SECTION 8

Summary of Mitigation Measures

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8 SUMMARY OF MITIGATION MEASURES

In accordance with the SEARs, this section provides a consolidated summary of South32's commitments in relation to mitigation, management and monitoring activities for the Project.

Section 8.1 describes general Project environmental management, Section 8.2 lists key specific environmental management measures and monitoring. Section 8.3 describes adaptive management measures while Section 8.4 describes relevant environmental reporting for the Project. Section 8.5 provides a reconciliation of the Project's mitigation measures and monitoring against the IEP's recommendations.

8.1 PROJECT ENVIRONMENTAL MANAGEMENT

Section 6 of this EIS outlines proposed environmental mitigation, adaptive management, monitoring and offset measures for the Project.

These include measures relating to land resources, groundwater, surface water, biodiversity, road transport, Aboriginal heritage, historic heritage, noise, blasting, air quality, visual character, social impact, regional and NSW economic impact, greenhouse gas emissions and hazard and risk.

Section 7 of this EIS describes the approach to rehabilitation, and how surface disturbance areas (including those disturbed by Project subsidence impacts) would be rehabilitated and remediated for the Project. The Biodiversity Offset Strategy for the Project is described in Section 6 of this EIS.

The Dendrobium Mine currently operates in accordance with its EMS, which comprises a number of monitoring and management plans for underground and surface operations. These existing monitoring and management plans at the Dendrobium Mine would be reviewed accordingly to address the Project activities.

Subsidence performance measures and mining constraints would be detailed in Extraction Plans for the Project, along with monitoring, mitigation, adaptive management and contingency measures.

Table 8-1 presents a proposed list of management plans for the Project. Management plans relating to underground operations would be included as part of Extraction Plans for the Project, and would be progressively updated as mining progresses.

It is recognised that changes to the Project environmental mitigation, adaptive management, monitoring and reporting proposed in the EIS may be considered necessary during further consultation with government agencies in the assessment and approval process of the Project, as well as incorporating adaptive management for the Extraction Plans for the Project.

Project environmental mitigation, adaptive management, monitoring and reporting will be conducted in accordance with the finalised Development Consent conditions and associated licences and approvals, with the final monitoring details (locations, parameters and frequencies) to be provided in the relevant management plans and monitoring programs for the Project.

8.2 KEY SPECIFIC ENVIRONMENTAL MITIGATION MEASURES AND MONITORING

Key environmental management measures and commitments to be implemented for the Project include:

- management of potential Project subsidence impacts and associated consequences to natural and built features, which would be included in Extraction Plans for the Project;
- compensation for predicted surface water losses from the Metropolitan Special Areas;
- appropriate licensing of water take;
- water quality improvement actions;
- biodiversity offsets for upland swamps and other listed species and communities; and
- the company-wide South32 Climate Change Strategy, which compliments the Paris Agreement.

The key environmental management measures and commitments are described in the sections below, with reference to the relevant sections of this EIS where further detail is available.

Table 8-1
Summary of Project Management, Mitigation, Monitoring and Reporting

Proposed Management, Monitoring and Reporting	Key EIS Sections and Appendices
Mining Area – Plan to be Incorporated into Extraction Plans	
• Strategic Biodiversity Offsets	Section 6.8 and Appendix D
• Watercourse Impact Monitoring, Management and Contingency Plan	Section 6.7 and Appendix D
• Swamp Impact Monitoring, Management and Contingency Plan	Section 6.8 and Appendix D
• Groundwater Monitoring Program	Section 6.5 and Appendix C
• Aboriginal Heritage Management Plan	Section 6.10 and Appendix F
• WaterNSW Asset Protection Plan	Section 6.3
• Monitoring, Management and Contingency Plans – Landscape – Terrestrial Flora and Fauna – Ecology	Sections 6.3 and 6.7 to 6.9
Operations	
• Noise Management Plan	Section 6.13 and Appendix J
• Air Quality Management Plan	Section 6.17 and Appendix I
• Water Management Plan – Surface Water Monitoring Program – Site Water Balance – Surface and Groundwater Response Plan – Erosion and Sediment Control	Sections 6.4, 6.6, 6.9 and 6.22 and Appendices C and N
• Landscape Management Plan	Sections 6.9 and 6.22 and Appendices D and N
• Mining Operations Plan (MOP)	Section 7.4
• Mine Closure Plan	Section 7.7
• Bushfire Management Plan	Sections 6.9 and 6.22 and Appendices D and N
• Traffic Management Plan	Section 6.12 and Appendix H
• Picton Road Management Plan	Section 6.3 and Appendix A
• Lighting Management Plan	Section 6.18
• Waste Management Plan	Section 6.22 and Appendix N
• West Cliff Coal Wash Emplacement Area Management Plan	Section 6
• Greenhouse Gas and Energy Efficiency Management Plan	Section 6.21
• Property Subsidence Management Plans	Section 6.3 and Appendix A
• Koala Plan of Management	Section 6.9 and Appendix D
• Surface Services Management Plan	Section 6.9 and Appendix D
• Conservation Management Plan	Section 6.11 and Appendix G
• Blast Management Plan	Section 6.16
• Biodiversity Offset Strategy	Section 6.9 and Appendix D
• Social Impact Management Plan	Section 6.20 and Appendix K
Reporting Requirements	
• Annual Review	Section 4.5.1
• Greenhouse Gas Reporting	Sections 4.5.2 and 6.21

8.2.1 Subsidence

Section 6.3 describes the subsidence mitigation and management measures. Key components of the proposed Project subsidence mitigation and management measures are described below.

Named Streams, Drainage Lines and Mapped Stream Features

Avoidance

The Project longwalls would be setback from the Avon River, Cordeaux River and Donalds Castle Creek, such that predicted incremental closure is limited to 200 mm. This represents a low-likelihood (e.g. Type 3) impact rate of approximately 10%. Along the pools and channels of the sections of the named streams located within 400 m of the proposed longwalls, the average likelihood of potential impacts is less than 10% for the pools and channels.

While it is not considered economic for the Project to avoid undermining all ephemeral drainage lines (Section 9), the longwall layout proposed for the Project has been designed by South32 to avoid the direct undermining of mapped key stream features (Section 3.5.3), to minimise the likelihood that the stream features will be physically damaged by subsidence impacts.

Mitigation and Remediation

Potential stream mitigation and remediation measures have been developed in consideration of previous mining experience in the Southern Coalfield, including at Dendrobium Mine, and are discussed in Section 7.

If physical damage to named streams and key stream features occurs due to the Project as a result of subsidence impacts, remediation techniques would be implemented to repair the damage.

Current mitigation and remediation methods for subsidence impacts on streams at the Dendrobium Mine are described within the WIMMCP (Section 7.3.6).

The WIMMCP would be reviewed and updated accordingly for the Project, and it is proposed that similar remediation methods would be implemented for the Project as required, incorporating any learnings and experience from existing operations using an adaptive management approach (Section 7.3.6).

Cliffs, Rock Outcrops and Steep Slopes

The mitigation, management and monitoring measures developed for potential subsidence impacts to cliffs, rock outcrops and steep slopes for the Project would be included as a component of future Extraction Plans for the Project.

Remediation measures may be required for the Project to manage any potential subsidence impacts to rock outcrops and steep slopes, and if required, would include:

- infilling of surface cracks with soil or other suitable materials;
- regrading and recompacting of the surface; and
- implementation of erosion protection measures, such as planting of additional vegetation, where appropriate.

State Conservation Areas

While a small portion of CCL 768 underlies the Upper Nepean State Conservation Area, there would be no longwall mining beneath the State Conservation Area for the Project.

Railway Infrastructure

In its current state of completion, South32 would undertake periodic inspections of the disused Maldon-Dombarton Railway Corridor during active subsidence, and remediate larger surface cracking in the embankment and cutting if this were to occur as a result of the Project (Appendix A).

If the railway were to be completed prior to active subsidence at the Project, a management plan for the Project would be developed to manage subsidence impacts on the Maldon-Dombarton Rail Corridor, in consultation with the ARTC.

The future track and associated infrastructure could be managed using strategies similar to that adopted for the Main Southern Railway at Appin and Tahmoor Collieries. The management strategies could include the installation of rail expansion switches and real-time rail stress monitoring during active subsidence (Appendix A).

Roads

South32 would develop a Picton Road Management Plan, in consultation with RMS for the Project for managing potential subsidence-related impacts on Picton Road during the extraction of Longwalls 604 and 605 in Area 6.

The development of management measures would involve input from RMS, and would include:

- ground monitoring; and
- periodic visual inspections of Picton Road.

The mitigation, management and monitoring measures developed for potential subsidence impacts to Picton Road for the Project would be included as a component of the relevant Extraction Plan for longwalls in Area 6.

Unsealed Roads and Tracks

Monitoring and maintenance of the unsealed roads and access tracks (e.g. firetrails) would be detailed in future Extraction Plans. It is anticipated that any subsidence-related impacts would be remediated in accordance with existing management strategies implemented at the Dendrobium Mine.

Water Supply Infrastructure

Mining has previously occurred proximal to a number of WaterNSW infrastructure items in the Southern Coalfield (Appendix A). At the Dendrobium Mine, longwalls in Area 1 and Area 2 have been extracted proximal to the Upper Cordeaux No. 2 reservoir and associated dam wall (Appendix A).

The longwall layout proposed for the Project has been designed by South32 to reflect adoption of a number of longwall mine constraints to minimise potential impacts to WaterNSW infrastructure (Section 3.5.3).

There would be no direct undermining of the existing Avon and Cordeaux Dam waterbodies, with a minimum 300 m Project longwall setback adopted from the existing dam FSLs. South32 has also adopted Project longwall setbacks from both the Avon and Cordeaux Dam walls (adopted minimum setback distance of 1,000 m from any secondary extraction) (Section 3.5.3).

South32 would develop mitigation, management and monitoring measures for potential subsidence impacts to the Cordeaux Dam, Avon Dam and associated dam walls, in consultation with WaterNSW and the DSC. Measures may include the development of a detailed monitoring program and TARP. South32's existing WaterNSW Asset Management Plan would, as relevant, be reviewed and revised for the Project.

South32 would comply with any DSC requirements or conditions relating to mining within the Cordeaux Dam and Avon Dam Notification Areas for the Project (Section 4.5.1).

Gas Supply Infrastructure

South32 would conduct a numerical analysis of the gas pipelines based on the predicted subsidence movements to assess whether the existing gas pipelines could accommodate the predicted subsidence movements. If it was found that the existing gas pipelines could not accommodate these movements, then potential impacts would be managed using similar strategies to those adopted at the Appin and West Cliff Collieries, including:

- uncovering and exposing the sections of the pipelines located within the larger stream valleys;
- temporarily supporting the pipelines on sandbags to isolate them from the mining induced ground movements;
- monitoring the mine subsidence movements using ground monitoring lines;
- monitoring the pipe stresses using strain gauges; and
- the implementation of a TARP where preventive measures are undertaken when prescribed triggers have been reached, such as adjusting the profiles of the pipelines using sandbags or by reducing the operating pressures.

South32 would develop management strategies to address the potential subsidence impacts, in consultation with the gas pipeline owners (i.e. Jemena Gas Networks) as a component of future Extraction Plans.

Electricity Supply Infrastructure

South32 has developed a number of management measures for electricity supply infrastructure that have been directly undermined previously at the Dendrobium Mine (Appendix A).

South32 would review these existing measures, where appropriate, and develop management strategies to manage potential subsidence impacts on the electricity supply infrastructure for the Project, in consultation with the relevant infrastructure owners (i.e. TransGrid and Endeavour Energy) as a component of future Extraction Plans.

Predicted subsidence movements to the 330 kV transmission towers would be reviewed by TransGrid and a detailed structural analysis undertaken. If required, any necessary mitigation measures would be implemented so the towers could be maintained in a safe and serviceable condition throughout the life of the Project, including:

- the installation of cable rollers;
- the construction of cruciform bases;
- provision of monitoring points on the tower bases and tops; and
- development of a TARP.

Predicted subsidence movements to the 33 kV powerlines would be reviewed by Endeavour Energy and relevant preventative measures developed. These measures may include the installation of cable rollers, guy wires or additional poles, or the adjustment of cable catenaries. South32 would monitor the powerlines during active subsidence to maintain them in a safe and serviceable condition.

Telecommunications Infrastructure

Predicted subsidence movements to the telecommunications infrastructure (i.e. circular telecommunications antennae) would be reviewed by Telstra and relevant preventative measures developed. It is expected that potential subsidence impacts that affect the antennae line of sight can be managed by making relevant adjustments to the direction of the antennae during active subsidence (Appendix A).

South32 would develop management strategies to address the potential subsidence impacts to the telecommunications infrastructure, in consultation with the relevant infrastructure owner (i.e. Telstra) as a component of future Extraction Plans.

Other Structures and Facilities

Other structures and buildings potentially affected by subsidence impacts from the Project are those located proximal to proposed Area 6, including structures associated with Cordeaux Dam Picnic Area, owned by WaterNSW (Appendix A).

South32 would develop PSMPs in consultation with WaterNSW to manage any potential subsidence on relevant structures and buildings.

Survey Control Marks

Survey control marks that are required for future use would be re-established, as required, following mining, in consultation with the Department of Lands (Appendix A).

8.2.2 Land Resources and Land Uses

Land Use

Surface works in the Metropolitan Special Area would be undertaken in consultation with WaterNSW and in accordance with existing Dendrobium Mine procedures, to avoid significant adverse impacts on existing land use in the Metropolitan Special Area. Access to the Metropolitan Special Area would also continue to be undertaken in accordance with WaterNSW requirements.

Key rehabilitation principles and objectives are described in Sections 8.2.15 and 8.3.11.

Soil and Erosion Potential

Erosion and sediment control strategies for the Project would be based on similar practices currently undertaken as part of the existing Erosion and Sediment Control Plan (part of the existing Water Management Plan) for the Dendrobium Mine, which would be reviewed and updated for the Project.

Mitigation measures to control erosion and sediment migration would include:

- minimising disturbance of land;
- use of sediment retention storages to contain and treat runoff from surface facilities, where appropriate (e.g. sediment dams, Dendrobium Pit Top treatment plant);
- rehabilitation and revegetation of surface disturbance areas after the completion of construction works;
- track rehabilitation works; and
- installation of sediment traps and pits.

Specific erosion and sediment control works and additional minor controls would be developed in consultation with WaterNSW as required over the Project life within the Metropolitan Special Area.

Land Contamination Potential

Measures to reduce the potential for the contamination of land for the Project would be based on accepted practices currently undertaken at the Dendrobium Mine and would be further documented in relevant environmental management plans for the Project.

General measures to reduce the potential for contamination of land include the following:

- contractors that transport dangerous goods to and from the site would be appropriately licensed in accordance with the provisions of the *Australian Code for the Transport of Dangerous Goods by Road and Rail* (National Transport Commission, 2014) (or its latest version); and
- fuel and explosive storage areas would be regularly inspected and maintained.

Prior to commencing any potential works on the historical structures at the Dendrobium Pit Top, a hazardous material survey would be undertaken to assess the potential for lead paints and asbestos-containing material within building structures to allow management/removal actions to be appropriately implemented.

Additional mitigation and management measures would be implemented during activities such as surface development works to reduce the potential for land contamination in the Metropolitan Special Areas in consultation with WaterNSW, where appropriate.

8.2.3 Groundwater

Licensing

The *Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources 2011* is relevant to the Project. The Project underground mining areas are located entirely within the *Sydney Basin – Nepean Sandstone Management Zone 2* water source.

South32 holds sufficient licences to account for peak predicted take from the *Sydney Basin – Nepean Sandstone Management Zone 2* water source (Attachment 7).

The peak predicted take includes the volume of water that may be lost from the surface to the groundwater system.

Any additional licences required under the *Water Management Act, 2000* would be sought and obtained in consultation with DI Water.

Mitigation Measures

Predicted Surface Water Losses

Although surface water losses are predicted to result in negligible changes to catchment yields, South32 would pay WaterNSW for the volume of surface water diverted from the Drinking Water Catchment (i.e. as it would be no longer available for sale to other water users). Such payments would be in addition to holding appropriate licences under the *Water Management Act, 2000*.

It is proposed that payment would be calculated based on the following:

- Price per ML ($53.85 per ML) consistent with the IPART determination for WaterNSW's prices for bulk water operations in the Greater Sydney area for Council use of bulk water (IPART, 2016).
- To account for climate variability and the progressive stage of longwall mining, actual losses would be quantified annually using a combination of streamflow, mine inflow and climate data, and predictive groundwater and catchment runoff modelling.

It is expected that this would result in payment of approximately $100,000 per annum during peak predicted surface water losses for the Project.

Further, South32 would seek to divert a proportion of Project excess mine water to beneficial re-use at the Port Kembla industrial precinct, with the intention that the re-use volume matches or exceeds predicted Project surface water take, achieving no net reduction in the total WaterNSW water budget.

Monitoring

The recommendations of the Groundwater Assessment (Appendix B), in regard to ongoing monitoring, would be adopted for the Project.

Groundwater Inflow

The continuous monitoring that supports the calculation of groundwater inflow to the Dendrobium Mine would continue for the Project.

Analysis of water reporting to mine workings (e.g. water quality 'finger-printing') in Area 5 and Area 6 would also be conducted to inform the source of this water (e.g. overburden, surface water or upward flow from the underlying strata).

Groundwater Levels

The extensive groundwater monitoring network currently in place at Area 5 and Area 6 would be continued for the Project. This includes monitoring of groundwater levels in the deep and shallow strata.

Should the Project be approved, further review of the monitoring network would be conducted, including consideration of the IEP (2018) recommendations regarding the period of baseline data (e.g. the installation of additional monitoring sites in Area 5 and Area 6 to facilitate the recording of sufficient baseline data).

Groundwater Quality

Water quality sampling would be conducted for the Project, targeting electrical conductivity and pH (to confirm beneficial use categories) and tritium (as an indicator of the presence of modern water).

Hydraulic Conductivity

Packer testing is currently undertaken at the Dendrobium Mine Area 3B, including pre-mining and post-mining testing. Should the Project be approved, similar packer and permeability monitoring techniques would be employed, focussing on the hydraulic conductivity of the Hawkesbury Sandstone, Bald Hill Claystone and upper Bulgo Sandstone.

Surface Water Monitoring

The existing surface water monitoring network for Area 5 and Area 6 would be continued and expanded for the Project (Section 6.6.4). The network would include the installation of a monitoring site on Donalds Castle Creek, downstream of Area 5.

Model Review

Hydraulic Property Testing

Hydraulic property testing would continue at the Dendrobium Mine and for the Project, including permeability testing above longwalls prior to and following the completion of mining.

Geological Feature Investigation

The identification of geological structures has been undertaken using published data and surface-based exploration including boreholes, 2D seismic surveys and aerial magnetic surveys. These techniques identify the locations of geological structures, but do not necessarily identify their hydraulic characteristics.

As per the recommendations of PSM (2019), in-seam drilling would be undertaken during development works (i.e. longwall roadways) to further define the extent and character of geological structures as they are intersected, and identify the hydraulic characteristics of any intersected structures (particularly those between the longwall areas and the reservoirs).

As in-seam drilling would be conducted during roadway development, Project approval would be pre-requisite to conducting these additional investigations (Appendix P).

Further surface-based exploration would also be undertaken along the FSLs of the Avon and Cordeaux Dams and around the dam wall structures (Appendix P).

Geological structures would be included in the South32 geological model as they are identified.

Model Updates

The groundwater model would be progressively updated over the life of the Project to account for additional monitoring data, hydraulic property testing and geological structures.

Consistent with the recommendations of Dr Frans Kalf (Attachment 5) a full review of the groundwater model would be conducted every 3 to 5 years, including comparison of monitoring data against predictions and recalibration of the model if necessary.

8.2.4 Surface Water

Management Measures

The existing and approved water management systems at the Dendrobium Mine would continue to be used for the Project.

Additional surface water management requirements for the Project would include:

- management of surface runoff associated with Shaft Nos 5A, 5B, 6A and 6B through the implementation of sediment dams; and
- management of increased groundwater inflows to the underground mine workings, including the upgrade, replacement or duplication of the existing excess water pipeline following the Kemira Valley Rail Line to LDP5.

Mitigation Measures

Surface Water Flows

Section 8.2.3 describes proposed mitigation measures for the negligible predicted reductions in catchment yields due to the Project (i.e. paying WaterNSW for surface water that may no longer be available for sale to other water users).

This would be in addition to:

- appropriate licensing of predicted water take under the *Water Management Act, 2000*; and
- the objective of beneficial re-use of excess mine water at the Port Kembla industrial precinct, with the intention that the re-use volume matches or exceeds predicted Project surface water take, achieving no net reduction in the total WaterNSW water budget.

Water Quality

Although the potential impacts on water quality as a result of the subsidence-related impacts from the Project are predicted to be localised and temporary, the Project is required to demonstrate that the carrying out of the proposed development would have a neutral or beneficial effect on water quality (i.e. the Neutral or Beneficial Effects [NorBE] Test) (Section 9.3.6).

Project sediment controls for surface disturbance activities would be designed consistent with *Managing Urban Stormwater Soils and Construction – Volume 2E – Mines and Quarries* (DECC, 2008).

Controlled releases via LDP5 would be monitored to confirm EPL water quality objectives are being achieved. The volume of water to be released would be minimised as far as practicable through the proposed beneficial re-use of excess mine water.

Water quality improvement actions are proposed as part of the Project to offset potential localised effects associated with subsidence-related impacts (e.g. pulses of iron and manganese) and demonstrate the Project would have a net neutral or beneficial effect on water quality.

These actions for the Project would be additional to those already proposed and funded by WaterNSW and would target reduced sedimentation in the Special Catchment Areas, and would include:

1. Transfer of 28.5 ha of South32-owned land within the Metropolitan Special Area to WaterNSW.

   This would enable WaterNSW to manage and protect this land in accordance with the *Special Areas Strategic Plan of Management 2015*, which does not cover privately-owned land in the Special Catchment Areas.

   For example, access restrictions could be imposed on land transferred from South32 to WaterNSW, as access restrictions do not apply to privately-owned land in the Special Catchment Areas (WaterNSW and OEH, 2015).

2. Direct implementation (by South32) or funding (to WaterNSW) of water quality improvement works within the Special Catchment Areas (Table 8-2).

   WaterNSW's *Catchment Protection Work Program 2018-19: Sydney Catchment Area* outlines planned activities for water quality management in the Sydney Catchment Area, as well as the planned benefits for these activities.

   The additional works proposed for the Project would complement those planned by WaterNSW.

Remediation

Where monitoring indicates that subsidence-related impacts have occurred to key stream features (i.e. named watercourses and key stream features), South32 would implement remediation measures to mitigate physical damage to the streams where it is practicable to do so.

An example of where it may not be practicable to implement remediation is where the works themselves may cause greater environmental impacts than the subsidence-related impact (e.g. if clearance is required to provide access for materials and equipment to the remediation site).

Monitoring

Surface water monitoring of water management systems would be undertaken in accordance with EPL 3241 for the Dendrobium Mine (and any other EPL required for the Project) targeting discharge locations and key water storages.

HEC (2019) has provided recommendations for ongoing and additional surface water monitoring for the Project, which are summarised below.

Meteorological Monitoring

An automatic weather station would be installed in Area 5 or 6 and would include meteorological monitoring such as temperature, humidity, wind speed, wind direction and solar radiation.

Pluviometers would also be installed in locations representative of catchments of the drainage lines overlying Areas 5 and 6 to provide rainfall data.

Flow Rates

The existing Area 5 and Area 6 gauging station network would be expanded and augmented. The gauging station would target low flow accuracy of ± 0.0025 ML/day resolution and ±10% accuracy over the flow range 0.01 to 10 ML/day.

Table 8-2
Proposed Water Quality Improvement Works

Water Quality Improvement Work	Estimated Financial Contribution (if works not conducted by South32)
Fire Management: • Slashing grass and vegetation for fire breaks (100 km and 200 ha). • Mulching trees and woodland along fire trails to maintain fire breaks (at least 22.5 km). • Conducting hazard reduction burns (at least 100 ha) in consultation with relevant authorities.	$371,500[1]
Inspect and Maintain Unsealed Road Network: • Inspect 150 km of unsealed roads. • Repair and upgrade 40 km of unsealed roads within the Special Catchment Areas.	$146,000[1]
Install and Maintain Appropriate Barriers and Fences: • Install barriers as required around any land transferred to WaterNSW. • Install barriers and fences to replace those that are damaged or vandalised.	$100,000[2]
Total	**$617,500**

[1] Based on conducting an additional 50% of WaterNSW's Planned Activities for Fire Management and Unsealed Roads Program as per the *Catchment Protection Work Program 2018-19: Sydney Catchment Area*.

[2] Estimation only.

Manual flow gauging would also be conducted to verify flow rating curves.

Pool Water Levels

Continuous pool level data would be collected on a selection of key stream features, plus control pools.

Manual water level monitoring would also be conducted to verify the continuous monitoring.

Water Quality

The existing Area 5 and Area 6 water quality monitoring network would be continued and expanded for the Project.

Water quality monitoring would also continue in existing surface water storages and at LDP5 to confirm compliance with EPL water quality objectives. Water quality monitoring would also be conducted in new water management storages required for the Project (e.g. at the ventilation shaft sites).

Observational and Photographic Monitoring

Observations and photographs along streams (e.g. at key stream features) would be undertaken before, during and following mining to identify visual signs of impacts (e.g. cracking, erosion, iron floc).

Monitoring of Water Transfers

Monitoring of water transfers between the underground and surface water management systems would continue for the Project.

Model Review

Catchment Runoff Model

The catchment runoff model would be progressively updated over the life of the Project in consideration of the stage of longwall mining, data collected from the monitoring network (e.g. rainfall and flow rates) and updated predictions from the groundwater model.

Site Water Balance

The site water balance would be reviewed over the life of the Project in consideration of monitoring data (e.g. water transfers) and updated predictions from the groundwater model.

8.2.5 Biodiversity

Aquatic Ecology

Avoidance and mitigation measures for streams, as described in Section 6.6.4, would also reduce potential impacts to aquatic ecology habitat. This includes:

- longwall setbacks from named watercourses and key stream features (e.g. certain pools and waterfalls/steps);
- erosion and sediment control strategies; and
- remediation of physical damage to stream features.

The Project-specific aquatic ecology monitoring plan would include monitoring at sites both upstream and downstream of the proposed longwalls for the following indicators:

- changes in aquatic habitat, including photo recording;
- water quality;
- macrophyte composition and coverage area;
- AUSRIVAS macroinvertebrate sampling and artificial macroinvertebrate collection;
- threatened species identification; and
- electrofishing.

Upland Swamps

The Project has considered various measures to avoid and mitigate potential impacts to upland swamps which include:

- The selection of proposed mining in Areas 5 and 6 as opposed to Area 4 in addition to siting surface infrastructure to avoid direct impacts to upland swamps.
- Alternative longwall geometry/methods within Areas 5 and 6 have been considered, however, no material difference in the potential for impacts to upland swamps associated with alternative longwall layouts is expected.
- The implementation of the mine constraints for the Project (Section 3) would result in avoidance of directly undermining a number of upland swamps including Den124, Den115, Den131, Den132, Den119 and Den134.

- Avoidance of direct disturbance of mapped upland swamp TECs[1].
- Relinquishment of existing authority to impact upland swamp vegetation areas in Area 3.

Residual predicted impacts to upland swamps would be offset via the Project Biodiversity Offset Strategy, developed consistent with NSW and Commonwealth Government policy (Section 6.9.6). This includes offsets for potential subsidence impacts to TECs associated with upland swamps, as well as offsets for threatened fauna species for which the upland swamps provide habitat.

Current mitigation and remediation measures for subsidence impacts on upland swamps at the Dendrobium Mine are described within the SIMMCP (South32, 2017b).

South32 is conducting research into methods for swamp rehabilitation as described in the *Dendrobium Area 3B Swamp Rehabilitation Research Program* (South32, 2017b). Subject to confirmation from key stakeholders that swamps undermined in Area 3 have been successfully remediated, swamp remediation measures could be implemented for the Project.

Terrestrial Ecology

South32 has well established and accepted management practices for operating an underground coal mine in the same environment as the Project. South32 would continue to implement management and mitigation measures currently employed at the Dendrobium Mine for the Project, as outlined below.

Bushfire Management

Bushfire risk management measures currently employed at the Dendrobium Mine as part of the existing Bushfire Management Plan would continue for the Project.

South32 would continue to consult with WaterNSW with respect to management of bushfire risk activities within the Special Areas.

Erosion and Sediment Control

Erosion and sediment control strategies for the Project would be based on similar practices currently undertaken as part of the existing Erosion and Sediment Control Plan (part of the existing Water Management Plan) for the Dendrobium Mine. Site-specific Erosion and Sediment Control Management Plans would be developed for construction activities for the Project where required.

Vehicle Strikes

Existing speed limits and traffic rules would be maintained along roads travelling to and from the Project. Vehicle strikes would be monitored to inform implementation of future protocols to reduce potential impacts.

Landscape Management

Landscape management measures for the Project, including vegetation clearance protocols, weed control and pest management, would be implemented in accordance with the existing approved Landscape Management Plan. The Landscape Management Plan would be reviewed and revised where necessary for the Project.

If installation of surface infrastructure is required outside of the proposed ventilation shaft site disturbance areas, the areas would be subject to environmental assessment studies. These studies and any associated management measures would be detailed in a Surface Services Management Plan (Section 3.10.4).

Koala Plan of Management

A Koala Plan of Management has been prepared in accordance with SEPP 44, which describes management measures proposed for potential impacts to core Koala habitat (refer to Appendix D).

Rehabilitation and Remediation

All areas of native vegetation subject to direct disturbance would be progressively rehabilitated following decommissioning of surface infrastructure, such that only a practical minimum area is disturbed at any one time. Section 7 details relevant rehabilitation performance measures and completion criteria for the Project.

Current mitigation and remediation measures for subsidence impacts on upland swamps and watercourses at the Dendrobium Mine are described within the WIMMCP and SIMMCP (South32, 2017a; 2017b).

[1] Other than minor disturbance associated with the installation of monitoring equipment

Other Measures

Other measures implemented by South32, relevant to reducing potential indirect impacts to biodiversity values within the Project area, would include noise, air quality and lighting management and mitigation measures consistent with existing Dendrobium Mine management plans (which would be updated to incorporate the Project).

Avoidance

A number of avoidance measures were developed by South32 and are incorporated in the design of the Project layout, including (Section 6.9):

- Longwall design constraints to reduce potential environmental impacts to named watercourses and certain pools and waterfalls/steps.
- Shortening of longwall panels where the conceptual layout had longwall panels ending coincident with the location of upland swamps.
- Avoidance of direct disturbance of upland swamps.
- Avoidance of direct disturbance of threatened flora species.
- Minimisation of Shale Sandstone Transition Forest TEC clearance required for installation and maintenance of supporting surface infrastructure, as far as practicable.
- Relinquishing the existing authority to impact upland swamps within Area 3.

Biodiversity Offset Strategy

The existing approved Biodiversity Offset Strategy for the Dendrobium Mine would be augmented with an additional Biodiversity Offset Strategy for the Project to account for further impacts to TECs, flora and fauna.

The proposed Biodiversity Offset Strategy for the Project has been prepared in consideration of the Project SEARs, the NSW Offset Policy (and supporting FBA), the Swamp Offset Policy and the Commonwealth *Environment Protection and Biodiversity Conservation Act Environmental Offsets Policy* (DSEWPAC, 2012).

The following options are available to South32 to address the NSW and Commonwealth offset liability:

1. Retirement of FBA credits through existing South32 BioBank sites.
2. Establishment of Stewardship sites on South32 landholdings and/or privately-owned property.
3. Other direct offset options such as rehabilitation.
4. Payment into the BCT Payment Fund.
5. Other direct or supplementary measures.

South32 would satisfy the Project's offset liability via a combination of these available mechanisms.

In accordance with the Swamp Offset Policy, should monitoring indicate impacts greater or less than those predicted, the ultimate offset liability would be increased or decreased accordingly.

South32 is conducting research into methods for swamp rehabilitation as described in the *Dendrobium Area 3B Swamp Rehabilitation Research Program* (South32, 2017b). Subject to confirmation from key stakeholders that swamps undermined in Area 3 have been successfully remediated, swamp remediation measures could be implemented for the Project.

8.2.6 Aboriginal Heritage

Aboriginal Heritage Management Plans

An AHMP would be developed for the Project in consultation with the RAPs and the relevant regulatory authorities.

The AHMP would include:

- Protocols for the involvement of RAPs in cultural heritage works conducted under the AHMP for the life of the Project.
- A protocol describing methods of communication, including expectations of suitable notification and response time, between South32 and the RAPs.

- A protocol to allow for access to Aboriginal heritage sites as required by the AHMP (noting that access is also subject to the requirements of WaterNSW).
- Procedures to establish, maintain and update a database of Aboriginal heritage sites identified within the Project underground mining area.
- A protocol for the determination of the final location of Project surface infrastructure and surface works, including systematic survey of the relevant development area(s) (in consultation with the RAPs) if the area has not already been surveyed.
- If previously unknown Aboriginal heritage sites or items are identified during the life of the Project, procedures for the management and reporting of these sites.
- Protocols for the incorporation of heritage awareness training into mine site inductions for both Illawarra Coal employees and external contractors who may be conducting works that have the potential to impact on any Aboriginal heritage sites.
- A protocol that defines actions to be followed in the event that human remains are discovered (e.g. stop work provisions and notification protocols).
- A description of fencing of site ACHA AGG-1 to avoid the risk of indirect or accidental harm from surface disturbance activities.

Subsidence Monitoring

Monitoring of potential impacts to Aboriginal heritage items would be conducted prior to and following subsidence from longwall mining. This would include detailed baseline and archival site recordings of Aboriginal heritage sites prior to the commencement of mining operations to ensure appropriate documenting of sites. The details of the subsidence monitoring program would be outlined in the AHMP and detailed in Extraction Plans for the Project.

8.2.7 Non-Aboriginal Heritage

A Conservation Management Plan would be developed for the Project, which would provide guidance for management of heritage items during the detailed design, construction and operational phases of the Project.

The proposed upgrades and construction of additional structures at the Dendrobium Pit Top would be designed to reduce potential physical impact to the values and significance of the Nebo Colliery and the Kembla Heights Mining Village (Heritage Conservation Area), and would consider construction techniques that would not require sub-surface excavations (Appendix G).

Any significant heritage items not previously identified would be recorded if they are subject to potential damage or demolition.

Mitigation and management measures to reduce the potential visual impacts of the proposed ventilation shaft sites on the visual amenity of the Cordeaux Dam heritage site would include colouring the infrastructure similar to the surrounding vegetation.

8.2.8 Road Transport

Although the Project is not predicted to significantly alter the proportion of Dendrobium Mine contribution to traffic on the majority of the public road network, South32's existing TMP would be reviewed for the Project and updated accordingly.

The following mitigation measures would continue to be implemented as a component of the TMP for the Project:

- use of signage and physical structures to notify and control drivers to maintain correct driver behaviour;
- curfew times for road use at the Dendrobium Pit Top, consistent with the Dendrobium Mine Driver's Code of Conduct (i.e. vehicle access restrictions during night-time hours and during peak traffic periods during the day);
- control of materials being transported on the road network consistent with the *Storage and Handling of Dangerous Goods – Code of Practice 2005* (WorkCover, 2005);
- encouragement of the Project construction and operational workforce as well as contractors to use 'car-pooling' to minimise related light vehicle movements to site; and
- notification of relevant stakeholders when large loads are required, or road closures are to occur along relevant road networks.

Where new car parking facilities are to be developed for the Project, these would be designed and constructed in accordance with Australian Standards and in consultation with the relevant authorities.

Access to the Metropolitan Special Area and the Illawarra Escarpment and Upper Nepean Conservation Areas would be in accordance with relevant landholder requirements (e.g. conditions of entry, speed limits, etc.).

Driver's Code of Conduct

South32 employees as well as contractor staff would be required to continue to observe the Driver's Code of Conduct as a component of the Project.

Carpark Extension Intersection

The intersection between the overflow carpark and Cordeaux Road would be designed and constructed consistent with Council Standards to maintain a satisfactory Level of Service.

8.2.9 Noise and Blasting

Operational Noise

South32's existing NMP would, as relevant, be revised for the Project to include the following:

- applicable Development Consent noise criteria;
- a summary of relevant Project noise mitigation/management measures;
- procedures to be followed in the event of an exceedance of applicable noise criteria, should this occur; and
- updated complaint response protocols, where applicable.

Construction Noise

Construction activities for the Project would be temporary in nature, and general construction noise management measures would be implemented to minimise noise levels at the nearest private receptors, where applicable.

Rail Transport Noise

South32's existing NMP would be reviewed for the Project, and updated where required.

Rail noise mitigation measures for the Project would include, but would not necessarily be limited to:

- continuation of restricted rail haulage operating hours for the Kemira Valley Rail Line to between 6.00 am and 11.00 pm (i.e. no rail haulage occurs after 11.00 pm at night or before 6.00 am in the morning);
- regular track walks to identify defects in the rail infrastructure that may contribute to rail noise; and
- continued implementation of the track maintenance program.

Road Transport Noise

South32's existing NMP would be reviewed and updated for the Project, where required.

Traffic movements to and from the Dendrobium Pit Top would continue to be controlled by South32 via the Dendrobium Mine Driver's Code of Conduct (i.e. vehicle access restrictions during night-time hours and during peak traffic periods during the day).

South32 would also continue to encourage construction workers and operational workers to carpool to reduce employment related traffic movements in and out of the Dendrobium Mine surface facilities.

Blasting

When blasting is required for the management of particular geological structures underground, South32 would design blast parameters to meet the applicable criteria with a high margin of conservatism at the nearest sensitive receptors or any infrastructure that overlies the blast location.

Blasting potentially required at the surface during construction activities would be subject to detailed engineering design and/or collection of site-specific geotechnical data (e.g. for the Cordeaux Pit Top upgrades and construction of the proposed ventilation shafts).

In the event that some limited surface blasting is required in support of the Project upgrades, South32 would employ a blast maximum instantaneous charge that provides a high margin of conservatism for compliance with the relevant criteria at the nearest private receptors, and applicable structural criteria for any proximal infrastructure such as ETLs.

The locations of Aboriginal and non-Aboriginal heritage sites would also be considered in blasting design, with blasts designed accordingly to avoid damage as would be detailed in the Blast Management Plan for the Project.

8.2.10 Air Quality

South32 would review and update the AQMP, where appropriate, to reflect the mitigation and management measures, complaint response protocols and reporting requirements for the Project.

Air quality management measures currently implemented at the Dendrobium Mine would continue to be implemented for the Project, including:

- use of automated dust suppression spray systems on access roads, conveyors and train loading chamber;
- enclosed train loading facility to eliminate fugitive emissions;
- reduced drop height of rill tower;
- use of dust suppression spray system to maintain moisture content of ROM coal in rail wagons above the DEM level;
- enclosed conveyor and conveyor transfer points;
- regular operation of a road sweeper on sealed travel routes;
- dust suppression sprays on underground mining equipment to reduce ventilation fan emissions;
- wind protection on conveyor gantries; and
- scrapers to clean return conveyors.

8.2.11 Visual Character

Proposed Ventilation Shaft Sites

Proposed ventilation shafts and associated infrastructure with the potential to be visible from the Cordeaux Dam wall would be coloured similar to the surrounding vegetation.

Night-lighting and Flaring

An LMP is currently implemented at the Dendrobium Mine. South32 would review and update the LMP, where appropriate, to reflect the mitigation and management measures for the Project.

Flares would be enclosed to minimise visibility and fire risk, and would be designed in accordance with the relevant design and safety standards and guidelines.

Other Short-term Surface Activities

Surface disturbance areas associated with any short-term surface activities would be rehabilitated progressively (Section 7).

Impacts to Streams and Key Stream Features

The Project underground mining layout has been designed to reduce subsidence effects on named watercourses and key stream features identified by South32, which would also reduce the potential for aesthetic damage (noting public access to the Metropolitan Special Areas is restricted).

Mitigation measures and management for potential impacts to key stream features are described in Section 8.2.1. Remediation measures would be developed as part of relevant Extraction Plans for the Project, where applicable.

Impacts to Cliffs, Other Rock Features and Steep Slopes

No specific visual remediation measures are proposed for isolated rock falls that may occur as result of the Project. Such events occur naturally within the sandstone landscape, and exposed rock surfaces weather over time and any disturbed vegetation re-establishes naturally.

8.2.12 Socio-Economic

South32 would develop a Mine Closure Plan for the Project approximately 5 years prior to closure, which would be developed in consultation with the Wollongong City Council, Wollondilly and Wingecarribee Shire Councils, the DPE and the local community. The Mine Closure Plan would include consideration of amelioration of potential adverse socio-economic effects due to the reduction in employment at Project closure (Section 7).

South32 would continue to work with local government and the local community to minimise potential social impacts of the Project and maximise potential opportunities.

A number of mitigation and management strategies have been identified and would be implemented by South32, including:

- identifying and engaging with Indigenous businesses;
- providing ongoing community engagement;
- providing access to dust monitoring for concerned households in Mount Kembla and Cordeaux Heights, to provide reassurance about the potential for health issues due to coal dust;
- providing clear, accessible and independently-sourced information to the local community about management and monitoring of subsidence and groundwater impacts in the lead up to Project execution;
- establishing goals for female representation (10%) and Indigenous participation (2.5%) in the Project workforce;
- implementing standard construction noise management techniques and consult with nearby neighbours during the duration of construction activities;
- continuing to implement the Dendrobium Mine Driver's Code of Conduct;
- maintaining rail noise mitigation initiatives (e.g. installation of modified brake shoes) throughout the life of the Project;
- continuing South32's existing employment, contracting and training strategies for the Project, including continuation of existing apprenticeship and graduate traineeship programs;
- implementing South32's Diversity and Inclusion policy;
- establishing strategies to achieve Indigenous participation in the Project's workforce and supply chains, supporting the key objective of improving Indigenous community well-being through greater economic participation;
- supporting Indigenous community and economic well-being initiatives that benefit the communities in which the Dendrobium Mine operates; and
- maintaining the DCEP for the life of the Project.

8.2.13 Greenhouse Gas

Greenhouse gas management at the Dendrobium Mine is currently undertaken in accordance with the Greenhouse Gas & Energy Efficiency Management Plan.

The Greenhouse Gas & Energy Efficiency Management Plan describes a number of greenhouse gas abatement measures and mining efficiency improvement projects, including:

- flaring of coal mine waste gas extracted by surface means;
- selection and design of equipment and processes to optimise efficiency and reduce energy consumption;
- maintaining plant and equipment to optimise reliability and efficiency;
- routine calibration and servicing of monitoring equipment;
- use of alternative fuels where practical;
- mining at the optimum coal seam height to reduce energy consumption and waste production;
- use of automated process controls to optimise plant run time and performance;
- operational practices (e.g. optimising the utilisation of available plant and personnel); and
- maintenance of transport roadways and surfaces to reduce fuel consumption of mobile equipment.

Energy use (electricity consumption and diesel usage) for the Project would continue to be recorded through direct measurement and/or invoicing and minimised as far as possible.

Greenhouse gas and energy data would continue to be accounted for and reported in compliance with legislative and other requirements.

The existing Greenhouse Gas & Energy Efficiency Management Plan would be reviewed and updated accordingly to address the Project. South32 would continue to assess and implement energy and greenhouse gas management initiatives during the life of the Project.

South32's Company-wide Climate Change Strategy would also be implemented for the Project, which reflects key strategies of the Paris Agreement.

8.2.14 Hazard and Risk

South32 implements a safety management system at the Dendrobium Mine to manage risks to health and safety in accordance with the requirements of the *Work Health and Safety (Mines and Petroleum Sites) Act, 2013* and the *Work Health and Safety (Mines and Petroleum Sites) Regulation, 2014*. South32 would continue to meet these obligations for the Project.

In addition, a number of hazard control and mitigative measures are currently in-place. These measures are described in the existing Dendrobium Mine management plans relevant to the Project, including:

- Water Management Plan;
- Landscape Management Plan;
- Mining Operations Plan;
- Pollution Incident Response Management Plan;
- Air Quality Monitoring Program;
- Bushfire Management Plan; and
- Waste Management Plan.

The management plans would be revised or replaced where necessary to address mitigation measures, monitoring, reporting and review requirements for the Project.

The following hazard control and/or mitigation measures would be adopted by South32 to reduce the likelihood and/or consequences of potentially hazardous incidents associated with the Project:

- **Maintenance** – Ongoing and timely maintenance of all mobile and fixed plant and equipment in accordance with the recommended maintenance schedule, and consistent with the maintenance schemes required by legislation.
- **Staff Training** – Operators and drivers would be trained and (where appropriate) licensed for their positions. Only those personnel licensed to undertake skilled and potentially hazardous work would be permitted to do so.
- **Engineering Structures** – Mining and civil engineering structures would be constructed in accordance with the applicable codes, guidelines and Australian Standards. Where applicable, South32 would obtain the necessary licences and permits for engineering structures.
- **Contractor Management** – All contractors employed by South32 would be required to operate in accordance with the relevant Australian Standards and NSW legislation.
- **Water Management** – As reported in Appendix C of the EIS, water management structures would be constructed to generally separate runoff from undisturbed areas and disturbed areas.
- **Storage Facilities** – Storage and usage procedures for potentially hazardous materials (i.e. fuels, lubricants and chemicals) would be developed in accordance with Australian Standards and relevant legislation. A register of chemicals and dangerous goods stored on-site would be kept up-to-date via a tracking, storage and chemical information management system.
- **Emergency Response** – Emergency response procedures, manuals and systems would continue to be implemented.
- **Waste Management System** – Waste would be managed according to a hierarchy of waste control (avoidance, resource recovery and disposal). Waste disposal measures and a monitoring program are described in the Waste Management Plan.

Bushfire Hazards

Bushfire risk management measures currently employed at the Dendrobium Mine as part of the existing Bushfire Management Plan would continue for the Project. Specific mitigation and management measures to reduce bushfire risk could include:

- Fire awareness and fire safety training would continue to be included in the induction of appropriate South32 staff and contractors.
- Mitigation measures that would be implemented by South32 to reduce bushfire risk would focus on education and training, reducing bushfire hazard (principally fuel levels), minimising and controlling ignition sources (e.g. by appropriate engineering design, where relevant) and developing appropriate responses and evacuation strategies.
- South32 has implemented a number of management and mitigation measures to reduce the potential risk of bushfire, including hazard treatment and mitigation measures (as described in Section 6.22), fire management plans and emergency response to bushfires and evacuation procedures.
- Suitable fire breaks and/or radiation zones would be established to reduce bushfire hazards, where required. Fire breaks have been established around the existing surface facility locations, including Cordeaux Pit Top, Dendrobium Pit Top and the Kemira Valley Coal Loading Facility, and extensive firefighting water pipelines and booster pump facilities are available around the Dendrobium and Cordeaux Pit Top sites. South32 would continue to regularly inspect bushfire management controls on its properties. Bushfire risk management works would be undertaken on an as required basis and would include clearing of excessive growth within property fire protection boundaries.

South32 would continue to consult with WaterNSW with respect to management of bushfire risk activities within the Special Areas.

8.2.15 Rehabilitation and Mine Closure

Section 7 of this EIS describes the rehabilitation and mine closure planning for the Project. Key components are summarised below.

Where relevant, existing rehabilitation objectives for the Dendrobium Mine and Cordeaux Colliery would be augmented or built upon for the Project (Section 7.2).

A MOP would be developed for the Project and would incorporate the proposed changes in operations at the Dendrobium Mine and the Cordeaux Colliery.

The MOP would describe the rehabilitation and performance measures and completion criteria, including more detailed and quantified criteria where applicable (based on the Development Consent conditions for the Project). The rehabilitation performance measures and completion criteria included in the MOP would be specific, measurable, realistic and time-bound.

Rehabilitation of the West Cliff Stage 3 Coal Wash Emplacement would continue to be conducted in accordance with the *West Cliff Coal Wash Area Emplacement Management Plan* (Illawarra Coal, 2017) (or the latest approved version) and the Bulli Seam Operations MOP.

Over the life of the Project, rehabilitation performance measures and completion criteria would, periodically, be updated and refined in consultation with relevant regulatory authorities and stakeholders to reflect evolving mine site rehabilitation practices and standards.

In the long-term, all sites would be rehabilitated to a safe, stable and sustainable landform of a similar character to surrounding areas. A conceptual post-mining land use of native vegetation has been selected for the majority of Project domains, with the final landform in surface development areas designed to be generally consistent with the topography of the surrounding landscape and appropriate for the post-mining land use.

A Mine Closure Plan would be developed for the Project in consultation with relevant regulatory authorities and community stakeholders, which would be reviewed and updated over the Project life. The Mine Closure Plan would include consideration of amelioration of potential adverse socio-economic effects due to the reduction in employment at Project closure.

8.3 ADAPTIVE MANAGEMENT

8.3.1 Subsidence

Subsidence performance measures and mining constraints would be detailed in Extraction Plans for the Project, along with monitoring, mitigation, adaptive management and contingency measures for the key natural and built features described in the preceding sections and below.

Where relevant, performance measures, monitoring locations/methods, trigger levels (set below performance measures) and contingency measures would be developed in consultation with relevant asset owners and government agencies.

Should monitoring data indicate impacts are exceeding trigger levels, adaptive management would be implemented. This would include the implementation of additional contingency measures as required.

8.3.2 Groundwater and Surface Water

Monitoring locations, methods, trigger levels and contingencies relating to groundwater would be detailed in Extraction Plans for the Project.

If monitoring data indicates that the Project longwalls are resulting in trigger exceedances then adaptive management measures would be implemented.

Potential contingency measures for greater than expected groundwater impacts could include:

- obtaining additional water licences;
- increased payments to WaterNSW for estimated surface water take;
- remediation of surface cracks (i.e. to minimise diversion of surface flows to the groundwater system) (Section 7);
- increased biodiversity offsets (e.g. for upland swamps); and
- mine plan review.

8.3.3 Biodiversity

Aquatic Ecology

South32 would continue to conduct aquatic ecology monitoring within the Project underground mining area throughout the Project life, consistent with the methods outlined in the WIMMCP (South32, 2017a), as amended for the Project.

The Project-specific aquatic ecology monitoring plan would be detailed in Extraction Plans to be prepared for the Project, along with performance measures, triggers and contingency measures.

Monitoring specific to aquatic ecology would be undertaken in addition to surface water and groundwater monitoring.

In the event that monitoring identifies impacts to aquatic ecology greater than those predicted, South32 would consider implementing contingency measures such as stream remediation, further erosion and sediment control measures and review of the mine layout with respect to watercourses.

Upland Swamps

Baseline surface water and groundwater monitoring (including shallow piezometers and soil moisture probes) of upland swamps within 400 m of the proposed longwalls would be undertaken to refine the maximum predicted offset liability based on observed impacts to swamp water levels and vegetation.

Monitoring would be detailed in the Extraction Plans for the Project, and would include subsidence, surface water, groundwater and vegetation composition.

In accordance with the Swamp Offset Policy, should monitoring indicate impacts greater or less than those predicted, the ultimate offset liability would be increased or decreased accordingly.

Terrestrial Ecology

Monitoring of threatened fauna habitat, flora and TECs, predicted to be impacted by subsidence, would be undertaken by South32 to refine the maximum offset liability for threatened fauna species.

Details of monitoring, performance measures, trigger levels and contingencies for subsidence-related impacts would be described in Extraction Plans prepared for the Project.

8.3.4 Aboriginal Heritage

South32 would avoid disturbance of known Aboriginal heritage sites where practicable during development of surface infrastructure for the Project. Depending on the Aboriginal heritage site type and nature of proposed surface development works, further management measures would be undertaken prior to any potential disturbance of Aboriginal heritage sites (e.g. additional archival recording and the implementation of fencing to isolate the site).

The management and reporting of previously unidentified Aboriginal heritage sites identified during the life of the Project would be detailed in the AHMP developed for the Project.

8.3.5 Non-Aboriginal Heritage

In the unlikely event that previously unrecorded historical archaeological relics were to be discovered during ground disturbance for the Project, work in the immediate area would cease and a suitably qualified archaeologist would be engaged to assess the condition, extent and likely significance of the remains. If required, the Heritage Council would be notified of the discovery in accordance with section 146 of the *Heritage Act, 1977*.

8.3.6 Road Transport

The intersection of Picton Road with the Cordeaux Pit Top Access Road and Cordeaux Dam Access Road may require improvements in order to accommodate an increase in future traffic volumes due to projected background traffic growth and the contribution of Project-related turning traffic (Section 6.12.3). Operational shift arrangements and peak traffic demand would be reviewed prior to 2035 at the intersection of Picton Road with the Cordeaux Pit Top Access Road and the Cordeaux Dam Access Road (Appendix H).

In accordance with the recommendations in Appendix H, South32 would consult with RMS to assess the need for any mitigation measures to manage the operation of these intersections when accounting for long-term growth in traffic on Picton Road.

8.3.7 Noise and Blasting

Operational and Construction Noise

South32 would continue to conduct Dendrobium Mine operational noise monitoring in accordance with the NMP (as amended for the Project).

In addition to mitigation measures already incorporated, Project noise adaptive management measures would include:

- response to any community issues of concern or complaints including discussions with relevant landowners;
- refinement of on-site noise mitigation measures and mine operating procedures, where practicable; and
- if necessary (i.e. as informed by operational noise monitoring results), implementation of feasible and reasonable mitigation at relevant private receivers, in accordance with the Voluntary Land Acquisition and Mitigation Policy.

Rail Transport Noise

Rail noise monitoring would continue to be undertaken in accordance with the NMP.

South32 would also continue to investigate, and where reasonable and feasible, implement further progressive rail noise mitigation measures over the life of the Project. This would include addressing any further rail brake or wheel squeal issues that may arise during the life of the Project from landholder complaints, or if material deterioration of rail noise performance is identified by rail noise monitoring in accordance with the NMP.

8.3.8 Air Quality

South32 would continue to conduct Dendrobium Mine air quality monitoring in accordance with the AQMP (as amended for the Project).

As a component of the Project South32 would also install additional PM_{10} and $PM_{2.5}$ real-time monitoring equipment to evaluate the emissions of the Project against contemporary particulate matter criteria at a location reflective of the nearest private receivers to the Kemira Valley Coal Loading Facility.

Project air quality adaptive management measures would include response to any community issues of concern or complaints including discussions with relevant landowners and/or refinement of on-site air quality mitigation measures and mine operating procedures.

In the event of an issue or complaint arising with respect to odour, suitable complaint response and management measures would be implemented.

8.3.9 Socio-Economic

A number of adaptive management strategies have been identified and would be implemented by South32, including:

- collecting, monitoring and reporting mitigation performance data, at least six monthly during the first 5 years after Project execution and at intervals determined in consultation with the DCCC thereafter;
- monitoring of social indicators that may change how Project impacts and benefits are experienced;
- engaging with stakeholders who should benefit from mitigations, to ensure their opinions are identified and considered in review of mitigation and performance outcomes;
- reviewing (annually) the delivery of mitigation strategies, performance outcomes, any unexpected impacts or benefits and the status of social indicators, conducted in consultation with the DCCC; and
- identifying and implementing required changes to mitigation and enhancement strategies.

A Social Impact Management Plan would also be developed by South32 for the Project, if required (Appendix K).

8.3.10 Greenhouse Gas

South32 would continue the ongoing management of its contribution to Australian greenhouse gas emissions inventories through participation in the Commonwealth Government's NGERS, as well as any other government initiatives implemented to manage emissions at the national level.

8.3.11 Rehabilitation and Mine Closure

Rehabilitation progress of the Project and rehabilitation techniques and materials would be regularly evaluated. The results would inform future rehabilitation initiatives and refinement/amendment of the practices and rehabilitation measures through adaptive management.

8.4 REPORTING

The following subsections describe the expected reporting requirements for the Project (based on requirements at the time of preparation of this EIS). South32 would adjust its reporting requirements should they change in the future.

8.4.1 Incident Reporting

Consistent with existing reporting requirements of the Dendrobium Mine Development Consent DA 60-03-2001, South32 would notify the DPE within 24 hours following the occurrence of an environmental incident, and prepare a report outlining the nature of the incident and mitigation measures undertaken.

8.4.2 Annual Review

Consistent with existing reporting requirements of the Dendrobium Mine Development Consent DA 60-03-2001, South32 would produce an Annual Review to describe the environmental performance of the Project for a 12-month reporting period. Copies of the Annual Review will be made available on the South32 website.

Environmental monitoring results would be compared against relevant statutory requirements, monitoring results of previous years and relevant predictions of this EIS.

Biodiversity management, proposed development and rehabilitation, as well as environmental performance improvement measures proposed for the next 12 months will also be discussed in the Annual Review.

Consistent with existing reporting requirements of the Dendrobium Mine Development Consent DA 60-03-2001, South32 would report the management of coal wash in the AEMR for the West Cliff Stage 3 Coal Wash Emplacement.

8.4.3 Development Consent Requirements

South32 would provide regular reporting of environmental performance of the Project on its website, in accordance with the reporting arrangements in any plans or programs approved under the conditions of the Project Development Consent and associated licences and approvals.

8.4.4 Independent Environmental Auditing

South32 would commission an independent environmental audit of the Project every 3 years or at an alternative interval as required by any Development Consent for the Project.

Upon completion of the independent environmental audit, South32 will submit a copy of the audit and its responses to the DPE.

8.4.5 Other Reporting

Annual Return

A summary of monitoring required by an EPL for the Project (including the recording of complaints) and a Statement of Compliance will be reported in Annual Returns and submitted to the EPA.

EPBC Act Approval – Annual Reporting

South32 would prepare annual reports, as required, assessing compliance with relevant conditions of an EPBC Act approval for the Project.

Greenhouse Gas Reporting

South32 would continue the ongoing management of its contribution to Australian greenhouse gas emissions inventories through participation in the Commonwealth Government's NGERS. Greenhouse gas and energy data would continue to be accounted for and reported in compliance with legislative and other requirements.

NPI Reporting

South32 will continue to provide annual National Pollutant Inventory (NPI) reports to the EPA (as Dendrobium Coal Pty Ltd). Emissions data for the Project will be made publicly available on the Federal Government's NPI website (www.npi.gov.au) and will also be reported in the Annual Review.

Community Complaints Register

A community complaints register is maintained as part of the Dendrobium Mine, which would continue for the Project. Complaints and subsequent actions undertaken will be reported in the Annual Review and on the South32 website.

8.5 INDEPENDENT EXPERT PANEL FOR MINING IN THE CATCHMENT – INITIAL REPORT

The IEP for Mining in the Catchment's report: *Initial Report on Specific Mining Activities at the Metropolitan and Dendrobium Coal Mines* (the Initial Report) was released in November 2018 (IEP, 2018).

The Initial Report focuses on the mining activities at the Dendrobium Mine and Metropolitan Mine and provides recommendations the IEP considers would inform longwall mine design and approvals, monitoring and performance.

A reconciliation of the Project's mitigation measures and monitoring against the IEP's recommendations is provided in Table 8-3 below.

Table 8-3
Independent Expert Panel for Mining in the Catchment - Major Recommendations

IEP (2018) Recommendation	Consideration for the Project
Mine Design	
• *Notwithstanding that uncertainty is associated with both the Tammetta and the Ditton height of complete drainage equations, it is recommended to err on the side of caution and defer to the Tammetta equation until:* - *field investigations quantify the height of complete drainage at the Dendrobium Mine and Metropolitan Mine, and/or* - *alternative geomechanical modelling of rock fracturing and fluid flow is utilised to inform the calibration of groundwater models*	• FLAC2D geomechanical modelling has been used in the groundwater modelling to estimate the height of fracturing for longwall panels panels with void width of 305 m (Appendix B). • For other longwall panels the height of fracturing has been estimated using the Tammetta Equation (Appendix B).
• *The potential implications for water quantity for faulting, basal shear planes and lineaments need to be very carefully considered and risk assessment at all mining operations in the Catchment Special Areas*	• PSM (2019) has reviewed geological structures in the Project area and concludes that based on the information provided, there is no strong evidence suggesting there are geological structures persistent from seam to surface that would be affected by Areas 5 or 6 mine subsidence (Appendix P). • Further investigations of geological structures would be conducted for the Project (Section 6.5). This would include in-seam drilling, noting this would occur during roadway development and as such cannot occur prior to approval of the Project (Section 6.5).
• *The concept of restricting predicted valley closure to a maximum of 200 mm to avoid significant environmental consequences should be revised for watercourses.*	• 200 mm predicted closure has been used successfully to date in the Southern Coalfields as a performance indicator for low likelihood (i.e. less than 10%) of subsidence-related fracturing resulting in flow diversion. • The Project adopts 200 mm additional predicted closure as mining constraint for named watercourses.
Mine Approval	
• *Government should verify that sufficient entitlements are retained by Dendrobium and Metropolitan mines to cover surface water losses resulting from mining-induced effects.*	• South32 holds groundwater licences under the *Water Sharing Plan for the Greater Metropolitan Regional Groundwater Sources 2011* to account for peak groundwater inflows associated with the Project (cumulatively with the approved Dendrobium Mine) (Attachment 7). • Any other licences required to be obtained for the Project would be obtained in consultation with DI Water.
• *The Panel recommends that in future:* - *mine design methodologies and procedures that underpin critical aspects of mining proposals should be supported by robust, independent peer review and/or a demonstrated history of reliability when applications are submitted to government*	• The EIS has been prepared by a number of specialists, including key assessments such as Subsidence (Appendix A), Groundwater (Appendix B), Surface Water (Appendix C), Biodiversity (Appendix D) and Geological Structures (Appendix P). • The Groundwater and Surface Water Assessments have been peer reviewed by Dr Frans Kalf and Emeritus Professor Thomas McMahon, respectively (Attachment 5).

Table 8-3 (Continued)
Independent Expert Panel for Mining in the Catchment - Major Recommendations

IEP (2018) Recommendation	Consideration for the Project
- *all applications to extract coal within Catchment Special Areas should be supported by independently facilitated and robust risk assessments that conform to ISO 31000 (the international standard for risk management subscribed to by Australia)*	• An ERA has been conducted for the Project in conformance with ISO 31000 (Appendix M).
- *government needs a sustainable mechanism for accessing objective expert advice when assessing mining applications.*	[N/A – this recommendation is directed at the NSW Government]
Monitoring and Performance	
• *In future, mines operating in the Catchment Special Areas need to develop, in consultation and with the agreement of regulators and key stakeholders, a standard for field investigations, data collection, and data processing that provides for and integrates the interests of all stakeholders and facilitates the sharing of the information by being presented on a common platform. This should be canvassed in submissions to inform Term of Reference 2*	• The recommendations of the EIS specialist studies in regard to monitoring would be adopted for the Project, as summarised in Section 8. • Should the Project be approved, monitoring location, methodologies, performance measures and triggers would be documented in Extraction Plans.
• *This monitoring standard in relation to groundwater should include provision for:*	
- *Installation of multi-level piezometers on the centreline of panels at Dendrobium and Metropolitan mines in order to monitor pore pressure changes associated with subsidence. These should include at least five transducers per borehole with installation being completed at least two years in advance of being undermined*	• Centreline groundwater monitoring prior to and following mining is currently adopted at the Dendrobium Mine and would continue for the Project.
- *Daily monitoring of local rainfall and mine water ingress from overlying and surrounding strata, and separation of rainfall correlated inflows for base flow volumetric analyses*	• The recommendations of the EIS specialist studies in regard to monitoring would be adopted for the Project, as summarised in Section 8.
- *Dendrobium Mine and Metropolitan Mine to develop site-specific databases in relation to the height of complete drainage in-lieu of relying on height of drainage equations.*	• Height of fracturing and groundwater depressurisation at the Dendrobium Mine is modelled using FLAC2D software and measured by centreline groundwater monitoring and this would continue for the Project.
• *In future, surface water monitoring requirements should include:*	
- *a distinction between primary watercourse monitoring sites, which are the sites at which performance measures are specified; and secondary watercourse monitoring sites, which will provide additional information identified as necessary as the mine plan evolves*	• Primary and secondary watercourses would be identified in monitoring programs prepared for Extraction Plans for the Project.
- *a specification of the minimum flow measurement accuracy required at the primary and secondary sites*	• Gauging stations installed for the Project would target low flow accuracy of ± 0.0025 ML/day resolution and ±10% accuracy over the flow range 0.01 to 10 ML/day (Appendix C). • Manual flow gauging would also be conducted to verify flow rating curves (Appendix C).
- *the identification of the primary sites in proposed future mining areas and the installation of flow monitoring at these sites at least four years in advance of mining activities*	• Flow gauges have already been installed at key sites downstream of Areas 5 and 6. • Primary and secondary watercourses would be identified in monitoring programs prepared for Extraction Plans for the Project, and additional flow gauges would be installed as required.
- *the identification of the secondary sites as the mine plan evolves and the installation of flow monitoring at these sites at least two years in advance of mining activities or a shorter time if approved as part of the mine plan approval*	

Table 8-3 (Continued)
Independent Expert Panel for Mining in the Catchment - Major Recommendations

IEP (2018) Recommendation	Consideration for the Project
- *paired piezometers in swamp sediments and nearby bedrock, and flow gauges at the swamp exit stream, complemented by soil moisture sensors at selected sites.*	• Piezometers in swamp sediment, and supporting piezometers in underlying strata, flow gauges and soil moisture probes, have already been installed in Area 5 and 6, and the monitoring network would be continued and expanded for the Project.
- *consistent use of inter-site comparisons using suitable control sites to complement rainfall-runoff modelling*	• Control sites be identified in monitoring programs prepared for Extraction Plans for the Project.
• *Surface flow monitoring associated with mining should be required to be continued until the consequences of mining (including any rehabilitation) have stabilised or the mine is considered by the relevant regulatory authorities to be closed. This requires clear metrics of stabilisation*	• Flow gauge monitoring would continue as required for the Project.
• *There is a need for groundwater modellers to address apparent inconsistency in the hydrogeologic parameters used to model Dendrobium and Metropolitan mines as it calls into question the robustness of current model predictions*	• Hydraulic conductivity values in the groundwater model are well constrained by field data from the existing Dendrobium Mine, the Bulli Seam Operations and the Tahmoor Mine.
• *Research needs to be progressed into the use of tritium for calculating 'modern' water contributions at Dendrobium Mine, including the potential for results to be affected (skewed) by adsorption*	• This research is already being progressed, with the use of additional isotypes being assessed to complement the tritium database.
• *A reservoir water balance model needs to be developed. A limitation of using either groundwater or rainfall-runoff models as currently applied is that these models do not necessarily correspond to the space or time scales relevant for quantifying water losses to the Sydney drinking water supplies. Water balances should include drought periods and results for these periods should be highlighted*	• Predictions of potential surface water losses for the Project (Appendix C) combine the outputs of the groundwater model with surface water catchment runoff modelling. • This enables consideration of daily variations in rainfall to be accounted for (as well as maximum potential subsidence-related losses) for various climate sequences.
• *In setting performance measures, government should have regard for those measures relevant to strategic resources (such as flow to storage) and to sanctions which rapidly prevent escalation of impacts and consequences if there are exceedances, clearly linked to monitoring results. Future consent conditions should clearly specify the acceptable levels of impacts and consequences on catchment resources, and that assessment of these should continue at strategic locations beyond the life of mine*	[N/A – this recommendation is directed at the NSW Government]

Table 8-3 (Continued)
Independent Expert Panel for Mining in the Catchment - Major Recommendations

IEP (2018) Recommendation	Consideration for the Project
• *TARP triggers should be based on meaningful surface water loss performance measures developed in consultation with relevant agencies with oversight and regulatory responsibilities for mining*	• The EIS base case mine plan adopts factors of safety based on experience from previous mining in the catchment to avoid or minimise the potential for impacts to water supply infrastructure, significant streams and key stream features: – Avon Dam wall and FSL. – Cordeaux Dam wall and full supply level. – Named watercourses (Cordeaux River, Avon River and Donalds Castle Creek). – Key stream features (pools >100 m³ and permanent, and steps >5 m with permanent pool at the base). • Extraction Plans for the Project would be developed in consultation with regulator agencies and would specify monitoring locations/methods, performance measures (including those specified in any Development Consent for the Project), trigger levels (set below performance measures) and contingency measure in the event that triggers are approached or exceeded. • Where trigger levels are exceeded, adaptive management would be implemented to prevent exceedances of performance measures. • For water supply infrastructure additional approval and TARPs would be developed with the DSC (for mining within DSC Notification Areas).
• *TARPs should be related to the desired outcomes (such as maintenance of water flows) and be consistent both within and between mine domains. The TARP triggers for surface and groundwater should be replaced by meaningful flow loss indicators developed in consultation with relevant agencies and authorities with oversight and regulatory responsibilities for mining*	
• *In situations where performance measures of negligible or minor environmental consequences are set by government, mine planning should incorporate appropriate factors of safety to avoid marginal situations associated with gaps in the current knowledge base.*	