



PO Box 323 Penrith NSW 2750
Level 4, 2-6 Station Street
Penrith NSW 2750
Tel 1300 722 468 Fax 02 4725 2599
Email info@sca.nsw.gov.au
Website www.sca.nsw.gov.au

Our Ref: D2009/05532
Your Ref: S08/00475

Howard Reed
Manager Mining
Major Projects Assessment
Department of Planning
GPO Box 39
SYDNEY NSW 2001

Dear Mr Reed *Howard,*

BULLI SEAM OPERATIONS PROJECT APPLICATION NUMBER 08_0150

I refer to your letter dated 14 October 2009 inviting the Sydney Catchment Authority (SCA) to make a written submission on the Bulli Seam Operations Project. As you are aware the SCA has a major interest in the project given its specific roles, objectives and functions stated in the *Sydney Water Catchment Management Act, 1998* and its significant landholdings in the Project area.

The SCA has carried out a review of the Environmental Assessment and has prepared the attached submission. The SCA has developed a set of principles to assess proposed mining Projects against.

The SCA requests that if the project is approved, the approval include an amended mine plan and/or a range of conditions to prevent or minimise impacts upon the Upper Canal, Cataract Dam, Cataract storage, other SCA infrastructure and associated catchments and key watercourses.

The SCA has collaborated with the Department of Environment, Climate Change and Water (DECCW) in developing this submission. While the SCA has not specifically commented on the environmental consequences of the Project for upland swamps, it considers that swamps have an important hydrological function and their ecological health is critical to the overall ecological integrity of the Special Areas.

The SCA welcomes the assessment of key aspects of the project by the Planning and Assessment Commission and would welcome the opportunity to discuss the project with the Commission.

Should you wish to discuss any issue above please do not hesitate to contact Malcolm Hughes on 47242452 or via email on malcolm.hughes@sca.nsw.gov.au

Yours sincerely


GEORGE DODDS
General Manager Catchment Operations

Cc: Mr Rohan Tayler – Planning Assessment Commission

SUBMISSION BY THE SYDNEY CATCHMENT AUTHORITY

on the

BULLI SEAM OPERATIONS PROJECT

December 2009

The SCA's submission is structured in 6 parts as follows:

1. Introduction and the SCA's mining principles which outlines a process the SCA has commenced with the Proponent for managing joint interests of the SCA and the Proponent (pages 1 to 4).
2. Performance Measures developed specifically for this Project by the SCA to guide its assessment (pages 4 to 5).
3. Summary of the SCA's assessment (pages 5 to 10).
4. SCA's Recommendations including suggested conditions should the Project be approved (pages 10 to 11).
5. Matters considered by the SCA in assessing the Project (pages 11 to 14).
6. Detailed assessment of the Project (pages 14 to 28).

1. INTRODUCTION

The Sydney Catchment Authority (SCA) has specific roles, objectives and functions specified in the *Sydney Water Catchment Management Act, 1998* (SWCM Act). In particular the SCA has certain functions including:

- managing and protecting the catchment areas, and the dams, storages and canals; and
- protecting and enhancing water quality.

The SCA is a major stakeholder with respect to the proposal because:

- a significant component of the proposal is located under lands owned by the SCA;
- SCA has special responsibilities including regulatory under the SWCM Act over its land holdings which form a significant portion of the land under which mining is proposed. This area is the Metropolitan and Woronora Special Areas and the Upper Canal;
- the proposal has the potential to significantly impact upon catchment infrastructure works owned and operated by the SCA; and
- the proposal has the potential to adversely affect water storages, water quality, watercourses and the ecological integrity of the Special Areas.

The SCA has no statutory planning role with respect to the proposal. However approval of the SCA is required for entry to and conducting activities in the Special Areas. Specific SCA approval is required by the provisions of the SWCM Act and the *Sydney Water Catchment Management Regulation 2008*.

This submission relates to that part of the Project which is located within the SCA's operational area, or which may otherwise affect the SCA's operational area or catchment infrastructure works.

The SCA's Principles for Managing Mining Impacts

The SCA Board has endorsed SCA mining principles that provide a framework, consistent with the SCA's statutory role, for consideration in the assessment and management of any current or proposed mining activity and impacts on the SCA's catchment infrastructure works and its area of operations including special areas. The principles are:

1. Quantity of water is protected

Mining and associated activities should not result in a reduction in the quantity of surface and groundwater inflows to storages or loss of water from storages or their catchments.

Fundamental to fulfilling the SCA's role is protecting the yield of the catchments and storages. Mining and associated activities have the potential to impact yield from the catchment to the stored waters, and affect the integrity of water supply assets and the catchment lands.

In assessing the impact of mining activities, mining proponents must demonstrate to the SCA that there is a very low risk of water loss from storages and that appropriate safeguards are in place to prevent any loss. Mining under or within the vicinity of storages has the potential to create pathways for stored waters to enter mine workings. The SCA would oppose any mining under or within the vicinity of water storages, unless it can be demonstrated there is an acceptable very low risk of water being lost through mining activities.

2. Quality of water is protected

Mining and associated activities should not result in a reduction in the quality of surface and ground water inflows to storages.

Mining has the potential to affect the quality of water in watercourses and groundwater systems. The potential impacts of mining and associated activities vary according to a range of geographic factors, including proximity to watercourses and upland swamps. While subsidence movements can now be predicted with reasonable accuracy, predicting the consequences of these movements on watercourses and upland swamps is complex and problematic.

3. The structural integrity of SCA infrastructure is maintained

The integrity of the SCA's infrastructure must not be compromised.

The SCA opposes mining (i.e. first or second workings) under any prescribed dam owned by the SCA. Mining should only result in negligible impact within the Dams Safety Committee notification area or under crucial assets.

4. Adoption of Best Practice and Compensation for SCA Costs and Losses

The SCA expects mining and associated activities to be conducted in accordance with regulatory requirements and adoption of best practice, and to be compensated for any costs or economic loss resulting from the impacts of mining on infrastructure, catchment yield or loss of stored waters.

In the SCA area of operations the SCA supports a precautionary and adaptive management approach and the adoption of best practice and recommendations by the 2008 NSW Southern Coalfield Inquiry relating to improved assessment and regulatory processes, subsidence impact management, prediction of subsidence effects and impacts, and suitable quality environmental baseline information.

Proponents of coal mining activities should be accountable for all aspects of the planning and conduct of their operations, and the mitigation and rehabilitation of any impacts resulting from their operations. Operators of coal mining or associated activities should be responsible for assessing, monitoring, avoiding, mitigating, repairing, remediating or rehabilitating impacts attributable, or likely to be attributable, to their activities. They are liable for all costs associated with those activities.

The SCA expects to be financially compensated for any economic loss resulting from loss of catchment yield or stored waters attributable, or likely to be attributable, to the impact of coal mining within, or under, the SCA's Special or Controlled Areas.

Location of Mining Area and Relationship to Areas of Interest to the SCA

The Project general arrangement and areas of interest to the SCA and the reasons for interest are summarised below:

- West Cliff Area 5 and Appin Area 7 – these parts of the Project have the potential to impact on the Upper Canal and Menangle Weir (both these assets are owned by the SCA).
- North Cliff - this part of the Project has the potential to impact on the upper part of the Woronora River and its associated catchment including upland swamps (all of this land is owned by the SCA).
- Appin Areas 2 and 3 Extended - these parts of the Project have the potential to impact on:
 - Cataract Dam and reservoir and its associated catchment including upland swamps (the dam, reservoir and all these lands are owned by the SCA);
 - Upper Canal (including the Nepean tunnel);
 - Broughtons Pass and Jordans Crossing weirs (both these assets are owned by the SCA); and
 - parts of the Cataract River, Lizard Creek, Wallandoola Creek and Cascade Creek and their associated catchments including upland swamps (all of these lands are owned by the SCA).

Cataract Dam and the Upper Canal (including the Nepean and Cataract tunnels, Broughtons Pass weir and aqueducts) are State listed heritage items.

Given the significance of the Proponent's Project and its other previous and ongoing activities within the SCA's operational area, the SCA established a governance framework with the Proponent. The SCA and the Proponent have been jointly working on this framework. The framework will comprise an umbrella agreement, master agreement and joint working groups which will assist with communications, access control, resolution of technical matters, identification of new science and monitoring requirements and remediation. The master agreement will address all of the Proponent's mining activities within the SCA's operational area and the following:

- The implementation of works/measures to ensure that performance measures/outcomes for critical built and natural assets relating to the SCA that are set in any mining approval are met.
- Data and research sharing arrangements.
- SCA requirements for financial assurance for undertaking mining activities and the costs of the SCA in responding to the impacts of activities.

The SCA has initiated the above process with the two other mining companies with operations in the SCA's area of operation. The SCA has previously entered into master agreements with the Proponent.

2. PERFORMANCE MEASURES FOR KEY ASPECTS

In assessing impacts the SCA has identified specific performance measures and used terms defined in the Part 3A approval for the Metropolitan Coal Project for "negligible" and "safe, serviceable and repairable".

Catchment Infrastructure Works

- Cataract Dam wall – Zero impact.
- Upper Canal (including Nepean Tunnel and Cataract Tunnel) – "Negligible" impact and the structure is "safe and serviceable".
- Broughtons Pass Weir – "Negligible" impact and the structure is "safe and serviceable".
- Jordans Crossing Weir and Menangle Weir walls – "Safe, serviceable and repairable".
- Douglas Pass Weir and Menangle Weir fishways – "Safe, serviceable and repairable".
- Baden Powell Drive (access road from Appin Road to Cataract Dam) – "Safe, serviceable and repairable".
- Fire trails – "Safe, serviceable and repairable".

Water Resources

- Catchment yield to the Cataract Reservoir – "negligible" reduction in the quality and quantity of water resources reaching the Cataract Reservoir. No connective cracking between the surface and the mine.
- Cataract Reservoir – "negligible" leakage from the Cataract Reservoir. "Negligible" reduction in the water quality of Cataract Reservoir.
- Catchment yield to the Broughtons Pass Weir pool – "negligible" reduction in the quality and quantity of water resources reaching the Broughtons Pass Weir pool. No connective cracking between the surface and the mine.
- Broughtons Pass Weir pool – "negligible" leakage from the Broughtons Pass Weir pool. "Negligible" reduction in the water quality of Broughtons Pass Weir pool.
- Catchment yield to the Woronora Reservoir – "negligible" reduction in the quality and quantity of water resources reaching the Woronora Reservoir.

Watercourses

- Cataract River (from the Cataract Dam wall to the full supply level of Broughtons Pass Weir) – "Negligible" environmental consequences (that is, no diversion of flows, no change in the natural drainage behaviour of pools, minimal iron staining, and minimal gas releases).
- Appin Falls - No rock fall occurs at Appin Falls. The structural integrity of the waterfall, its overhang and its pool are not impacted.

- Cataract Tributary 1, Lizard Creek, Wallandoola East Creek (3rd order section), Wallandoola Creek and Cascade Creek (for their full length) – “Negligible” environmental consequences (that is, no diversion of flows, no change in the natural drainage behaviour of pools, minimal iron staining, and minimal gas releases).
- Cataract Reservoir Tributary 1 and Cataract Reservoir Tributary 2 (3rd order sections) – “Negligible” environmental consequences (that is, no diversion of flows, no change in the natural drainage behaviour of pools, minimal iron staining, and minimal gas releases).
- Woronora River (tributary downstream of the crossing of Fire Trail 14 and adjacent to the northern end of Longwall 19 – and 3rd order tributary downstream of Longwall 18) – “Negligible” environmental consequences (that is, no diversion of flows, no change in the natural drainage behaviour of pools, minimal iron staining, and minimal gas releases).

3. SUMMARY OF SCA’S ASSESSMENT

The SCA’s assessment is based on information available at this point in time. It may change as a result of the provision of further information by the Proponent, other new information and issues raised by other parties including the Planning Assessment Commission.

The SCA’s assessment of potential impacts is summarised below.

3.1 SCA Infrastructure

Cataract Dam

Assessment of potential impacts: Maximum predicted total subsidence, upsidence and closure movements at the dam wall are all less than 20mm. Some small far-field horizontal movements could potentially be observed at the dam wall. **The SCA considers that these movements would have insignificant impact on the dam structure and therefore is satisfied the Project will not affect the structural integrity of Cataract Dam.** The SCA notes that the Dams Safety Committee will be involved in a detailed assessment of the potential impacts on the dam. The SCA supports this process to more accurately understand potential impacts and to determine appropriate management responses.

Upper Canal

Assessment of potential impacts:

- Nepean Tunnel – is a critical component of the water supply system to the Macarthur Area. The tunnel is expected to be affected by the full range of systematic subsidence movements. Maximum predicted total subsidence of 1250mm would result in parts of the tunnel becoming an inverted siphon which could affect the serviceability of the tunnel, and could cause roof and wall instabilities. A recent assessment has shown the tunnel is in a poorer state generally than the previously undermined Cataract Tunnel. **The SCA is not satisfied that the Project’s likely overall impacts on the Nepean Tunnel would be “negligible” or that the Nepean Tunnel would remain “safe and serviceable”.**
- Cataract Tunnel - Maximum predicted total subsidence is less than 20mm. The additional movements at the Cataract Tunnel resulting from the Appin Area 3 longwalls are small compared with the

previously mined longwalls beneath the tunnel. It is unlikely that the extraction of the proposed longwalls would result in any significant additional impact on the tunnel. **The SCA is generally satisfied that the Project's likely impacts on the Cataract Tunnel would be "negligible" and it would remain "safe and serviceable"**.

- Devines tunnels - Predicted systematic subsidence at the tunnels resulting from the extraction of the proposed longwalls, is less than 20mm. It is therefore unlikely that the tunnels will be subjected to any significant subsidence impact, however far field horizontal movement may potentially affect the tunnels. **The SCA is generally satisfied that the Project's likely impacts on these tunnels would be "negligible" and they would remain "safe and serviceable"**.
- Upper Canal Open sections - The canal is expected to be affected by the full range of predicted systematic subsidence movements including a maximum predicted subsidence of 960mm. Given this magnitude of movement, the canal having a minimum freeboard of 500mm is likely to overtop. There is also the possibility of spalling or fracturing and falling of the sandstone blocks making up the canal wall. Fracturing could result in increased leakage or collapse of the canal wall. **The SCA is not satisfied that the Project's likely overall impacts on the open section of the Upper Canal above and/or adjacent to longwalls 720 to 724 would be "negligible" and it would remain "safe and serviceable"**.

The SCA is generally satisfied the Project's overall likely impacts on the open section of the Upper Canal north of Mallaty Creek would be "negligible" and it would remain "safe and serviceable".

- Ousedale Aqueduct – Ousedale aqueduct is located above proposed longwall 724 with maximum predicted subsidence of 210mm and closure of 300mm. The effect of subsidence on Ousedale aqueduct could be more serious than that experienced at Simpsons aqueduct due to mining of longwall 409. This is particularly due to the fact that Ousedale Aqueduct is significantly different in nature than Simpsons Aqueduct being very much longer and not in a straight alignment vertically. **Notwithstanding that protective works have already been implemented on Ousedale aqueduct due to earlier Westcliff Area 5 longwalls, the SCA is not satisfied that the Project's likely overall impacts on Ousedale aqueduct due to the direct undermining of Appin Area 7 longwalls would be "negligible" or that it would remain "safe and serviceable"**.
- Other Aqueducts – The predicted subsidence resulting from the proposed longwalls at the Elladale and Mallaty aqueducts located outside the extent of the proposed longwalls is less than 20mm, while maximum predicted subsidence and closure movement at Mallaty aqueduct, the two concrete aqueducts, Leaf's Gully aqueduct and Nepean aqueduct is about 20mm. **The SCA is satisfied that the Project's likely overall impacts on these aqueducts would be "negligible" and they would remain "safe and serviceable"**.

The SCA is investigating the long term management of the Upper Canal with options of refurbishment and replacement being considered. It may be that scope exists for longwall mining to be phased with refurbishment or replacement works undertaken by the SCA to address the SCA's concerns.

Weirs

Assessment of potential impacts:

- Broughtons Pass - The weir has been significantly damaged (cracked and uplifted on one side) by previous mining. There is predicted to be significant further movement at the weir and this may cause further cracking resulting in water seepage and structural instability. This weir is the most critical piece of infrastructure involved with sole supply of water to the Macarthur Area. **The SCA is not satisfied that the Project's likely overall impacts on the weir would be "negligible" and that it would remain "safe and serviceable"**.
- Menangle – The predicted subsidence and upsidence at this weir could cause minor cracking of the weir. **The SCA is generally satisfied the Project's likely impacts on the wall of the weir would be minor or that it would remain "safe, serviceable and repairable"**.
- Jordans Crossing – The predicted subsidence and upsidence at this weir could cause minor cracking of the weir and this may compromise its role as a gauging station. **The SCA is satisfied the Project's likely overall impacts on the wall of the weir could be minor and it would remain "safe, serviceable and repairable"**. This is subject to investigations being undertaken prior to mining and any necessary preventative works being carried out.
- Fish passages – Menangle and Douglas Park – The SCA is constructing new fish passages at both these weirs to a standard that has been endorsed by the Mines Subsidence Board. Notwithstanding these standards there remains the potential for cracking and separation of the structures from the bedrock. **The SCA is generally satisfied the Project's likely overall impacts on the fish passages of both weirs would be minor and they would remain "safe, serviceable and repairable"**.

3.2 Water Quantity and Quality

a. Cataract Reservoir

Assessment of potential impacts: No mining is proposed under or within the immediate vicinity of the reservoir. **The SCA is reasonably satisfied subject to there being no significant structural geological features, that the risk of loss of water from the storage to the mine is "negligible"**. The tolerable sustainable loss from the stored waters of Cataract Reservoir is as defined by the tolerable loss criteria for Codeaux Dam developed by the SCA and the Dams Safety Committee for Dendrobium Areas 1 and 2.

b. Surface Water

Assessment of potential impacts:

The SCA is generally satisfied that due to the depths of cover and the characteristics of the cover that connective cracking from the ground surface to the mined seam is not expected. **The SCA is therefore generally satisfied that there is “negligible” potential for the loss of surface water from fractured streams to the mine.** However there is some uncertainty in the south eastern part of the Project area due to inconsistencies in the predicted maximum height of the fractured zone.

The SCA is generally satisfied that the current evidence indicates that a portion of diverted surface water flows, through the upside created rock fractures beneath stream beds, will re-emerge further downstream.

The SCA considers there is evidence that all water diverted from surface flows does not return to the surface. **The SCA is therefore concerned that the Project may reduce the catchment yield to Cataract Dam, Woronora Dam and Broughtons Pass Weir.**

The SCA is not satisfied that there would be “negligible leakage” from the Broughtons Pass Weir pool given there is the possibility of significant cracking in the vicinity of the weir.

The SCA's understanding of the impacts of longwall mining on surface water quality is largely informed by the impacts of mining in the Waratah Rivulet area of the Woronora catchment. The surface water in Waratah Rivulet, overlying longwall mining, has and continues to show elevated electrical conductivity, cations, anions and metals and reduced dissolved oxygen.

The SCA is generally satisfied that the likely impacts of the Project on the quality of water entering Woronora Reservoir would be “negligible” due to the distance from the mine area to the reservoir.

The SCA is generally satisfied that there would be a “negligible” reduction in the water quality of Cataract Reservoir as a result of mining Appin Area 3. This is primarily due to the diluting affect of the stored waters in the reservoir. This does not mean that it is acceptable for water of a lesser quality than naturally occurs to enter the reservoir.

The SCA is not satisfied that the Project would not result in a “negligible” reduction in the quality of water reaching the Cataract Reservoir from Cataract Reservoir Tributaries 1 and 2 (notwithstanding that the Proponent would carry out remediation works on sections of third order streams).

The SCA is concerned that the Project would not result in a “negligible” reduction in the quality of water reaching Broughtons Pass weir pool from Cataract River when there is only environmental flows being released from Cataract Dam.

The SCA considers there would be a “negligible” reduction in the water quality of Broughtons Pass Weir pool – because it would be transferring water from either Cataract Dam or Pheasants Nest weir to this weir pool and this would dilute any decline in water quality.

The SCA considers that overall the Project will not have a neutral or beneficial effect on water quality in watercourses above and in the vicinity of mining area.

c. Groundwater

Assessment of potential impacts: The groundwater assessment in the EA has shortcomings which are likely to result in the failure to identify probable impacts and underestimate the extent of impacts. The main deficiencies include:

- Insufficient groundwater monitoring data (implications for assessing prior impacts, current conditions and calibrating the numerical model);
- Underestimation of the height of the fractured zone, with a potential fractured zone extending to the surface in the south eastern part of the Project area;
- Inappropriate hydraulic properties for the numerical model - the initial values are based on limited site specific data, the model calibration was based on limited groundwater levels, and the hydraulic properties representing the mining situation did not consider the surface zone, rib zone and there are inconsistencies in the EA regarding the height of the fractured zone;
- Inappropriate model grid size over the Project area; and
- No assessment of perched groundwater levels, including no assessment in the numerical model.

The SCA's concerns about the Project are supported by our experience of the clear mining effects on the shallow groundwater near the Georges River, Nepean River and Cataract River.

The applicant should address the above and develop and implement a more comprehensive groundwater monitoring plan, determined in consultation with the SCA and taking into consideration the deficiencies in monitoring discussed in this assessment, to assist in an improved understanding of the effects and impacts of subsidence due to proposed mining on the groundwater systems, and its interaction with surface water and swamp ecosystems. Decisions must be based on a minimum of 2 years baseline information.

3.3 Environmental Consequences

a. Watercourses

Assessment of potential impacts:

There is widespread acceptance that longwall mining under and in the vicinity of rock lined watercourses can cause upsidence which fractures the bed of these watercourses resulting in diversion of a portion of surface flows through the fracture network. The environmental consequences include a loss of surface flows during low flow periods, draining of pools, and declines in water quality. These environmental consequences are most severe directly above the mining area. The environmental consequences extend downstream.

The SCA is not satisfied that the Project would result in “negligible” environmental consequences for the section of Cataract River from the Cataract Dam to Broughtons Pass weir. The EA predicts some diversion of water from pools.

The SCA is not satisfied that the project would result in “negligible” environmental consequences for Lizard Creek.

The SCA is not satisfied that the Project would have “negligible” environmental consequences for Wallandoola East Creek, Wallandoola Creek and Cascade Creek. It is expected that impacts would be significantly less for Cascade Creek than the other two creeks. It is noted that the EA predicts the maximum valley closure along Wallandoola Creek to be 1280 mm – and based on the experience and observations at Waratah Rivulet, it is considered the environmental consequences along Wallandoola Creek would be similar or more severe than that experienced along Waratah Rivulet.

The SCA is not satisfied that the Project would have “negligible” environmental consequences for Woronora River (tributary downstream of the crossing of Fire Trail 14 and adjacent to the northern end of Longwall 19 – and the 3rd order tributary downstream of Longwall 18).

b. Appin Falls

Assessment of potential impacts: The SCA is not yet able to determine whether the Project would affect the structural integrity of the waterfall, its overhang and its pool because of insufficient data presented.

4. SCA'S RECOMMENDATIONS

The SCA requests the project approval if granted, include a range of conditions to prevent or minimise to negligible or minor levels impacts upon Cataract Dam, Cataract storage, the Upper Canal, other SCA catchment infrastructure works and the catchment, including Cataract River and other key watercourses. The SCA expects that this would require amendments to the mine plan. In particular the SCA considers conditions must be included which requires the applicant to:

- Provide evidence on the issues the SCA has identified above.
- For identified risks detail the risks and measures to be put in place to monitor the potential risks.
- Provide agreed actions to address the risks if they materialise before mining occurs in each mining domain.
- Meet all costs associated with preventing, minimising and rehabilitating impacts and compensate the SCA if it suffers an economic loss due to a reduction in the quantity and/or quality of water entering the Cataract and Woronora storages and Broughtons Pass weir pool arising from the Project.

Requirements with regard to the following should be included in the approval conditions:

- Performance Measures – the SCA expects the approval to include a schedule of performance measures for water resources, watercourses and built features. It is important that specified performance measures are measurable and compliance testable.
- Catchment Monitoring Program – prepared in consultation with and to the satisfaction of the SCA for those parts applying to the Metropolitan and Woronora Special Areas. The program must be approved prior to the Proponent carrying out any second workings in the Metropolitan or Woronora Special Areas.

- Extraction Plan – the SCA expects the approval to include a requirement for extraction plans similar to that specified in the Metropolitan Coal Project approval (Schedule 3 – condition 6) – but with the exception that for those parts within the Metropolitan and Woronora Special Areas, the water management plan, land management plan and built features management plan are to be prepared in consultation with and to the satisfaction of the SCA. Where the Extraction Plans affect any part of the Upper Canal (including the Nepean and Cataract Tunnels) or Menangle and Jordans Crossing weirs, the built features management plan shall be prepared in consultation with and to the satisfaction of the SCA.
- Rehabilitation Objectives – the Proponent shall achieve the following rehabilitation objectives:
 - For all SCA catchment infrastructure works – repair/restore to pre-mining condition or equivalent;
 - For all 3rd order watercourses and above located within the Metropolitan and Woronora Special Areas – restore surface flow and pool holding capacity as soon as reasonably practicable to pre-mining levels.
- Rehabilitation Management Plan – for all areas within the Metropolitan and Woronora Special Areas the Proponent shall, in consultation and to the satisfaction of the SCA, prepare and implement a Rehabilitation Management Plan prior to carrying out second workings.
- Environmental Offsets – should be required to compensate for either predicted or non-predicted impacts on natural features, where such impacts are non-remediable.

The SCA supports the recommendation by the Department of Environment, Climate Change and Water (DECCW) that any approval of the Project includes explicit staging of the mining, so that the Eastern domains be delayed until the science of predicting environmental consequences and developing preventative and remedial measures is improved in this more challenging environment and that a 10 year review process be included in the approval.

The SCA notes the recommendation of the NSW Southern Coalfield Independent Inquiry that “mining which might unacceptably impact highly-significant natural features should be subject to an increased security deposit sufficient to cover both anticipated rehabilitation costs, and potential rehabilitation costs in the event of on non-approved impacts to the highly significant feature.” The SCA requests the Department to carefully consider this recommendation to ensure that there is an adequate security deposit.

5. MATTERS CONSIDERED IN ASSESSING THE PROJECT

In undertaking its assessment of the Project the SCA has considered its legislation and associated plans, the catchment infrastructure works present in and adjacent to the Project area and the characteristics of the catchment. The SCA has also had regard for the outcomes from the Southern Coalfield Independent Inquiry and the Metropolitan Coal Project Planning Assessment Commission report.

Legislation and associated plans

Coal mining and associated activities within the SCA’s area of operations have the potential to affect the SCA’s stored waters and catchment infrastructure works and to

impact on water yield from the catchments, and the quality of water in rivers and streams.

The SCA has specific roles, objectives and functions detailed in the SWCM Act. The SWCM Act requires the SCA to manage and protect catchment areas and catchment infrastructure works. Catchment infrastructure works includes dams and water storages.

Significant parts of Appin Area 3 Extended and Appin Area 2 Extended mining areas are located in the Metropolitan Special Area. A small portion of the North Cliff mining area is located in the Woronora Special Area.

The SWCM Act identifies Special Areas as having the following purposes:

- protecting the quality of stored waters; and
- maintaining the ecological integrity of the land.

The Special Areas Strategic Plan of Management (2007) provides the framework for the SCA and the Department of Environment, Climate Change and Water to jointly manage the Special Areas.

While the Drinking Water Catchments Regional Environmental Plan No 1 does not apply to the project, the SCA nevertheless considers the project should seek to achieve a neutral or beneficial effect on water quality.

Issues of Interest to the SCA

The main issues of interest to the SCA are the potential impacts on:

- catchment infrastructure works including dams, weirs canals, water storages, and roads;
- surface and ground waters; and
- the catchment and Special Areas including watercourses, upland swamps and groundwater.

The SCA is a significant landholder in the Project area – being the major landholder for those parts of the project located in the Metropolitan and Woronora Special Areas.

Potential impacts are substantially due to subsidence effects and impacts and the subsequent environmental consequences. Lesser impacts may result from exploration activities, and the use of the SCA fire trails overlying the longwall mining areas.

Other considerations

NSW Southern Coalfield Independent Inquiry

The SCA has considered the advice and recommendations regarding best practice in regard to subsidence impact management and assessment and regulatory processes detailed in the NSW Southern Coalfield Independent Inquiry (SCI) Report (2008). In particular the SCA notes that the report recommends:

- Risk Management Zones should be identified in order to focus assessment and management of potential impacts on significant natural features;
- A precautionary approach should be applied to the approval of mining which might unacceptably impact highly-significant natural features;

- Mining which might unacceptably impact highly-significant natural features should be subject to an increased security deposit sufficient to cover both anticipated rehabilitation costs and potential rehabilitation costs of non-approved impacts to the highly significant feature;
- Increased use should be made of conditions requiring environmental offsets to compensate for either predicted or non-predicted impacts on significant natural features, where such impacts are non-remediable; and
- Coal mining companies should provide a minimum of two years of baseline environmental data to support any application under Part 3A.

The SCA has also used the following terms as used in the SCI Report in this assessment report:

Subsidence effects to describe subsidence itself – ie deformation of the ground mass caused by mining, including all mining-induced ground movements such as vertical and horizontal displacements and curvature as measured by tilts and strains; **Subsidence impacts** to describe the physical changes to the ground and its surface caused by the subsidence effects. These impacts are principally tensile and shear cracking of the rock mass and localised buckling of strata caused by valley closure and upsidence but also include subsidence depressions or troughs.

Environmental consequences of subsidence impacts include loss of surface flows to the subsurface, loss of standing pools, adverse water quality impacts, development of iron bacterial mats, cliff falls and rock falls, damage to Aboriginal heritage sites, impacts on aquatic ecology, ponding etc.

Planning Assessment Commission Review Report - Metropolitan Coal Project

While this report focussed on the assessment of the Metropolitan Coal Project, it did also provide an assessment of how the SCI recommendations might be applied to a substantive mining proposal and to suggest any variations or enhancements that may facilitate application to future proposals. In particular the Planning Assessment Commission developed an expanded risk framework for natural features using the Risk Management Zone concept and set out suggested approaches for assessing relative significance of natural features and the acceptability or otherwise of subsidence-induced impacts and consequences for those features. Application of this risk approach by the Commission resulted in them adopting a strategy of specifying the outcomes or performance measure to be achieved.

Project Approval – Metropolitan Coal Project

The SCA has assumed that if the project is approved, the approval will be in a similar format to that recently granted for the Metropolitan Coal Project. In particular the SCA has assumed that the approval would specify subsidence impact performance measures. For this reason the SCA has specified its desired performance measures for key aspects and used where appropriate the same or similar terminology to that contained in the approval for the Metropolitan Coal Project.

Key definitions are 'negligible' and 'safe, serviceable and repairable'. The approval for the Metropolitan Coal Project defines 'negligible' as *small and unimportant, such as to be not worth considering* and 'safe, serviceable and repairable' as *safe means no danger to users, serviceable means available for its intended use, and repairable means damaged components can be repaired economically*.

Assessment Precision

The EA has been undertaken at a broad scale – with more detailed assessment and refinement of the location of longwalls expected to occur at the time that Extraction Plans are prepared. Consequently the SCA has not been able to form a precise opinion on expected consequences arising from ground movement.

Monitoring

The NSW Southern Coalfield Independent Inquiry recommended that environmental assessments should be based on a minimum of 2 years of baseline data, collected at an appropriate frequency and scale. The EA contains a paucity of baseline data and rarely does it extend for a period of more than 2 years. This has severely constrained the ability of the Proponent to accurately assess and predict subsidence consequences.

6. SCA ASSESSMENT

IMPACTS ON CATCHMENT INFRASTRUCTURE WORKS

Catchment infrastructure works are defined in Section 3 of the *Sydney Water Catchment Management Act 1998* as meaning:

- a) water storages, water mains, or connected or associated works, or
- b) monitoring devices in, under, over or near any works referred to in paragraph a), or
- c) any works ancillary or antecedent to any works referred to in paragraph a) or b)

Desired Performance Measures

- Cataract Dam wall – Zero impact.
- Upper Canal (including Nepean Tunnel and Cataract Tunnel) – “Negligible” impact and the structure is “safe and serviceable”.
- Broughtons Pass Weir – “Negligible” impact and the structure is “safe and serviceable”.
- Jordans Crossing Weir and Menangle Weir walls – “Safe, serviceable and repairable”.
- Douglas Pass Weir and Menangle Weir fishways – “Safe, serviceable and repairable”.
- Baden Powell Drive (access road from Appin Road to Cataract Dam) – “Safe, serviceable and repairable”.
- Fire trails – “Safe, serviceable and repairable”.

The SCA defines the term ‘impact’ as the total project impacts not just the impacts from the actual extraction of coal. The total impacts therefore include the impacts associated with implementation of preventative measures (including operational impacts such as temporary shutdowns of key components of the water supply system), direct impacts arising from extraction of coal, impacts associated with monitoring and impacts associated with the implementation of remediation measures.

Assessment of Impacts

Cataract Dam

Cataract Dam, a prescribed dam along the Cataract River, is located approximately 1km southeast of the Appin Area 2 longwalls. The Area 2 longwalls are partly located within the Dams Safety Committee notification area. Maximum predicted

total subsidence, upsidence and closure movements at the dam wall are all less than 20mm. Although these movements are small, the dam wall could be sensitive to any differential movements from far-field horizontal movements or valley related movements. The SCA considers that these movements would have insignificant impact on the dam structure and therefore is satisfied the Project will not affect the structural integrity of Cataract Dam.

Even if the level of movement is low and the risk of damage to the dam wall is small, any potential impacts on the dam wall should be managed by the implementation of suitable management strategies because Cataract Dam is an extreme consequence category dam.

Risk-based management strategies developed in consultation with and to the satisfaction of SCA and Dams Safety Committee should include risk assessment on the impact of mining, detailed structural analysis of the dam wall, remediation plan, contingency plan, Trigger Action Response Plan (TARP), and monitoring plan.

Upper Canal

The Upper Canal transfers raw water from the Upper Nepean dams to the SCA's customers – including to Sydney Water sites at Prospect and Macarthur. The Upper Canal is a crucial part of the water supply system and it is critical that it be kept safe and serviceable.

The Upper Canal has a number of components including the Nepean tunnel, the Cataract tunnel, other tunnels, the open canal and associated aqueducts. The Upper Canal was constructed in the late 19th century – and partly for this reason is fragile. The Upper Canal is listed on the State heritage register.

The SCA is investigating the long term management of the Upper Canal with options of refurbishment and replacement being considered.

Nepean Tunnel: Appin Area 3 longwalls 303 to 306 are located adjacent to and under a section of the Nepean Tunnel. The tunnel transfers water from Pheasants Nest Weir to Broughtons Pass Weir and is critical to the ability of the SCA to supply this sole source of water to the Macarthur region and also as a supply to the Sydney region. The tunnel is in a poorer state generally than the previously undermined Cataract Tunnel. The Nepean Tunnel is expected to be affected by the full range of systematic subsidence movements with a maximum predicted total subsidence of 1250mm. “The predicted subsidence could potentially result in parts of the tunnel becoming a siphon which could affect the serviceability of the structure. The predicted curvatures and ground strains could also result in instabilities in the roofs and walls resulting in spalling or rock falls.” (p. 165 - EA Appendix A Subsidence Assessment). The structural condition of the Nepean Tunnel is deemed to be in poorer condition than the previously undermined Cataract Tunnel.

The SCA is not satisfied that the Project's likely overall impacts on the Nepean Tunnel would be “negligible” and it would remain “safe and serviceable”.

Cataract Tunnel: The Cataract Tunnel was directly undermined by previous Appin Area 4 longwalls (401 to 408). Maximum predicted subsidence was 1530mm and actual measured subsidence was 1279mm. Installation of protective and remedial works (wire mesh, shotcrete, rockbolts, megabолts, timber props) and rigorous monitoring during the active mining period protected the tunnel against roof collapse and minimised closure, but did not prevent the formation of a subsidence bowl

between chainage 1800 and chainage 2500. Because of this subsidence bowl water can no longer drain freely and will require the permanent installation of a pump to dewater the subsided section of the tunnel.

Mining of longwall 409, adjacent to longwall 408 and located about 275m north of the downstream end of Cataract Tunnel, was completed in September 2009. The predicted maximum subsidence at the tunnel portal after longwall 409 is 380mm compared with 400mm after longwall 408.

The northern extent of the proposed Appin Area 3 (longwall 313) is located about 800m south of the upstream end of Cataract Tunnel. Maximum predicted total subsidence is less than 20mm. The additional movements at the Cataract tunnel resulting from the Area 3 longwalls are small compared with the previously mined longwalls beneath the tunnel. It is unlikely that the extraction of the proposed longwalls would result in any significant impact on the tunnel.

The SCA is generally satisfied that the Project's likely impacts on the Cataract Tunnel would be "negligible" and it would remain "safe and serviceable".

Risk-based management strategies developed in consultation with and to the satisfaction of SCA should include risk assessment on the impact of mining, detailed structural analysis of the dam wall, remediation plan, contingency plan, Trigger Action Response Plan (TARP), and monitoring plan.

Open Section of Upper Canal, and Elladale, Mallaty Wrought Iron Aqueducts and Concrete Aqueducts: The proposed Appin Area 7 longwalls 720 to 724 would be mined very close to and under an open section of the canal and several wrought iron and concrete aqueducts, while West Cliff Area 5 longwalls 33 to 37 are also in close proximity to the canal, the downstream section of Devines Tunnel No.2, Leaf's Gully aqueduct and Nepean aqueduct.

The canal is expected to be affected by the full range of predicted systematic subsidence movements with maximum predicted total subsidence of 960mm and maximum predicted total tilt of 4mm/m. The maximum movements are predicted to occur in the vicinity of longwalls 723 and 724.

"The Upper Canal has a minimum freeboard of 500mm and, without mitigation measures in place, the maximum predicted total subsidence is likely to result in the canal overflowing. The canal is constructed from sandstone blocks and, it is possible that the predicted ground curvatures and strains could result in spalling or fracturing of the blocks or collapse of the walls. If fracturing were of sufficient magnitude, it could result in increased leakage from the canal or collapse of the canal walls." (p. 167 - EA Appendix A Subsidence Assessment).

The SCA is not satisfied that the Project's likely overall impacts on the open section of the Upper Canal above and/or adjacent to longwalls 720 to 724 would be "negligible" and it would remain "safe and serviceable".

The predicted subsidence resulting from the proposed longwalls at the Elladale and Mallaty aqueducts located outside the extent of the proposed longwalls is less than 20mm, while maximum predicted subsidence and closure movement at Mallaty aqueduct, the two concrete aqueducts, Leaf's Gully aqueduct and Nepean aqueduct is about 20mm.

Except for Leafs Gully and Nepean aqueducts, preventative works have previously been undertaken on the wrought iron aqueducts from Elladale to Mallaty (including Ousedale) and the two concrete aqueducts.

The SCA is generally satisfied that the Project's likely overall impacts on the open section of the Upper Canal north of Mallaty Creek would be "negligible" and it would remain "safe and serviceable".

Additional detailed engineering assessment should be undertaken for Leafs Gully and Nepean aqueducts to determine if mining protective measures are required due to the total subsidence impact resulting from the mining of Appin Area 7 and West Cliff Area 5 longwalls. Subject to the above the SCA is satisfied that the Project's likely overall impacts on these aqueducts would be "negligible" and they would remain "safe and serviceable".

Ousedale Aqueduct: Ousedale aqueduct is located above the proposed longwall 724 with maximum predicted upsidence of 210mm and closure of 300mm. Ousedale aqueduct is a rigid, asymmetrical 128m long wrought iron pipe with a 2.44m diameter and whose northern and southern ends are encased in mass concrete headwalls. Unlike Simpsons aqueduct (45.7m long) or Mallaty aqueduct (52m long) which are both straight symmetrical wrought iron aqueducts supported by two 7 to 9 m tall sandstone masonry piers in the middle and concrete pad support on both ends, Ousedale aqueduct is supported by four low concrete pad supports on its inclined southern end and another set of four low concrete pad supports founded on sandstone on its inclined northern end section. Three sandstone masonry piers support the horizontal section of the pipe, with the tallest central pier approximately 14.4m.

Because of its shape and length, the aqueduct could experience maximum valley related closure movements resulting from mining. The three central piers could likewise experience maximum upsidence movement associated with the valley closure. Therefore, the effect of subsidence on Ousedale aqueduct could be more serious than what was experienced at Simpsons aqueduct due to mining of longwall 409.

Notwithstanding protective works have already been implemented on Ousedale aqueduct due to earlier Westcliff Area 5 longwalls, the SCA is not satisfied that the project's likely overall impacts on Ousedale aqueduct due to the direct undermining of Area 7 longwalls would be "negligible" and it would remain "safe and serviceable".

Devines Tunnels 1 and 2: Devines Tunnel No.1 and No.2 along the canal are located outside the footprints of proposed West Cliff Area 5 and Appin Area 7 longwalls but are within 500 metres at the closest point. Predicted systematic subsidence at the tunnels resulting from the extraction of the proposed longwalls, is less than 20mm. It is therefore unlikely that the tunnels will be subjected to any significant subsidence impact, however far field horizontal movement may potentially affect the tunnels.

Apart from minor rock bolting to protect the tunnel portals from potential rock falls resulting from the earlier West Cliff Area 5 longwalls, there have been no preventative tunnel support measures installed in the unlined tunnels.

The SCA is generally satisfied that the Project's likely impacts on these tunnels would be "negligible" and they would remain "safe and serviceable". It is

recommended that a Management Plan including a Survey Monitoring Plan should be developed by the Proponent to the satisfaction of SCA.

Long Term Management of the Upper Canal: As stated above the SCA is investigating the long term management of the Upper Canal with options of refurbishment and replacement being considered. It may be that scope exists for longwall mining to be phased with refurbishment or replacement works undertaken by the SCA. The SCA will discuss phasing with the Proponent.

Weirs

The SCA has three weirs on the Nepean River system which are predicted to be impacted by the Project. Broughtons Pass Weir is located on the Cataract River and is a crucial part of the raw water supply system and it is critical that it be kept safe and serviceable. Water from the weir pool is directed to either the Upper Canal (through the Cataract tunnel) or pumped direct to the Macarthur water treatment plant operated by Sydney Water.

Jordans Crossing weir is located on the Cataract River upstream of Broughtons Pass weir. Jordans Crossing weir is used by the SCA as a water monitoring point.

Menangle weir is located on the Nepean River and has no SCA water supply function.

Broughtons Pass Weir: Broughtons Pass weir is located about 700m north of the Appin Area 3 longwalls, and the extent of mining extends to about 100m of the weir. The weir has been cracked and uplifted on one side by the previous Appin Area 4 longwalls. Maximum predicted total subsidence is less than 20mm, maximum predicted total tilt is less than 0.2mm/m, maximum predicted total upsidence is 50mm and maximum predicted total closure is 50mm.

Although the predicted movements at the weir are relatively small, there is the possibility of further cracking developing resulting in water seepage and structural instability of the structure. The SCA is very concerned that the Project could result in "structural instabilities of the weir." Broughtons Pass weir is a key part of the water supply system and its integrity is critical to the ability of the SCA to supply continuous high quality water to its customers. Notably water obtained from the weir is the sole supply of water to the Macarthur Area.

The SCA is therefore not satisfied that the Project's likely impacts on Broughtons Pass weir would be "negligible" and it would remain "safe and serviceable".

Menangle Weir: Menangle weir on the Nepean River is located about 300-400m east and north of the Appin Area 7 longwalls. The weir is not used by the SCA for water supply purposes. The weir pool is accessed by others for pumping purposes.

Maximum predicted total subsidence at Menangle weir is 30mm, with maximum predicted upsidence of 50mm and closure of 60mm.

The predicted subsidence and upsidence at the weir could affect the water levels for the full length of the stream sections upstream of the weir.

The SCA is generally satisfied that the Project's likely overall impacts on the wall of the weir would be minor and it would remain "safe, serviceable and repairable". Any potential impacts on the weir can be managed by the development and

implementation of suitable management strategies in consultation with and to the satisfaction of SCA. This could include ground and weir movement monitoring as well as water flow and level monitoring.

Jordans Crossing Weir: Jordans Crossing weir along the Cataract River is located about 500m north of the Appin Area 3 longwalls and within the Metropolitan Special Area. The Proponent is proposing that the longwalls be extracted at a similar distance from Jordans Crossing as the previously extracted Appin Area 3 longwalls 301 and 302. This weir is solely used for gauging flows.

Maximum predicted total subsidence at Jordans Crossing weir is less than 20mm, with maximum predicted upsidence of 60mm and closure of 100mm. This could affect the ability of the weir to be a reliable gauging station if it causes the weir to separate from the underlying bedrock.

Any potential impacts on the weir can probably be managed by the development and implementation of suitable management strategies in consultation with and to the satisfaction of SCA. This could include preventative measures, ground and weir movement monitoring as well as water flow and level monitoring.

The SCA is generally satisfied that the Project's likely overall impacts on the wall of the weir would be minor and it would remain "safe, serviceable and repairable".

Douglas Park and Menangle Fish Passages

Fish passages are being built by the SCA at both weirs using reinforced concrete supported on piers into bedrock near the weirs. These would be affected by mine subsidence movements similar to those predicted for the weirs.

Potential impacts on fish passages include cracking of reinforced concrete, separation of the structures from the bedrock. Unrepaired cracking of concrete could lead to accelerated corrosion of reinforcement.

The SCA is generally satisfied that the Project's likely impacts on the fishways of both weirs would be minor and they would remain "safe, serviceable and repairable". The Proponent would need to develop suitable management strategies including regular monitoring of ground movements at the fish passage as well as remediation and contingency measures for the structures in consultation with and to the satisfaction of SCA.

Other SCA Assets

Based on past experience, the assessment, monitoring and management measures proposed with regards to impacts on SCA fire trails and four wheel drive tracks and Cataract Dam access road in the EA are considered appropriate.

IMPACTS ON WATER RESOURCES

Desired Performance Measures

- Catchment yield to the Cataract Reservoir – "negligible" reduction in the quality and quantity of water resources reaching the Cataract Reservoir. No connective cracking between the surface and the mine.

- Cataract Reservoir – “negligible” leakage from the Cataract Reservoir. “Negligible” reduction in the water quality of Cataract Reservoir.
- Catchment yield to the Broughtons Pass Weir pool – “negligible” reduction in the quality and quantity of water resources reaching the Broughtons Pass Weir pool. No connective cracking between the surface and the mine.
- Broughtons Pass Weir pool – “negligible” leakage from the Broughtons Pass Weir pool. “Negligible” reduction in the water quality of Broughtons Pass Weir pool.
- Catchment yield to the Woronora Reservoir – “negligible” reduction in the quality and quantity of water resources reaching the Woronora Reservoir.

Assessment of Impacts

Surface water

Hydrology

The SCA would be concerned about the potential of the Project to reduce the yield of water to its storages and the potential to reduce surface flow in streams. These issues are discussed at length in the EA. The EA concludes that:

- the Project would not result in adverse consequences to the quantity of water reaching the Cataract Dam, Woronora Dam or Broughtons Pass Weir;
- at the substantial depths of cover at the Project, connective cracking from the ground surface to the mined seam is not expected;
- there is considered to be negligible potential for the loss of surface water from fractured streams to the mine due to the lack of continuity of fractures from the surface to the mine; and
- while a portion of surface water flows may be diverted through the rock fractures beneath stream beds, flows will re-emerge further downstream.

The SCA notes the EA contains minimal baseline data on flows and none on flows of significant tributaries draining to the Cataract Reservoir and Cataract River.

The Project includes mining in significant parts of the catchments of Cataract Reservoir, Cataract River between the dam and Broughtons Pass Weir and Woronora Reservoir.

The SCA is generally satisfied that due to the depths of cover and the characteristics of the cover that connective cracking from the ground surface to the mined seam is not expected. The SCA is therefore generally satisfied that there is “negligible” potential for the loss of surface water from fractured streams to the mine. However there is some uncertainty in the south eastern part of the Project area due to inconsistencies in the predicted maximum height of the fractured zone.

The SCA is reasonably satisfied subject to there being no significant structural geological features, that the risk of the loss of water from the storage to the mine is “negligible”. The tolerable sustainable loss from the stored waters of Cataract Reservoir is as defined by the tolerable loss criteria for Cordeaux Dam developed by the SCA and the Dams Safety Committee for Dendrobium Areas 1 and 2.

The SCA is generally satisfied that the current evidence indicates that a portion of diverted surface water flows, through the upside down created rock fractures beneath stream beds, will re-emerge further downstream.

The above assessment of the SCA is influenced by the Planning Assessment Commission report for the Metropolitan Coal project which concluded in regard to the issue of flow loss:

The Panel is of the view that analyses based on standard flow measurement techniques at discrete points on Waratah Rivulet are not capable of providing a definitive position on the likelihood or otherwise of water loss from the catchment of Woronora Reservoir, nor is a definitive position provided by the hydrologic modelling that has been reported to date. However the local and regional groundwater conditions coupled with the mine parameters, would suggest that the likelihood of water being lost from the surface water system as a consequence of mining, and then by-passing Woronora Reservoir, is very low.

The Panel recommended, because the issue is not beyond reasonable doubt, that a specific program be developed between the SCA and the Proponent to further investigate the existence or otherwise of catchment yield impacts.

The SCA's recent analysis of streamflow suggests that there has been a net reduction in streamflow in Waratah Rivulet coincident with the timing and location of mining activity. The water yield from Waratah Rivulet, above the lower gauge which is located 1,350 m downstream of Longwall 12, may have been reduced as a result of longwall mining activity to date. A more accurate assessment is not possible due to the absence of pre-mining data, some deficiencies with the existing data, and the limitations and differences in the analytical methods used.

The SCA considers that with the Bulli Seam Project, the issue of water loss is also not beyond reasonable doubt and therefore a specific program should be developed between the SCA and the Proponent to further investigate the existence or otherwise of catchment yield impacts. As part of this it is critical to monitor low flows.

The SCA is also mindful of the broader implications of the recent incident at Springvale Colliery at Newnes where subsidence has resulted in surface flows not re-emerging further downstream¹. The SCA recognises that the geological conditions and mining arrangements at Newnes differ from those for the Project, however it is possible that a similar situation could arise in this Project area.

The SCA is therefore concerned the Project may reduce the catchment yield to Cataract Dam, Woronora Dam and Broughtons Pass Weir.

The SCA is not satisfied that there would be "negligible" leakage from the Broughtons Pass Weir pool given there is the possibility of significant cracking in the vicinity of the weir and that this "could result in the seepage of water around the weir or could result in structural instabilities of the weir." (p. 166 - EA Appendix A Subsidence Assessment). The SCA understands the term 'around' includes below.

Water Quality

The SCA would be concerned about the potential of the Project to reduce the quality of water in streams and in its storages (reservoirs and weir pools). Water quality is discussed at length in the EA. The EA predicts that for streams in incised valleys in Hawkesbury Sandstone areas, where subsidence and in particular valley closure and

¹ See report prepared by Aurecon Australia Pty Ltd for Centennial Coal titled – *Newnes Plateau Shrub Swamp Management Plan – Investigation of Irregular Surface Movement in East Wolgan Swamp* – dated 15 September 2009.

upsidence is sufficient to cause fracturing of rockbars and development of dilation cracking, the following environmental consequences are expected:

- diversion of a portion of streamflow along the stream length via the created fracture network;
- re-emergence of surface flow downstream of the effected area;
- reduced frequency of pools overflowing and lower pool water levels during dry weather;
- reduced and periodic loss of interconnection between pools during dry weather;
- small changes in bed gradients and limited potential for scouring at locations where tilts considerably increase the natural pre-mining stream gradients;
- localised and transient increases in iron concentrations and other minerals due to flushing from freshly exposed fractures in sandstone rocks;
- creation and/or enhancement of existing iron rich springs; and
- drainage of strata gas.

The EA states that “the primary environmental consequences described above have the potential to result in secondary consequences, such as impacts on the ecological and aesthetic condition of waterways, mainly through diversion of surface flow and reduced water quality.” In discussing specific stream surface water impacts the EA states that the following streams are predicted to have a range of impacts including “transient spikes in water quality parameters such as iron”:

- Cataract Reservoir tributaries;
- Cataract River downstream of the reservoir to the Broughtons Pass weir;
- Lizard Creek;
- Wallandoola East Creek;
- Wallandoola Creek;
- Cascade Creek; and
- Woronora River.

The EA provides no further specific details on water quality impacts for these streams. In addition there is no information provided on water quality impacts on other streams located with the Metropolitan and Woronora Special Areas which will be subject to subsidence (and potentially upsidence).

The SCA expected the EA to contain a more comprehensive assessment of water quality impacts.

The SCA's understanding of the impacts of longwall mining on surface water quality is largely informed by the impacts of mining in the Waratah Rivulet area of the Woronora catchment. The surface water in Waratah Rivulet, overlying longwall mining, has and continues to show elevated electrical conductivity, cations, anions and metals and reduced dissolved oxygen.

The SCA is generally satisfied that the likely impacts of the Project on the quality of water entering Woronora Reservoir would be “negligible” due to the distance from the mine area to the reservoir.

The SCA is generally satisfied that there would be a “negligible” reduction in the water quality of Cataract Reservoir as a result of mining Appin Area 3. This is primarily due to the diluting affect of the stored waters in the reservoir. This does not mean that it is acceptable for water of a lesser quality than naturally occurs to enter the reservoir.

The SCA considers there would be a “negligible” reduction in the water quality of Broughtons Pass Weir pool – because it would be transferring water from either Cataract Dam or Pheasants Nest weir to this weir pool and this would dilute any decline in water quality.

The SCA is concerned that the Project would not result in a “negligible” reduction in the quality of water reaching the Cataract Reservoir from Cataract Reservoir Tributaries 1 and 2 (notwithstanding that Proponent would carry out remediation works on sections of third order streams). Subsidence and potentially upsidence will occur over large portions of the catchments of these tributaries. As these portions are located close to the reservoir, water quality impacts are likely where these tributaries enter the reservoir (the EA predicts localised impacts on stream water quality – which extend up to 600m downstream – and the distance along Cataract Reservoir Tributary 1 from the edge of longwall 235 to the reservoir is approximately 450m).

The SCA is concerned that the Project would not result in a “negligible” reduction in the quality of water reaching Broughtons Pass weir pool. A reduction in the quality of water reaching the weir pool is possible in situations where the SCA is releasing the minimum environmental flow from Cataract Dam and the mining of longwalls 307 to 313 in Appin Area 3 has substantially progressed.

The SCA considers that overall the Project will not have a neutral or beneficial effect on water quality in watercourses above and in the vicinity of mining area.

Groundwater

Introduction

There are shortcomings in the groundwater assessment which are likely to result in the failure to identify probable impacts and underestimate the extent of impacts. The main deficiencies include insufficient groundwater monitoring data, an underestimation of the height of the fractured zone, inappropriate hydraulic properties for the numerical model, inappropriate model grid size over the Project area, and no assessment of perched groundwater levels.

Groundwater monitoring

There are deficiencies in the distribution, duration and frequency of the groundwater monitoring data, which typically conflict with the SCI report and Metropolitan Coal Project Planning Assessment Commission report. Generally:

- Perched groundwater – There is no perched groundwater monitoring within swamps, which is considered to be a significant deficiency.
- Shallow groundwater – The distribution of shallow piezometers is not representative of the whole Project area, as the piezometers are only concentrated near the Georges, Cataract and Nepean Rivers. There is insufficient duration of baseline data and the frequency of groundwater level measurements should be increased for all piezometers. The need for additional shallow piezometers with appropriate monitoring frequency is particularly important considering the impacts to the shallow groundwater system near the Georges, Cataract and Nepean Rivers from previous mining.
- Deep groundwater – The distribution of multi-level piezometers is not representative of the whole Project area. There is insufficient duration of data from the multi-level piezometers, with approximately 2.5 to 9.0 months of groundwater level monitoring data available for incorporation into the EA for EAW5, EAW7, EAW9 and EAW18. As S1993, S1996 and S1997 were installed in mid 2009, time series data was not available and could not be incorporated

into the numerical model. The monitoring duration and location of multi-level piezometers is not considered sufficient to obtain an accurate representation of the groundwater conditions within the Project area. The monitoring data is concentrated in the northwestern portion of the Project area, with no continuous monitoring available in the part of the Project area covered by the SCA's Special Areas. Additionally, not all the aquifers and aquitards overlying the Bulli Coal Seam are monitored and there is no deep groundwater quality data.

Baseline groundwater data

Clear mining effects have been shown for the shallow groundwater near the Georges River, Nepean River and Cataract River. Some of the notable trends include: groundwater levels below the nearby pool level or river level, suggesting the river is losing water at GR67 (Georges River) and NGW4 (Nepean River); and a relatively large effect on the groundwater levels at NGW6 and NGW10 (Nepean River) due to the development headings of longwalls 701-703.

There is insufficient discussion of the shallow groundwater quality, with only salinity discussed.

Based on the vertical gradients, there is a clear mining influence on the groundwater levels of S1997, from the Bulgo Sandstone and below (Scarborough Sandstone, Coal Cliff Sandstone and Bulli Coal Seam), and potentially from the lower Hawkesbury Sandstone. S1997 is located close to the current mining at Metropolitan Colliery and previous mining at Darkes Forest.

Conceptual model

Heritage Computing states that there will be no loss of shallow water to the mine as 'there will be no continuity of fractures from the surface to the mine' and that there will be diversion of some surface water through streambed fractures, with emergence further downstream. However, the EA states that the potential maximum height of the fractured zone above the longwalls for the Project is between 330 and 385 m above seam level. Heritage Computing expects the fractured zone to extend into the lower Bulgo Sandstone. With the Bulli Coal Seam within the Project area ranging from 300 to 850 m below the surface, the fractured zone may extend to the ground surface at various locations. Therefore, there is potential for fracturing to extend from the surface to the mine and for surface flows not to return to the stream.

Indicative hydraulic properties of the stratigraphic units were provided by Heritage Computing, based on limited tests outside the Project area, some results from modelling outside the Project area and limited packer testing of one borehole within the Project area, to the base of the Scarborough Sandstone only. For the purpose of the EA for the Project, additional testing of the hydraulic properties of the stratigraphy (each stratigraphic unit overlying, and including, the Bulli Coal Seam) would have ensured a better representation of the actual stratigraphic properties. There are also modelling approaches which could have aided in determining these properties such as FLAC and UDEC/3DEC and which would have been particularly useful for identifying the hydraulic properties for the mining scenario given the lack of actual measurements.

Additionally, the majority of the initial vertical permeabilities adopted for the numerical model are not based on any previous studies and many of the initial horizontal permeabilities for the numerical model varied from the indicative hydraulic properties based on hydraulic testing and modelling.

Modelling

Model software and geometry

In addition to MODFLOW-SURFACT that was used for numerical groundwater modelling, FEFLOW could be used to simulate the groundwater conditions above a longwall mine, and may be superior to MODFLOW-SURFACT. For both model codes, it is recommended that a finer grid/mesh be used in the mine areas with the coarser grid/mesh at a distance from the mine areas. It is expected that the surface and rib zones were not incorporated in the model due to the large model cells, yet incorporating the increased permeabilities is important for determining any reduction in baseflow discharge, which is a major concern for the SCA and potentially a major consequence of the proposed Project.

MODFLOW-SURFACT does not automatically allow for changing hydraulic properties with time to represent mining progression, however the use of "time slices" of short duration can allow parameters to be changed periodically in specific areas to represent mining. Heritage Computing used a time slice of 2 years, which is considered too large a time slice to appropriately represent the changing hydraulic properties. A time slice of every 6 months is considered more appropriate.

Although MODFLOW-SURFACT has the capability of modelling perched conditions, it was not undertaken. As stated in the Metropolitan Coal Project Planning Assessment Commission report, modelling perched conditions is recommended. Additionally, the model did not include structural features, although faults and dykes have the potential to affect the groundwater systems and longwall mining operations.

Calibration

Calibration for the steady state model of current conditions was based on numerous groundwater levels within the Hawkesbury Sandstone, yet the location of all the piezometers monitoring this unit, a significant stratigraphic unit for the SCA's operations, was not provided and expected to be deficient within the SCA's Special Areas. There are limited groundwater levels in the other stratigraphic units for calibration, for example, for the Bald Hill Claystone (two locations), Stanwell Park Claystone (one), Wombarra Claystone (none) and Coal Cliff Sandstone (none).

Different horizontal hydraulic conductivities and vertical hydraulic conductivities were given to layers 6 to 13 (Lower Bulgo Sandstone to the layer below the Bulli Coal Seam), to allow for the fractured zone above and below the mining operations. A constrained zone was defined for the upper Bulgo Sandstone. Due to the large variation in the depth to the coal seam, from 300 to 850 m, defining the fractured and constrained zones based on the stratigraphic unit is not deemed appropriate.

The EA states the potential maximum height of the fractured zone will extend from 330 to 385 m above the Bulli Coal Seam. Therefore, based on the minimum depth to the coal seam and the potential maximum height of the fractured zone, the fractured zone may extend to the ground surface at Appin Area 2 Extended, Appin Area 3 Extended and North Cliff. These mining domains are within the SCA's Special Areas.

The deficiencies with the increasing permeability for the various zones (fractured, surface and rib) are expected to result in potentially significant impacts that have not been adequately assessed and underestimated, particularly relating to baseflows, the overlying upland swamps and streams.

The change in the initial permeabilities for the numerical model versus the calibrated permeabilities was quite large for some of the stratigraphies. For example, there is a

three to four order of magnitude difference between the vertical and horizontal permeabilities of the lower Hawkesbury Sandstone, the upper and lower Scarborough Sandstone, and the Coal Cliff Sandstone. This illustrates the need for the better estimation of the initial hydraulic properties.

The calibration performance, when compared to the vertical head profiles, does not appear to be a good fit.

Scenario analysis

Heritage Computing states that the Hawkesbury Sandstone is protected from significant changes in head, however this statement is uncertain due to the concerns with the modelling discussed above. Further, the effects on the shallow groundwater from the previous mining in the area also suggest a likelihood of further impacts from the proposed mining.

Heritage Computing states that it is unlikely that there will be a loss of baseflow from perched water tables due to the isolation between perched and regional water tables. However, since perched water tables were not assessed and mining can cause the fracturing of the low permeability base of perched systems, the statement by Heritage Computing is unfounded.

IMPACTS ON HIGHLY-SENSITIVE FEATURES - WATERCOURSES

Desired Performance Measures

- Cataract River (from the Cataract Dam wall to the full supply level of Broughtons Pass Weir) – “Negligible” environmental consequences (that is, no diversion of flows, no change in the natural drainage behaviour of pools, minimal iron staining, and minimal gas releases).
- Appin Falls - No rock fall occurs at Appin Falls. The structural integrity of the waterfall, its overhang and its pool are not impacted.
- Cataract Tributary 1, Lizard Creek, Wallandoola East Creek (3rd order section), Wallandoola Creek and Cascade Creek (for their full length) – “Negligible” environmental consequences (that is, no diversion of flows, no change in the natural drainage behaviour of pools, minimal iron staining, and minimal gas releases).
- Cataract Reservoir Tributary 1 and Cataract Reservoir Tributary 2 (3rd order sections) – “Negligible” environmental consequences (that is, no diversion of flows, no change in the natural drainage behaviour of pools, minimal iron staining, and minimal gas releases).
- Woronora River (tributary downstream of the crossing of Fire Trail 14 and adjacent to the northern end of Longwall 19 – and 3rd order tributary downstream of Longwall 18) – “Negligible” environmental consequences (that is, no diversion of flows, no change in the natural drainage behaviour of pools, minimal iron staining, and minimal gas releases).

The SCA considers it critical that for each performance measure included in any approval, the measure must be measurable and compliance testable. Further consideration of this issue is warranted by the Planning Assessment Commission.

Risk Assessment

The EA contains a stream risk assessment – Appendix P and summarised in Section 5.2.1 of Volume 1. The risk assessment identifies the Nepean River as the only stream within the Project area which is of special significance. The SCA considers

the Cataract River between Cataract Dam and Broughtons Pass weir is also of special significance. The SCA is of this opinion because:

- This section of river is a key component of the Sydney water supply system as it is used to transfer raw drinking water from Cataract Dam to Broughtons Pass weir;
- This section of the river is largely in pristine condition – due in part to its classification as a Schedule 1 Special Area where public access is severely restricted;
- While the flow in this section of the river is significantly affected by releases from Cataract Dam, the SCA releases a minimum of 1.3 ML/d for environmental purposes. From July 2010 the environmental flow releases from the dam will be dependant upon inflows to the dam (80th percentile transparent flows and 20 percent translucent flows) – and consequently the minimum release from the dam is expected, on average, to be greater than the current minimum release; and
- A significant waterfall – known as the Appin Falls – is located on this section of the river. Within the Project area Appin Falls is the largest waterfall, the top of the falls is the largest rockbar and the pool at the base of the falls is understood to be the deepest of any pool. It is also understood that the Appin Falls is the largest falls on the entire Woronora plateau.

Assessment of Impacts

There is widespread acceptance that longwall mining under and in the vicinity of rock lined watercourses can cause upsidence which fractures the bed of these watercourses resulting in diversion of a portion of surface flows through the fracture network. The environmental consequences include a loss of surface flows during low flow periods, draining of pools, and declines in water quality. These environmental consequences are most severe directly above the mining area. The environmental consequences extend downstream with distances dependant upon a range of factors including time since mining occurred, condition and yield of the upstream catchment and extent of success of remediation measures.

The SCA understands that the likelihood and level of potential impacts of subsidence on watercourses depends on a number of site specific attributes, including the geomorphic, hydrological and ecological characteristics. The more significant watercourses located within the Metropolitan and Woronora Special Areas have the following characteristics:

- they are dominated by Hawkesbury Sandstone;
- they are usually defined upstream by waterfalls;
- due to the common flashy rapid runoff events and confined steep nature of the watercourses loose sediment is washed through the system;
- the beds and banks of watercourses are therefore typically rock lined;
- the watercourses are located within confined incised valley and gorges;
- the watercourses are characterised by rockbars, pools and boulder strewn reaches.

The EA classifies these watercourses into 3 groups and identifies stream impacts and associated management measures (Table 5-2 of Volume 1). The SCA has the following comments on the stream impacts and management measures:

- The Proponent's stream impact minimisation criteria for Cataract River and Lizard Creek is a lesser standard than the SCA's performance measure of "negligible" environmental consequences. The SCA's performance measure of "negligible" environmental consequences equates to that specified for

sections of Waratah Rivulet and the Eastern Tributary by the Minister for Planning in her approval for the Metropolitan Coal Project. It is a higher standard than that proposed by the Proponent for any watercourse.

- For each of the Proponents 3 groups the EA states there will be localised impacts on stream water quality. While this may be the case for where longwall design aims to achieve a maximum predicted closure of 200mm at controlling rockbars, the SCA does not consider it would be the case where streams are directly undermined. In these cases the likely impacts on water quality would be similar to those experienced at the Metropolitan Colliery in the sections of Waratah Rivulet which were directly undermined (the impacts locally were significant and extended downstream beyond the mining area).
- Remediation is proposed in a number of cases where it is "technically feasible". It is unclear from the EA as to what the term "technically feasible" means and consequently the SCA does not understand the potential spatial scope of the remediation. This makes it very difficult for the SCA to understand the environmental impacts of the Project on watercourses.
- There is likely to be rockbars located on streams of less than 3rd order which would not undergo any remediation.
- There is proposed to be no remediation of any 1st or 2nd order stream that will be directly undermined. It is likely that these streams will have localised impacts on stream water quality which could impact downstream 3rd order sections.

The SCA is not satisfied the Project would result in "negligible" environmental consequences for the section of Cataract River from the Cataract Dam to Broughtons Pass weir. The EA predicts some diversion of water from pools.

The SCA is not yet able to determine whether the Project would affect the structural integrity of the Appin Falls waterfall, its overhang and its pool because of insufficient data presented.

The SCA is not satisfied that the project would result in "negligible" environmental consequences for Lizard Creek.

The SCA is not satisfied that the Project would have "negligible" environmental consequences for Wallandoola East Creek, Wallandoola Creek and Cascade Creek. It is expected that impacts would be significantly less for Cascade Creek than the other two creeks. It is noted that the EA predicts the maximum valley closure along Wallandoola Creek to be 1280 mm – and based on the experience and observations at Waratah Rivulet, it is considered the environmental consequences along Wallandoola Creek would be similar or more severe than that experienced along Waratah Rivulet.

The SCA is not satisfied that the Project would have "negligible" environmental consequences for Woronora River (tributary downstream of the crossing of Fire Trail 14 and adjacent to the northern end of Longwall 19 – and the 3rd order tributary downstream of Longwall 18).

In conclusion, if mining goes ahead as proposed, the predicted impacts on a number of watercourses will not meet the SCA's desired performance measures and are not considered acceptable, notwithstanding the proposal to carry out remediation at controlling rockbars (where this work is technically feasible).