by the DSC as “Tolerable Loss of Dam Water” and are a loss of more than 1ML/day long-term and 2ML/day short-term (for the Cordeaux Reservoir).

These Plans are:

- ***The Cordeaux Dam Notification Area - Inrush Management Plan DENMP0005.*** This Plan addresses all issues concerning potential Inrush into Dendrobium Mine, one of which is related to surface waters. It is considered that surface waters do not constitute a credible Inrush hazard ie "water flow of such high volume and delivery rate as to put personnel and/or mine equipment or workings at risk" (refer IMP, Section 1.5). Rather, this source has greater potential to seep or flow into the mine resulting in long-term losses rather than a safety-related hazard.

- ***The Cordeaux Dam Notification Area - Monitoring Management Plan DENMP0003.*** This Plan defines the monitoring undertaken to assess the volume and provenance of the water entering the mine, specifically to understand if water from the dam is reporting to the workings.

- ***The Cordeaux Dam Notification Area - Contingency Plan DENMP0049*** This Plan defines the remedial actions to be taken should seepage or inflows from Cordeaux Reservoir exceed pre-defined levels. The Contingency Plan is based on key criteria of acceptable short and long term loss of water from the reservoir that was determined by the SCA and DSC.

- ***The Cordeaux Dam Notification Area - Closure Plan DENMP0030.*** This Plan defines the strategy and details relating to the construction and monitoring of seals within the mine in the event of :

  ◊ The need to seal the mine at the completion of operations or
  ◊ The need to seal the mine upon failure of the Inrush Management Plan provisions to control an inrush, or
  ◊ The need to seal the mine upon failure of the Contingency Plan provisions to control inflows from the Cordeaux Reservoir below limits set by the DSC.

These Plans were in place and endorsed by the DSC for Area 1, Area 2 and Area 3A operations.

These Plans have been consolidated into one document to simplify it and at the same time include information on Area 3B. The Dams Safety Committee will consider this document later in 2012.

- ***The Cordeaux Dam Notification Area – DSC Management Plans DENMP0072 Revision 0 – Draft 3***

Discussions are taking place with the Dams Safety Committee in relation to mining in the Avon Reservoir DSC Notification Zone which is expected to occur in early 2014. A hydrological model for Area 3B is presently being developed and when completed will assist the risk assessment that is being arranged for the mining of Area 3B. It is expected that the risk assessment will be carried out

later in 2012 and form an important part of the Plans required for Lake Avon. At this stage it is expected that similar arrangements will be used for the Avon Reservoir that are used for the Cordeaux Reservoir, or potentially the two plans will be combined to manage the issues associated with both Reservoirs.

4 PREVENTATIVE AND REMEDIAL MEASURES

4.1 MEASURES APPLYING TO ITEMS OF SCA INFRASTRUCTURE

For the layout of longwalls described in this document for Area 3B, the impacts on the listed assets will be minimal. Except for the fire trail and access tracks directly overlying the longwalls, subsidence will be virtually nil and any movements will be limited to regional horizontal displacements. Table 7 summarises the subsidence impacts and associated proposed preventative or remedial measures.

Table 7: Summary of Subsidence Impacts with Associated Preventative or Remedial Measures.

SCA Infrastructure	Subsidence Impacts	Reference: MSEC459 RevA	Management Strategy
Unsealed Roads	• Maximum predicted subsidence along typical Fire Trails 6A, 6N & 6Q of 2800mm. • Maximum predicted travelling tilt along typical Fire Trails 6A of 40mm/m.	Ch. 6.2.2	• Actions will be carried out in accordance with the "Subsidence Landscape Monitoring Management Plan" and associated TARP document. This will include o Visual monitoring during extraction of LW 9-18 o Conduct initial baseline survey and monitor condition of road as mining occurs. o Repair and/or minor regrading as appropriate and necessary as mining occurs. As specified in SLMMP TARP

SCA Infrastructure	Subsidence Impacts	Reference: MSEC459 RevA	Management Strategy
Stored Waters in Avon and Cordeaux Reservoirs (DSC)	• Lake Cordeaux is not expected to experience any impacts. • Predicted to experience subsidence in Area 3B of < 20mm • Maximum Predicted total upsidence in Area 3B will be 50mm near LW16 • Maximum Predicted total closure in Area 3B will be 100mm near LW16	Ch. 6.13.2 to Ch 6.13.4 Risk Assessment related to the Potential Impacts of Mining on Avon Reservoir will occur prior to entering the DSC notification Zone.	• Liaise with the asset owners and DSC and address under the provisions of the Management Plans (see below). These will include Monitoring, Contingency and Closure Plans including Trigger Action Response Plans (TARPs).

The impacts of subsidence on man-made surface features and infrastructure, due to mining the proposed longwalls, are considered to be manageable. With proper management plans in place all items of surface infrastructure can be maintained in a safe and serviceable condition throughout and after the mining period.

4.2 MONITORING

Monitoring is a significant measure to be undertaken in relation to surface Asset protection during the life of Dendrobium Area 3B. Monitoring will be conducted according to the provisions of the separate SCA Assets Management Plans specified in Section 4.3 (and detailed as Appendices A, B and C) and to the standards that will be defined within the DSC Consolidated Management Plan. The Monitoring section of the Plan will define all monitoring to be conducted and the Contingency section define the frequency of monitoring related to detecting and quantifying dam water inflows and the triggers that increase that particular monitoring frequency.

4.3 SCA ASSETS MANAGEMENT PLANS

Details of items of infrastructure along with predicted subsidence effects and monitoring and preventative and/or remedial measures (including monitoring) to be undertaken are detailed in individual SCA Assets Management Plans developed in consultation with SCA. The individual Plans are:

1. SCA Assets (Including Stored Waters) for Area 1 and 2 (as documented in Revision 3 of the Asset Protection Plan) – Appendix A. The actions specified in this Plan have been completed pending DSC endorsement of cessation of the remaining Area 2 monitoring.
2. SCA Assets (Including Stored Waters) for Area 3A (as documented in Revision 4 of the Asset Protection Plan) – Appendix B

3. SCA Assets (Including Stored Waters) for Area 3B- Appendix C

For Area 1, 2 and 3A BHP Billiton has fulfilled the requirement to liaise with the SCA owner and provide details of 'Predicted Movements', 'Predicted Impacts', proposed 'Monitoring' and 'Mitigatory or Preventative Measures' proposed to be undertaken. This process is currently being undertaken for Area 3B.

5 MASTER AGREEMENT

A Master Agreement letter has been sent to SCA by BHP Billiton specifically for the development of Area 3A and Area 3B roadways and the extraction of Longwall 8 and Longwall 9, similar to that developed in relation to preceding longwalls. They provide that SCA will be financially protected against mining impacts. It also provides for heritage values to be protected in accordance with heritage approvals. The current letter is in place until March 2013 at which time they will be updated if necessary. Negotiations are taking place between BHPB Illawarra Coal and SCA to develop Umbrella and Master Agreements to cover all Illawarra Coal operations that impact on Sydney Catchment Authority assets. When those agreements are completed they will supersede the current arrangements.

6 QUALITY ELEMENTS

6.1 AUDIT REVIEW AND REPORTING

The provisions described in this plan will be reviewed and the results of the review may be used to initiate a revision of the Asset Protection Plan.

The Asset Protection Plan will be audited within the BHPB Management System (which is nominally every 3 years).

An audit report will be prepared and submitted to SCA and DSC and other regulatory authorities as appropriate. The plan will be reviewed following each audit and updated as required to incorporate new information from studies and monitoring carried out and to incorporate any audit findings and recommendations.

Regular meetings will be held between BHP Billiton, SCA and the DSC to review the progress of the mining related activities that may impact on the surface assets described in this Plan.

Copies of all reports to the DSC required by this or related plans shall be separately forwarded to the SCA. The Monthly report (including the compliance report) will be emailed to the SCA Group General Manager, Assets and Projects.

6.2 BHPBIC PERSONNEL RESPONSIBILITIES

Dendrobium General Manager

The General Manager will ensure that the resources required by this Plan are provided as and when required by the Manager of Mining Engineering and/or any other Official with defined responsibilities.

Dendrobium Manager of Mining Engineering

The Manager of Mining Engineering will:

- Ensure that the onsite preventative, remedial and quality provisions of this Plan are conducted and reported as required by personnel competent to conduct each task.
- Ensure that elements of the Inrush Management Plan regarding 'Monitoring of Workings' are completed according to DSC approval requirements Annexure D, Section IV.
- Ensure that the Manager Infrastructure remains advised of the progress of the longwall and relevant monitoring results which may have effects on surface assets.

Manager Infrastructure

The Manager Infrastructure will:

- Be BHP Billiton's Authorising Officer for this Plan.
- Attend liaison meetings with SCA on a regular basis to review the progress of all mining related activities, which may impact on the SCA infrastructure and discuss and assess those impacts.
- The Illawarra Coal's representative to provide liaison and notification of monitoring results (including anomalies) to SCA.
- Advise the Manager Subsidence Engineering if there is mining related impacts on the SCA infrastructure.
- Participate in any review and amendment of the Plan.
- Ensure the subsidence surveys and monitoring requirements on surface infrastructure are carried out in accordance with the requirements of the Plan.

Manager Subsidence Engineering

The Manager Subsidence Engineering will:

- Attend liaison meetings with DSC to review the progress of all mining related activities, in relation to relevant DSC approval condition.
- Be Illawarra Coal's representative to provide regular reports and notification of monitoring results (including anomalies) to DSC
- Participate in any review and amendment of the Plan.
- Ensure data, records and reports relating to the Plan are forwarded to relevant parties and kept in accordance with the provisions of the Plan.
- Be a member of the DSC water monitoring team which meets regularly
- Shall advise the Manager Infrastructure and or the Manager of Mining Engineering of any issues in relation to the Plan that require their attention or action.

6.3 RECORD KEEPING AND CONTROL FOR RELIABILITY

It is imperative that the processes defined within the Asset Protection Plan can be demonstrated as being effective over time in the protection of surface man-made structures and the water within the Avon and Cordeaux Reservoirs from the effects of mining operations in Dendrobium Area 1, Area 2, Area 3A and Area 3B.

To do this a history needs to be established of normal operation, the circumstances identified by monitoring that indicated any subsidence-related adverse affects on surface structures problems and corrective actions implemented that were applied to bring the system back under control.

Data derived from subsidence monitoring will be archived and stored for a period of at least 5 years.

Reports containing information relating to monitoring, inspections and observations, relevant correspondence, notification and approvals, records of communication, particularly with statutory authorities, audit reports and review recommendations shall be maintained for a period of at least 2 years.

Reports relating to any remedial actions taken in relation to surface structures or the stemming of flows from Avon or Cordeaux Reservoir shall be kept by the Manager of Mining Engineering for a period of at least 5 years.

Illawarra Coal utilises the BHP Billiton Information Management Policy, 2007. The ongoing use of “Documentum” will ensure the appropriate retention period for the data.

6.4 DOCUMENT CONTROL

The Asset Protection Plan shall be controlled as part of the Illawarra Coal Document Control System.

Modifications to the content of The Plan or the standards and procedures that are referenced by the Plan may occur as a result of the auditing and review process, the assessment and implementation of a corrective action or as a result of system improvements or modifications. The Manager Subsidence Engineering shall approve all modifications and amendments to the Plan or associated documentation

The Manager Infrastructure shall delegate, to an appropriately qualified person, the responsibility to document any changes to the Plan, decide the personnel who are to receive Controlled copies of The Plan and its associated standards and procedures.

The Plan forms part of the SMP documentation which requires approval by the, Department of Trade and Investment and Department of Planning.

The Manager Infrastructure shall delegate, to an appropriately qualified person, the responsibility to document any changes to the Plan, decide the personnel who are to receive Controlled copies of The Plan and its associated standards and procedures.

6.5 DOCUMENT HISTORY AND DISTRIBUTION

History

Revision	Date	Description
Drafts A to H	To 19/11/04	Versions – for consideration of the SCA
0	9/03/05	Initial – for SCA Approval of Area 1
1	28/4/05	Finalised Plan incorporating modifications to gain SCA endorsement
2-Draft 1	26/10/06	Update to incorporate LW 2 extension and mining of Area 2 and results of audit carried out after completion of Longwall 1
2-Draft 2	22/2/07	Incorporate SCA comments received 1/2/07
2	15/3/07	Finalised Plan incorporating SCA comments received 14th March 2007
3-Draft 1	18/7/08	Revised to incorporate changes to Area2 LW layout including the addition of LW 5A and the recommendations of the audit carried out after LW 2 & 3
3-Draft 2	20/11/08	Revised to incorporate the shortening of Longwall 5 and the removal of the proposed Longwall 5A.
3	28/11/08	Finalised Plan covering Areas 1 and Area 2 incorporating SCA comments received 27/11/08
4-Draft 1	30/7/09	Plan revised to cover Area 3A Longwalls 6 to 10 Previous Area still covered by Revision 3
4-Draft 2	23/10/09	Plan updated to incorporated comments provided by SCA
4-Draft 3	19/2/10	Plan updated to incorporated comments provided by SCA
4-Draft 4	7/4/10	Plan updated to incorporated comments provided by SCA on Draft 3 and modified Area 3A layout
4		Finalised Plan covering Area 3A
5-Draft 1	3/8/12	Plan revised to cover Area 3B Longwalls 9 to 18.

Distribution

Copies of this Plan will be serviced with amendments. As these are agreed and approved they will be provided to:

1. The Dams Safety Committee
2. The Sydney Catchment Authority
3. Manager Subsidence Engineering
4. Manager Infrastructure
5. Dendrobium General Manager
6. Dendrobium Manager of Mining Engineering

Any other copies will not be serviced automatically with amendments and persons utilising such copies must be mindful to ensure that they have the most up-to-date version before they apply any provisions.

In addition SCA will be provided with an electronic copy of the current Plan and all the Appendices.

7 ASSOCIATED DOCUMENTATION AND REFERENCES

1) Consent Conditions for Dendrobium Underground Coal Mine.
Determination of Development Application Pursuant to Sections 76(A)9 & 80
File No. S00/01177

2) Consent Conditions for Dendrobium Underground Coal Mine.
Notice of Modification pursuant to Section 75W, dated 8th December 2008

3) Environmental Assessment: Dendrobium Coal Mine-Modification of Consent (Area 3A) Department of Planning November 2008

4) Dendrobium Mine, Environmental Management System, Asset Protection Plan Area 1 and 2, DENMP0040 Revision 3 dated 28/11/08

5) The Cordeaux Dam Notification Area - Monitoring Management Plan DENMP0003 - Rev 10 dated 6/4/10.

6) The Cordeaux Dam Notification Area - Contingency Plan DENMP0049 - Rev 5 dated 22/2/11.

7) The Cordeaux Dam Notification Area - Closure Plan DENMP0030 – Rev 4 dated 6/4/10.

8) Dendrobium Mine, Environmental Management System, Asset Protection Plan Area 3A, DENMP0040 Revision 4 dated 14/4/10

9) Dendrobium Area 3B –Longwalls 9 to 18
Subsidence Management Plan Application; June 2012(Draft)

   a) *Volume 1* *Written Report-November 2007*

   b) *Volume 2* *Subsidence Management Plan*

   c) *Volume 3* *Approved Plans*

   d) *Attachment A* *Mine Subsidence Engineering Consultants Report MSEC459 Revision A, dated January 2012.*

   e) *Attachment B* *Surface and Shallow Groundwater(Ecoengineers, 2011)*

   f) *Attachment C* *Groundwater (Coffey Geotechnics, 2012)*

   g) *Attachment D* *Terrestrial Ecology (Niche Environment and Heritage, 2011)*

   h) *Attachment E* *Aquatic Ecology (Cardno Ecology Lab, 2011)*

   i) *Attachment F* *Cultural Heritage (Biosis, 2011)*

   j) *Attachment G* *Community Consultation Documents*

Appendix B

Management Plans
for Area 3A

APPENDIX "B" -- SCA Assets Management Plan for Area 3A

Asset Item	Predicted Movement	Predicted Impacts	Monitoring		Mitigatory or Preventative Measures
			Type	Frequency	
Cordeaux Dam	• Unlikely to be subject to any significant systematic or valley related movements. • Unlikely to be subjected to any significant far-field horizontal movements.	Negligible	Nil	Nil	Nil
Upper Cordeaux No2 Dam	• Less than 2mm subsidence-survey tolerance • Expected to be less than Area 1 • Area 2 LW expected to redistribute any in situ horizontal stress	Negligible.	• SCA to carry out normal dam surveillance.	As Required	• Nil
Fire Trails (6C and 6F) and 4WD tracks	• Predicted subsidence up to 2275mm • Predicted Travelling Tilt 21mm/m • Predicted Travelling Tensile strain 4.5mm/m • Predicted Travelling Compressive Strain is 11mm/m.	• Some potential for cracking in unsealed surfaces of roads. • Some potential for bucking and cracking in topmost bedrock.	• Visual inspection by IC personnel. • Additional visual inspections by asset owner.	• Pre mining survey of roads to be carried out. • In accordance with SMP s19.5. ie nominally 6mthly increasing to monthly during active subsidence areas.(ie 100m in front of LW to 400m behind) • Resulting from any reports	Repairs and/or minor regrading as applicable and as necessary as mining occurs.

Items of Historical and Heritage Significance. (not including Dam Walls) at the Upper Cordeaux No 2 Dam site.	• Unlikely to be subject to any significant systematic or valley related movements. • Unlikely to be subjected to any significant far-field horizontal movements.	• Negligible	• Nil	• Nil	• Nil
Stored Waters in Cordeaux Reservoir	• Max. Predicted Subsidence of lake <20mm. • Max Predicted Upsidence 20mm at LW 6 to 120mm at LW 10. • Max predicted closure of 50mm at LW 6 and 180mm at LW 10. • Potential for water losses from Cordeaux Reservoir, where considered to be credible, are assessed generally as 'low' to 'very low'.	• Predicted systematic subsidence <20mm • Possible minor isolated cracking in bed of Lake. Potential Inflow mechanisms and likely initiating circumstances have been identified. The risk issues related primarily to storage loss from the reservoir.	As per DSC Monitoring and DSC Contingency Plan provisions.	The frequency and triggers for monitoring are included in the DSC Contingency Plan.	Dendrobium has developed : • Inrush Management Plan, • DSC Contingency Plan, • DSC Closure Plan and • DSC Monitoring Plan to address the issues relating to the potential for leakage of Cordeaux Reservoir stored waters.

APPENDIX "C" -- SCA Assets Management Plan for Area 3B

Asset Item	Predicted Movement	Predicted Impacts	Monitoring		Mitigatory or Preventative Measures
			Type	Frequency	
Unsealed Roads (Fire Trails 6A, 6N & 6Q)	• Maximum predicted subsidence up to 2800mm • Maximum predicted Travelling Tilt along fire trails of 40mm/m	• Some potential for cracking in unsealed surfaces of roads. • Some potential for bucking and cracking in topmost bedrock.	• Actions will be carried out in accordance with the "Subsidence Landscape Monitoring Management Plan" and associated TARP document approved as part of the SMP process. This will include o Visual monitoring during extraction of LW 9-18	• Conduct initial baseline survey and monitor condition of road as mining occurs. Refer SLMMP • In accordance with Subsidence Landscape Monitoring Management Plan approved as part of the SMP	Repair and/or minor regrading as appropriate and necessary as mining occurs. As specified in SLMMP TARP
Drainage Culverts	• Could be experience full range of predicted subsidence movements • Maximum predicted tilts could be 40mm/m • Maximum Predicted curvatures are both 15mm/m tensile and compressive	• Some potential for changes in culvert gradient. • Some potential for cracking in concrete culverts	• Actions will be carried out in accordance with the "Subsidence Landscape Monitoring Management Plan" and associated TARP document approved as part of the SMP process. This will include o Visual monitoring during extraction of LW 9-18	• Conduct initial baseline survey and monitor condition of road as mining occurs. Refer SLMMP • In accordance with Subsidence Landscape Monitoring Management Plan approved as part of the SMP	Repair and/or minor regrading as appropriate and necessary as mining occurs. As specified in SLMMP TARP

APPENDIX "C" -- SCA Assets Management Plan for Area 3B

Asset Item	Predicted Movement	Predicted Impacts	Monitoring		Mitigatory or Preventative Measures
			Type	Frequency	
Stored Waters in Avon Reservoir	• Max. Predicted Subsidence of lake <20mm. • Max Predicted Upsidence 50mm at LW 1. • Max predicted closure of 100mm at LW 16. • Unlikely to any significant impacts on the lake from proposed mining. (MSEC459).	• Predicted systematic subsidence <20mm • Possible minor isolated cracking in bed of Lake. Potential Inflow mechanisms and likely initiating circumstances have been identified for Lake Cordeaux and need to be .reviewed for Lake Avon.	Will be as the agreed DSC Management Plans provisions which are currently being developed and will be agreed to prior to entering the Avon DSC notification zone.	The frequency and triggers for monitoring will be are included in the DSC Consolidated Management Plan for the Avon Reservoir.	Dendrobium will update/develop and agree on the following: Inrush Management Plan, DSC Consolidated Management Plan which will incorporate Monitoring, Contingency and Closure Requirements to address the issues relating to the potential for leakage of Cordeaux Reservoir stored waters.