6.0 Statutory Planning

This Chapter outlines the relevant statutory planning provisions in accordance with the Director General's Requirements:

***General Requirements** – Consideration of any relevant statutory provisions including the consistency of the project with the objects of the Environmental Planning and Assessment Act 1979.*

In accordance with these requirements, this Chapter provides information on:

Local matters

Regional matters

State matters

Commonwealth matters.

In most cases, the same statutory provisions relate to the project whether it is coal fired or gas fired technology. Where there are differences, these exceptions have been noted in the sections below.

6.1 Local Matters

The proposed Bayswater B site has the potential to extend over two different LGAs, Singleton and Muswellbrook.

The two local Environmental Planning Instruments (EPIs) which apply to the land subject of the concept, are the Singleton Local Environment Plan 1996 (Singleton LEP) and the Muswellbrook LEP 2009 (Muswellbrook LEP).

6.1.1 Permissibility

This section provides details on the zoning and permissibility of the project in accordance with the Singleton and Muswellbrook LEPs. A map illustrating the zoning in relation to the project is provided in **Figure 6-1.**

Singleton LEP 1996

The proposed project is defined as a *utility installation* under Singleton LEP 1996, being:

> *a building or work used by a public utility undertaking, but does not include a building designed wholly or principally as administrative or business premises or as a showroom.*

A *public utility undertaking* is defined under Singleton LEP 1996 as:

> *any of the following undertakings carried on or permitted or suffered to be carried on by or by authority of any Government Department or under the authority of or in pursuance of any Commonwealth or State Act:*
>
> *a) railway, road transport, water transport, air transport, wharf or river undertakings,*
>
> *b) undertakings for the supply of water, hydraulic power, electricity or gas or the provision of sewerage or drainage services,*

and a reference to a person carrying on a public utility undertaking includes a reference to a council, county council, Government Department, corporation, firm or authority carrying on the undertaking.

MacGen is an electricity supply authority authorised under the *Energy Services Corporations Act 1995* (ESC Act) with the following principal functions:

c) to establish, maintain and operate facilities for the generation of electricity and other forms of energy, and

d) to supply electricity and other forms of energy to other persons and bodies

As an electricity generator, under the ESC Act, MacGen may also:

e) provide facilities or services that are ancillary or incidental to its principal functions, and

f) conduct any business (whether or not related to its principal functions) that it considers would further its objectives.

The proposed Bayswater B project falls within the bounds of facilities which are part of the principal functions of MacGen and are therefore adequately defined as a *utility installation*.

The land on which the proposed project is to take place is zoned Rural 1(a) under *Singleton LEP 1996*. Within the Rural 1(a) zone, development which is not exempt development and that which is not identified as prohibited is permissible with consent. The proposed development for a 'utility installation' is not listed as exempt or prohibited and is therefore permissible with consent in the Rural 1(a) zone.

Muswellbrook LEP 2009

The proposed project comprises an *''electricity generating works': a building or place used for the purpose of making or generating electricity.*

Under the provisions of *Muswellbrook LEP 2009*, the lands which may be affected by the proposed project are predominantly zoned SP2 Infrastructure "Power Station" (see Land Zoning Map - Sheet LZN-022). Transmission lines also traverse land zoned RU1 Primary Production.

Development permitted with consent includes development for "The purpose shown on the Land Zoning Map, including any development that is ordinarily incidental or ancillary to development for that purpose; Roads" and therefore is permissible with consent.

Within the RU1 Primary Production zone, development which is not listed as being Permitted with Consent or Permitted Without Consent is classed as Prohibited. Electricity generation and associated infrastructure for the purposes of electricity generation is not listed as Permitted with or without consent and would therefore be prohibited under the LEP. However, the Infrastructure State Environmental Planning Policy (SEPP) (2007) under clause 34 notes that certain development in relation to electricity generation is permitted with consent:

(1) Development for the purpose of electricity generating works may be carried out by any person with consent on land in a prescribed zone.

The definition of "prescribed zone" is defined as a series of specific zones in the definitions under section 33 and includes (a) RU1 Primary Production

The SEPP Infrastructure also notes under Section 8 clause (1) in terms of relationship to other environmental planning instruments that *"if there is an inconsistency between this Policy and any other environmental planning instrument, whether made before or after the commencement of this Policy, this Policy prevails to the extent of the inconsistency"*

As such, the Bayswater B project is permissible with consent within the RU1 zone.

Table 6-1: Summary of Permissibility of Bayswater B

Relevant EPI	Landuse Zone	Permissible	Comment
Singleton LEP 1996	Rural 1(a) (Rural Zone)	✓	Public utility undertaking permissible with consent
Muswellbrook LEP 2009	RU1 Primary Production	✓	Permitted under the auspices of the Infrastructure SEPP (2007)
	SP2 Infrastructure	✓	Power Station permissible with consent

6.1.2 Consistency with Zone Objectives

Singleton LEP 1996

The zone objectives for Rural 1(a) relate primarily to the protection of land uses and the maintenance of natural and scenic qualities.

This project is compliant with all zone objectives:

- The land is currently used for grazing under lease. The land however is owned by MacGen and lies within the vicinity of the Bayswater-Liddell Power Generation Complex. The project would not impact on the broader agricultural uses of land within the area.
- Environmental impacts on ecology have been avoided via footprint design and any residual impacts would be mitigated by the proposed safeguards of the development outlined in **Chapter 15**.
- The dominant features of the landscape are currently the Bayswater and Liddell facilities and the topography of the preferred site provides some shielding from broader visual receptors. The development is consistent with the existing amenity
- The development would utilise current water entitlements which is managed under the *Hunter Water Sharing Plan* to ensure sustainable use of water supply. Water is addressed in **Chapter 11** of this EA.

Muswellbrook LEP 2006

The objectives of the SP2 primarily relate to the protection of infrastructure and this project complies with those objectives.

The objectives of Zone RU1 relate primarily to the maintenance of primary industries. The project site lies across a section of the Greta Coal Measures (refer **Figure 6-2**). MacGen previously assessed the coal measures within its landholding and based on the information derived from that assessment, it is not believed however that this represents a constraint to primary industries because:

- The 3 identified underlying coal seams have been largely heat affected, indurated and cindered by the intrusion of the igneous sill (the Savoy Sill-Jurassic volcanics);
- The forces involved with the intrusion of the Savoy Sill and later cooling fractured the surrounding coal seams and other sedimentary strata;

- This heating has altered the coal quality by reducing the inherent moisture, significantly decreasing the volatile content, increasing the fixed carbon, decreasing the total sulphur (not seam A), increasing the relative density, lowering the Hardgrove Grindability Index number (HGI) and affecting the relative ash and calorific content; and
- The coal quality indicates that the coal tonnages present under the proposed site would not make a suitable domestic fuel source. (Seam A also contains high sulphur content which makes the coal unsuitable for a domestic thermal fuel source on its own).

In addition to the quality of the coal, the power station site lies on the southern most extremity of the coal measures on the southern side of the igneous intrusions (refer **Figure 6-2**). The site also lies towards the periphery of an Exploration Lease held by Dellworth Pty Ltd. The license was granted in June 2007 for three years and is due to expire next year. Given the location of the site at the extremity of the Greta Coal Measures, on the periphery of the Exploration Lease, and the poor quality of the coal deposit, it is not believed that the power station project represents a significant impact on the availability of coal resources for utilisation.

The proposed works for the purpose of pipelines and other such infrastructure associated with the proposed project would not sterilise land for agricultural purposes and would not have a significant impact upon the amenity of the area outside of the construction period as discussed in **Chapters 9 to 25** in this EA. These works, which are ancillary to the proposed primary use, are therefore considered to be generally in line with the objectives of the zone.

6.2 Regional Matters

6.2.1 Hunter Regional Environmental Plan (REP)

This Environmental Planning Instrument was repealed as of 26 June 2009 and so has not been considered further in this report.

6.2.2 Water Sharing Plan for the Hunter Regulated River Water Source 2003

The Water Sharing Plan for the *Hunter Regulated River Water Source 2003* (Water Sharing Plan) applies to areas and waters as listed in Clause 4 (1):

> *(a) between the banks of all rivers, from the upstream limit of Glenbawn Dam water storage downstream to the estuary of the Hunter River, and from the upstream limit of Glennies Creek Dam water storage downstream to the junction with the Hunter River, which at the date of commencement of this Plan have been declared by the Minister to be regulated rivers, and*
>
> *(b) the unconsolidated alluvial sediments underlying the waterfront land of all rivers referred to in subclause (a), except those unconsolidated alluvial sediments within one metre of works taking water pursuant to licences issued under Part 5 of the Water Act 1912 or their equivalent aquifer access licences issued under the Act.*

The overall objectives of the plan are identified in Clause 11 and aim to protect natural flow environments and ecosystems, protect reserve water and rights of supply, and recognise priority for traditional water rights.

Clause 37 of the *Water Sharing Plan* relates specifically to major utility licenses of which MacGen is defined under Schedule 2 of the *Water Management Act 2000 (WM Act)*. MacGen is therefore subject to the determinations made by this Clause and considerations given should the water volume requirements from the Hunter be significantly altered.

6.3 NSW State Legislation and Planning Policies

6.3.1 Environmental Planning and Assessment Act 1979

The *EP&A Act and the Environmental Planning and Assessment Regulation (EP&A Regulation)* provide the framework for environmental planning in NSW and include provisions to ensure that proposals which have the potential to impact the environment are subject to detailed assessment, and provide opportunity for public involvement.

As outlined in **Chapter 1** of this EA, the proposed development has been declared by the Minister to be a major project and a critical infrastructure project under Part 3A of the *EP&A Act.*

Under Part 3A, a proponent can seek a Project approval or Concept approval (where the Minister authorises a concept plan to be lodged). Concept approval allows the project to be assessed by focusing on the broader strategic issues. The proponent is able to obtain approval for the Concept Plan prior to undertaking detailed studies of the various components of the project. Further details and approvals would subsequently be required before works could commence on the project.

In accordance with the provisions of Part 3A of the EP&A Act, the Proponent is seeking Concept approval for the development of the proposed Bayswater B project. Specific details of works and facilities contained within the Concept have been detailed in **Chapter 5** of this EA.

The Minister for Planning is the approval authority for the Concept Plan.

The sections below provide further detail in relation to requirements with respect to the *EP&A Regulation*. However, under the *EP&A Act (ss. 5 and 5A)* the assessment must consider the potential significance of effects on threatened species, populations or ecological communities, or their habitats as discussed in **Table 6-2** and **Table 6-3** below.

Table 6-2: Statutory Requirements for EA (S.5 of the *EP&A Act*)

Considerations under s.5 of the EP&A Act	Reference in EA
The objects of this Act are:	
(a) to encourage:	
(i) the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment,	This project would provide benefits to the State of NSW in the form of base load power generation. Direct impacts to the natural environment would be minimised or avoided. Chapter 18 discusses the potential social and economic effects during construction and operation with a detailed response on how potential effects may be managed.
(ii) the promotion and co-ordination of the orderly and economic use and development of land,	This project would be co-located with other power generation facilities and mining operations.
(iii) the protection, provision and co-ordination of communication and utility services,	This project represents the support of provision of utility services.
(iv) the provision of land for public purposes,	Not applicable

Considerations under s.5 of the EP&A Act	Reference in EA
(v) the provision and co-ordination of community services and facilities, and	Chapter 18 assesses in detail local community services, infrastructure and amenities and the potential effects upon them. The assessment also details a process for moving forward with a planned approach to their management as the project progresses through detailed design.
(vi) the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats, and	This EA includes a detailed flora and fauna assessment specifically with a view to avoiding, minimising or managing any potential impacts to the natural environment.
(vii) ecologically sustainable development, and	Chapter 27 of this EA discusses the principles of ESD in detail with respect to this project, which has been undertaken in consideration of these principles.
(viii) the provision and maintenance of affordable housing, and	Not applicable
(b) to promote the sharing of the responsibility for environmental planning between the different levels of government in the State, and	Not applicable to this development project.
(c) to provide increased opportunity for public involvement and participation in environmental planning and assessment.	Consultation has been undertaken as part if this project and this would continue throughout the project process.

Table 6-3: Statutory Requirements for EA (S.5A of the *EP&A Act*)

Considerations under s.5A of the EP&A Act	Reference in EA
In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.	The project would not impact on the lifecycle of a local population, given the restricted nature of direct impacts (impacts on specific areas of importance can be avoided) and the high level of mobility of species.
In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.	See above
In the case of an endangered ecological community (EEC) or critically endangered ecological community, whether the action proposed:	
is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or	No EECs were identified within the project area. Two communities identified as being preliminary listed were identified and some direct impacts are predicted. The impacts are not considered significant in that the direct impacts are limited and the species are not at the extent of their distribution and do not represent critical habitat for any species.

Considerations under s.5A of the EP&A Act	Reference in EA
is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.	See above
In relation to the habitat of a threatened species, population or ecological community:	
the extent to which habitat is likely to be removed or modified as a result of the action proposed, and	The project would result in some direct effects to linear aquatic features identified as potential habitat for the Green and Golden Bell Frog. This habitat would be affected by the construction of linear infrastructure which means that the impacts can be avoided through responsible design where possible, and impacts restricted or minimised through design and management to avoid any down stream effects.
whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and	The proposal is unlikely to affect habitat connectivity of the species. While there may be some impacts on potential habitat, the overall habitat health and connectivity of Green and Golden Bell Frog habitat on the site would be maintained and enhanced
the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.	The project has been assessed with a view to retention of areas of conservation significance
Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),	There is no critical habitat known to occur on the site for any of the threatened species occurring on the site.
Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.	Management of potential effects would be designed in accordance with all relevant plans and guidelines to ensure a consistent approach to management within the locality and within the region.
Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.	Potential impacts resulting from the project were identified as being primarily related to construction of the associated infrastructure (roads, pipelines) rather than the power plant site, and included associated runoff from construction and operation works

Critical Infrastructure

On 26 February 2008 the Minister for Planning declared certain power generating facilities to be 'critical infrastructure projects' being development that:

- Has capacity to generate at least 250 MW; and
- Is the subject of an application lodged pursuant to Section 75E or Section 75M of the *EP&A Act* prior to January 2013

The project proposes a Power Station with the capacity of 2000 MW and would be lodged to Section 75M prior to January 2013 and hence is considered a critical infrastructure project.

Environmental Planning and Assessment Regulation 2000

Part 1A of the *EP&A Regulation 2000* relates to Major Projects.

Clause 8F of the *EP&A Regulation* addresses owner's consent or notification in relation to Major Projects and states that:

The consent of the owner of land on which a project is to be carried out is required for a project application unless:

b) the application relates to a critical infrastructure project, or

d) the application relates to a linear infrastructure project.

Clause 8F defines 'linear infrastructure' project as:

development for the purposes of linear transport or public utility infrastructure.

While the route is only indicative at this stage, the proposed Bayswater B project comprises linear infrastructure (the pipeline/spur line), therefore the consent of the owner of land on which the project is to be carried out is not required under the *EP&A Regulation*.

However, Clause 8F states that, if consent is not required, the proponent is required to give notice of the application as follows:

- in the case of the pipeline notice is to be given to the public by advertisement published in a newspaper circulating in the area of the project before the start of the public consultation period for the project

Notice of the component parts of the project was given in accordance with the provisions of Clause 8F through advertisements, letters and face to face contact.

Environmental Planning Instruments

A range of EPIs are created under the *EP&A Act* to provide further detailed guidance and regulation for development at a State, regional and local level.

In accordance with Clause 75J and 75O of the *EP&A Act,* in deciding whether or not to approve a Concept Plan or the carrying out of project, the Minister may (but is not required to) take into account the provisions of any EPI that would not apply if the Project were approved. As this is a discretionary matter for the Minister, a range of EPIs have been considered in relation to the Concept Plan/Project.

The following SEPPs are of relevance to the project:

- *State Environmental Planning Policy (Major Development) 2005*
- *State Environmental Planning Policy (Infrastructure) 2007*
- *State Environmental Planning Policy No. 33 – Hazardous and Offensive Industries*
- *State Environmental Planning Policy No. 44 – Koala Habitat Protection*
- *State Environmental Planning Policy No. 55 – Remediation of Land*
- *State Environmental Planning Policy No. 71 – Coastal Protection.*

These policies are discussed in relation to the proposed project in the following sections of this EA.

6.3.2 State Environmental Planning Policy (Major Development) 2005

SEPP (Major Development) 2005 (SEPP 2005) was gazetted on 25 May 2005. It replaces all existing provisions related to former '*state significant development' and 'major project'* in planning instruments, directions and declarations.

The primary aim of *SEPP 2005* is:

> *to identify development of economic, social or environmental significance to the State or regions of the State so as to provide a consistent and comprehensive assessment and decision making process for that development.*

Schedule 1 of the SEPP identifies classes of development which are classified as 'major development'. This includes development for the purpose of an electricity generation facility that:

g) has a capital investment value of more than $30 million for gas or coal-fired generation, or co-generation, or bioenergy, bio-fuels, waste gas, bio-digestion or waste to energy generation, or hydro or wave power generation, or solar power generation, or wind generation.

The proposed Bayswater B project meets the requirements of a major project under clause 24 of Schedule 1 to *SEPP 2005* as it involves:

- a capital investment of more than $30 million. The proposed project is anticipated to consist of a capital investment of greater than $2 billion
- is for the purposes of coal-fired and gas electricity generation.

Therefore, under the provisions of clause 24 in Schedule 1 to *SEPP 2005*, the proposed project is a candidate for declaration as a major development, with the Minister being the approval authority.

6.3.3 State Environmental Planning Policy (Infrastructure) 2007

The aim of this Policy is to facilitate the effective delivery of infrastructure across the State by:

h) improving regulatory certainty and efficiency through a consistent planning regime for infrastructure and the provision of services, and

i) providing greater flexibility in the location of infrastructure and service facilities, and

j) allowing for the efficient development, redevelopment or disposal of surplus government owned land, and

k) *identifying the environmental assessment category into which different types of infrastructure and services development fall (including identifying certain development of minimal environmental impact as exempt development), and*

l) *identifying matters to be considered in the assessment of development adjacent to particular types of infrastructure development, and*

m) *providing for consultation with relevant public authorities about certain development during the assessment process or prior to development commencing.*

Division 4 defines the development as an *electricity generating works* meaning *a building or place used for the purpose of making or generating electricity*. Clause 34 of the SEPP permits the development for the purpose of electricity generating works with consent on land in a prescribed zone.

Clause 104 of the SEPP relates to traffic generating development and requires that certain development with the potential to generate a substantial level of traffic be referred to the RTA for comment. Development to which the clause applies is set out in Schedule 3 of the SEPP and includes development for any purpose not specifically identified in the schedule with the potential to generate traffic of more than 200 vehicles.

The RTA has been consulted with respect to the proposed project (as detailed in **Chapter 7**) and would be further consulted as part of this EA.

6.3.4 State Environmental Planning Policy No. 33 – Hazardous and Offensive Industries

SEPP No. 33 – Hazardous and Offensive Development (SEPP 33) aims to ensure that due consideration is given to the potential off-site risks of proposals for potentially hazardous or offensive industries in terms of the surrounding environment, amenity and health. The SEPP aims to ensure that locational and design considerations are an integral part of the assessment process and provides that, in relation to these forms of development, the consent authority should impose conditions to minimise any adverse impact.

The SEPP defines *potentially hazardous industry* as being:

> *development for the purposes of any industry which, if the development were to operate without employing any measures (including, for example, isolation from existing or likely future development on other land) to reduce or minimise its impact in the locality or on the existing or likely future development on other land, would pose a significant risk in relation to the locality:*

n) *to human health, life or property, or*

o) *to the biophysical environment, and includes a hazardous industry and a hazardous storage establishment.*

The SEPP defines *potentially offensive industry* as being:

> *a development for the purposes of an industry which, if the development were to operate without employing any measures (including, for example, isolation from existing or likely future development on other land) to reduce or minimise its impact in the locality or on the existing or likely future development on other land, would emit a polluting discharge (including for example, noise) in a manner which would have a significant adverse impact in the locality or on the existing or likely future development on other land, and includes an offensive industry and an offensive storage establishment.*

One of the key requirements of SEPP 33 with regard to potentially hazardous industry is that a 'Preliminary Hazard Analysis' (PHA) be prepared. The primary purpose of the PHA is to ensure that the proposed location is appropriate for the development in terms of the risks imposed upon surrounding land uses.

The proposed project is defined as a *utility installation* or a *public utility undertaking* (see **Sections 6.1.1**) and therefore does not meet the definition of an *industry*. As such, a PHA is not strictly required. However, in order to satisfy community and stakeholder concerns regarding risk issues, a preliminary screening of hazard and risk has been conducted as part of this EA (refer **Chapter 20**).

6.3.5 State Environmental Planning Policy No. 44 – Koala Habitat Protection

State Environmental Planning Policy No.44 – Koala Habitat Protection (SEPP 44) applies to both Singleton and Muswellbrook LGAs. The aim of SEPP 44 is:

- To encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline by:
  - requiring the preparation of plans of management before development consent can be granted in relation to areas of core koala habitat;
  - encouraging identification of core koala habitat area; and
  - encouraging the inclusion of core koala habitat areas in environment protection zones.

SEPP 44 requires the consent authority to consider whether land subject to a development application (DA) is potential koala habitat or core koala habitat, as defined in SEPP 44. The flora and fauna assessment carried out as part of this EA (refer **Chapter 15** and **Appendix F**) indicates that the site of the proposed Bayswater B project is unlikely to contain potential or core koala habitat, however the infrastructure and pipelines have the potential to impact on koala feed trees. An assessment of the potential impacts on koalas has been included as part of the EA, in accordance with the provisions of SEPP 44.

6.3.6 Water Management Act 2000

As the project site is subject to a water sharing plan created under the WM Act 2000 (WM Act), the licence and approval provisions under the WM Act apply. However, as the project is being assessed under Part 3A of the *EP&A Act,* approvals under the WM Act are not required.

6.3.7 Native Vegetation Act 2003

The objects of this Act are:

p) to provide for, encourage and promote the management of native vegetation on a regional basis in the social, economic and environmental interests of the State, and

q) to prevent broadscale clearing unless it improves or maintains environmental outcomes, and

r) to protect native vegetation of high conservation value having regard to its contribution to such matters as water quality, biodiversity, or the prevention of salinity or land degradation, and

s) to improve the condition of existing native vegetation, particularly where it has high conservation value, and

t) *to encourage the revegetation of land, and the rehabilitation of land, with appropriate native vegetation, in accordance with the principles of ecologically sustainable development.*

u) Native vegetation is defined in Clause 6 as any of the following types of indigenous vegetation:

a. trees (including any sapling or shrub, or any scrub),

b. understorey plants,

c. groundcover (being any type of herbaceous vegetation),

d. plants occurring in a wetland.

V*egetation is considered indigenous if 'it is of a species of vegetation, or if it comprises species of vegetation, that existed in the State before European settlement*.'

The *Native Vegetation Act 2003* prohibits the clearing of native vegetation unless consent is granted by the Minister and a vegetation plan is developed. The proposed project may require the clearing of some trees. The ecological assessment undertaken as part of this EA (**Chapter 15**) has identified Hunter Central Rivers Vegetation Communities within the identified buffer zone of the site. The proposed Bayswater B site does not directly overly any of the identified communities and is therefore unlikely to require the clearing of any native woodland or forest areas.

6.3.8 Waste Avoidance and Resource Recovery Act 2001

The purpose of the Waste Avoidance and Resource Recovery Act (WARR Act) is to encourage and ensure efficient use of resources and reduce environmental harm. The objectives of the WARR Act include:

v) to encourage the most efficient use of resources and to reduce environmental harm in accordance with the principles of ecologically sustainable development,

w) to ensure that resource management options are considered against a hierarchy of the following order:

i) avoidance of unnecessary resource consumption,

ii) resource recovery (including reuse, reprocessing, recycling and energy recovery),

iii) disposal,

x) to provide for the continual reduction in waste generation,

y) to minimise the consumption of natural resources and the final disposal of waste by encouraging the avoidance of waste and the reuse and recycling of waste.

Chapter 22 of this EA discusses waste generation associated with the project and the means by which waste has been avoided and minimised for both construction and operation.

6.3.9 Heritage Act 1977

The purpose of the *Heritage Act 1977* (Heritage Act) is to protect and conserve non-Aboriginal cultural heritage, including scheduled heritage items, sites and relics. The Heritage Act is administered by the NSW Heritage Office.

The *Heritage Act* makes provision for a place, building, work, relic, moveable object, precinct, or land to be listed on the State Heritage Register. As the project falls under Part 3A of the *EP&A Act*, once the proposal is approved under Part 3A, it is exempt from requirements for approvals required under the *Heritage Act.* However an assessment of Aboriginal and European heritage has been undertaken as part of the EA which provides an assessment of the potential impact of the project on items or places of heritage significance. The heritage assessment is provided in **Appendix F**.

6.3.10 National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (NP&W Act) provides for the establishment, care control and management of national parks, historic sites, nature reserves, State conservation areas, Aboriginal areas and state game reserves.

The NP&W Act also provides for the protection of Aboriginal objects and the protection of native flora and fauna. These provisions however do not apply under Part 3A which acts as an overarching approval/permit. An assessment of the impact of the proposal on items protected under the NP&W Act, has been undertaken as part of this EA (**Chapter 17** and **Appendix G**) with recommendations to be included in the Statement of Commitments guiding the management of heritage aspects via the conditions of consent.

6.3.11 Threatened Species Conservation Act 1995

The *TSC Act 1995* (TSC Act) provides for the conservation of threatened species, populations and ecological communities of animals and plants. This is achieved by the following:

- conserving biological diversity and promoting ecologically sustainable development;
- preventing extinction and promoting the recovery of threatened species, populations and ecological communities;
- protecting critical habitat of threatened species, populations and ecological communities;
- eliminating or managing certain processes that threaten the survival or evolutionary development of threatened species, populations and ecological communities; and
- encouraging the conservation of threatened species, populations and ecological communities by the adoption of measures involving co-operative management.

The *TSC Act* provides a framework to ensure that the impact of any action affecting threatened species is assessed. Schedule 1 of the *TSC Act* lists endangered species, populations and ecological communities, Schedule 2 lists vulnerable species and Schedule 3 lists key threatening processes. Part 3 of the *TSC Act* defines critical habitat.

Whilst the *TSC Act* does not strictly apply to Part 3A of the EP&A Act, the EA has considered items subject to the *TSC Act* with respect to the concept in the flora and fauna assessments undertaken for the project.

6.4 Other Licenses and Approvals

6.4.1 Protection of the Environment Operations Act 1997

Schedule 1 of the *NSW Protection of the Environment Operations Act 1997* (POEO Act) prohibits any person from causing pollution of waters, or air, and provides for penalties for air, water and noise pollution offences. Schedule 1 of the *POEO Act* identifies "scheduled activities" which are required to be licensed by the DECC.

'Electricity generation' is a scheduled activity under clause 17 of Schedule 1 of the *POEO Act* and therefore requires an Environment Protection Licence (EPL). 'Electricity generation' refers to *General electricity works* with the *capacity to generate more than 30 megawatts of electrical power*.

Section 45 of the *POEO Act* identifies matters to be taken into consideration in licensing functions. All practical measures would be taken to reduce or mitigate any potential environmental impacts from the proposed development, as outlined in this EA.

If approval is granted for the proposed project, an application for an EPL for the project cannot be refused and must be substantially consistent with the Part 3A approval.

6.4.2 NSW Pipelines Act 1967

Should the proposal be a gas fired technology, a connecting gas pipeline would be required to supply the facility fuel source.

The *NSW Pipelines Act 1967* regulates the construction and operation of pipelines within the State, with certain exemptions such as those operated for the purposes of supply of water or those to be constructed by a public authority.

Clause 11 of the Act provides that a pipeline (other than those identified as exempt) cannot be constructed or operated without a licence. The Act also addresses the ongoing maintenance and management of pipelines.

Should the gas-fired concept be utilised, the construction of a high pressure pipeline would be required to transport gas from the Queensland to Newcastle Pipeline to the site. Construction and operation of this proposed pipeline would require a licence under Part 3 of the *NSW Pipelines Act*. Should concept approval be granted for the pipeline, an application for a Pipeline Licence would be made in accordance with clause 13 of the Act. Should concept approval be granted under Part 3A of the *EP&A Act*, the Pipelines Licence cannot be refused.

6.4.3 Electricity Supply Act 1995

The objects of this Act are:

> *(a) to establish a competitive retail market in electricity so as to promote efficient and environmentally responsible production and use of electricity and to deliver a safe and reliable supply of electricity, and*
>
> *(b) to confer on network operators such powers as are necessary to enable them to construct, operate, repair and maintain their electricity works, and*
>
> *(c) to regulate network operations and electricity supply in the retail market in a manner that ensures open access to electricity distribution systems, promotes customer choice and creates customer rights in relation to electricity connections and electricity supply, and*
>
> *(d) to promote and encourage the safety of persons and property in relation to the generation, transmission, distribution and use of electricity.*

It is within the auspices of this Act that MacGen operates and within which this project would be undertaken. Similarly the Proponent for the Project Application (subsequent to this Concept Application) would operate within the framework of this act.

6.4.4 Modifications under the EP&A Act

Should the coal fired option be selected, a modification to the approval for the operation of the Antiene Rail Coal Unloader would be required.

Antiene Rail Coal Unloader (DA 50-3-2005) was approved in November 2005. It was classed as a State Significant Development and was approved to carry 15 million tonnes per year. There were no noise limits included in the consent conditions aside from the following requirements in relation to operation:

Acquisition Upon Request

> *1. Upon receiving a written request for acquisition from the landowner of the land listed in Table 1, the Applicant shall acquire the property in accordance with the procedures set out in conditions 1 -3 of schedule 4. [Table 1 landowner listed as Wayne Smith of Kapunda]*

Noise Mitigation Measures

> *2. Upon receiving a written request from a landowner of the land listed in Table 2 [Green Knobby], the Applicant shall implement noise mitigation measures (which may take the form of double glazing, insulation, and/or air conditioning) at any residence on the land in consultation with the landowner. These mitigation measures must be reasonable and feasible, If within 3 months of receiving this request from the landowner, the Applicant and the landowner cannot agree on the measures to be implemented, or there is a dispute about the implementation of these measures, then either party may refer the matter to the Director-General for resolution.*
>
> *Note: If following the implementation of architectural modification to any of the residences on land listed on Table 1, a landowner of one of these residences requests acquisition, the offer made to the landowner by the Applicant may exclude the cost of the architectural modifications already implemented at these residences by the Applicant.*

Should a coal fired technology become the preferred technology, the Antiene Rail Loop would require an increase in train movements to accommodate an additional 6.3 million tonnes per year of coal. This would require a modification to the existing consent for the Antiene Rail Loop.

Should coal become the preferred technology, the Proponent for the Project Application would need to seek resolution on this point with MacGen (the Proponent for the rail loop approval).

Should a gas fired option be selected and the approved Queensland to Hunter Gas Pipeline is accessed, a modification to the approval would be required for the increase in capacity of the pipeline and installation of additional compression facilities along the pipeline route.

Whether coal or gas options are selected the Proponent would consult with the relevant parties to ensure that all appropriate approvals can be gained.

6.5 Commonwealth Matters

6.5.1 Environment Protection and Biodiversity Conservation Act 1999

The *EPBC Act 1999* came into effect in July 2000 and requires the approval of the Commonwealth Minister administering the EPBC Act for actions that may have a significant impact on matters of National Environmental Significance (NES). Approval from the Commonwealth is in addition to any approvals under NSW legislation.

The objects of the EPBC Act are as follows:-

z) *to provide for the protection of the environment, especially those aspects of the environment that are matters of national environmental significance; and*

- e. *to promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources; and*
- f. *to promote the conservation of biodiversity; and*

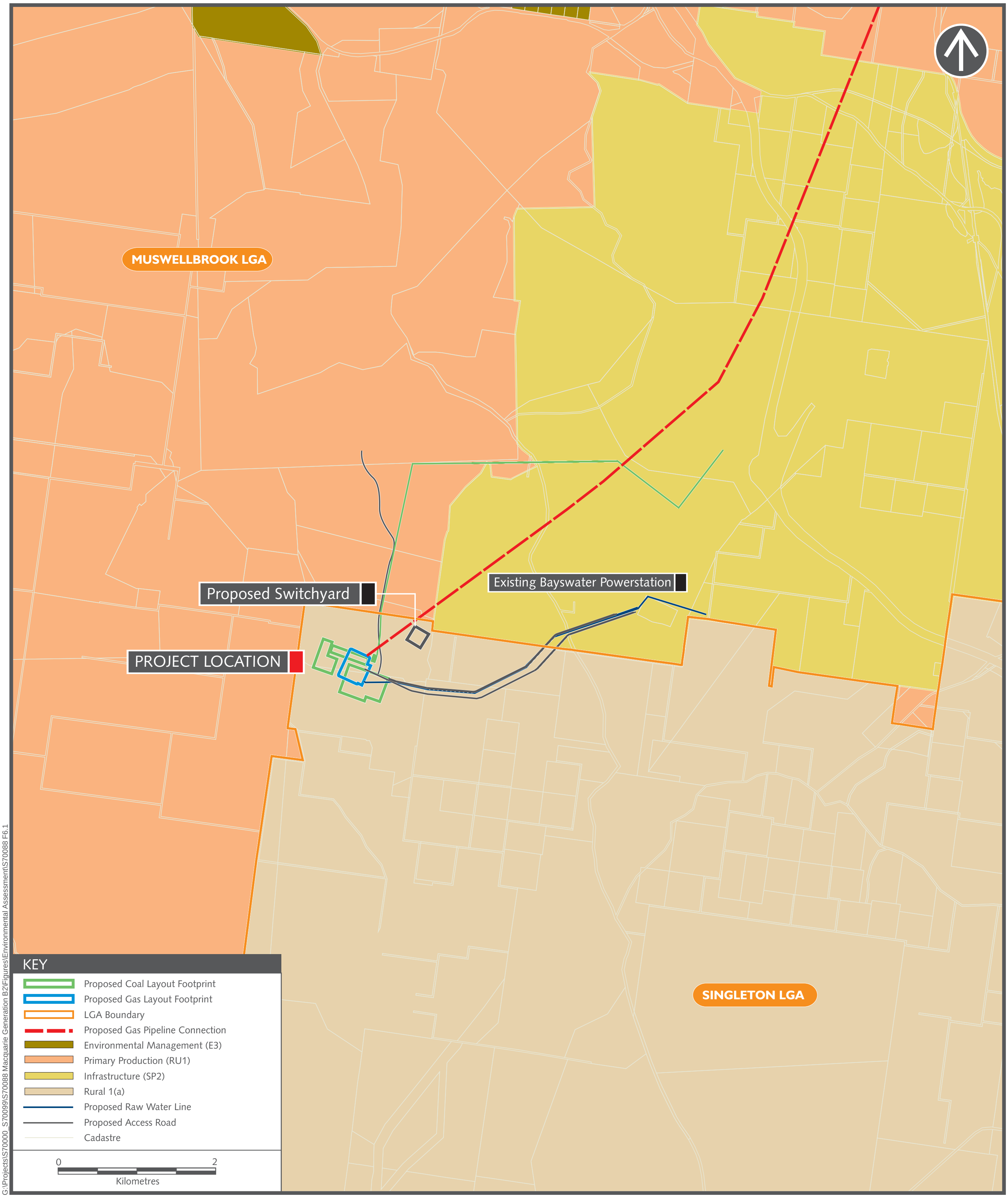
aa) c) *to provide for the protection and conservation of heritage; and*

- g. *to promote a co-operative approach to the protection and management of the environment involving governments, the community, landholders and indigenous peoples;*
- h. *to assist in the co-operative implementation of Australia's international environmental responsibilities;*
- i. *to recognise the role of indigenous people in the conservation and ecologically sustainable use of Australia's biodiversity;*
- j. *to promote the use of indigenous people's knowledge of biodiversity with the involvement of, and in co-operation with, the owners of the knowledge.*

bb) Approval under the EPBC Act is triggered by a proposal which has the potential to have a significant impact on a matter of NES or by a proposal which has the potential to have a significant impact on the environment which involves the Commonwealth. The *EPBC Act* lists eight matters of NES which must be addressed when assessing the impact of a proposal, they are:

- World Heritage properties;
- National Heritage places;
- Wetlands of International Importance;
- Listed threatened species and ecological communities;
- Listed migratory species;
- Commonwealth Marine Areas; and
- Nuclear action.

The PEA prepared earlier in the approvals process and ecological surveys carried out as part of this EA found the proposed Bayswater B project is not expected to significantly impact on matters of NES. However, due to the large scale and short timeframe of the proposed Bayswater B project, a referral was made to ensure potential findings of EPBC protected matters as a result of the surveys, were protected under the EPBC Act. This is discussed further in **Chapters 7** and **16**.



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AECOM

LAND USE ZONING
Environmental Assessment
Bayswater B Power Station

Figure 6.1

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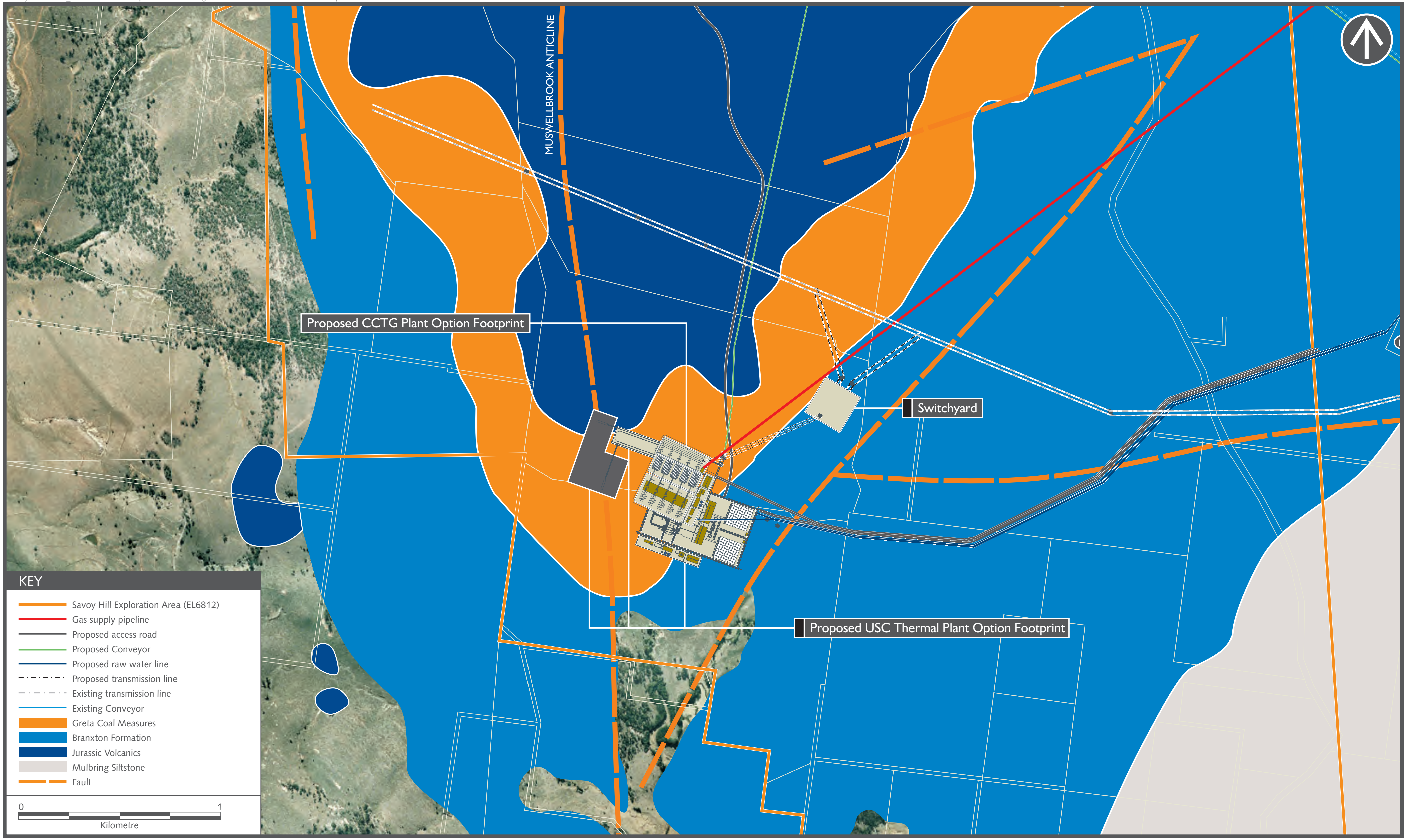

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LOCATION OF THE GRETA COAL MEASURES IN RELATION TO THE PROJECT FOOTPRINT

Environmental Assessment

Bayswater B Power Station

Figure 6.2

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7.0 Consultation

This Chapter sets out the consultation activities that have been undertaken as part of this project, the issues raised by each party consulted and how they are addressed in the EA. This also includes matters required by the Director-General's Requirements including:

***Heritage Impacts** – The EA must demonstrate effective consultation with Aboriginal communities has been undertaken in determining and assessing impacts and mitigation measures.*

***Consultation Requirements** - You must undertake an appropriate and justified level of consultation with the following parties during the preparation of the EA:*

Commonwealth Department of Climate Change

NSW Department of Environment and Climate Change

NSW Department of Water and Energy

NSW Department of Primary Industries

Singleton Council

Muswellbrook Council

The local community.

The EA must clearly describe the consultation process and indicate the issues raised by stakeholders during consultation and how these matters have been addressed.

7.1 NSW Formal Procedures

This EA has been prepared in accordance with Part 3A of the EP&A Act and its Regulation. Part 3A of the EP&A Act ensures that the potential environmental effects of a proposal are properly assessed and considered in the decision making process.

In preparing this EA, the Director-General's EARs have been addressed as required by Clause 75F of the EP&A Act. The key matters raised by the Director-General for consideration in the EA are outlined in **Table 7-1** below, together with the relevant section of the EA which addresses that matter. A full copy of the Director-General's EARs for the project is provided in **Appendix B**.

Table 7-1: Director-General's Environmental Assessment Requirements

Issue Reference	Key Matters	Reference in EA
	General Requirements	
DG-G1	an executive summary	At front of EA
DG-G2	a description of the proposal including: details of project construction, operation, decommissioning, staging and key ancillary infrastructure (e.g. transmission line connection, ash disposal, haulage roads, fuel delivery and storage) under both coal fired and gas generation scenarios including identification of likely worst case development footprint	**Chapter 5**
DG-G3	details of the extent to which existing infrastructure and facilities (including water sourcing and ash disposal) would be used for the project	**Chapters 2** and **5**
DG-G4	identification of fuel source options for the project and feasibility of those options	**Chapter 2** and **3**
DG-G5	supporting maps/plans clearly identifying existing environmental features (e.g. watercourses, vegetation), infrastructure and landuse (including nearby residences and any approved sensitive landuse) and the siting of the project in the context of this existing environment	**Chapter 4**
DG-G6	consideration of any relevant statutory provisions including the consistency of the project with the objects of the *Environmental Planning and Assessment Act 1979*	**Chapter 6**
DG-G7	an assessment of the key issues outlined below, during construction, operation and decommissioning (as relevant). The Environmental Assessment must assess the worst case as well as representative impact for all key issues considering cumulative impacts, as applicable, from the adjacent Bayswater- Liddell generating complex and surrounding mining development (as relevant) considering both coal fired and gas generation scenarios including associated key ancillary components (as relevant)	**Chapters 9 to 23**
DG-G8	a draft Statement of Commitments detailing measures for environmental mitigation, management and monitoring for the project	**Chapter 25**
DG-G9	a conclusion justifying the project taking into consideration the environmental, social and economic impacts of the project; the suitability of the site; and the public interest	**Chapter 27**
DG-G10	certification by the author of the Environmental Assessment that the information contained in the assessment is neither false nor misleading	At front of this EA

Issue Reference	Key Matters	Reference in EA
	Key Assessment Requirements	
DG-SP1	**Strategic Planning and Justification** include a strategic assessment of the need, scale, scope and location for the project in relation to predicted electricity demand, transmission constraints and the strategic direction of the region and the State in relation to electricity supply, demand and electricity generation technologies	**Chapter 2**
DG-SP2	include an analysis of site suitability with respect to potential land use conflicts with existing and future land uses (including existing and approved residential development and mineral reserves) taking into account local and strategic landuse objectives; and	**Chapter 2**
DG-SP3	describe alternatives considered for the project in particular technology and configuration including fuel source, air emission, water use and options for waste disposal beneficial reuse and provide justification for the project demonstrating its benefits at a local and strategic scale in comparison to alternatives considered, including the do nothing option	**Chapter 3**
DG-GHG1	**Greenhouse Gases** the Environmental Assessment must include a comprehensive greenhouse gas assessment undertaken in accordance with the methodology specified in the *National Greenhouse Accounts (NGA) Factors* (Department of Climate Change, November 2008) including:	**Chapter 10**
DG-GHG2	quantification of emissions (in tonnes of carbon dioxide equivalent) in accordance with the *Greenhouse Gas Protocol: Corporate Standard* (World Council for Sustainable Business Development & World Resources Institute) including: direct emissions (Scope 1), indirect emissions from electricity (Scope 2) and any significant up or down stream emissions (Scope 3) considering all stages of the project (construction, operation and decommissioning)	**Chapter 10**
DG-GHG3	comparison of predicted emissions intensity and thermal efficiency against best achievable practice and current NSW averages for the activity, and of predicted emissions against total annual national emissions (expressed as a percentage of total national greenhouse gases production per year over the life of the project);	**Chapter 10**
DG-GHG4	evaluation of the availability and feasibility of measures to reduce and or offset the greenhouse emissions of the project including options for carbon capture and storage. Where current available mitigation technology is not technically or economically feasible, the Environmental Assessment must demonstrate that the proposal will use best available technology, including carbon capture readiness, and identify options for triggers that would require staged implementation of emerging mitigation technologies; and	**Chapter 10**
DG-GHG5	evaluation of the project in the light of carbon emission prices of $10, $25 and $50 per tonne under the proposed Commonwealth Carbon Pollution Reduction Scheme, both with and without proposed mitigation measures.	**Chapter 10**

Issue Reference	Key Matters	Reference in EA
DG-AQ1	**Air Quality Impacts** the Environmental Assessment must include a comprehensive air quality impact assessment prepared in accordance with the *Approved Methods for the Modelling and Assessment* of *Air Pollutants in New South Wales* (DECC, 2005) (Approved Methods) considering worst case operating scenarios and meteorological conditions, representative monitoring and receiver locations and cumulative impacts, as applicable, from the adjacent Bayswater-Liddell generating complex and surrounding mining operations (as relevant).	**Chapter 9**
DG-AQ2	The Environmental Assessment must address air quality impacts at a local, regional and interregional level, assess the potential impacts of emissions on photochemical smog formation in the Sydney basin,	**Chapter 9**
DG-AQ3	give consideration to cumulative fluoride emissions and the potential for contribution to acid deposition considering surrounding sensitive landuse (such as viticulture).	**Chapter 9**
DG-AQ4	The assessment must demonstrate that the project would meet the impact assessment criteria in Section 7 of the Approved Methods and the requirements of the *Protection of the Environment Operations (Clean Air) Regulation 2002.* The Environmental Assessment must clearly demonstrate that the project has been designed to include the application of Best Available Control Technology (BACT) in relation to air emissions. The assessment must include a framework for the mitigation, management and monitoring of air quality impacts, particularly with respect to sensitive receptors likely to be significantly impacted by cumulative air quality impacts in the local area.	**Chapter 9**
DG-WC1	**Water Cycle Management** the Environmental Assessment must: include a water balance for the project identifying indicative water use, wastewater generation and disposal requirements for the operation of the project;	**Chapter 11**
DG-WC2	demonstrate the availability of viable water sources to sustainably meet the water requirements of the project for the life of the project. Consideration shall be given to water reuse and recycling options (including use of treated effluent, rainwater, on site treatment and use of mine waste water), the security of supply, current and future water demand in the region and potential impacts on other users; and	**Chapter 11**
DG-WC3	reflect a design philosophy of zero water discharge from the site, except for natural surface water flows and provide an assessment of the likely risks to water quality associated with the project considering key ancillary components (such as ash disposal).	**Chapter 11**

Issue Reference	Key Matters	Reference in EA
DG-N1	**Noise Impacts** the Environmental Assessment must include a comprehensive operational noise impact assessment for the project, prepared in accordance with *NSW Industrial Noise Policy* (EPA, 2000) considering worst case operating scenarios and meteorological conditions, representative monitoring and receiver locations, and cumulative impacts from the adjacent Bayswater-Liddell generating complex, surrounding mining operations (as relevant) and the connection/upgrade of the Antiene coal conveyer.	**Chapter 14**
DG-N2	The assessment must consider the potential for low frequency noise generation and peak noise events with the potential to cause sleep disturbance. The Environmental Assessment must also consider the potential for:	**Chapter 14**
DG-N3	construction noise impacts consistent with the DECC's "construction noise existing guidelines" available electronically at http://www.environment.nsw.gov.au/noise/constructnoise.htm	**Chapter 14**
DG-N4	vibration impacts during construction and operation consistent with *Assessing Vibration: A Technical Guideline* (DECC, 2006); and	**Chapter 14**
DG-N5	traffic generated noise during construction and operation consistent with *Environmental Criteria for Road Traffic Noise* (EPA, 1999).	**Chapter 14**
DG-N6	The Environmental Assessment must include a framework for the mitigation, management and monitoring of noise impacts, particularly with respect to sensitive receptors likely to be significantly impacted by cumulative noise impacts in the local area.	**Chapter 14**
DG-E1	**Ecological Impacts** The Environmental Assessment must include an assessment of the impacts on native vegetation, threatened species, populations, ecological communities and their habitats (both terrestrial and aquatic as relevant).	**Chapter 15**
DG-E2	The Environmental Assessment must include a screening of species, populations, ecological communities and habitats based on ecological significance and the potential for impact as a consequence of the project.	**Chapter 15**
DG-E3	For species, populations, ecological communities and habitats with high ecological significance and significant potential for impact, include sufficient information to demonstrate the likely impacts, consistent with *Guidelines for Threatened Species Assessment* (DEC & DPI, July 2005).	**Chapter 15**
DG-E4	The Environmental Assessment must include an assessment of impacts to aquatic and riparian values where waterway crossings are proposed.	**Chapter 15**
DG-E5	The assessment must demonstrate a design philosophy of impact avoidance on ecological values, and in particular, ecological values of high significance and include a framework for the further consideration of ecological impacts at the project approval stage, and during detailed design of the project, including options for mitigation and/ or offset consistent with "improve or maintain" principles.	**Chapter 15**
DG-E6	Sufficient details must be provided to demonstrate the availability of viable and achievable options to offset the impacts of the project	**Chapter 15**

Issue Reference	Key Matters	Reference in EA
DG-H1	**Heritage Impacts** The Environmental Assessment must include sufficient information to demonstrate the likely impacts on Aboriginal heritage values/items (archaeological and cultural) and proposed mitigation measures consistent with the Draft *Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (DEC, 2005).	**Chapter 17**
DG-H2	The Environmental Assessment must demonstrate effective consultation with Aboriginal communities has been undertaken in determining and assessing impacts and mitigation measures.	**Chapter 17**
DG-V1	**Visual Impacts** The Environmental Assessment must include an assessment of the visual impact of the project from representative viewing points including residential receivers, settlements and significant public view points and include a framework for the mitigation and management of visual amenity impacts on affected receivers	**Chapter 19**
DG-V2	An overview of the effectiveness and reliability of the measures and any residual impacts after the implementation of such measures must be included.	**Chapter 19**
DG-HR1	**Hazards and Risk Impacts** The Environmental Assessment must include a screening of potential hazards on site to determine the potential for off site impacts and any requirement for a Preliminary Hazard Analysis (PHA).	**Chapter 20**
DG-HR2	The Environmental Assessment must also provide a preliminary screening of potential risks to aviation safety associated with the exhaust plumes from the operation of the project with consideration to the Commonwealth Civil Aviation Safety Authority's Advisory Circular *Guidelines for Conducting Plume Rise Assessments* (June 2004).	**Chapter 20**
DG-W1	**Waste Management** Identification of the major waste streams to be generated by the proposal (including waste from water treatment and coal ash) and measures for its management and disposal including options for recycling and reuse where reasonable and feasible.	**Chapter 22**
DG-GER1	**General Environmental Risk Analysis** Notwithstanding the above key assessment requirements, the Environmental Assessment must include an environmental risk analysis to identify potential environmental impacts associated with the project (construction and operation), proposed mitigation measures and potentially significant residual environmental impacts after the application of proposed mitigation measures. Where additional key environmental impacts are identified through this environmental risk analysis, an appropriately detailed impact assessment of the additional key environmental impact(s) must be included in the Environmental Assessment.	**Chapter 8 and 26**

Issue Reference	Key Matters	Reference in EA
DG-CC1	**Consultation Requirements** You must undertake an appropriate and justified level of consultation with the following parties during the preparation of the Environmental Assessment: • Commonwealth Department of Climate Change; • NSW Department of Environment and Climate Change; • NSW Department of Water and Energy; • NSW Department of Primary Industries; • Singleton Council; • Muswellbrook Shire Council; and • the local community. The Environmental Assessment must clearly describe the consultation process and indicate the issues raised by stakeholders during consultation and how these matters have been addressed.	**Chapter 7**

7.2 Consultation with Stakeholders and Other Relevant Authorities

7.2.1 Planning Focus Meeting

The Department of Planning (DoP) advised that a Planning Focus Meeting (PFM) would be required in order for the Proponent to formally seek the views of relevant statutory authorities in respect of potential impacts of the proposal and issues to be addressed during preparation of the EA.

A PFM was held on 23 July 2008. The PFM provided an opportunity for statutory authorities to establish the requirements for the form and content of the EA. The minutes from the PFM are provided in **Appendix D**. Issues raise by statutory authorities at the PFM are addressed in **Table 7-2**.

Table 7-2: Summary of Issues Raised at the PFM

Issue Raised	Relevant Section of this EA
Does the project represent the latest in technology?	Refer **Chapters 3** (Alternatives) and **5** (Project Description)
Is the Queensland to Hunter pipeline critical as fuel supply for the gas option?	Refer **Chapter 3** Alternatives
Need to demonstrate water mass balance for the dry cooled technology	Refer **Chapter 11** Surface Water
Would a brine concentrator be part of the development?	This is not required for the project
Would there be a requirement to amend the approval for the Antiene Rail Loop?	This would be required if coal were to become the preferred option. Refer **Chapter 6** Statutory Planning
Alternatives assessed in the Owen Inquiry and other documents needs to be reflected	Refer **Chapters 2** and **3** Strategic Justification and Alternatives
Need to illustrate how base load power is achieved	Refer **Chapter 5** Project Description
Need to address acid deposition	Refer **Chapter 9** Air Quality
Need to address potential for future carbon capture and storage	Refer **Chapter 10** Greenhouse Gas Assessment

Issue Raised	Relevant Section of this EA
Potential impacts of water discharge	This project would be a zero discharge site. Refer **Chapter 11** Surface Water
Potential water impacts on other users	This project is seeking approval for a dry cooled technology which allows for water supply within MacGen's own entitlements
Greenhouse gas issues need to be clearly expressed as Scope 1, 2 and 3	Refer **Chapter 10** Greenhouse Gas Assessment
Would need to meet Group 6 limits for NOx	Refer **Chapter 9** Air Quality
Require a discussion on best practice *Note: Best practice was defined as reasonably achieved control technology based on environmental and economic considerations*	Refer **Chapters 5** Project Description and **10** Greenhouse Gas Assessment
Need a discussion on stormwater management	Refer **Chapter 11** Surface Water
Need an assessment of waste minimisation options	Refer **Chapter 22** Waste
Strategic discussion on how the preferred option was chosen	Refer **Chapter 3** Alternatives
Require consultation with Aboriginal community representatives	Refer **Section 7.4.4** and **Chapter 17 Heritage**

7.2.2 Statutory and Other Relevant Authorities

The proponent has undertaken consultation with key local and State Government agencies as specified in the EARs during the preliminary design phase and preparation of this EA. The purpose of this consultation was to provide an overview of the project and to seek input into matters they would like to see addressed in the EA.

In this regard, face to face meetings, where possible, were held with relevant statutory agencies and written comments sought from those parties identified in the EARs to assist with the preparation of the EA. **Table 7-3** below summarises the responses received together with the relevant section of the EA which addresses the matter.

Table 7-3: Agency Responses

Key Matters	Reference in EA
1. The Proposal	
The objectives of the proposal should be clearly stated and refer to:	**Chapter 2**
• the size and type of the operation; • the anticipated level of performance in meeting required environmental standards and cleaner production principles; • the staging and timing of the proposal; and • the proposal's relationship to any other industry or facility.	
2. The Premises	

Key Matters	Reference in EA
The EA should fully identify all of the processes and activities intended for the site over the life of the development. This should include details of: • the location of the proposed facility and details of the surrounding environment; • the proposed layout of the site; • appropriate land use zoning; • ownership details of any residence and/or land likely to be affected by the proposed facility; • maps/diagrams showing the location of residences and properties likely to be affected and other industrial developments, conservation areas, wetlands, etc in the locality that may be affected by the facility;	**Chapter 4 and 6**
• all equipment proposed for use at the site; • all chemicals, including fuel, used on the project site, the maximum quantity of each chemical, proposed methods for their transportation, storage, use and emergency management; • waste generation and disposal; and • methods to mitigate any expected environmental impacts of the development.	**Chapter 5** **Chapter 20 and Appendix G** **Chapter 22**
3. Air	
The EA should include a comprehensive air quality impact assessment prepared in with the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (the Approved Methods) for each operating scenario. The air quality impact assess should consider worst case operating scenarios and meteorological conditions, and impacts from the adjacent Bayswater-Liddell generating complex. The air quality impact assessment should address impacts at a local, regional and interregional level and assess the impacts of emissions on photochemical smog formation in the Sydney Basin. Recognising the need for future economic growth and the ongoing protection of population health, the EA should demonstrate that sufficient mitigation is proposed for ozone precursors to ensure ongoing compliance with the *National Environment Protection Measure for Ambient Air Quality* ozone goals while providing capacity for future industrial growth in the air-shed.	**Chapter 9**
Given the proximity of the proposed power station to the wine industry, the air quality impact assessment should examine the cumulative impact of fluoride emissions on agricultural activities in the region, in particular grape vine productivity. Additionally, following studies into rainfall quality in the Upper Hunter, DECC recommends that the air quality assessment also investigate acid deposition and its impacts (refer *Rainfall Quality in the Upper Hunter EPA, 1994*).	**Chapter 9**

Key Matters	Reference in EA
The air quality impact assessment should demonstrate the proposal will cause no additional exceedences of the relevant impact assessment criteria in Section 7 of the Approved Methods. The EA should demonstrate that emissions of fine particles and heavy metals will be minimised to the maximum extent practicable through the application of best practice process design and/or emissions controls. Practicability includes a consideration of technical, logistical and financial considerations. It is not expected that reductions in emissions should be pursued at any cost, nor will the preferred option necessarily be the lowest cost option. However, the preferred option should be cost effective. The EA should demonstrate how proposed operating scenarios will comply with the requirements of the *Protection of the Environment Operations (Clean Air) Regulation 2002*. The EA should also propose an air quality monitoring program to monitor emissions, to assess compliance with the requirements of Schedule 4 of the *Protection of the Environment Operations (Clean Air) Regulation 2002* and verify model predictions.	**Chapter 9**
The EA should include a review of the location of ambient air monitoring stations and the need for additional monitoring stations to reflect highest ground level concentration locations, and locations representative of residential and public receptors.	**Chapter 9**
4. Greenhouse Gas Emissions	**Chapter 10**
The following requirements are provided on the basis that the proposed national *Carbon Pollution Reduction Scheme (CPRS)* will be the primary regulatory instrument for greenhouse gas (GHG) emissions. The EA should comprehensively assess and report on the project's predicted greenhouse gas (GHG) emissions in tonnes of carbon dioxide equivalent **(tC02-e)** undertaken in accordance with the methodology specified in the *National Greenhouse Accounts (NGA) Factors* (Department of Climate Change, November 2008) including:	**Chapter 10**
• quantification of emissions in accordance with the *Greenhouse Gas Protocol: Corporate Standard* (World Council for Sustainable Business Development & World Resources Institute) including direct emissions (Scope 1), indirect emissions from electricity (Scope 2), and upstream and downstream emissions (Scope 3) both before and after implementation of the project, including annual emissions for each year of the project (i.e. during construction, operation and decommissioning of the project);	**Chapter 10**
• identification of which emissions will be covered by the proposed CPRS (*Carbon Pollution Reduction Scheme Bill*) and analysis of the expected carbon costs for the proposal including at prices of $10, $25 and $50 per tonne of C02e. Analysis is to be presented showing how, at these prices, the project will be prepared to operate successfully within the CPRS;	**Chapter 10**
• evaluation of the availability and feasibility of measures to reduce and/or offset greenhouse gas emissions including investigation of currently available greenhouse gas mitigation technology, such as Carbon Capture and Storage (CCS).	**Chapter 10**

Key Matters	Reference in EA
When assessing CCS technology, the proponent should investigate and report on: a) potential storage options; b) feasibility of transport to storage options; c) other environmental issues relating to CCS such as gas leakage, and d) any foreseeable barriers to implementing CCS	**Chapter 10**
If installation of currently .available technology is not practical, then the proponent should continually assess the feasibility of incorporating new greenhouse gas mitigation technologies, such as CCS, as those new technologies are developed and become available and incorporate in the project design provision for either: a) suitable technology, such as CCS, to be implemented; or project emissions to be offset using a method acceptable to DECC;	**Chapter 10**
to be implemented from 2020 In the event that no national cap and emissions reduction legislation or scheme is in operation by that date;	**Chapter 10**
• evaluation of the feasibility of measures to reduce greenhouse gas emissions associated with the project, concentrating on emissions not covered by the CPRS; and • evaluation of emissions intensity and thermal efficiency of the new facility against current best available technology and against current NSW averages.	**Chapter 10**
5. Noise	**Chapter 14**
The EA should include a comprehensive noise impact assessment for each operating scenario as follows:	
• Construction noise should be assessed using DECC's "Existing Guidelines" available electronically at http://www.environment.nsw.gov.au/noise/constructnoise.htm • Operational noise from all activities to be undertaken on the premises should be assessed using the guidelines contained in the *NSW Industrial Noise Policy* (EPA, 2000) and Industrial Noise Policy Application Notes. • Operational vibration from all activities to be undertaken on the premises should be assessed using the guidelines contained in the *DECC Environmental Noise Management Assessing Vibration: a technical guideline* (DEC, 2006). • Noise from increased traffic resulting from the operation of the premises on public roads should be assessed using the guidelines contained in the *Environmental Criteria for Road Traffic Noise* (EPA, 1999). • If blasting is required for any reasons, blast impacts should be demonstrated to be capable of complying with the guidelines contained in "*Australian and New Zealand Environment Council- Technical basis for Guidelines to minimise annoyance due to Blasting Overpressure and Ground Vibration"* (ANZEC 1990). • Assessment requirements for potential noise from increased rail movements on the NSW Rail network can be provided if rail transport is proposed as part of the application.	**Chapter 14**

Key Matters	Reference in EA
Note that:	
• levels of operational noise and vibration from the any existing power station on the licensed remises needs to be presented, together with predicted levels for any new power station; and, • the combined operational noise and vibration from both existing and proposed power stations on the licensed premises, not just solely from the proposed power stations alone, needs to be compared against the relevant criteria.	Not applicable – refer below with respect to consultation with DECCW **Chapter 14**
• cumulative noise and vibration impacts are to be assessed by consideration of noise from other premises. • operational noise and vibration assessment, as indicated above, should be completed for both cooling options (dry and wet) identified in the PEA and the range of scenarios (e.g. dry cooling attemperation) within these options.	**Chapter 14**
6. Water	
Wastewater Although the Preliminary Environment Assessment (PEA) does not identify any discharge of wastewater from the site to waters (with this being confirmed during discussion at the Planning Focus Meeting), Section 8.2.2 of the PEA identifies "*Degradation of water quality in the local area during operation*" as a "High" priority in the Environmental Prioritisation Analysis (Table 18). The EA should clarify this apparent contradiction. The PEA should include information as to how wastewater generated from operations (under all operating scenarios presented) will be managed to prevent a discharge to waters. This should include detail on the final fate of wastewater and wastewater contaminants.	**Chapter 11**
Water Management Plan The EA should provide sufficient information to demonstrate that the proposed development can be operated while complying with the *Protection of the Environment Operations Act 1997,* in particular, the protection of water quality, including ground water, during construction and during operation of the project. The methodology, data and assumptions used to design any pollution control works and assess the potential impact of the proposal on water quality, should be fully documented and justified. The EA should include a water management plan and site water balance incorporating the following principles:	**Chapter 11**
a) maximum on-site reuse of wastewater together with the use of control and storage works to avoid any discharge of pollutants from the premises. This should include correct installation and sizing of the wastewater collection and recycling systems; b) prevention of wet weather overflows of contaminated stormwater by collection and reuse or treatment of contaminated first flush stormwater; c) segregation of contaminated water from non-contaminated water to minimise the volume of polluted water to be dealt with;	**Chapter 11**

Key Matters	Reference in EA
d) spillage controls and bunding; e) sealing and effectively bunding material storage areas and active areas of the plant to prevent soil, stormwater and groundwater contamination;	
f) effective management of stormwater to segregate surface water runoff from undisturbed areas and disturbed areas; g) maintenance of sediment and erosion control structures: h) sealing, kerbing and guttering of trafficable areas; and i) provision of truck washing facilities capable of washing wheels and under body of vehicles leaving the premises.	
7. Waste and Chemicals	**Chapter 22**
The EA should include an assessment of all likely waste streams associated with the project both during construction and operation, and how waste would be managed by the project in line with the principles of waste avoidance, reuse, and recycling. The EA should include information to ensure:	**Chapter 22**
a. waste is managed in accordance with the principles of the waste Hierarchy, *NSW Waste Avoidance and Resource Recovery Strategy* and cleaner production concepts; b. the handling, processing and storage of all waste materials used at the premises does not have a negative environmental or amenity impact; and c. the beneficial reuse of all waste generated at the premises is maximised where it is safe, practical and lawful to do so both during the construction and ongoing operational phase of the proposed development.	
Specific information on waste management should include:	**Chapter 22**
• An assessment and quantification of the types of waste which will be generated, reused, and recycled during the construction and ongoing operational phase of the proposed development, for example;	
• fly and bottom ash residues from the burning of coal and other non-standard fuels, • residues from the treatment of water in filters, screens, softeners, reverse osmosis units and brine concentrators, • liquid wastes including cooling or boiler water 'blowdown', reagents used to regenerate de-mineralisers or operate closed cooling water systems, • irregularly generated liquid cleaning solutions or other materials generated during maintenance turnarounds,	
• construction waste and fill materials, • all waste derived non-standard fuels, and • any other residue or waste.	
a. Proposed disposal options for the waste generated on-site. • An assessment of whether any proposed on-site waste management options will require an Environment Protection Licence under Schedule 1 of the *Protection* of *the Environment Operations Act 1997.*	

Key Matters	Reference in EA
In addition to matters listed above, the EA should provide detailed information on the manner of disposal of ash, including but not limited to: a. the manner of transportation of ash to its disposal point; b. the quantity of ash generated each year and over the life of the project; c. the surface area expected to be required to dispose of the ash over the project life; d. options to maximise the re-use of ash; this should include a cost / benefit analysis on the feasibility of each re-use option, or a combination of re-use options to achieve this goal; e. if the preferred disposal option (as indicated during the Planning Focus Meeting) is to utilise coal mine voids, the impacts this will have on the regulatory rehabilitation requirements for the mine; and f. management strategies to prevent dust nuisance, surface water contamination and ground water contamination from disposed ash.	
The EA should provide details of chemicals to be stored in bulk on the site, and the expected maximum storage volume for each. A commitment should also be made to construct, operate and maintain all storages in compliance with recognised standards and all applicable legislation.	
8. Contaminated Land	**Chapter 12**
The mechanisms for the management of any known, or discovered, contaminated land on the site should be detailed in the EA.	
9. Threatened Species and their Habitat	**Chapter 15**
As proposed in the PEA, the proponent should provide an assessment of the potential impacts on threatened species, populations, endangered ecological communities and their habitats as part of the EA. This assessment should include the proposed power station as well as areas required for, and potentially impacted by, the development of infrastructure off site, including but not limited to:	
a. the 15km gas pipeline spur; b. required railway for coal delivery; c. conveyors to transfer coal to the site; and d. roadways, including the planned road to transfer ash from the site.	
There are two assessment tools that can be used by proponents for this purpose:	
a. the factors identified in the *Threatened Species Assessment Guidelines - The Assessment of Significance (DECC 2007 and NSW DPI 2008);* or b. the *BioBanking Assessment Methodology*. Further information can be found on the DECC website at: http://www.environment.nsw.qov.au/biobankinq/assessmethodoloqv.htm.	
Any offsets proposed should comply with DECC's *'Principles for the use of Biodiversity Offsets in NSW'* identified in Attachment D. Justification for any area(s) proposed as compensatory habitat should include an assessment of the threatened species values impacted on by the proposed works and whether the proposed area(s) provides equivalent values.	

Key Matters	Reference in EA
The EA should:	
a. document all known and likely threatened species, their habitats, population and ecological communities of the site (including any adjacent areas that may be indirectly impacted upon by the proposal). The EA should provide details of survey methodologies and / or techniques utilised; b. provide a detailed assessment of the impacts on such species, habitats, population and ecological communities; and c. detail the actions that will be taken to avoid or mitigate impacts, or to compensate or offset unavoidable impacts of the project on threatened species, populations, ecological communities and their habitat.	
10. Aboriginal Cultural Heritage	**Chapter 17**
DECC notes the existence of 107 registered Aboriginal sites in the immediate locality. These include open camp sites, isolated artefacts, grinding grooves and Potential Archaeological Deposits (PADS). The EA should consider any potential impacts of the proposal on these known sites, the sensitivity and significance of these sites to the traditional Aboriginal custodians and any relationship that may exist between these sites and any Aboriginal cultural values of the project area.	**Chapter 17**
In addition to the above, the EA should:	**Chapter 17**
a. address and document the information requirements set out in the draft *"Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation'* (Department of Environment and Conservation 2005) and the *'Part 3A EP&A Act Guidelines for Aboriginal Cultural Heritage Assessment and Community Consultation'* (Department of Planning and Department of Environment and Conservation 2007); b. include surveys by suitably qualified archaeological consultants and include evidence of consultation with traditional Aboriginal custodians;	
a. identify the nature and extent of impacts on Aboriginal Cultural Heritage values across the project area and the strategies proposed to avoid / minimise these impacts. If impacts are proposed as part of the final development, clear justification for such impacts should be provided; b. assess the archaeological and Aboriginal significance of the site's Aboriginal Cultural Heritage values; c. describe the actions that will be taken to avoid or mitigate impacts of the project on Aboriginal Cultural Heritage values. This should include an assessment of the effectiveness and reliability of the measures and any residual impacts after these measures are implemented; and d. clearly demonstrate that effective community consultation with Aboriginal communities has been undertaken in assessing impacts, developing options and making final recommendations. DECC supports broad-based Aboriginal community consultation and as a guide the *'Interim Community Consultation Requirements for Applicants* (DECC 2005)' provides a useful model to follow.	

Key Matters	Reference in EA
If impacts on Aboriginal cultural values are proposed as part of the final development, an assessment of the regional significance of the values to be impacted, the extent to which these values are protected elsewhere in the landscape and consideration of the proposed impacts in the context of 'inter generational equity' should be undertaken. Note: If the EA is relying on past surveys, it is critical to confirm that the surveys are consistent with the requirements of the above Part 3A guidelines. Furthermore. if any new sites or objects are located, they should be recorded on NPWS site cards and registered on the Aboriginal Heritage Information Management System (AHIMS).	**Chapter 17**
Department of Environment and Water (DWE) requires the Environmental Assessment (EA) for the proposal demonstrate that the proposed mining operation will achieve the following: compliance with rules, limitations and operational constraints set within Macquarie Generation Major Water Utility licence under the Hunter Regulated River Water Sharing Plan (HRRWSP) in force under the *Water Management Act 2000* (WMA) no impact on adjacent licensed water users, basic landholder rights, or minimum base flows in the Hunter or Barnard Rivers, or surface or ground water-dependent *ecosystems*	**Chapter 11**
The information provided in the PEA does not explain the class or security level of Increased water supply required to the operation, nor how the project may achieve the above outcomes, The conceptual statements made in the PEA do not convey understanding of the risks associated with any increased extraction from the Hunter River or increased transfer from the Barnard River water sources, nor how it will comply with the operating ruies of the HRRWSP. This must be explained in detail in the Environmental Assessment, and justification of the proposal provided in terms of protection to the two water source	Not applicable. Refer **Chapter 11**

7.3 Ongoing Agency Consultation

7.3.1 Commonwealth Dept. Environment Water Heritage and the Arts

A preliminary meeting was held with the Commonwealth Department of Environment Water Heritage and the Arts (DEWHA) on 9 July 2009. The purpose of this meeting was to introduce the project, to gain initial feedback and to begin a process of communication with respect to a referral.

Initial concerns and areas of interest included threatened flora and fauna listed under the Environmental Protection and Biodiversity Conservation Act (EPBC Act), particularly in relation to the adjacent water courses and the location of the associated infrastructure.

7.3.2 Commonwealth Dept. Climate Change

A letter outlining the project was sent to Dept of Climate Change on 17 July 2009. Follow ups were undertaken by telephone but at the time of writing this EA, no response has yet been received.

7.3.3 NSW Mine Subsidence Board

A letter was sent to the Mine Subsidence Board on 17 July and a response was received on 23 July. They noted that the property is within the Patrick Plains Mine Subsidence District and approval of the Mine Subsidence Board would be required prior to any construction and building erection.

They also noted that the site is not currently undermined and there are no mining leases. However, it appears to be within an Exploration Licence area held by Dellworth P/L. This was also highlighted by Dept of Primary Industries (refer below) and is discussed in Chapter 6 (Statutory Planning).

A full copy of this correspondence is provided in **Appendix C**.

7.3.4 NSW Dept. Primary Industries

A letter outlining the project was sent to Dept of Primary Industries on 17 July 2009. A letter was received on 4 August 2009 and raised the following key issues:

- Minerals resources (specifically in relation to the Dellworth Exploration lease and the Greta Coal Measures) (refer Chapter 6 Statutory Planning);
- Land resource ad management issues (refer Chapter 12 Land Capability);
- Water related issues (refer Chapter 3 Alternatives, Chapter 5 Project Description and Chapter 11 Surface Water); and
- Air quality issues (refer Chapter 9 Air Quality).

A full copy of this correspondence is provided in **Appendix C**.

7.3.5 NSW Dept of Water and Energy (now DECCW)

Key issues raised by DWE (now DECCW) related to the requirements for additional water supply and the need for separate accounting of water use at the Bayswater B site in using water from existing purchases and entitlements from the existing Bayswater site.

7.3.6 NSW DECC (now DECCW)

Air Quality

Initial face to face consultation was undertaken with DECC subsequent to the PFM to clarify the expectations regarding the Air Quality Assessment. A summary of the issues raised are provided below.

- **Particulate Emissions**. DECC would be looking for an examination of the potential to reach 'best practice', that is better than the regulated benchmark, for emissions of fine particulate matter with an indication of its feasibility.
- **Pollutants for Modelling**. It was expected the air impact assessment will include SOx, NOx, PM, type 1 & 2 metals, hydrogen fluoride, sulphur trioxide, cadmium and mercury.

  It was not expected there would be a requirement to assess dioxins and furans as the fuel type (either coal or gas) is a conventional fuel.

Noise

Consultation was undertaken with DECC regarding the noise requirements, with particular reference to:

- *levels of operational noise and vibration from the any existing power station on the licensed remises needs to be presented, together with predicted levels for any new power station; and*
- *the combined operational noise and vibration from both existing and proposed power stations on the licensed premises, not just solely from the proposed power stations alone, needs to be compared against the relevant criteria.*
- *operational noise and vibration assessment, as indicated above, should be completed for both cooling options (dry and wet) identified in the PEA and the range of scenarios (e.g. dry cooling attemperation) within these options.*

With respect to the first two points, the proposed Bayswater B project is to be a separately licensed facility at some distance to the existing Bayswater Power Station. The noise modelling and assessment for the EA is based on the cumulative effect of the power stations as the existing power stations are integral to the current ambient noise characteristics of the area. As such, there is not a need to present the individual noise data for the existing facility.

With respect to the wet and dry cooling options presented in the PEA, only dry cooling is to be assessed as water supply for a wet cooled option cannot be guaranteed. Given the lack of available water, a dry cooled option was chosen and is the subject of this concept approval. As such, the assessment only includes modelling for the dry cooled option.

These points were discussed with DECC in Sydney and Newcastle by telephone and at a face to face meeting a consensus was reached and the assessment has been undertaken on this basis.

Greenhouse Gas Issues

A meeting was held with DECC on 22 July 2009 to clarify expectations around the Greenhouse Gas assessment. A summary of discussion points and clarifications included:

- use data collected and reported under the Greenhouse Gas Reduction Scheme (GGAS) for benchmarking emissions intensity and thermal efficiency of the proposal against current NSW averages;
- use the data collection framework developed by MacGen to meet existing National Greenhouse and Energy Reporting (NGER) obligations for comparisons of the predicted emissions from the proposal against total annual national emissions. It is noted that this methodology is consistent with the National Greenhouse Accounts (NGA) Factors methodology;
- report total emissions and a break down of emissions as Scope 1, Scope 2 and Scope 3 emissions;
- report significant Scope 3 emissions and include the rationale for determining the test of significance;
- include statements addressing which Scope 3 emissions are considered insignificant, with reference to the test of significance;
- identify options for offsetting emissions;
- identify options for triggers that would require the staged implementation of emerging technologies such as carbon capture and storage. This necessitates the

implementation of a framework that provides ongoing evaluation of emerging technologies and trigger set points;

- provide quantitative evaluation of the impacts on the project of CPRS carbon costs, both with and without currently available mitigation technologies; and
- an evaluation of carbon costs on the project with consideration of the emerging mitigation technologies identified in the Environmental Assessment.

It was also noted that:

"It is important that the Environmental Assessment identifies the framework for continual evaluation of emerging mitigation technologies. The EA must include options for identifying when emerging technologies have matured sufficiently to become technically and/or economically feasible. If a national emissions trading scheme does not eventuate this requirement provides NSW with the appropriate mechanism to call for the implementation of mitigation technologies, such as carbon capture and storage, as those technologies mature and become commercially available."

The GHG assessment has been prepared on the basis of this discussion and is provided in **Chapter 10** of this EA.

A review of carbon capture and storage options is also provided in **Chapter 10 Greenhouse Gas Emissions**.

7.3.7 Roads and Traffic Authority

A letter outlining the project was sent to the RTA on 28 July 2009. A response was received on 4 September 2009 and recommended the following:

- The Proponent should undertake a Traffic Impact Study to identify and consider the likely traffic impact of the proposed project on the existing New England Highway interchange, during both construction and operation, and identify any road upgrades that may be required as a result of traffic generation. The study should be prepared in accordance with the RTA's *Guide to Traffic Generating Developments*.

An assessment of the likely traffic impacts of construction and operation of Bayswater B has been undertaken in **Chapter 21 Traffic and Transport** of this EA.

7.3.8 Singleton Council

A letter outlining the project was sent to Singleton Shire Council on 17 July 2009. An email response was received on 24 July 2009 and raised the following key issues:

- Social impact, particularly in respect of future housing needs;
- Economic impact during and post construction;
- A detailed assessment of air quality impacts;
- A cumulative assessment of potential adverse air quality impacts on community health;
- Traffic generation and impact on the local road network throughout the Singleton Local Government Area;
- Greenhouse gas emissions and impact on climate change; and
- An assessment of the adequacy of existing infrastructure to cope with a new power station, particularly water.

A presentation was given to a Council meeting on Monday 10 August. The queries and issues raised and addressed at that meeting included:

- Health impacts, including from carbon dioxide emissions;
- Water requirements;
- Gas supply and security;
- Number of construction and operational staff expected.

7.3.9 Muswellbrook Council

A letter outlining the project was sent to Muswellbrook Shire Council on 17 July 2009. A response was received on 22 July 2009 outlining the following key issues to be considered in the EA:

- Ecologically Sustainable Development;
- Public Consultation;
- Noise impacts;
- Statement of Commitments;
- Roads and other Council Infrastructure;
- Air Quality Impacts (particularly in relation to health effects);
- Ecological Impacts;
- Social Impacts.

A full copy of this correspondence is provided in **Appendix C**.

A presentation was given to the Muswellbrook Council Environment Committee which includes representatives of Council and the community. The queries and issues raised and addressed at that meeting included greenhouse gases and potential impacts on the local community.

A follow up meeting was held on 11 August with the Mayor of Muswellbrook and several directors of Council departments. The key issues raised during that meeting were primarily related to the appropriate management of social and economic effects of the project in an area already stressed by large projects. This is of particular issue since the main footprint of the Bayswater B project lies within the Singleton LGA, but is geographically closer to Muswellbrook, with the assumption that (as has occurred with other projects), Muswellbrook is required to provide the bulk of services and amenities to construction and operational staff. The Council noted that they were in principle supportive of the project as long as appropriate management of these issues could be demonstrated. The key areas of concern included:

- Accommodation for construction workers within the town of Muswellbrook;
- Accommodation within a construction camp and the request to plan the construction camp with a view to workforce management as well as a potential long term sustainable use for the facility;
- Accommodation for operational staff to allow Council to appropriately plan for emerging requirements;

- Stress on the employment market and potential exacerbation of skills shortages;
- Potential stress on community services, particularly child care and medical services;
- Potential stress on local infrastructure including sewer, waste facilities, water infrastructure and the local road network.

7.4 Community Consultation

As part of the preliminary project planning for the proposed works, MacGen prepared a Communication and Consultation Plan. Details of this consultation program are provided in the following sections.

7.4.1 Objectives

The purpose of the consultation strategy was to:

- Facilitate a consistent approach to consultation that builds credibility and trust.
- Ensure that engagement with stakeholders undertaken as part of the approvals strategy is carefully planned, adequately resourced, thoroughly documented and implemented through a clearly defined and staged process.
- Promote early engagement with stakeholders to enable MacGen to understand the key issues early and respond to them. This proactive approach can lead to more certainty for project planning and government confidence that issues have been addressed.

7.4.2 Stakeholder Consultation

Key meetings were held with:

- Macquarie Generation Community Consultative Committee;
- Muswellbrook Council Environment Committee;
- Muswellbrook Shire Council Commerce, Industry and Tourism Committee;
- Hunter Central Rivers Catchment Management Authority;
- Hunter Business Chamber;
- Landowners along the potential pipeline route.

7.4.3 Issues Raised

A summary of issues raised and addressed during the consultation with the key stakeholders is provided below and included:

- Local infrastructure, housing and services ability to handle growth and temporary population increase;
- Management of community expectation and concern;
- Environmental concerns;
- Health impact;
- Water usage and supply;
- Air quality issues;
- Fuel supply, specifically gas supply;

- How will the decision be made as to owner, operator;
- Who owns the land;
- How close are neighbours;
- Will it be difficult to find a buyer;
- How much will it cost;
- Social and economic effects, particularly in relation to accommodation, employment, services, amenities and infrastructure;
- Greenhouse gas assessment and the inclusion of all relevant aspects in the calculations (ie Scopes 1, 2 and 3).

7.4.4 Aboriginal Consultation

This EA includes a Heritage Assessment that was undertaken in consultation with Wanaruah Local Aboriginal Land Council. This report is currently being updated to include the broader Aboriginal consultation that has been taking place in accordance with DECC guidelines. The full consultation process to support a Cultural Heritage Assessment is still ongoing. This report includes consultation results where received to date.

Aboriginal community consultation has been undertaken in accordance with the DEC (2004) *Interim Community Consultation Requirements for Applicants* (ICCRs). These guidelines outline a process of inviting Aboriginal groups to register their interest in being party to consultation (including local newspaper advertising), seeking responses on proposed assessment methodology, and seeking comment on proposed assessments and recommendations. The guidelines require proponents to allow ten working days for Aboriginal groups to respond to invitations to register, and then 21 days for registered Aboriginal parties to respond to a proposed assessment methodology.

Stage 1 – Notification and Registration of Interest

Specifically, consultation consisted of the following:

- advertisement of the project in the Hunter Valley local newspaper, inviting Aboriginal groups to register interest;
- letters sent to organisations requesting advice on Aboriginal stakeholders to consult and any known heritage issues to be taken into consideration;
- contacted known Aboriginal organisations around the project area, as a result of advice received from those organisations

Stage 2 – Briefing and Methodology Advice

Briefing letters were sent to the Aboriginal groups that initially registered their interest (Stage 1), advising the proposed methodology for the survey.

As a result of this process, and after the 21-day response period required by the ICCRs, specific Aboriginal community groups were registered as stakeholders in the project.

Stage 3 – Consultation

Letters were sent to the registered stakeholders inviting them to attend a presentation and workshop and visit to the project site and at the same time, requesting feedback on any known cultural heritage issues for the project area.

Consultation with the Aboriginal community has been ongoing throughout this project and all registered stakeholders will be invited to comment upon the draft Heritage Assessment report prior to its finalisation.

A detailed consultation log and Aboriginal community comments as received to date are presented in the detailed Heritage Assessment in this EA. In addition, where received, specific comments regarding the cultural significance of the project area (and any associated “sites”) and report recommendations have been incorporated into the Heritage Assessment.

8.0 Issues Prioritisation

8.1 Issue Identification

8.1.1 Methodology

Preparation of a PEA and consultation with the DoP and relevant agencies and authorities (including the PFM held on 19 June 2009 and subsequent DGR's issued on 6 July 2009) assisted in the identification of issues relating to the project. The PEA prepared in respect of the proposed Bayswater B project involved a desktop analysis and preliminary investigations to provide an outline of information and background environmental data on the site and the proposed Bayswater B project, sufficient to establish the key environmental issues. This information and the DGR's were used to identify the level of assessment required for this EA.

8.1.2 The Issues

Key environmental issues identified by AECOM through the PEA process and through the DGR's are as follows:

- Air quality;
- Greenhouse gas;
- Water;
- Visual impact;
- Soils and stability;
- Noise and vibration;
- Flora and fauna;
- Cultural heritage;
- Transport and traffic;
- Social; and
- Economic.

8.2 Prioritisation of Issues

8.2.1 Approach

The prioritisation of issues for the proposed Bayswater B project is based on the need to recognise that the higher the potential severity of adverse environmental effects and the greater the consequence of those unmanaged effects, the higher the degree of environmental assessment required.

Where a high potential effect was identified, the attribute or issue was allocated a higher priority for assessment.

Table 8-1 provides the Issues Prioritisation Matrix upon which the ranking of environmental issues has been based. This method assesses priority on the basis of the potential severity of environmental effects and the likely consequences of those potential effects if unmanaged. The potential severity and consequence of the environmental effect are each given a numerical value between 1 and 3. The numbers are added together to provide a result which is then ranked and shaded in the matrix by the level of priority being High, Medium or Low.

Table 8-1: Issues Prioritisation Matrix

Severity of Effects	Perceived Consequence of Unmanaged Effects		
	3. High	2. Medium	1. Low
1 Low	4 (Medium)	3 (Low)	2 (Low)
2 Medium	5 (High)	4 (Medium)	3 (Low)
3 High	6 (High)	5 (High)	4 (Medium)

8.2.2 Prioritisation Assessment

The prioritisation of environmental issues related to the proposed project is shown in **Table 8-1.** This assessment aims to allow the prioritisation of issues for assessment and does not consider the application of mitigation measures to manage environmental effects. In all cases, appropriate and proven mitigation measures, chosen based upon the experience of regulators and other similar projects would be used to minimise potential impacts. These measures will be discussed in **Chapters 8** to **22** of this EA.

The allocation of risk is based upon the following considerations:

Severity of Risk

1. *Low:* *Localised implications; imperceptible or short term cumulative impacts.*
2. *Medium:* *Regional implications; modest or medium term accumulation of impacts.*
3. *High:* *Inter-regional implications; serious or long term cumulative impacts.*

Consequences of Unmanaged Effects

1. *Low:* *Minor environmental change; offsets readily available.*
2. *Medium:* *Moderate adverse environmental change; offsets available.*
3. *High:* *Important adverse environmental change, offsets not readily available.*

Table 8-2: Prioritisation Analysis of Environmental Issues

	Severity	Consequence	Priority
Aspect: Air Quality			
Construction related impacts on air quality.	2	2	**4 (Medium)**
Emissions to the atmosphere with the potential to result in reduction of air quality in the local area.	3	3	**6 (High)**
Community concern regarding reduction of air quality.	3	3	**6 (High)**
Regional and inter-regional impacts upon air quality.	3	3	**6 (High)**
Aspect: Greenhouse Gases			
Community concern regarding contribution to greenhouse effect.	3	3	**6 (High)**

	Severity	Consequence	Priority
Release of greenhouse gases resulting in potential contribution to the greenhouse effect.	3	3	**6 (High)**
Aspect: Water			
Degradation of water quality in the local area during construction.	2	2	**4 (Medium)**
Degradation of water quality in the local area during operation.	2	3	**4 (Medium)**
Aspect: Visual Impact			
Change to observed landscape character as a result of new buildings.	1	2	**3 (Low)**
Obstruction of views/vistas.	1	2	**3 (Low)**
Aspect: Soils and Stability			
Erosion and sedimentation during construction.	1	2	**3 Low)**
Erosion and sedimentation during operation.	1	2	**3 Low)**
Changes to landform.	1	1	**2 (Low)**
Land capability.	1	1	**2 (Low)**
Aspect: Noise and Vibration			
Temporary noise nuisance to local residents during construction.	1	1	**2 (Low)**
Noise nuisance to local residents during operation.	1	2	**3 (Low)**
Aspect: Flora and Fauna			
Loss of habitat due to clearing and development.	2	2	**4 (Medium)**
Reduction in biodiversity due to loss of habitat for native species.	2	2	**4 (Medium)**
Spread of weeds and feral animals.	1	1	**2 (Low)**
Detrimental impact on nearby bushland due to edge effects.	1	2	**3 (Low)**
Impact upon threatened species.	2	2	**4 (Medium)**
Community concern regarding clearing of land.	2	2	**4 (Medium)**
Indirect ecological impacts due to emissions, noise and potential water pollution.	1	2	**3 (Low)**
Impact upon koala habitat.	2	2	**4 (Medium)**
Aspect: Cultural Heritage			
Damage or removal of Aboriginal artefacts or places.	2	2	**4 (Medium)**
Detrimental impact upon items of non-indigenous heritage significance.	1	1	**2 (Low)**

	Severity	Consequence	Priority
Aspect: Transport and Traffic			
Increase in traffic on local road network during construction.	2	2	**4 (Medium)**
Increase in traffic on local road network during operation.	1	1	**2 (Low)**
Aspect: Social			
Impacts upon residential amenity such as noise, visual, etc.	1	2	**3 (Low)**
Impacts upon demand for community resources.	1	2	**3 (Low)**
Aspect: Economic			
Job creation during construction.	1	1	**2 (Low)**
Job creation during operation.	1	1	**2 (Low)**

Table 8-3 identifies that the prioritisation of environmental issues, and therefore the focus of assessment for the proposed project should be as follows:

Table 8-3: Prioritisation of Issues

Low	Medium	High
Visual Impact Soils and stability Noise and Vibration Cultural heritage Transport and Traffic Social Economic	Flora and fauna Water	Air quality Greenhouse gases

The level of information on each issue provided in this EA corresponds to the priority of the issue. The above issues have been addressed in **Chapters 8 to 22** of this document.

9.0 Air Quality

This Chapter provides a summary of all matters relating to the Air Quality Assessment undertaken by Katestone Environmental. The full Air Quality Report is provided in Appendix C, with this chapter providing a summary. This assessment has been undertaken in consultation with DECCW and with recourse to the Director General's Requirements which include:

***Air Quality Impacts** - the Environmental Assessment must include a comprehensive air quality impact assessment prepared in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (DECC, 2005) (Approved Methods) considering worst case operating scenarios and meteorological conditions, representative monitoring and receiver locations and cumulative impacts, as applicable, from the adjacent Bayswater-Liddell generating complex and surrounding mining operations (as relevant).*

The Environmental Assessment must address air quality impacts at a local, regional and interregional level, assess the potential impacts of emissions on photochemical smog formation in the Sydney basin, give consideration to cumulative fluoride emissions and the potential for contribution to acid deposition considering surrounding sensitive landuse (such as viticulture).

The assessment must demonstrate that the project would meet the impact assessment criteria in Section 7 of the Approved Methods and the requirements of the Protection of the Environment Operations (Clean Air) Regulation 2002. The Environmental Assessment must clearly demonstrate that the project has been designed to include the application of Best Available Control Technology (BACT) in relation to air emissions. The assessment must include a framework for the mitigation, management and monitoring of air quality impacts, particularly with respect to sensitive receptors likely to be significantly impacted by cumulative air quality impacts in the local area.

9.1 Existing Environment

The existing environment in the Upper Hunter Valley was summarised and an analysis was carried out in terms of the local climate, inter-annual climate variability, local meteorology, terrain and land use, identification of sensitive land uses and receptors, air pollutants emitted by other industrial sources and the existing air quality based on observations at MacGen's monitoring locations for the period 1994 to 2009.

In regard to the local meteorology and plume dispersion from the existing Bayswater and Liddell Power Stations, and the proposed Bayswater B Power Station, the following conclusions were drawn:

- The predominant ground-level wind flows in the region tend to follow the valley directional axis and flow up-valley from the southeast and down-valley from the northwest. There is a greater frequency of south-easterly winds during the summer and a greater frequency of north-westerly winds during the winter. Flows during the spring and autumn months are more even distributed between these directions.
- Wind speeds (at ten metres above the ground) in the valley, based on observations at Ravensworth and Liddell, tend to be less than five metres per second for almost 90% of the time, and less than two metres per second for between 39-48% of the time.
- Wind speeds at the elevated area on Mount Arthur are, on average, significantly greater than wind speeds lower down the valley.
- The wind fields in the region suggest the areas that are likely to experience the highest ground-level concentrations of air pollutants are to the northwest and southeast of the proposed Bayswater B Power Station and existing power stations.

- The study of the inter-annual variability of wind fileds found that the wind speed and wind direction does not vary significantly from year to year or between monitoring sites. This indicates that other meteorological variables such as the exchanges of surface energy fluxes, boundary layer development or the formation of nocturnal jets are more important to the dispersion of pollutants in the Upper Hunter Valley.

In regard to inter-annual climatic variability, the following conclusions were drawn:

- There was little variation found in the annual mean temperature during the period 1994 – 2009 based on observations at the BoM monitoring station at Cessnock. During this time, annual mean temperatures ranged between 16.3 oC and 17 oC. No significant positive or negative trend was found to suggest a warming or cooling of the local climate in this period.
- There was some variation found in relative humidity in the region, with the period after 2003 tending to be drier than the period before 2003. The drying of the climate in the period 2006 – 2008 coincides with the peak drought years.
- There was some variation found in the daily mean rainfall during the period 1994 – 2009, with the mean ranging between 0.7 - 1.5 millimetres. The periods between 1994 to 1998 and 2002 to 2007 were relatively dry, while the periods between 1996 to 1997, 1998 to 2002 and 2007 to 2009 were relatively wet.

In regard to the existing air quality in the region, the following conclusions were drawn:

- Considering the presence of heavy industry, mining, agricultural and other activities in the Upper Hunter Valley between Singleton and Muswellbrook, the air quality in the region is relatively good when compared to DECC impact assessment criteria.
- For NO2 during the period 1994 – 2009, there have been a small number of exceedances of the 1-hour average criterion, with five exceedances at Singleton in 2005 and one exceedance at Muswellbrook in 2001 while there have been no exceedances of the annual average. The exceedances at Singleton may be partly attributable to the location of the monitor near a major roadway.
- For SO2 during the period 1994 – 2009, there have been several exceedances of the short-term 10-minute and 1-hour average criteria. However, there has only been one exceedance of the 24-hour average and no exceedances of the annual average criteria. Many of the exceedances for the 10-minute and 1-hour average criteria were related to the spontaneous combustion of coal and spoil heaps associated with coal mining activities near the Mt Arthur monitoring station. They were unrelated to plume dispersion associated with MacGen operations.
- For PM10 during the period 1994 – 2009, there have been several exceedances of the 24-hour average criterion, based on observations at the Ravensworth monitoring station. However, this site is significantly influenced by its proximity to local coal mines and coal handling facilities. The elevated dust concentrations are unlikely to be the result of plume impacts. This conclusion is supported by the very low maximum 24-hour average PM10 impact predicted for the proposed Bayswater B project in isolation.

- For HF during the period March 2004 – February 2008, observations of monthly average ground-level concentrations at Ravensworth and Mitchell Line Road indicate the 30-day average criterion of 0.4 µg/m3 for specialised land use (such as grape vine cultivation) was exceeded once in September 2006. This observation is for total fluoride (gaseous fluoride as HF and particulate fluoride) with a breakdown of 0.34 µg/m3 and 0.18 µg/m3 for the gaseous and particulate components, respectively. It is important to note that the gaseous component (HF) is significantly more reactive than the particulate component, with the gaseous HF concentration below the criterion.

9.2 Sensitive Receptors

Sensitive receptors identified for this assessment are shown on **Figure 9.1**. They were selected on the basis of being private residential, non-commercial/non-industrial premises within a ten kilometre radius of the Bayswater B Coal-Fired Power Station stack. Also included were receptors at locations further than 10km where there are currently ambient air quality monitoring stations.

9.3 Potential Impacts

9.3.1 Gas Fired Power Station

Construction

The primary potential impact from construction would be dust generated from a variety of possible sources including:

- Open excavations (for the power station footprint as well as the gas pipeline);
- Stockpiles (soils and raw materials);
- Internal unsealed access tracks and construction haul roads;
- Concrete batching plant;
- Bulk earthworks and soil handling.

The gas fired option is predicted at this stage to be constructed over nearly 3 years. This is subject to detailed design and construction logistics however, particularly with respect to construction staging an activity staging.

Operation

In regard to air quality assessment of the proposed Bayswater B Gas-fired Power Station, the air quality impact assessment has found that the proposed power station would cause a relatively minor impact on ambient air quality. The most important air pollutant is nitrogen dioxide. Ground-level concentrations of nitrogen dioxide can be managed and minimised with the proposed use of low emissions technology. The specific outcomes of the assessment are detailed below for each air pollutant:

For nitrogen dioxide:

- The predicted maximum 1-hour average for Bayswater B with background at all sensitive receptor locations is below 202 µg/m3 for all modelled years. The impact assessment criterion is 246 µg/m3.
- The predicted maximum annual average for Bayswater B with background at all sensitive receptor locations is 22 µg/m3 for all modelled years. The impact assessment criterion is 62 µg/m3.

For carbon monoxide:

- The maximum 15-minute, 1-hour and 8-hour averages for Bayswater B in isolation are predicted to be well below the impact assessment criterion of 100,000 µg/m3, 30,000 µg/m3 and 10,000 µg/m3, respectively.

For PM_{10}:

- The predicted maximum 24-hour and annual averages for Bayswater B in isolation are a very small proportion of the background levels of these pollutants and of the criterion.
- Impacts associated with the emission of fine particles from the Bayswater B gas-fired plant option, in conjunction with Bayswater and Liddell Power Stations, are not likely to significantly contribute to the ground-level concentrations of fine particles in the region. They comprise a small proportion of the background dust levels.

For individual air toxics:

- There are no predicted exceedances of the impact assessment criterion for any air toxics at any sensitive receptor location for all modelled periods. Predicted maximums (99.9th percentiles) are all well below the criterion.

9.3.2 Coal Fired Power Station

Construction

As with the gas fired option, the key potential impact would be dust from construction related activities as noted in **Section 9.2.1** above. The potential dust sources for the coal fired option would be the same with the exception of open excavation areas for the pipeline.

The coal fired option is predicted to be constructed over 5 years.

Operation

In regard to air quality impacts associated with emissions from the proposed Bayswater B Coal-fired Power Station, the air quality impact assessment has found that the proposed power station would cause a relatively minor change to ambient air quality. The most important air pollutant is sulfur dioxide. Ground-level concentrations of sulfur dioxide can be managed and minimised with the use of low sulfur coal. The specific outcomes of the assessment are detailed below for each air pollutant:

For sulfur dioxide:

- Based on the stochastic modelling of the distribution of coal sulfur content, one additional exceedance of the impact assessment criterion of 570 µg/m3 is predicted due to the operation of the proposed Bayswater B Power Station. The additional exceedance is predicted for the 2007-2008 modelled period, which was selected as an atypical year for wind speed and direction.
- The predicted maximum 24-hour average for Bayswater B with background at all sensitive receptor locations is below 200 µg/m3. The impact assessment criterion is 228 µg/m3.
- The predicted annual average for Bayswater B with background at all sensitive receptor locations is below 25 µg/m3. The impact assessment criterion is 60 µg/m3.

The dispersion modelling assessment of sulfur dioxide concluded that the development of Bayswater B would be likely to produce one additional exceedance of the 1-hour impact assessment criterion. This should be viewed within the context of the exceedances currently recorded at the ambient air quality monitoring stations at Lake Liddell, Mount Arthur, Ravensworth, Muswellbrook and Mitchell Line. At some or all these locations, several exceedances of the 1-hour air quality objective were recorded in all years since 1994. This is outlined in Section 7.6.3 of the Katestone Air Quality Assessment in **Appendix D** of this EA.

This additional exceedance occurs in one of the three modelled years. That year being a non-normal year. No additional exceedances were predicted in the other years.

For nitrogen dioxide:

- The predicted maximum 1-hour average for Bayswater B with background at all sensitive receptor locations is below 202 µg/m3 for all modelled years. The impact assessment criterion is 246 µg/m3.
- The predicted maximum annual average for Bayswater B with background at all sensitive receptor locations is 22 µg/m3 for all modelled years. The impact assessment criterion is 62 µg/m3.

For carbon monoxide:

- The maximum 15-minute, 1-hour and 8-hour averages for Bayswater B in isolation are predicted to be well below the impact assessment criterion of 100,000 µg/m3, 30,000 µg/m3 and10,000 µg/m3, respectively.

For hydrogen fluoride:

- The results indicate that the impact assessment criterion for specialised vegetation for the 24-hour average is exceeded at all sensitive receptor locations, while the general land use criterion is only exceeded at receptors R7, R8 and R9. However, the only receptor location with a specialised vegetative land use is the Arrowfield Winery, where the predicted maximum 24-hour average is 2.88 µg/m3, which is 191% of the criterion.
- There are no predicted exceedances of the 7-day average impact assessment criterion for specialised vegetation of 0.8 µg/m3 at any sensitive receptor locations for all modelled years.
- An exceedance of the short-term 24-hour average criterion of HF is unlikely to significantly affect the cultivation of grapevines due to the rate of plant growth. The most reliable indicator of the potential for adverse impact of HF on specialised vegetation is the longer 30-day and 90-day averages, which provide for the assessment of air quality in relation to the growing season. It is more likely an adverse affect would be sustained in vegetation if HF levels are elevated throughout the growth cycle, primarily between November and grapevine harvest time in February.
- There are no predicted exceedances of the 30-day average impact assessment criterion for general land use of 0.84 µg/m3 at any sensitive receptor locations for all modelled years. While the 30-day average impact assessment criterion for specialised vegetation of 0.4 µg/m3 is predicted to be exceeded at Mount Arthur North, R4, R5, R6, R7, Liddell and Ravensworth, no specialised vegetation such as viticulture has been identified there. Consequently, the applicable criterion is for the general land use. At the only receptor location with a specialised vegetative land use, the Arrowfield Winery, the predicted maximum 30-day average is 0.31 µg/m3.

- There are no predicted exceedances of the 90-day average impact assessment criterion for general land use of 0.5 µg/m3 at any sensitive receptor locations for all modelled years. While the 90-day average impact assessment criterion for specialised vegetation of 0.25 µg/m3 is predicted to be exceeded at Mitchell Line Road, Mount Arthur North, R4, and Ravensworth, no specialised vegetation such as viticulture has been identified there. Consequently, the applicable criterion is for the general land use. At the only receptor location with a specialised vegetative land use, the Arrowfield Winery, the predicted maximum 90-day average is 0.24 µg/m3.

The predictions have been made assuming that HF emissions from the Bayswater B Coal-Fired Power Station would occur at a rate equivalent to the regulation limit of 50 mg/Nm3. Measurements from Bayswater and Liddell Power Stations show emissions of HF to be less than half the regulation limit. Consequently, predicted levels are believed to be an over-estimate of ground-level concentrations that would occur in reality.

For PM_{10}:

- The predicted maximum 24-hour and annual averages for Bayswater B in isolation are a very small proportion of the background levels of these pollutants and of the criterion.
- Impacts associated with the emission of fine particles from the Bayswater B coal-fired option in conjunction with Bayswater and Liddell Power Stations are not likely to significantly contribute to the ground-level concentrations of fine particles in the region. They comprise a small proportion of the background dust levels.

For individual air toxics:

- There are no predicted exceedances of the impact assessment criterion for any air toxics at any sensitive receptor location for all modelled periods. Predicted maximums (99.9th percentiles) are all well below the criterion.

For metals and metalloids:

- There are no predicted exceedances of the impact assessment criterion for any metals and metalloids at any sensitive receptor location for all modelled periods. Predicted maximums (99.9th percentiles) are all well below the criterion.

9.4 Management and Mitigation

9.4.1 Construction

The Air Quality assessment would be reviewed and updated on the basis of the detailed design and construction logistics reports to ensure appropriate consideration of potential impacts in relation to the construction period, construction area (ie gas pipeline location and construction laydown area) and construction staging. This is particularly important of the concrete batching plant to demonstrate appropriate management and mitigation for the plant once its location is confirmed and the length of time for which it would be present at the site.

An Air Quality Management Plan (AQMP) would be prepared as part of the Construction Environmental Management Plan (CEMP) that would include (but not be limited to) such measures as:

- Control of access via sealed roadways
- Vehicle speed limits on site

- Monitoring of wind speed and direction to manage dust-generating activities during undesirable conditions
- Contingency measures in the event of adverse weather conditions
- Minimisation of areas of disturbed soils during construction
- Dust suppression with water sprays or other media during windy periods (as required)
- Stockpiling of soils on site to be kept to a minimum
- Excavation with limited soil free fall
- Management procedures governing the concrete batching plant, including transport and storage of materials and materials handling (including controlled loading to avoid dust plumes)
- Construction equipment idling time minimisation and appropriate engine tuning and servicing to minimise exhaust emissions
- Procedures to address complaints received
- Development of contingency measures.

9.4.2 Operation

While the systems of the proposed power station include design measures to reduce or avoid potential air quality impacts, there are several key areas of interest in the ongoing management of potential effects during operation that require particular management attention, if the coal fired option is chosen. These are, management of dust from the stockpiled coal area, the maintenance of filter bags to avoid particulate exceedances, and the management of the disposed ash. An Air Quality Management Plan (AQMP) would be prepared as part of the Operation Environmental Management Plan (OEMP) that would address these areas of interest if applicable, as well as detailing an Air Quality Monitoring Program.

Stockpiled/Processed Coal Fugitive Dust Management

The proposed Bayswater B Coal-Fired Power Station stack is situated approximately 600 metres from the western boundary of the site. The coal stockpiles have been proposed to be located in the area to the west of the plant stack. The area to the west of the boundary is largely occupied by other coal mining operations and forested land.

Trees would provide a windbreak and reduce wind speeds, thereby minimising the transport of dust in that direction. In addition to this, the nearest sensitive receptor to the coal stockpile is Arrowfield Winery, approximately eight kilometres to the southwest of Bayswater B. Winds from the northeast that are likely to transport dust in this direction are relatively infrequent in comparison to the annual wind flows and tend to be quite light at less than 3 m/s. Consequently, it is very unlikely that dust emissions generated at the Bayswater B coal stockpiles could be transported the significant distance to the nearest sensitive receptor to cause a nuisance to amenity. Receptor R7 is also close to the existing MacGen power generation complex and dust emissions generated by activities at Liddell and Bayswater Power Stations do not provide a nuisance at that location.

The application of appropriate management and dust suppression techniques would manage dust emissions from the coal stockpiles including:

- Application of a dust suppression veneer to raw material stockpiles
- Minimisation of drop heights for raw materials
- Application of water sprays on haul roads and stockpile pads
- Wind guards on raw material transfer systems and conveyors

Filter Bag Management Regimes and Replacement Cycles

Past experience has shown that new fabric filter bag material types that have been trialed but have not to lived up to manufacturer's claims and failed prematurely. When this occurs on individual bags it results in a momentary decline in bag filter performance. However, a coal fired power station such as Bayswater typically has 50,000 filter bags per unit. If bags fail prematurely on a regular basis the result is a consistent decline in filter bag performance.

Traditionally power stations changed out all bag filters on a particular unit on a four yearly basis during Unit outages. However, recently, Bayswater Power Station has moved from 4 yearly change-out of filter bags during Unit outages to progressive changeout of bags while Units are in service. This management model was developed to ensure consistent performance of bag filters over time as opposed to the gradual decline in bag filter performance that was inevitable with the 4 year change out management model.

In September 2007, Bayswater Power Station developed an electronic system for tracking bag failure rates, the Progressive Bag Failure Status database. This system assists the monitoring of changes in individual filter bag cell performance and assists power station management anticipate the need to changeout whole cells rather than individual bags.

Further, Bayswater Power Station has increased fourfold the quantity of independent testing for particulate emission testing in order to validate in a shorter time frame any potential improvement/deterioration in bag filter performance with particular emphasis on PM 10 levels. The results of these additional tests are analysed to monitor improvement and develop strategies to address any deterioration in fabric filter performance.

The Bayswater B Power Station would use the same or similar technique for the monitoring and management of the filter bags since the existing Bayswater experience illustrates that it is practical and successful process. As such, while the particulate emission rates from the filter bags remains at the level which is guaranteed by the vendor, the management process in place would ensure an optimisation of the performance of the fabric filter plant. Potential improvement in fabric filter bag technology would also be monitored and implemented as appropriate.

Management of Ash Disposal

An Operational Environmental Management Plan (OEMP) would be prepared to ensure that potential impacts during the operation of the facility are minimised. This includes an Ash Disposal Plan if coal fired technology becomes the preferred option. As noted previously, ash would be generated at a rate of approximately 1.69 million tonnes per year, of which approximately 20% would be bottom ash and the remainder fly ash.

The likely method for the disposal of fly ash would be use as fill material for rehabilitation of local open cut mines that have completed operation. It should be noted that some of the ash may be sold for use in concrete production or other beneficial uses (refer **Chapter 22**) however this is likely to be a very low proportion of the ash generated due to the remote location from major construction areas and cement manufacturing facilities. As such, disposal is more likely and disposal to a mine void (progressively utilising and rehabilitating an open cut mine area) is the preferred disposal option.

The final location of the ash disposal point is currently unknown and would depend on local mine operations and subsequently landowner negotiations. Notwithstanding, the potential management of ash is well understood, being already undertaken as part of the existing Bayswater and Liddell operations.

As an example, the following details methods by which ash from the existing Bayswater Power Station is disposed of in the Ravensworth Mine void. For Bayswater, the mine rehabilitation method is currently being used, whereby fly ash material is transported to Ravensworth Mine to rehabilitate the completed mining voids. The ash disposal process for the existing Bayswater Power Station has some key differences to that which may be used for Bayswater B. However, it provides a useful illustration of how ash disposal can be managed to minimise dust impacts to air quality. A summary of the key processes of ash management are outlined below to provide an illustration of the likely dust management measures for Bayswater B.

A key difference in fly ash management for Bayswater B as opposed to the existing Bayswater power station is that the latter uses wet slurry pumping (approximately 30% water) whereas the proposed Bayswater B power station would employ ash conditioning (approximately 15% water). As such, only the applicable measures from Bayswater-Ravensworth have been detailed below. The likely method for the disposal of fly ash at Bayswater B would include:

- Conveying fly ash to a silo or holding tank
- Conditioning the ash with water to control dust during transport (15% water)
- Conveying the conditioned ash to the mine void for rehabilitation.

For the Bayswater B project, the fly ash would only be conditioned with water to minimise dust during transport to the mine void in a semi-enclosed conveyor. This method of transport uses less water (as opposed to a wet slurry process) which reduces the potential for ash contaminated water reaching groundwater. Conditioned ash can also be placed at a higher angle of repose than can a slurry.

For Bayswater B, bottom ash from the submerged chain conveyor would be dewatered before being transported by covered truck on a private haul road to the disposal point.

Potential dust impacts from Bayswater B ash disposal would be minimised through the transport of bottom ash material in covered trucks, and fly ash in semi-enclosed conveyors with washing facilities. In addition, restrictions to traffic and access to disposal sites and minimal reworking of ash upon deposition in the mine void would assist in managing dust.

To minimise the potential impacts of ash material drying and becoming windborne, the process of placing ash in the mine void would be undertaken in a cyclic manner with fresh deposits of moist material overlying the previous deposition. The mine void would be progressively filled with ash one section at a time in layers, followed by spreading of a soil layer over the ash surface when finished with each section. This would reduce the potential for ash drying and wind spreading. This is the process by which the ash disposal is undertaken at the current Ravensworth mine void and a similar process may be adopted at the Bayswater B disposal point. Water spraying for dust suppression may also be needed during adverse weather conditions.

A monitoring program would be implemented for Bayswater B ash disposal activities to ensure that dust levels are managed within agreed limits. Monitoring may include High Volume Samplers, dust deposition gauges and regular visual observations.

Upon completion of ash disposal or completion of infilling a particular section of a mine void, management measures would be implemented to reduce the potential for post rehabilitation impacts associated with the ash material. These may include capping with Virgin Excavated Natural Material and revegetation of exposed soils.

The Proponent would gain all the appropriate approvals from the relevant authorities for the deposition of ash into the void, including agreement on environmental management measures such as dust mitigation. This would be undertaken in consultation with the owner of the final disposal point as well as the regulatory agencies.

An Ash Disposal Plan would be prepared which would confirm disposal methods and management measures to ensure that any dust emissions from ash are avoided, reduced or managed on an ongoing basis. This would be prepared on the basis of the detailed design, once the technology has been chosen and the location of the ash disposal has been identified and confirmed.

Air Quality Monitoring Program

Overall the existing MacGen ambient air quality monitoring network provides good coverage of the key air pollutants that are likely to be emitted from the proposed Bayswater B Power Station. Monitoring stations are generally located in a line running from the southeast to northwest, reflecting the location of major townships and the predominant valley wind flows. Improved spatial coverage could be achieved by the addition of monitoring station to measure SO_2, NO_X and HF to the southwest to be representative of the Arrowfield Winery and nearby residences around Jerrys Plains.

For a coal fired power station, the Proponent would monitor at commissioning and continuously thereafter for sulphur dioxide and oxides of nitrogen and opacity.

For other pollutants (including solid particles, hydrogen fluoride and acid gases) the Proponent would monitor on commissioning and then quarterly thereafter.

For a gas-fired power station, the Proponent would monitor on commissioning and continuously thereafter for oxides of nitrogen.

The OEMP would include an Air Quality Monitoring Program. This would be prepared in consultation with DECCW once the preferred technology is confirmed.

The Ash Disposal Plan would include (as noted above) a monitoring plan for dust (should coal fired technology be the preferred technology).

9.5 Residual Impacts

As shown above, the modelling has shown that the majority of criteria would be met under both coal and gas fired options. The residual effects would be managed, mitigated and monitored to ensure that any residual effects are minimal.

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AECOM

AIR QUALITY RECEPTOR LOCATIONS

Environmental Assessment

Bayswater B Power Station

Figure 9.1

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10.0 Greenhouse Gas Emissions

This Chapter provides details of the greenhouse gas emissions for the project and addresses the requirements of the Director-General's Environmental Assessment Requirements as follows:

Greenhouse Gases *– the Environmental Assessment must include a comprehensive greenhouse gas assessment undertaken in accordance with the methodology specified in the National Greenhouse Accounts (NGA) Factors (Department of Climate Change, November 2008) including:*

- *Quantification of emissions (in tonnes of carbon dioxide equivalent) in accordance with the Greenhouse Gas Protocol: Corporate Standard (World Council for Sustainable Business Development & World Resources Institute), including direct emissions (Scope 1), indirect emissions from electricity (Scope 2) and any significant up or down stream emissions (Scope 3) considering all stages of the project (construction, operation and decommissioning)*
- *Comparison of predicted emissions intensity and thermal efficiency against best achievable practice and current NSW averages for the activity, and of predicted emissions against total annual national emissions (expressed as a percentage of total national greenhouse gases production per year over the life of the project).*
- *Evaluation of the availability and feasibility of measures to reduce and or offset the greenhouse emissions of the project including options for carbon capture and storage. Where current available mitigation technology is not technically or economically feasible, the Environmental Assessment must demonstrate that the proposal will use best available technology, including carbon capture readiness, and identify options for triggers that would require staged implementation of emerging mitigation technologies.*
- *Evaluation of the project in the light of carbon emission prices of $10, $25 and $50 per tonne under the proposed Commonwealth Carbon Pollution Reduction Scheme, both with and without proposed mitigation measures.*

10.1 Introduction

Greenhouse gases (GHG) are a natural part of the atmosphere. They absorb and re-radiate the sun's warmth and maintain the Earth's temperature. As defined in the *National Greenhouse and Energy Reporting Act* 2007, GHGs include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulphur hexafluoride (SF_6), hydrofluorocarbons and perfluorocarbons. GHG emissions are the release of GHGs into the atmosphere, and occur as a result of:

- Burning fossil fuels, such as coal, oil or gas
- Using energy generated by burning fossil fuels
- Some aspects of farming, such as raising cattle and sheep, using fertilisers and growing certain crops
- Clearing of vegetation
- Breakdown of food and plant wastes and sewerage
- Some industrial processes, such as production of cement and aluminium.

The GHG emissions relevant to the proposed Bayswater B Project are primarily CO_2, CH_4 and N_2O.

10.1.1 Methodology

Consultation has occurred with the NSW Department of Environment, Climate Change and Water (DECCW) to clarify the intent of the EARs and determine which emissions quantification and benchmarking methodologies are most appropriate to use for the proposed project, in terms of being standard practice in NSW and/or Australia as applicable. DECCW has confirmed that the *National Greenhouse and Energy Reporting System* (NGERs) *Technical Guidelines* (Australian Department of Climate Change (DCC), 2009) are appropriate to use for emissions quantification, as these are based on the National Greenhouse Accounts (NGA) Factors (DCC, 2009). MacGen's data collection framework developed to meet NGERs requirements for the existing Bayswater and Liddell Power Stations has been used to calculate the predicted emissions from the proposed Bayswater B Project.

The anticipated Scope 1, 2 and 3 emissions for Bayswater B (as described in **Section 10.2**) have been quantified using the NGERs methodology. Total GHG emissions within each Scope have been calculated by summing the emissions of each relevant greenhouse gas (CO_2, CH_4 and N_2O) to generate a CO_2 equivalent (CO_2-e) figure.

Scope 1 emissions from electricity generation have been calculated using NGER Method 2 , which involves sampling and analysing the fuel likely to be combusted at the facility in order to determine the specific emissions factor of that fuel source. Scope 2 and 3 emissions (as well as Scope 1 transport emissions) have been calculated using Method 1, which is derived directly from the NGA Factors methodology and uses designated national average emissions factors to estimate emissions. In both methods, GHG emissions have been calculated using the anticipated quantity of fuel combusted, along with the energy content and emissions factor of the fuel type.

Benchmarks can assist in identifying and assessing methods of reducing emissions as low as reasonably practicable utilising technological options. The Scope 1 emissions calculated for the proposed Project using NGERs methodology have been compared against total annual national emissions as derived from the National Greenhouse Gas Inventory (NGGI). Using the NSW Greenhouse Gas Reduction Scheme (GGAS) reporting structure, Scope 1 emissions for the Project have also been benchmarked against emission intensity from other NSW power stations, so that the relative significance can be assessed and understood. DECCW has confirmed that GGAS is the standard, accepted and most transparent benchmarking method available for NSW. GGAS sets benchmarks against which industry performance is monitored by the Independent Pricing and Regulatory Tribunal of NSW (IPART) in its role as Compliance Regulator.

10.2 Quantification of Emissions

10.2.1 Scope 1 – Direct Emissions

In accordance with the NGERs and NGA Factors, Scope 1 includes direct or point-source emissions controlled by the company. During operation of Bayswater B, Scope 1 emissions would primarily be those from the on-site stationary combustion of gas or coal for electricity generation (as well as from fuel oil used during start-up of coal fired boilers). Method 2 from the NGERs Guidelines has been used to estimate CO_2–e emissions from electricity generation. This is a higher order method involving sampling and analysing the fuels actually combusted at the facility.

Scope 1 emissions for Bayswater B would also include transport emissions from vehicles owned, operated or controlled by the Proponent. It is expected that most vehicles used during both construction and operations would be either contractors' or private vehicles (Scope 3, see **Section 10.2.3**). Scope 1 transport emissions for both construction and operations are based an estimated 10 company-owned vehicles for the coal fired option or 7 company-owned vehicles for the gas fired option (as it would be a smaller site with less plant). During construction these vehicles would be those used by supervisors overseeing construction, whereas company-owned vehicles during operations would be miscellaneous site vehicles used for site patrols and maintenance activities. All Scope 1 transport emissions are based on petrol vehicles each travelling 500km per week, and have been calculated using Method 1. No other Scope 1 emissions are anticipated for the Project. Refer to **Table 10-1**.

Table 10-1: Annual Scope 1 Emissions

Activity	GHG Emissions (t CO_2-e p.a.)	
	Coal fired Option	Gas fired Option
Combustion of fuel during operations	12,147,000	5,771,000
Transport emissions from Proponent-owned or operated vehicles: construction	60	40
Transport emissions from Proponent-owned or operated vehicles: operations	60	40

10.2.2 Scope 2 – Indirect Emissions from Purchased Electricity

Scope 2 accounts for indirect emissions from the generation of electricity that is purchased and consumed by the organisation. As discussed in **Chapter 5 Project Description**, Bayswater B would use electricity on-site to power motors in items such as coal conveyors, boiler fans, air compressors and water treatment, as well as for lighting and battery back-up systems.

As Bayswater B would operate as a base load generator, the electricity used on the Bayswater B site would most likely be entirely derived from that generated on site, as opposed to being purchased from another generator. Therefore Scope 2 is not generally a relevant category for the Project. Emissions associated with auxiliary energy demands are included with those from generation of electricity and have already been accounted for as direct emissions (Scope 1). If Bayswater B were to utilise power from the grid (in the event of all generating units being out of service), this is estimated to be no more than 100 MWh per year at a maximum, for either the coal or gas fired option. Maximum Scope 2 emissions have been calculated using Method 1, based on the NGERs emission factor provided for NSW and ACT. Refer to **Table 10-2**.

Table 10-2: Scope 2 Annual Maximum Emissions from Purchased Electricity

Activity	GHG Emissions (t CO_2-e p.a.)
Emissions from purchased electricity (maximum): coal or gas fired option	89

10.2.3 Scope 3 – Indirect Emissions from Other Sources

Scope 3 includes all other indirect emissions, including those that are a consequence of the activities of the Proponent, but occur from sources not owned or controlled by them. The *Greenhouse Gas Protocol: Corporate Standard* (World Council for Sustainable Business Development & World Resources Institute, 2004) suggests that it is valuable to focus on significant or relevant GHG-generating activities, for example if they are large relative to the company's Scope 1 emissions.

In accordance with the EARs for this EA, only 'significant' Scope 3 up or downstream emissions would be included in the Total Anticipated Emissions for the Project. For the purposes of this EA, the definition of 'significant' used is as per the *EPBC Act Policy Statement 1.2 – Significant Impact Guidelines* (DEH, 2006), whereby a 'significant' item is one which is "important, notable, or of consequence" and depends upon the magnitude (relative size or importance) of the item. Based upon this definition, potentially relevant Scope 3 emissions items have been calculated and ranked in order of magnitude. Those of a higher rank that are of consequence when compared with the remainder of the group have been considered significant indirect emissions items.

Scope 3 emissions items have been calculated using Method 1, incorporating estimates of expected activity level. Refer to **Tables 10-3** and **10-4**. Scope 3 includes emissions from:

- Extraction and production of other purchased materials or goods, such as major construction materials (e.g. steel and concrete). Smaller quantities of such materials are estimated to be required for the gas fired option, as it would be a physically smaller power station.
- Road transport related activities during construction and operation, involving private / contractor or other non-Proponent-owned vehicles, which may include:
  - Employees commuting to and from work
  - Road transport of purchased materials or goods (including transporting ash from the existing Bayswater Power Station to the Project site for re-use as road base during construction)
  - Road transport of waste generated from operations (for the operational stage of the coal fired option, this includes truck haulage of bottom ash to a disposal site)
- Fugitive emissions from extraction or production of fuel (coal or gas), prior to transport and use at the proposed Power Station
- Transport of coal via train or gas via pipeline, prior to use at the proposed Power Station

Table 10-3: Scope 3 Emissions during Construction Phase (Total Period)

Activity	GHG Emissions - Total Construction Period [1] (t CO_2-e)	
	Coal fired Option	Gas fired Option
Emissions related to manufacture of steel for construction	472,000	176,000
Emissions related to concrete batching plant for construction	151,000	59,600
Transport emissions from non-Proponent-owned vehicles during construction	89,800	51,000
TOTAL	**712,800**	**286,600**

1. Note that construction phase emissions are not able to be annualised, as they relate to events within the construction program rather that time periods. These total period estimates apply regardless of the construction phase timeframe.

Table 10-4: Scope 3 Emissions during Operations Phase (Per Annum)

Activity	GHG Emissions Per Annum (t CO_2-e p.a.)	
	Coal fired Option	Gas fired Option
Fugitive emissions from fuel extraction (coal or gas)	281,200	147,600
Emissions from transporting fuel to site (coal via trains or gas via pipeline)	13,200	6,100
Transport emissions from non-Proponent-owned vehicles during operations	5,400	1,100
TOTAL	**299,800**	**154,800**

10.2.4 Total Anticipated Emissions

A comparison of the individual GHG emissions figures calculated for the proposed Bayswater B Project indicates that the most significant emissions are the Scope 1 emissions from combustion of fuel (coal or gas) during the operations phase. All other operations phase emissions items have been compared against these figures to assess for significance or relevance. Those items that equate to 2% or more of the associated Scope 1 fuel combustion emissions figure (coal fired or gas fired) have been included in the Total Emissions for that option.

Based upon this, within the Scope 3 operations phase emissions for both the coal and gas fired options, the only significant item is fugitive emissions from fuel extraction. The remaining Scope 3 operations phase items are considered insignificant based on their relative magnitude; with the next largest item (emissions from transporting fuel to site) equating to only 0.01% of Scope 1 fuel combustion emissions. Scope 2 emissions from purchased electricity and Scope 1 transport emissions are far smaller numbers than this and hence are also considered insignificant.

Therefore, the significant emissions items for the operations phase of the proposed Bayswater B Project are Scope 1 direct emissions from fuel combustion and Scope 3 fugitive emissions resulting from fuel extraction. Refer to **Table 10-5**.

Scope 3 total construction phase emissions cannot be compared to Scope 1 emissions that occur during the operations phase, as they relate to a separate project phase and are not able to be annualised. As such, construction phase emissions have been reported separately. Refer to **Table 10-6**.

Table 10-5: Summary of Total Annual Emissions during Operations Phase

Activity	GHG Emissions (t CO_2-e p.a.)	
	Coal fired Option	Gas fired Option
Scope 1 – Direct emissions - fuel combustion (coal or gas)	12,147,000	5,771,000
Scope 3 – Indirect emissions - fugitive emissions from fuel extraction (coal or gas)	281,200	147,600
TOTAL	**12,428,200**	**5,918,600**

Table 10-6: Summary of Total Emissions during Construction Phase (Total Period)

Activity	GHG Emissions (t CO_2-e)	
	Coal fired Option	Gas fired Option
Scope 3 – Indirect emissions – manufacture of steel, concrete batching plant and non-Proponent-owned vehicles	712,800	286,600
TOTAL	**712,800**	**286,600**

10.3 Benchmarking

10.3.1 Current NSW Averages

This section compares the GHG emissions intensities predicted for the Bayswater B coal and gas fired options against the NSW 2009 average using the GGAS methodology. For comparison, GGAS emissions intensities are also provided for the existing Bayswater and Liddell Power Stations. Refer to **Table 10-7**. These figures include relevant CO_2 equivalent (CO_2-e) items, namely CO_2, CH_4 and N_2O; and also take into account fuel oil used for boiler start-up in the coal fired option, as well as fugitive emissions from fuel extraction. Comparison of emissions intensity along with thermal efficiency against best achievable practice is discussed in **Section 10.3.3**.

Table 10-7: Emissions Intensity Benchmarking of Bayswater B against NSW Average

GGAS Emissions Intensity Item	GHG Emissions Intensity (t CO_2-e/MWh)
NSW Pool Co-efficient (2009)	0.967
Liddell Power Station (2008, sent out)	0.981
Bayswater Power Station (2008, sent out)	0.960
Bayswater B Coal Fired Option	0.840
Bayswater B Gas Fired Option	0.398

10.3.2 Annual National Emissions

As per the EARs, benchmarking of the proposed Project against National figures compares predicted Project emissions (as calculated using NGERs) as a percentage of Total Annual National Emissions. According to DCCW, in 2007 Australia's Annual National Emissions were 541,200,000 t CO_2-e p.a. (*NGA: National Greenhouse Gas Inventory: accounting for the KYOTO target May 2009*) and the annual emissions growth rate between the September quarter 1998 and the March quarter 2009 was 1.6% (*NGA: Quarterly Update of Australia's National Greenhouse Gas Inventory: March Quarter 2009*).

It is assumed that the National emissions growth rate of 1.6% is a worst case scenario, as this rate should reduce with the introduction of a Carbon Pollution Reduction Scheme (CPRS) and with other emissions reduction measures and technologies. Therefore it is assumed that it is appropriate to utilise 1.6% as a standard National emissions growth rate in comparison against the base case calculations for Bayswater B, which do not incorporate emissions reductions from CPRS or CCS, etc.

It is possible that construction of Bayswater B could commence in 2011 and that operations could commence by 2015. With a theoretical lifespan of 30 years, the Power Station could cease operations at the end of 2044. Based upon the DCC data and assumptions above, it has been extrapolated that annual national emissions could be approximately 614,480,000 t CO_2-e p.a. in 2015 and 973,700,000 t CO_2-e p.a. in 2044. These national emissions estimates have been used in **Table 10-8** in comparison against predicted annual emissions from the Project during operations (from fuel extraction and combustion). It is not possible to compare Project construction emissions to annual National emissions as the construction emissions figures are not able to be annualised.

Table 10-8: Comparison of Bayswater B Predicted Operations Emissions against Total National Emissions

Predicted Emissions Item	GHG Emissions (t CO_2-e p.a.)	% of National Emissions p.a.
Total Annual National Emissions 2015 (Start of Operations)	*614,480,000*	*100%*
Operations Period - Bayswater B coal fired option	12,428,200	2.02%
Operations Period - Bayswater B gas fired option	5,918,600	0.96%
Total Annual National Emissions 2044 (End of Operations)	*973,700,000*	*100%*
Operations Period - Bayswater B coal fired option	12,428,200	1.28%
Operations Period - Bayswater B gas fired option	5,918,600	0.61%

10.3.3 Thermal Efficiency, Emissions Intensity and Best Achievable Technology

A fossil fuel fired power plant converts heat produced from the combustion of a fuel (chemical energy) into mechanical and then electrical energy. The process of energy conversion is governed by the laws of thermodynamics and to a lesser extent by mechanical and electrical efficiency losses. With over 100 years of development and refinement, the mechanical and electrical losses have essentially been minimised. Further maximisation of energy conversion is constrained within the laws of thermodynamics, including the relationship between heat and work.

In order to maximise energy conversion, improve thermal efficiency and reduce emissions intensity, every effort has to be made to maximise the temperature at which work is done and minimise the temperature at which work ceases to be done in the power plant cycle. Work is done by steam for coal fired plant and hot gas and steam for gas fired plant to produce mechanical energy. It is important to note that the relationship between heat and work for steam (coal fired) or gas and steam (gas fired) is non linear and hence benefits attained are not proportional.

For the Bayswater B coal fired option, steam conditions at the inlet of the steam turbine would maximise steam cycle temperatures; that is main steam of 600°C and a reheat temperature of 620°C. These maximum temperatures are limited by plant metallurgy and represent the current state-of-the-art steam conditions. Work ceases at the exhaust of the steam turbine.

For the Bayswater B gas fired option, CCGT would comprise gas turbines along with steam turbines. Gas turbines use hot gas and have a maximum cycle temperature of between 1300 and 1400°C, as governed by the ability of internal air cooling of the gas turbine components. The gas turbine exhaust, at around 590°C has significant heat energy which is recovered by a combined cycle steam plant, which has a steam turbine inlet temperature of around 540°C. Work ceases at the exhaust of the CCGT steam turbine. As the maximum working cycle temperature is significantly higher for the gas fired plant than for the coal fired plant, the gas fired plant can achieve higher thermal efficiency and lower emissions intensity.

For both the gas fired and coal fired options, the minimum temperature at which work ceases to be done is dictated by the exhaust conditions of the respective steam turbines. For Bayswater B, work by the steam turbine would cease to be done typically at 50°C, which is dictated by the prevailing ambient dry bulb temperature and the effectiveness of the proposed dry cooling system.

The thermal efficiency of Bayswater B with dry cooling would be about 39.5% for the coal fired option and around 50.0% for the gas fired option on a sent out basis. Thermal efficiency on a sent out basis is electrical energy from the plant (after electrical energy used in works has been accounted for) divided by the higher heating value fuel input.

Best achievable practice

The thermal efficiency of power stations is dictated largely by the temperature range within which work is done and energy is generated. Comparison of thermal efficiency and emissions intensity against best achievable practice is best demonstrated by a diagram of the thermodynamic cycle, which shows the relationship between heat and work. Refer to **Figure 10-1** for a simplified version of a thermodynamic cycle known as the Carnot cycle, as it relates to a coal fired power station. This illustrates the contributions made by USC technology, wet cooling and latitude (as they relate to temperature) towards increasing thermal efficiency and reducing emissions intensity of a coal fired power station, due to the greater range within which work is done.

Table 10-9 compares the predicted thermal efficiency and CO_2 emissions intensity (not CO_2-e) for the dry cooled Bayswater B coal fired and gas fired options against theoretical wet cooled USC power stations in the Upper Hunter and in Northern Europe, and against the existing coal-fired (sub critical technology) Bayswater and Liddell Power Stations. Note that the CO_2-e emissions intensity figures calculated for Bayswater B using GGAS in **Section 10.3.1** are different to those used in **Table 10-9** and **Figure 10-1** because the former includes CO_2, CH_4 and N_2O emissions, as well as accounting for fuel oil used for boiler start-up and fugitive emissions from fuel extraction, whereas the latter includes only CO_2 emissions from fuel combustion.

Table 10-9: Thermal Efficiency and Emissions Intensity Comparison

Power Station Location, Technology and Cooling Regime	Emissions Intensity from Fuel Combustion (t CO_2/MWh)	Thermal Efficiency of Power Station (sent out)
Upper Hunter Region, coal fired sub critical technology, wet cooled (Liddell, 2008)	0.946	33.2%
Upper Hunter Region, coal fired sub critical technology, wet cooled (Bayswater, 2008)	0.912	35.4%
Upper Hunter Region, coal fired USC, dry cooled (Bayswater B coal fired option)	0.817	39.5%
Upper Hunter Region, coal fired USC, wet cooled	0.791	41.0%
Northern Europe, coal fired USC, wet cooled	0.750	43.0%
Upper Hunter Region, gas fired CCGT, dry cooled (Bayswater B gas fired option)	0.364	50.0%

World's best practice for a coal fired power station would achieve a thermal efficiency on a sent out basis of 43.0% or higher using USC technology with direct water cooling, if using water at temperatures of less than 10°C (for example from the North Sea). For Bayswater B to achieve best practice, wet cooling would have to be deployed in order to reduce the minimum temperature at which work is done, and therefore increase the temperature range within which energy is generated. However, even with wet cooling, the best achievable thermal efficiency would be about 41.0% due to the ambient temperature conditions in the Upper Hunter region. To clarify this, power stations in coastal locations in Northern Europe can achieve higher thermal efficiency and lower emissions intensity due to lower ambient temperatures. A power station using identical technology in the Hunter Region would not achieve the same thermal efficiency and emissions intensity.

In comparison to the proposed coal fired option for Bayswater B Power Station, the existing Bayswater and Liddell power stations in the Upper Hunter utilise sub critical steam conditions, where the maximum temperature is approximately 540°C. As such there is a smaller temperature range within which energy is generated and hence thermal efficiency at these power stations is lower, at 33.2 – 35.4% (although both utilise wet cooling providing some performance improvement over dry cooling).

Best practice for CCGT plant would use H class plant and cold water direct cooling. In place of air cooling of the gas turbine internal components, H class machines use steam as well as operating with higher cycle (firing) temperatures compared to other classes. World's best practice for a gas fired power station also requires low air and cooling water temperatures that are available at high latitudes. As the prevailing ambient temperature at the Bayswater B site is warm temperate and dry cooling is proposed, the efficiency benefits of H class technology would be marginal.

Concept approval is sought for dry cooling of the proposed Bayswater B Power Station. The wet cooling alternative, as discussed in **Chapter 3 Alternatives**, does not form part of the project for which Concept approval is being sought.

10.4 Emissions Reduction and Offsetting

A number of technologies are currently available or under development for the control of emissions from power stations. The application of these technologies depends on considerations including technical feasibility, commercial viability and regulatory requirements. The following emissions control and associated technology options have been considered for Bayswater B Power Station:

- Wet cooling – to reduce CO_2 emissions
- Selective Catalytic Reduction (SCR) – to reduce NO_X emissions
- Selective Non Catalytic Reduction (SNCR) – to reduce NO_X emissions
- Dry low NO_X systems – to reduce NO_X emissions from the gas fired option
- Flue Gas Desulphurisation (FGD) – to reduce sulphur oxides (SO_X) emissions from the coal fired option
- Theoretical high efficiency thermal design – to reduce CO_2 emissions from the coal fired option
- Carbon Capture and Storage (CCS) – to reduce CO_2 emissions

10.4.1 Current Emissions Reduction Options

The following section describes the currently available technologies for emissions reduction and details the likely emissions reduction results and costs/benefits, as well as feasibility of each option.

Wet Cooling

Wet cooling involves the indirect cooling and condensing of exhaust steam from the low pressure steam turbines using surface condensers (tubed heat exchangers) to transfer heat to cooling water, which is pumped from a wet mechanical draught cooling tower. The heated water is returned to the cooling tower, which dissipates the heat to atmosphere before recirculating the cooling water again.

Wet cooling can achieve reduced emission in comparison with dry cooling because:

1. Wet cooling primarily transfers heat by evaporation, which depends on wet bulb temperature, compared with dry cooled systems that are convection cooled, which depends on dry bulb temperatures. Wet bulb temperatures are normally lower than dry bulb temperatures
2. Evaporation is a very effective heat transfer mechanism allowing a typical wet cooling system to be smaller but achieve better cooling than an equivalent dry cooled system.

As a result of the above factors, typical exhaust conditions from the steam turbine with a wet cooling tower system at Bayswater B would be cooler than the dry cooled (ACC) base case. This superior cooling would result in improved thermal efficiency, reduced CO_2 emissions and lower emissions intensity.

The main drawbacks of wet cooling systems are the requirement for additional raw water (for Bayswater B this would be some 22 GL p.a. for coal fired, or 11 GL p.a. for gas fired) and the treatment and disposal/storage of cooling tower wastewater.

In terms of the economic feasibility and cost/benefit of emissions reduction using wet cooling, implementing this technology at Bayswater B would actually result in a cost saving over dry cooling per tonne of CO_2 reduction. For coal fired plant this would be a saving of approximately $1300 per tonne of CO_2 reduction, while for gas fired it would be around $230 per tonne of CO_2 reduction; refer to **Table 10-10**.

Table 10-10: Summary of Wet Cooling

Item	Coal fired Option	Gas fired Option
Steam turbine exhaust conditions	Reduced by 7°C	Reduced by 10°C
Thermal efficiency	Increased from 39.5% to 41.0%	Increased from 50.0% to 50.7%
CO_2 Emissions	Reduced by ~39,000 t p.a.	Reduced by ~70,000 t p.a.
CO_2 Emissions intensity	Reduced from 0.817 to 0.791 tCO_2/MWh	Reduced from 0.364 to 0.359 tCO_2/MWh
Cost saving	~$1,300 / t CO_2 reduction	~$230 / t CO_2 reduction

Wet cooling is normally used for inland power stations where water is available; however this option is not presently available for Bayswater B based on current allocations of water.

Selective Catalytic Reduction (SCR)

SCR systems utilise ammonia vapour in the presence of a catalyst material to convert the nitrogen oxides (NO_X) into nitrogen and water. The ammonia is injected into the flue gas stream upstream of the SCR catalyst, where the flue gas temperature is between 300°C and 400°C; the optimum temperature for SCR removal rates of 80% to 90%. Due to the large duct size, an ammonia inject grid is located sufficiently upstream to ensure optimum mixing across the catalyst cross-section. For the coal fired option, the SCR system would be installed at the outlet of the economiser, while in the CCGT system it would be installed within the HRSG.

The efficiency of SCR process reactions allows high utilisation and effective ammonia injection-control based on feedback, of measured NO_X concentrations in the flue gas. This allows ammonia slip (unreacted ammonia emissions) to be minimised with typical values of 2 to 10 ppm.

The catalysts can have different compositions: based on titanium oxide, zeolite, iron oxide or activated carbon. Most catalysts in use in coal-fired plants consist of vanadium (active catalyst) and titanium (used to disperse and support the vanadium) mixture. Catalyst geometry is typically a flat plate or honeycomb, although other options are available. The performance of catalyst material declines over time with service life depending on operating conditions, but typically up to five years. To maintain design removal rates, additional catalyst material is progressively installed as initial catalyst material degrades and is then replaced. An ongoing programme of catalyst management is required to maintain NO_X removal performance.

SCR technology has been used commercially in Japan since 1980 and in Germany since 1986 on power stations and are used commercially worldwide to comply with stringent limits to regulate NO_X emissions.

For the Bayswater B Project, it is assumed that a SCR system would remove around 80% of NO_X emissions. For the coal fired option, annual NO_X emissions with SCR would be approximately 0.330 kg NO_X/MWh compared to 1.672 kg NO_X/MWh for base case (7% O_2, dry). For the gas fired option, annual NO_X emissions with SCR would be approximately 0.057 kg NO_X/MWh compared to 0.282 kg NO_X/MWh for base case (15% O_2, dry).

Apart from the increased capital and operating cost of the SCR system, there would be an additional pressure drop across the catalyst, as well as a small increase in boiler draught plant auxiliary energy (for the coal fired option) or a small decrease in gas turbine output (for the gas fired option). The cost/benefit of emissions reduction using SCR at Bayswater B would be a cost compared to base case, per tonne of NO_X reduction. For coal fired this would be a cost of approximately $4,000 per tonne of NO_X reduction, while for gas fired it would be around $11,900 per tonne of NO_X reduction. Refer to **Table 10-11**. SCR does not form part of the current Bayswater B Project.

Table 10-11: Summary of SCR

Item	Coal Fired Option	Gas Fired Option
NO_X Emissions intensity	Reduced from 1.672 to 0.330 kgNO_X/MWh	Reduced from 0.282 to 0.057 kgNO_X/MWh
Cost	$4,000 / t NO_X reduction	$11,900 / t NO_X reduction

Selective Non Catalytic Reduction (SNCR) – Coal Fired Option

SNCR involves the injection of ammonia into the flue gas to react with the NO_X to produce nitrogen and water. The reaction relies on the flue gas and ammonia mix remaining in the optimum temperature range of 900°C and 1,100°C. In a coal fired USC system, these temperatures typically occur at the outlet of the furnace or beginning of the convective pass, which makes effective injection and mixing of the ammonia difficult. Temperatures also vary with load and so multiple injection locations may be needed. In a gas fired system, the optimum temperature range typically occurs within the combustion zone, where high temperature variability and short retention times tend to limit NO_X removal effectiveness. As a result SNCR systems are not widely used for gas turbine applications and have not been considered for the gas fired option.

With SNCR, there is no reduction in NO_2, which can comprise up to 5% of total NO_X, while undesirable reactions can result in increased NO and N_2O emissions. Due to the less effective utilisation of the inject ammonia and no effective feedback for control, ammonia slip (untreated ammonia emissions) of 10 to 50 ppm is typical.

SNCR technologies came into commercial use on oil- or gas-fired power plants in Japan in the middle of the 1970s but are now used worldwide for coal fired plants, particularly in retrofit applications. While removal rates up to 80% can be achieved in ideal conditions, SNCR removal rates tend to be lower for larger plants. For the Bayswater B coal fired option, it is assumed that a SNCR system would remove around 40% of NO_X. Annual NO_X emissions with SNCR would be approximately 0.995 kg NO_X/MWh compared to 1.672 kg NO_X/MWh for base case (7% O_2, dry).

The cost/benefit of emissions reduction using SNCR for the Bayswater B coal fired option would be a cost compared to base case of approximately $4,400 per tonne of NO_X reduction. Refer to **Table 10-12**. SNCR does not form part of the current Bayswater B Project.

Table 10-12: Summary of SNCR for Coal Fired Option

Item	Results
NO_X Emissions intensity	Reduced from 1.672 to 0.995 kg SO_X/MWh
Cost	$4,400 / t of NO_X reduction

Dry Low NO_X Systems – Gas Fired Option

Dry low NO_X systems utilise lean combustion of pre-mixed air and fuel in multiple nozzles to limit temperatures in the primary combustion zone and staged admission of combustion air. Gas turbine dry low NO_X systems have been developed by the different manufacturers to achieve guarantee NO_X emissions of 25 ppm (15% O_2).

Dry low NO_X combustion systems are included as standard equipment on F Class gas turbines, which have been selected for the Bayswater B gas fired option. As such the emissions calculations for the gas fired option incorporate the reduced NO_X emissions due to this technology.

Flue Gas Desulphurisation (FGD) – Coal Fired Option

Flue Gas Desulphurisation (FGD) has been investigated for Bayswater B, incorporating the use of electrostatic precipitators (ESP) and limestone-gypsum wet FGD.

In the coal fired option, using pulverised fuel would result in the production of fine fly ash, which would be transported with the flue gases through the boiler. After the air heaters and before the induced draught fans, the fly ash would be removed from the gas stream by either fabric filter dust collecting plant (as proposed for the Bayswater B base case) or by ESP. The use here of ESP in conjunction with a wet FGD plant would achieve the high overall dust removal rates required but have the advantage of a smaller dust collecting plant and lower pressure drop through the flue gas system (compared to fabric filters).

An ESP would comprise a large collector chamber containing sets of charged electrodes. As the flue gas moves through the collector chamber the entrained fly ash particulates would first be negatively charged by the discharge electrodes and then attracted to the positively charged or grounded collecting electrodes, which are usually in the form of parallel plates. Periodically the collecting electrodes/plates would be rapped (vibrated) to loosen the fly ash, which falls into hoppers for collection and disposal by the fly ash handling plant.

An FGD plant would be designed to remove approximately 95% of the SO_2 in the flue gas. In the coal fired option, this would be located downstream of the dust collecting plant. A booster fan would take flue gas from the dust collection plant to a gas-to-gas heat exchanger where it would be cooled. The flue gas would then be delivered to the absorber and be “scrubbed” by the recirculating process fluid and the SO_2 removed.

At the top (outlet) of the absorber, the flue gas would pass through demisters to remove suspended water droplets. After leaving the absorber, the scrubbed flue gas would pass through the “cleaned” side of the gas-to-gas heat exchanger where the gas temperature would be raised to around 100ºC before being passed back to the induced draught fans and discharged to atmosphere through the stack. The ductwork between the dust collection plant and the induced draught fans would normally be configured to include a bypass duct.

The limestone slurry used in the desulphurisation process would be prepared from limestone delivered to site in bulk form and stored on site. A limestone ball mill on site would produce limestone powder after which it would be delivered to a mixing tank to be converted to slurry. This limestone slurry would be pumped to the sump of the absorber. The process fluid would then be recirculated from the absorber sump to the spray headers at the top of the absorber vessel. As the process fluid falls down, it would contact the rising flue gas. SO_2 would be dissolved in the water, neutralised (by reaction with the limestone), and thus removed from the flue gas. The limestone reaction would ultimately form gypsum. Although a certain amount of oxidation would occur naturally due to excess air in the flue gas, the sump fluid would be sparged with air to ensure complete oxidation to gypsum.

The resulting absorber sump fluid comprising gypsum with a small amount of limestone would be extracted, thickened by means of a hydro-cyclone, washed and dewatered using vacuum belt filters and stored on site for subsequent disposal. While opportunities for sale of gypsum would be explored, at this stage it is assumed the gypsum would be disposed with the ash. The use of ESP for dust collection does result in high ash in the gypsum from the FGD plant. This may impact potential alternative uses of the gypsum.

Significant evaporation of the process fluid occurs due to the elevated temperature of the incoming flue gases and so make-up water must be added. In addition various soluble salts and contaminants would be absorbed from the flue gas and would enter the process as impurities in the limestone and make-up water. These contaminants would be concentrated by the evaporation of water from the slurry. To control this accumulation, a purge stream is taken off as the overflow from the hydro-cyclone and further make-up water is added (diluting the contaminants). A wastewater treatment plant (clarifier and filter) produces a sludge which is also delivered to the ash plant for disposal. The treated water is returned as make-up to the absorber sump.

Various successful scrubber designs are available and would be suitable for Bayswater B. For the coal fired option, assuming that a FGD system would remove around 95% of SO_X, annual SO_X emissions with FGD would be approximately 0.232 kg SO_X/MWh compared to 3.905 kg SO_X/MWh for base case.

The cost/benefit of installing a FGD plant for the Bayswater B coal fired option indicates the cost compared to base case is approximately $3,700 per tonne of SO_X reduction. This cost includes the high additional capital cost, the use of limestone and additional auxiliary power and water as well as increased operating and maintenance costs. As a result, the FGD plant is costly relative to the small reduction in ground level concentrations of SO_X.

While FGD would reduce SO_X emissions, a drawback is that utilisation of approximately 100,000 t p.a. of limestone in the FGD plant would increase CO_2 emissions by around 38,000 t CO_2 p.a. due to the reaction of the limestone with SO_X to form gypsum. Coupled with the increase in auxiliary power, overall emissions intensity of the USC plant with FGD would be 0.826 t CO_2/MWh, compared to the base case of 0.817 t CO_2/MWh. Refer to **Table 10-13**. FGD does not form part of the current Bayswater B Project.

Table 10-13: Summary of FGD for Coal Fired Option

Item	Results
SO_X Emissions intensity	Reduced from 3.905 to 0.232 kg SO_X/MWh
CO_2 Emissions intensity	Increased from 0.817 to 0.826 t CO_2/MWh
Cost	$3,700 / t of SO_X reduction

Theoretical High Efficiency Thermal Design – Coal Fired Option

Various plant configurations have been investigated to improve the overall plant efficiency (and therefore thermal efficiency) of the coal fired option. These include additional stages of regenerative feedwater heaters to improve steam cycle efficiency, larger ACC to reduce steam turbine exhaust conditions and lower boiler exit temperatures to improve boiler efficiency. While these enhancements are technically available, the thermal efficiency improvement is relatively small compared to the additional capital costs involved. Annual sent out thermal efficiency improvements of up to 1% (to 40.2%) and CO_2 emissions intensity reduction from 0.817 to 0.796 t CO_2/MWh could be achieved, however the indicative cost/benefit of this option would be $120 per tonne of CO_2 reduction. As such this option is not considered commercially viable for attaining a small improvement in thermal efficiency. Refer to **Table 10-14**.

Table 10-14: Summary of Theoretical High Efficiency Thermal Design for Coal Fired Option

Item	Results
Thermal efficiency	Increased from 39.5% to 40.2%
CO_2 Emissions intensity	Reduced from 0.817 to 0.796 t CO_2/MWh
Cost	$120 / t of CO_2 reduction

10.4.2 Emissions Offsetting

There are a variety of potential opportunities to offset GHG emissions, either by investing in carbon offset projects or by directly augmenting with renewable energy. It should be noted that review of these options would need to be undertaken by the Proponent for the Project Application who would be the responsible party for the detailed design, construct and operation of the facility. This would be undertaken subsequent to the concept approval process.

Renewable energy augmentation

Solar thermal technology refers to the capture and utilisation of solar energy to produce steam for use in heat applications or electricity production. Similarly, wind energy can be used to generate electricity for use in on-site requirements. Either technology could potentially be used at a coal or gas power station to augment electricity supplies use on-site and thereby reduce emissions and fossil fuel requirements.

A small solar thermal power plant is established at the Liddell Power Station and was the first and only solar thermal power collector system for coal-fired power augmentation in New South Wales. There are several solar thermal electricity technologies competing in the world market, and plants are being built of all major types, including parabolic trough, paraboloidal dish, central receiver power towers and compact linear fresnel reflector technology (used at Liddell).

The solar plant at Liddell initially generated 1 MW equivalent of solar-generated steam and it has since been expanded to generate 9 MW. At the Bayswater B site, solar augmentation is unlikely to be technically feasible due to the largely shadowed location. Similarly, wind augmentation is unlikely to be technically feasible at the site as there is an insufficient wind resource. In addition, these technologies are costly in comparison to the scale and the ability to meaningfully offset large scale emissions, that is, in comparison to the Power Station capacity of 2000 MW.

Renewable energy augmentation does not form part of the current Bayswater B Project.

Carbon offset projects

Other carbon offset or GHG offset investment opportunities include bio-sequestration projects, methane projects, off-site renewable energy projects and energy efficiency projects that are available in the currently growing carbon credit market:

- Bio-sequestration is the process of capturing and storing CO_2 in plants or other living organisms via the natural process of photosynthesis, thereby reducing CO_2 in the atmosphere. The most common example of a bio-sequestration project for carbon offsetting is forestry. This may involve establishment of a plantation or reforestation of a site with native forest. Preferably, a bio-sequestration project should be in accordance with offset standards such as those under the NSW GGAS.
- Methane is a GHG which is emitted from sources such as landfills and coal mines. Methane projects involve capturing methane from such sources and preventing it from entering the atmosphere, either by flaring the gas or burning it to generate energy.
- Other carbon offset opportunities include investment in off-site renewable energy projects such as full-scale wind farms or solar energy plants, or investment in energy efficiency projects such as industrial process upgrades.

These would all be options for the Proponent to assess in future, however they would need to be balanced with commercial considerations and the potential for a formal CPRS which may be introduced in the near future.

10.4.3 Carbon Capture and Storage (CCS)

CCS is an emissions reduction approach based on capturing and permanently storing CO_2 from sources such as coal or gas power stations instead of discharging it to the atmosphere. There are various technologies currently under development for the capture of CO_2 emissions from power stations as well as various storage options. All of these technologies are currently in their infancy and require further development before large-scale implementation is feasible.

There are also significant costs associated with emissions reduction using CCS. These include the capital and operating costs for the carbon capture plant, additional energy requirements of the process (the amount of which is dependent on the technology implemented) and the cost of CO_2 transport to a storage location. These costs would increase the cost of energy from the power plant. Considerations for the Proponent include what percent of carbon capture is economically and technically feasible.

Carbon Capture Technologies

Several technologies are currently in development for carbon capture; these include post-combustion carbon capture (PCCC), pre-combustion carbon capture and oxy-fuel combustion.

Pre-combustion carbon capture

Pre-combustion carbon capture involves removing the carbon from the fuel source prior to combustion of the remaining hydrogen-rich fuel. In this process, the fuel is first partially oxidized (for example, coal may be reacted with oxygen in a gasifier), resulting in a gas fuel comprising carbon monoxide (CO) and hydrogen (H_2). This mixture is then converted into CO_2 and H_2. The CO_2 can then be captured before the remaining H_2 is used as fuel in a CCGT plant. One form of pre-combustion carbon capture is Integrated Gasification Combined Cycle (IGCC) technology. The main disadvantage of this technology is that it is unsuitable for retrofitting and has high cost.

Oxy-fuel combustion

In oxy-fuel combustion, coal or gas is burned in pure oxygen instead of air. This results in flue gas exhaust that is almost entirely CO_2, along with water vapour which is removed by cooling and condensation. All of the flue gas (approximately 90% CO_2) is then compressed and transported to a storage site. As such, this technique can potentially capture 100% of the CO_2 generated. A drawback of oxy-fuel combustion is that separating air from oxygen requires a large amount of energy. In addition, the technology is not suitable for retrofitting to the much larger boilers designed for air combustion, as these are sized for the 78% of nitrogen and other inert gases that are components of air. This technology is currently in the early development stages.

Post-combustion carbon capture (PCCC)

PCCC is the most promising method that might be used in the future at the proposed Bayswater B Power Station. With this technology, after combustion of coal or gas, the CO_2 is captured from flue gases. The technology is well understood and is currently used in other industrial applications, although not at the same scale as might be required in a commercial scale power station.

An assessment focusing on PCCC technology using monoethanolamine (MEA) absorbers has been undertaken to consider the impact and requirements of incorporating such a technology into the proposed Bayswater B Power Station (detailed impacts of a pipeline and storage site have not been included as part of this assessment; however general requirements of these are discussed below). It is currently considered that this PCCC technology option is one of the more likely to become feasible, however significant research and development of alternative technologies is currently underway and different options may become available in future.

A PCCC plant would include various process components including flue gas pre-conditioning (to cool the flue gas and remove particular contaminants such as SO_X), absorber vessels to bring the solvents that react with the CO_2 into contact with the flue gas, stripper vessels to recover the CO_2 from the solvents, which could then be returned to the absorber vessels, compressors to pressurise the CO_2 for transport by pipeline to storage location, various cooling and heating systems and numerous process pumps.

The assessment has considered the conceptual design of a Bayswater B PCCC plant with three levels of CO_2 removal: 20%, 50% and 90%. The anticipated emissions reduction results of the conceptual design PCCC plant are summarised in **Table 10-15**. The main system requirements and cost per tonne of CO_2 reduction for the PCCC plant are also included.

Table 10-15: Table 15: Estimated Impact of PCCC Plant at Bayswater B

Description	CO_2 Removal		
	20%	50%	90%
Proportion of Flue Gas Treated	22%	55%	100%
Removal Efficiency for Treated Flue Gas	90%	90%	90%
Coal Fired Option			
Approximate Emissions from Coal Combustion (CO_2 t pa)	9,717,600	6,073,500	1,214,700
Estimated Emission Intensity (t CO_2/MWh)	0.70	0.48	0.11
Additional Cooling [1] (MJ/s)	260	680	1,320
Additional Steam Heating (MJ/s)	150	400	770
Additional Auxiliary Energy [2] (MW)	80	150	250
Indicative Cost/Benefit [3] ($ / t CO_2 reduction)	$114	$75	$66
Gas Fired Option			
Approximate Emissions from Gas Combustion (CO_2 t pa)	4,616,800	2,885,500	577,100
Estimated Emission Intensity (t CO_2/MWh)	0.30	0.20	0.04
Additional Cooling [1] (MJ/s)	135	340	610
Additional Steam Heating (MJ/s)	135	350	620
Additional Auxiliary Energy [2] (MW)	30	75	130
Indicative Cost/Benefit [3] ($ / t CO_2 reduction)	$94	$70	$62

1 Additional cooling predominantly using fin-fan radiators although additional wet auxiliary cooling system may be needed to maintain required process temperatures.

2 Additional Auxiliary Energy includes auxiliary loads associated with carbon capture plant and changes to main plant equipment to accommodate additional demands (e.g. cooling system).

3 Indicative Cost/Benefit includes the anticipated cost of a carbon capture plant (estimated to increase the overall cost of the power station by 50%) but excludes pipeline and storage costs (estimated to increase the cost of the power station by another 5-10%, dependent upon distance of pipeline, nature of the storage site, storage requirements, etc).

While the assessment indicates that economies of scale are available by installing a large capacity PCCC plant, the current capital cost estimates are not economically feasible for the proposed Bayswater B Project. CCS technology would need to achieve significant capital cost reductions before full-scale application would be possible. The technology would also need to be proven in more than demonstration-scale installations and without government financial support.

The impact of a CPRS on electricity prices would impact upon the potential for CCS technology implementation.

Carbon Dioxide Transport

The price of CCS depends in part on the location of the carbon capture site in relation to the carbon storage site. If carbon capture were implemented at Bayswater B, large scale transport of CO_2 by pipeline would be required to transfer the captured gas to a storage site. Investigations into the cost of constructing a pipeline from the Hunter Region to the Darling Basin show that the cost of transporting CO_2 via pipeline over long distances is not prohibitive when large flows of CO_2 are assumed. However, a longer pipeline incurs higher construction costs and therefore a higher commercial risk for the project. At present there is no network of CO_2 pipelines in NSW nor is there currently an application before the regulators in NSW for such a pipeline network.

Carbon Storage Options

Storage of captured CO_2 is most likely to occur in deep geological formations. Geological storage or geosequestration of carbon involves injecting carbon dioxide directly into underground geological formations. A potential problem is that predictions about long term storage security are relatively unproven at this stage and CO_2 could potentially leak from the storage into the atmosphere. Ideally, various physical and geochemical trapping mechanisms would prevent the CO_2 from escaping the storage area. Geosequestration options that may be available for Bayswater B in the future include deep aquifers in the Darling Basin, deep coal seems in the Gunnedah and Hunter Regions, and depleted oil and gas reservoirs in the Cooper Basin. At present, geosequestration is not yet a proven and commercially available technology. However, it may be available in the future and may play a useful role in reducing emissions. Further investigation and pilot studies are required for all of the following options.

Deep aquifers

The Darling Basin in western NSW is one of the more promising potential sequestration sites in NSW due to good depth of aquifers as well as distance from population centres and competing land uses. Large high permeability areas under a sealing layer of low permeability strata are suitable for geosequestration. Additional work is required to determine the existence, extent and quality of storage sites. This area is some 700km west of the proposed Bayswater B Project site. The location of this area in relation to the proposed power station would have high piping and access costs. Carbon injection pilot studies would be required in the area to demonstrate the feasibility of injection and the integrity of storage, before implementation of carbon capture and transport could be considered at Bayswater B. The storage capacity and thus the injection lifespan of these sites also require further study.

Deep coal seams

Coal seams are known to have potential to contain CO_2 and hence it has been theorised that these could be used for geosequestration. However to date, minimal study has been done on this. Coal deposits used for geosequestration would have to be large to be capable of storing significant quantities of CO_2. The Hunter Region (within which the Bayswater B Project site is located) and Gunnedah (175 km north-north east of the Project site) are ranked as having the highest geosequestration potential among the coal seam sites in NSW due to their extensive areas of deep coal deposits. Gunnedah is ranked as having higher potential, due to fewer land use constraints and existing mining leases. Preliminary studies have shown that the Murrurundi Trough (some 50 km north of the Bayswater B site) is a possible coal seam geosequestration site option due to factors including its location, size (4,000 km^2) and less likelihood of land use conflicts. However, this and other coal seam sites would require further assessment of coal seam quality, pre-existing gas content, likelihood that CO_2 would remain trapped in the coal and not leak and seam permeability. Any land use conflicts are also a consideration; in particular, any future mining of the coal seams would conflict with the geosequestration use.

Depleted oil and gas reservoirs

Depleted oil and gas reservoirs in the Cooper Basin are another potential geosequestration option. As these are situated in north east South Australia and south west Queensland, over 1,000 km north west of the Bayswater B Project site, this may be a less feasible option due to transport considerations. However, existing petroleum extraction infrastructure and geological knowledge in this region may assist in implementing carbon injection at a lower cost.

10.4.4 Emissions Reduction Implementation

Carbon Capture Readiness

The proposed Bayswater B Power Station would be designed to be carbon capture ready. Carbon capture readiness includes the following:

- Provision of sufficient space to install carbon capture and compression plant – 4 ha has been included in the Bayswater B concept stage layout for this purpose
- Plant design including consideration for future retrofitting of PCCC plant – e.g. connection locations for flue gas ducting, auxiliary power, cooling water, steam, etc. Based upon the assessment of carbon capture technologies currently in development, it is expected that it would be technically feasible to retro-fit PCCC plant to the proposed Bayswater B Power Station. The specific technology and hence retro-fitting details are not able to be identified at this point in time, as technology selection depends upon further research and development as well as commercial considerations.
- Availability of suitable carbon storage sites – as discussed in **Section 1.4.3**, several storage site options have been identified as being potentially appropriate and available. Storage site selection would be undertaken by the Proponent at a later date based on further assessment of the site options, including storage integrity, commercial viability of CO_2 transportation to the location, site access agreements and relevant approvals.
- Availability of means of transporting CO_2 to the storage site – it has been identified that a pipeline is the most likely means of transport and that this would be a technically feasible option, subject to confirmation of a specific storage site and further commercial and regulatory assessments.

Triggers for Implementation of Emissions Reduction and Offsetting

A key aspect of the approach to GHG emissions management would be the implementation of a process to continually review the viability of technologies and opportunities, in order to appropriately plan for their eventual implementation at the proposed Bayswater B Power Station. While the assessment of PCCC technology has indicated that it is not currently economically feasible, the ongoing review process would incorporate potential trigger points for implementation of CCS. In addition, while at present renewable energy augmentation of the proposed power station appears unlikely to be feasible, the technologies available for this would be monitored along with other potential carbon offset investment opportunities.

The Proponent would undertake a review not less than every two years in order to monitor and keep abreast of opportunities, level of development, availability and feasibility regarding the following:

- Emissions reduction and carbon capture technologies available or in development
- Technologies and opportunities to transport and store captured CO_2
- Opportunities to invest in carbon offset projects.

The results of each review would be outlined in a report to be provided to DoP.

The review process would include assessment of what technologies are available at that point in time for carbon capture, transport and storage, with the following considerations:

1. Whether the technology has yet been technically proven and tested, in that there is an appropriate level of confidence that the plant is practically feasible, operable from an engineering perspective, and would deliver the desired outcomes.
2. Whether the technology is scalable and able to be retrofitted to the proposed Bayswater B Power Station.
3. The operational viability of each element of the technology in conjunction with other elements (i.e. carbon capture along with CO_2 transport and storage).
4. Whether all relevant environmental risks of the technology have been minimised (e.g. the potential for carbon leakage from storage sites).

Achievement of considerations one to four would be a trigger point for more detailed assessment of the available technology, including:

1. Whether the technology is commercially viable and has appropriate costs compared to benefits, including in relation to the presence or absence of a formal CPRS scheme if applicable and the broader financial implications for the Proponent.
2. Whether or not there are other significant constraints or opportunities related to CCS implementation.

When a review process successfully passes all six considerations, this would be a trigger point for the preparation of a detailed CCS implementation plan. The detailed implementation plan would be prepared in consultation with the relevant regulatory authority.

10.5 Carbon Pollution Reduction Scheme

The potential impacts of the proposed Commonwealth CPRS on the proposed Bayswater B Project have been calculated in consideration of potential carbon emission prices of $10, $25 and $50 per tonne of CO_2-e emissions. The cost burden of each potential price level has been considered for the coal fired and gas fired base case scenarios, as well as for CCS scenarios of 20%, 50% and 90% carbon capture. Refer to **Table 10-16**.

Table 10-16: Impacts of a CPRS on Bayswater B

Scenario	Potential Annual Cost of Carbon Emissions under a CPRS		
	$10 / t CO_2-e	$25 / t CO_2-e	$50 / t CO_2-e
Coal Fired Option			
Base case 12,900,200 t CO_2-e p.a.	$129,002,000	$322,505,000	$645,010,000
CCS 20% capture 10,320,160 t CO_2-e p.a.	$103,201,600	$258,004,000	$516,008,000
CCS 50% capture 6,450,100 t CO_2-e p.a.	$ 64,501,000	$161,252,500	$322,505,000
CCS 90% capture 1,290,020 t CO_2-e p.a.	$ 12,900,200	$ 32,250,500	$ 64,501,000

Scenario	Potential Annual Cost of Carbon Emissions under a CPRS		
	$10 / t CO_2-e	$25 / t CO_2-e	$50 / t CO_2-e
Gas Fired Option			
Base case 6,094,600 t CO_2-e p.a.	$ 60,946,000	$152,365,000	$304,730,000
CCS 20% capture 4,875,680 t CO_2-e p.a.	$ 48,756,800	$121,892,000	$243,784,000
CCS 50% capture 3,047,300 t CO_2-e p.a.	$ 30,473,000	$ 76,182,500	$152,365,000
CCS 90% capture 609,460 t CO_2-e p.a.	$ 6,094,600	$ 15,236,500	$ 30,473,000

Based on the assumption that the proposed Bayswater B Power Station would generate 15,000 GWh p.a. (15 million MWh p.a.), for the base case (without CCS) at each potential CPRS price level this would equate roughly to a per MWh cost of carbon of $8.60 / $21.50 / $43.00 per MWh for the coal fired option, or $4.00 / $10.15 / $20.30 per MWh for the gas fired option.

While there has been ongoing discussion of the proposed CPRS by the Federal Government and various authorities, at this point in time the following details of the scheme are unknown:

- The date at which a CPRS would be introduced
- Terms and conditions of the scheme
- Carbon price level/s (i.e. dollars per tonne of CO_2 emissions)
- Government policy regarding how the scheme would be implemented with regards to electricity generators.

10.6 Conclusion

The key GHG emissions from Bayswater B would be those from combustion of either coal or gas during operation of the proposed power station. Although the proposed project would have an improved emissions intensity compared to existing NSW fossil fuel power stations, in order to reduce GHG emissions the Proponent would ensure that Bayswater B would be capable of implementing CCS when this technology becomes feasible. An ongoing review process would keep abreast of CCS technologies and carbon offset opportunities, in order to implement either or both of these when appropriate.

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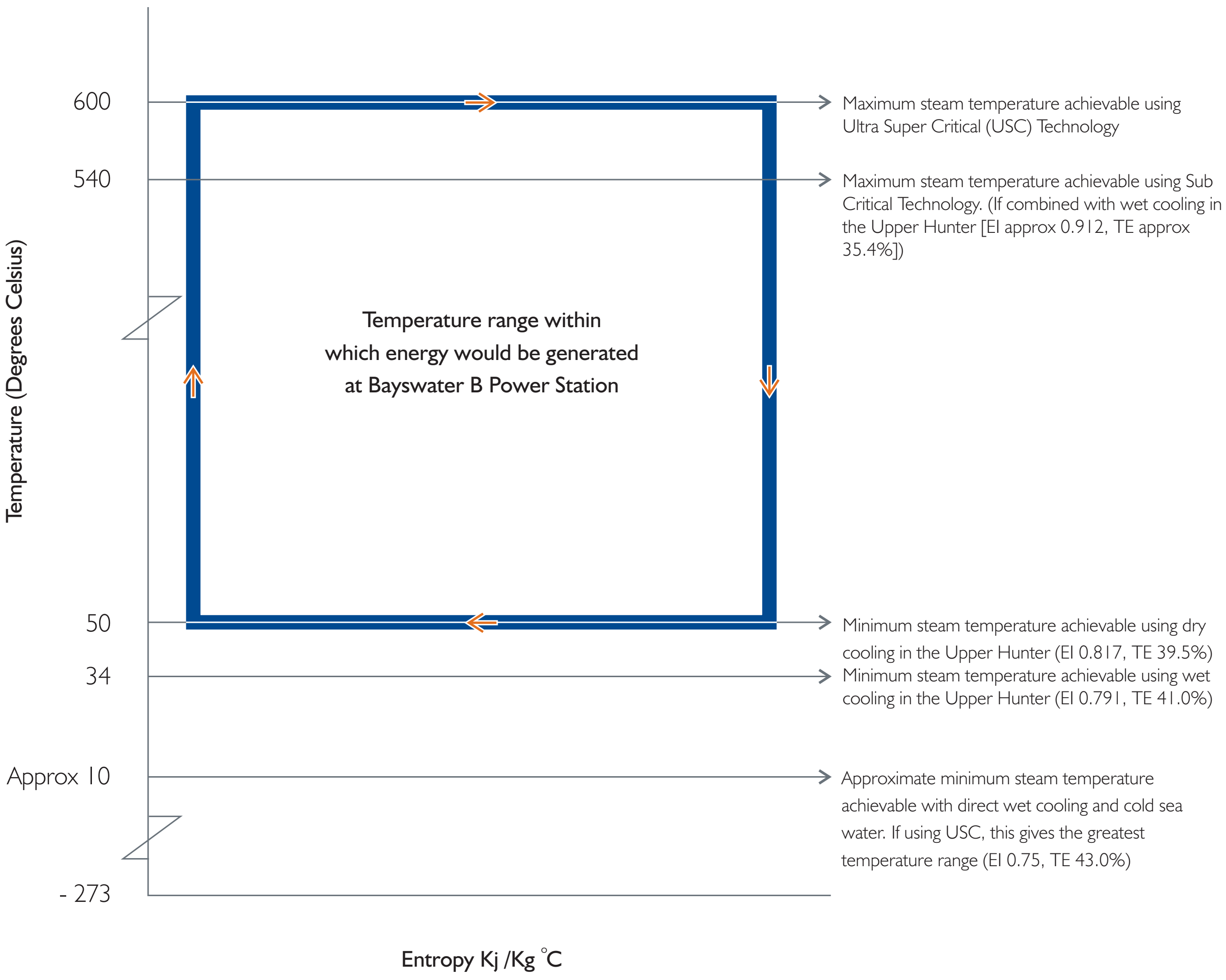

Note:
The greater the temperature range, the greater the thermal efficiency and
The lower the emissions intensity.

KEY	
EI	Greenhouse Gas Emissions Intensity (t CO2-e/MWh)
TE	Thermal Efficiency (%)
Entropy	State of heat in a cycle available to do work

AECOM

SIMPLIFIED DIAGRAM OF A THERMODYNAMIC CYCLE FOR A COAL FIRED POWER STATION

Environmental Assessment

Bayswater B Power Station

Figure 10.1

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11.0 Surface Water

This chapter outlines surface water and water quality management in accordance with the EARs which included:

***Water Cycle Management** – The EA must:*

- *Include a water balance for the project identifying indicative water use, wastewater generation and disposal requirements for the operation of the project;*
- *Demonstrate the availability of viable water sources to sustainably meet the water requirements of the project for the life of the project. Consideration shall be given to water reuse and recycling options (including use of treated effluent, rainwater, on site treatment and use of mine waste water), the security of supply, current and future water demand in the region and potential impacts on other users; and*
- *Reflect a design philosophy of zero water discharge from the site, except for natural surface water flows and provide an assessment of the likely risks to water quality associated with the project considering key ancillary components (such as ash disposal).*

11.1 Existing Environment

11.1.1 Regional Context

The Bayswater B project is located in the Hunter River basin, which covers an area of approximately 21,500km^2. The Hunter River is located to the south of the site as shown in **Figure 1-1**.

The main arm of the Hunter River starts north of Muswellbrook and flows south where it is joined by the Goulburn River and then flows eastwards to Newcastle. It covers a distance of some 467 kilometres and on average would discharge 1,800,000 megalitres (ML) of water to the ocean per annum (*Hunter-Central Rivers Catchment Management Trust, Undated*). Flows within the Hunter River are regulated by Glenbawn and Glennies Creek Dams, however the river is also still influenced by rainfall runoff from unregulated subcatchments. The Hunter River has a history of flooding and has also been known to cease to flow at times.

Downstream of the site, the Hunter River passes a number of urban settlements and water is extracted for a range of uses, including mining and agriculture. Between Maitland and Newcastle, the river is also used for a number of recreational activities and commercial fishing.

Lower tidal sections of the river near Newcastle include a number of significant wetlands, including the Hunter Estuary Wetlands (a Ramsar listed site) which comprises Kooragang Nature Reserve and Shortland Wetlands. Those areas are extremely important as both a feeding and roosting site for a large seasonal population of shorebirds and migratory species. There are also extensive areas throughout the estuary protected by *State Environmental Planning Policy No. 14 – Coastal Wetlands.*

Existing development in the Hunter catchment has resulted in the following impacts:

- Point source and diffuse pollution of waterways
- Changed patterns of vegetation cover caused by altered land use patterns and specific land management practices
- Flow manipulation through storage and consumptive use of the waters
- Altered flow behaviour and river morphology.

The Hunter River catchment includes a large proportion of salt bearing sedimentary rocks and soils, which contribute natural salinity to the river. However coal mining and power industries also generate saline water during their operations, and these activities have increased the level of salinity in the river.

11.1.2 Local Context

The proposed Bayswater B Project lies within the Saltwater Creek catchment. Saltwater Creek lies to the east of the Project Site and travels from north to south towards Plashett Dam. The footprint for the proposed power station gently slopes to the south east towards Saltwater Creek.

Plashett Dam is located on Saltwater Creek downstream of the Project Site. Saltwater Creek connects the spillway of Plashett Dam with the Hunter River immediately upstream of MacGen's pumping station on the Hunter River.

The Project Site is well elevated above Saltwater Creek and Plashett Dam which lies between the site and the Hunter River. Therefore, the site is not subject to inundation by either Hunter River or Saltwater Creek flooding.

The existing Bayswater and Liddell Power Stations receive virtually all raw water from pumps located on the Hunter River. Once pumped from the river, raw water is currently stored primarily in the Bayswater Cooling Water Dam, Lake Liddell and Plashett Dam for subsequent use.

11.1.3 Hydrology

The site is located within the temperate zone of NSW and therefore the climate is generally mild. Rainfall is seasonal with typically wet summers and low winter rainfall. Summers are relatively hot with mean daily maximum temperatures of approximately 31^{o}C during December – February.

Long-term rainfall statistics were obtained from the Bureau of Meteorology for the closest long-term weather station at Jerrys Plains Post Office, Site No. 061086 (Bureau of Meterology, 2009). This station has a period of record (for rainfall data) from 1884 until the present. Monthly statistics are summarised in **Table 11-1**.

Table 11-1: Climate Statistics (Rainfall and Evaporation) for Site 061086, Jerrys Plains Post Office

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual	No. of Years
Mean rainfall (mm)	76.9	72.5	59.1	44.7	40.4	47.5	43.6	36.7	41.7	52.2	59.9	67.6	**643.2**	123
Highest rainfall (mm)	226.3	340.4	264.3	172.2	314.3	288.4	231.6	206.9	156.1	170	222	233.1	**1191.2**	123
Lowest rainfall (mm)	0	0	0	0	0	2.3	0.3	0	0	1.4	1	0	**234.2**	123
Decile 1 monthly rainfall (mm)	24.1	9.2	10.2	4.9	5.7	9.4	8.4	7.3	9.1	10.3	12.7	15.6	**427.8**	123
Decile 5 (median) monthly rainfall (mm)	64.7	46.2	46	32.3	28.7	29.6	35.4	30.6	34	48	49.8	56	**644.2**	123
Decile 9 monthly rainfall (mm)	159.8	167	119	96.4	83.4	100	90.8	70.4	81.6	97.1	117.8	136.7	**829**	123

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual	No. of Years
Highest daily rainfall (mm)	97.3	139.7	132.1	86.6	99.1	190.8	137.2	65.3	67.3	68.6	82	108	**190.8**	123
Mean number of days of rain	7.8	7.4	7.4	6.4	6.5	7.5	7	7	6.7	7.5	7.7	7.6	**86.5**	123
Mean daily evaporation (mm)	7.1	6	5	4	2.9	2	2.3	2.6	3.7	5.3	6.5	6.6	**4.5**	10

Source: Bureau of Meterology, 2009

11.2 Water Management and Treatment Systems

This section outlines the personal water management systems on site including:

- Raw water supply and management
- Filtered water
- Domestic water
- Demineralised water
- Condensate Polishing and Regeneration Plant
- Auxiliary cooling systems
- Sewerage treatment
- Drain systems.

There are various options available within each sub-system for supplying the different water demands. The final requirements would depend on the main plant configuration, cost and reliability considerations, delivery methodology and would be determined at detailed design phase. The preferred option at this stage for each system is described below.

Figures produced by WorleyParsons (2009) showing the water cycle and mass balance for each of the coal and gas fired generation options are provided in **Figures 11.1**.

A summary and comparison of water balance volumes estimated for the gas and coal plant configurations respectively is provided in **Section 11.2.10**.

11.2.1 Raw Water

Existing Raw Water Systems

MacGen has existing water entitlements from the Hunter River and other upstream schemes. The Bayswater B Project site also receives some local catchment inflows.

Once pumped from the river, raw water is currently stored in Plashett Dam, the Bayswater Cooling Make-up Dam, the domestic dam or in Lake Liddell for subsequent use depending on operational requirements. The main role of Plashett Dam is to provide buffer storage between the river pumps and the power stations' demands, specifically:

- 50% of the make-up water required for Bayswater Power Station operations via the Bayswater Cooling Make-up Dam
- Domestic and service water (after lime softening)
- Water transfers to Lake Liddell (after lime softening).

Water from the Hunter River has a relatively high level of naturally occurring salinity. The type and concentration of salts have a tendency to form scale in the various heat exchangers associated with power generating plant and must be removed from the water systems at Bayswater and Liddell. Around 28,000 tonnes of salt is brought in with raw water makeup from the Hunter River each year, which if not removed, would concentrate in Lake Liddell.

Raw water from Plashett Dam or direct from the Hunter River is pumped to the Bayswater Cooling Make-up Dam, which has a capacity of some 360 ML and supplies make-up water to Bayswater's cooling towers and service water for the ash plant and wash down.

Raw water is also supplied to the Domestic Water Dam and Lake Liddell after lime softening treatment to reduce the concentration of naturally occurring calcium hardness and alkalinity. Up to around 6,000 tonnes of salt may be removed by the lime softening process each year. The Domestic Water Dam has a capacity of about 4 GL and supplies the Domestic Water Treatment Plant, the Demineralised Water Treatment Plant, fire water, service water, etc.

Lake Liddell has a capacity of about 150 GL and is used as a cooling pond for Liddell Power Station. The lake is subject to significant natural evaporation as well as evaporation due to the cooling pond duty, which results in the concentration of salts. Approximately 14,000 tonnes of salt is added with makeup to the lake each year, which must be removed to ensure the salinity concentration in the lake is controlled. The salinity level is controlled by limited releases to the Hunter River under the *Hunter River Salinity Trading Scheme* but primarily by transfer of water to Bayswater for use as cooling tower makeup and subsequent dilution, by transferring high quality raw water into Lake Liddell from Plashett Dam/Hunter River.

The Bayswater cooling tower make-up comprises about 50% raw water and 50% Lake Liddell water. This blend results in around 28,000 tonnes of salt being transported into Bayswater's cooling water system each year. The cooling towers evaporate the water leaving concentrated salts, which are removed by the water treatment plant (comprising clarification, alkalinity reduction, reverse osmosis, brine concentrators and crystalliser plants). Each of these plants progressively concentrates the salts for disposal in the brine dam and recover water for recycling in the cooling water and boiler feed water systems. The recently upgraded water treatment plant has sufficient capacity to remove the salt in the cooling water make-up plus some salts added to the cooling water in the treatment process. The plant can remove up to 32,000 tonnes of salt each year.

Existing Lime Softening Plant

The Hunter River contains significant amounts of calcium and magnesium bicarbonate alkalinity. Therefore, lime softening of the raw water is required to reduce the alkalinity for supplies other than that used for cooling tower make-up.

The current design flows for the existing Lime Softening Plant (LSP) at Bayswater Power Station are as follows:

- Normal operation 120 ML/d (1390 l/s)
- Maximum flow 160 ML/d (1900 l/s)
- Minimum flow 30 ML/d (350 l/s)

The treated water is pumped to the Bayswater Fresh Water Dam (4 GL) for domestic, demineralised water and service water purposes at Bayswater and Liddell Power Stations.

Proposed Bayswater B Project Raw Water Supply Options

Treated (softened) raw water would be required for service water at the proposed Bayswater B project, such as (but not limited to) the following:

- Fire/hydrant supply
- Plant wash down
- Dust suppression
- Irrigation
- Equipment cooling
- Auxiliary cooling tower make-up
- Ash conditioning (coal fired option only)
- Furnace ash submerged chain conveyor supply (coal fired option only).

Raw water is also required, after further treatment, for the domestic water and demineralised water treatment plants.

Based on MacGen's existing water entitlements and the future expected operating regimes for the Bayswater and Liddell Power Stations, it is estimated that up to some 4.6 GL pa would be available for use by the Bayswater B Project. This is estimated to be sufficient supply for both the coal fired and gas fired options using air cooled condensers.

The integrated nature of the water management systems for Bayswater and Liddell Power Stations means that MacGen can allocate the available water across its power stations to meet its operational and commercial objectives. There are two options for providing the raw water supply for Bayswater B:

- Treated raw water can be supplied from the existing Bayswater Freshwater Dam by pipeline to the proposed Bayswater B Project; or
- Construction of a new softening plant supplied with untreated raw water from the Bayswater Cooling Tower Make-Up Dam.

The preferred option is to supply treated raw water from Bayswater Fresh Water Dam for the common water systems. The maximum volume of treated raw water required at the Project Site is up to 7.2 ML/d (for coal-fired technology), which appears to be only an incremental increase for the existing Bayswater LSP. The 7.2 ML/day is worst case scenario and is sufficient to supply the items listed above. Using this existing capacity would allow treated raw water supplies for Bayswater B domestic and demineralised water treatment plants and service water to be supplied by pipeline from the existing Bayswater Freshwater Dam.

11.2.2 Filtered Water

Some of the softened raw water would be clarified and filtered to supply the domestic water and demineralised water treatment plants. The filtered water would be used for spraying the air cooled condenser during hot weather. A new filtration plant would be required for the proposed Bayswater B Project.

Softened raw water would enter the clarifier where it is dosed with ferric chloride (approximately 24 tonnes per annum), which reacts with alkalinity present in the water to form a ferric hydroxide floc. The suspended material in the water adheres to the floc particles, which coagulate in the clarifier and settle by gravity.

The resultant sludge (3% of flow) would be removed from the clarifier base and depending on the base case adopted, either transferred to the ash plant for ash conditioning and disposal (coal fired option) or stored on site and transported by tanker truck to the Bayswater water treatment plant.

The supernatant water from the clarifiers would then be pumped through two gravity sand filters to remove any floc carried over and other suspended particles, which would foul the ion-exchange resins in the demineralised water plant. The filtered water would be collected in two filtered water storage tanks (250 m^3 each) which would supply domestic and demineralised water treatment plants.

11.2.3 Domestic Water Supply

The preferred option for supplying domestic water would be to install a new treatment plant at Bayswater B. The capacity of the plant would be sized for staffing of approximately 100 personnel during normal operation, with additional capacity for periods when additional staff are required (during outages etc).

The feed for the domestic water plant would be drawn from the filtered water tanks, chlorinated to prevent growth of algae or bacteria, and pumped to the domestic water storage tanks (350m^3). The chlorine consumption would be approximately 27 kg per annum.

11.2.4 Demineralised Water Supply

Demineralised water is used in the power plant steam cycle and various auxiliary cooling systems. The demand of demineralised water is approximately 0.5 ML/day (5.6 L/s) and 2.1 ML/day (22.5 L/s) for a gas fired and a coal fired plant respectively, based on a 1.5% make-up to the feedwater system. These quantities allow for losses, boiler fills and for make-up to the auxiliary cooling systems using demineralised water (e.g. stator cooling, distilled water cooling systems). The feed supply assumes five percent (5%) loss for regeneration of the cation/anion exchangers. Neutralised wastewater is discharged via the chemical drains system.

The preferred option to provide demineralised water is to construct a new dedicated demineralised water treatment plant fed with filtered water. Alternatively, water could be supplied from the existing Bayswater Demineralised Water Treatment Plant by pipeline to the Project Site.

A new demineralised water treatment plant would provide approximately:

- 0.5 ML/day (5.6 L/s) for the gas fired option
- 2.1ML/day (22.5 L/s) for the coal fired option.

A demineralised water storage tank with a normal capacity of 0.5 ML for the gas fired plant or 2 ML for the coal fired thermal plant is proposed.

Regeneration chemicals used in the process would include sulphuric acid (H_2SO_4) and caustic soda (NaOH).

11.2.5 Condensate Polishing and Regeneration Plant

The condensate polishing plant removes impurities from the condensate to maintain the very high purity of feedwater required to prevent corrosion in the steam cycle. The polishing plant would also reduce water and energy losses by reducing boiler blowdown from the CCGT sub-critical steam cycle. The resins used to remove the impurities are regenerated in the regeneration plant.

3 The regeneration process is similar to that used in the demineralised water plant. The cation resin is regenerated with dilute sulphuric acid whilst the anion resin is regenerated with dilute caustic soda (sodium hydroxide). The neutralised wastewater is discharged via the chemical drains.

4 The condensate polishing and regeneration plant and the demineralised water treatment plant would have the following common bulk chemical storage facilities:

- For gas fired plant: one nominally 45,000 kg capacity tank (90 days) for storage of bulk concentrated sulphuric acid (98%) and one nominally 58,000 kg capacity tank (90 days) for storage of bulk sodium hydroxide (50%). Anticipated annual sulphuric acid usage is about 180 tonnes, while annual sodium hydroxide usage is some 230 tonnes.
- For the coal fired plant: one nominally 100,000 kg capacity tank (90 days) for storage of bulk concentrated sulphuric acid (98%) and one 140,000 kg capacity tank (90 days) for storage of bulk sodium hydroxide (50%). Anticipated annual sulphuric acid usage is 400 tonnes, while annual sodium hydroxide usage is about 565 tonnes.

11.2.6 Auxiliary Cooling Systems

The preferred option for the Bayswater B Project is a common auxiliary cooling system with wet auxiliary cooling towers, water-water heat exchangers and separate cooling water circuits.

The wet auxiliary cooling towers dissipate heat to the atmosphere mainly by evaporation, with the heat transfer depending on the ambient wet bulb temperature. Evaporation provides more effective heat transfer than convection while wet bulb temperatures vary less, and are lower, than dry bulb temperatures. As a result this option achieves lower auxiliary cooling water temperatures and a smaller, lower cost cooling tower compared to fin-fan coolers.

Wet auxiliary cooling towers require make-up water from the service water system to replace water losses by evaporation and blowdown. They also require chlorine dosing to control bio-fouling, bacteria, etc. Chlorine dosing of approximately 8.24 tonnes per annum would be required for the auxiliary cooling tower associated with the gas fired plant and 6.67tpa for the coal fired plant.

11.2.7 Liquid Waste and Hazardous Chemical Management

Coal fired and gas fired options would involve the storage and transfer of liquid wastes and hazardous chemicals on site. All hazardous liquids or contaminated wastewater storage vessels transfer and storage areas would be designed to mitigate the risk of accidental release or spills into the environment. In addition, operation procedures would be developed to further avoid the risk of accidental release. This would include for example:

- Provision of adequately-sized bunding and collection systems for storage of all fuels, oils, chemicals and wastewater / sludges;
- Lining of dams to prevent infiltration to groundwater and sized to cater for the maximum predicted storage volume;
- Design of all valves and operation systems to reduce the risk of accidental release due to human error, power interruption or other similar mechanisms;

- All hazardous chemicals would be stored well clear of site boundaries and stormwater drainage lines and stored in a designated covered area.
- Implementation of operational procedures on site for the delivery and removal of hazardous materials that ensure the risk of accidental release is significantly reduced
- Development of an Emergency Spill Preparedness and Response Plan to manage the containment, collection, neutralisation and disposal of any spills offsite through a licensed facility
- Implementation of appropriate monitoring and maintenance procedures on site for all hazardous chemical and liquid waste storage and transfer systems, to ensure they are in good working order throughout the life of the plant.

11.2.8 Drainage Systems and Wastewater Management

External Site Drainage and Cross Drainage for Access Roads

The site layout would be designed to divert all external drainage safely around the site within stable vegetated diversion drains.

All crossings of waterways or drainage depressions for access roads or other infrastructure would be designed to provide sufficient hydraulic capacity beneath the crossing (i.e. in pipe culverts or similar) in accordance with the relevant engineering standards. Overflows over culverts would be designed to safely carry the 1 in 100 year Average Recurrence Interval (ARI) event. Scour protection would be employed where required to prevent erosion of the waterway.

Similarly, all access roads would be constructed to provide adequate cross drainage where required. Such stormwater infrastructure would be designed and constructed in accordance with the relevant engineering standards.

On the proposed Bayswater B Project site, various drains systems to collect, treat and dispose of wastewater would be provided. Generally these drains are categorised into clean drains, dirty drains and contaminated drains. Each of the categories is described in the following sections.

Clean Drains

Stormwater collected from the roof areas is designated as ‘clean’ water and would be collected and piped to a detention pond before being discharged through natural stormwater channels to Plashett Dam. The detention pond temporarily retains flows from roof areas and flows from sealed areas that bypass the first flush pond (refer Dirty Drains for details) to ensure large stormwater flows from these sealed surfaces are released in a regulated manner (approximately equivalent to that of the natural undeveloped site).

The construction of impervious areas associated with the development would result in an increase in peak discharge and total runoff volume from the site. Use of a detention basin would mitigate the impact of increased peak discharge on Saltwater Creek and also limit erosion at the discharge point by reducing the peak outflow.

The detention basin would have an approximate size of 4500m^3 (based on a sealed area of about 8.5 hectares). Final sizing would be dependent on the final plant configuration and total area of the stormwater catchments. The outlet of the basin would be configured so that basin discharge mimics that of the natural site for a range of design events (up to and including the 1 in 10 year ARI storm). Larger storm events would bypass the detention basin and flows would be directed to the natural overland flow paths.

Following treatment and detention, stormwater would be directed to Plashett Dam for reuse.

Dirty Drains

Dirty water drains would collect water and runoff from sources which may contain dust and dirt and be directed to either a settling pond, or the first flush pond.

Access roads have the potential to accumulate stormwater contaminants dropped by vehicles (oils, grease and particulates). Coal fines contamination of stormwater may also occur in the surrounds of the coal conveyor.

Stormwater which may be contaminated with oil dropped from vehicles, and small volumes of spilt coal dust, ash, etc., would be controlled by sealed surface grades and kerbs. The water would be collected using grated inlet pits and transferred via a buried concrete pipe system to the first flush pond.

The first flush pond would be designed to capture runoff up to the first 10 minutes of a 10 year ARI storm. The pond would enable the capture and settlement of the majority of accumulated dirt/dust from sealed areas and would be sealed with approved low permeability clay or a membrane to prevent groundwater infiltration of pollutants. The first flush pond would be drained via a pump and plate separator to remove hydrocarbons (oils and grease) and cleaned water would be discharged to the detention pond. Flow rates in excess of the 10 minute, 10 year ARI storm would bypass the first flush pond and be directed to the detention pond.

Water from site entry access roads may not be able to drain to the first flush pond, and in this instance, water would be treated in small sedimentation basins placed at intervals along the length of the road to capture and treat the 75% percentile, 5 day rain event prior to discharge.

Stormwater captured from the coal stockpile and uncovered coal handling areas, or in the vicinity of the ash plant, would also be captured using sealed surface grades and concrete drains. These areas would have a higher potential pollutant load, consisting primarily of coal fines and ash. Stormwater from these areas would be directed to settling ponds to enable settlement and capture of these fines. The settling ponds would be cleaned out as required with collected fines transported by truck to the ash disposal site. The settling ponds would also be lined with an approved low permeability clay or membrane, and would be designed to provide sufficient residence time to allow settlement of fine particles to occur. Water from the settlement ponds would be discharged to Plashett Dam following treatment.

Coal conveyors would be covered to minimise the loss of coal fines and contamination of stormwater along the conveyor route. Wash down water from the conveyors would be drained to the settling ponds.

Contaminated Drains

Contaminated water drains would collect water from areas which may contain oil or other contaminants such as equipment drains, wash down water and boiler blow-down/drains. In general, these areas would be covered to avoid or significantly reduce the volumes of water requiring treatment due to stormwater ingress. Oily water from various equipment drain collection points and washdown water would be piped via oil traps and effluent collection systems to the first flush pond.

Transformer bunds would also be drained via an oil catch tank to the first flush pond. In the event of a transformer burst and/or fire, the oil and fire sprinkler water would flow via a flame trap to the Oil Catch Tank and displace the retained stormwater. The tank would be sized to provide 120% of the largest transformer oil volume. If a spill occurs, the oil can later be recovered by suction tanker and taken to an approved and licensed oil recycling facility. Under normal operation, the stormwater underflow potentially containing traces of oil, would be piped to the first flush pond and then released via the plate separator for further oil removal to the detention pond.

The use of water following oil removal would depend on the quality and quantity of recycled water, however recycling options include:

- Returning the clean water to Plashett Dam
- Pumping cleaned contaminated water to Bayswater for use as cooling tower make-up
- Use as service water for the ash plant (e.g. submerged chain conveyor, ash conditioning, etc).

Chemical Drains

Drains to collect process wastewater from sources which may contain chemicals and/or are unsuitable for recycling include:

- Wastewater from the demineralised water plant
- Wastewater from the condensate polishing plant
- Auxiliary cooling tower blowdown
- Clarified sewerage treatment plant effluent
- Wash down water from chemical storage areas / bunds
- Overflow from the submerged chain conveyor (which removes furnace ash).

Washdown water from bunded chemical storage areas would be a component of wastewater disposed of via the chemical drains system, however these areas would not require regular washing and are generally small, therefore the contribution of such flows to the chemical drains would not be significant. Furthermore, these areas would be covered to prevent stormwater in these areas increasing the volume of water requiring treatment.

On average, the gas fired option would generate approximately 0.3 ML per day of chemical drain flows. These would be transferred (by pipeline or tanker truck) to the existing Bayswater water treatment plant for water recovery in the brine concentrator at that site. The brine would then be transferred to the Bayswater brine dam (which has excess capacity), while the clean water would be used for treating Bayswater ash output. No offsite discharge of saline water would occur from the Bayswater B Project.

It is estimated that the coal fired option would generate approximately 0.4 ML per day of chemical drain flows. This wastewater would be transported via chemical drains and neutralised before being transferred to the ash plant for use in ash conditioning on site, thereby reducing the demand for service water.

11.2.9 Sewerage Treatment

The estimated sewerage produced from the proposed Bayswater B Project would be approximately 25 m^3/day from amenity blocks, staff kitchens etc. The sewerage system would collect wastewater and either pump the raw sewage to the existing Bayswater sewage treatment plant or to a new sewage treatment plant at the proposed Bayswater B Project site. Following assessment of both options, the preferred option selected includes installation of a new package-type aeration sewage treatment plant or a Pasveer channel treatment process at the proposed Bayswater B Project site.

For the typical package plant, the incoming raw sewage is screened and mixed with returned activated sludge from the settling chamber. This mixture drops into the aeration chamber, where interaction with oxygen produces activated sludge bacteria that consume the pollutants in the sewage stream. This stage of treatment takes approximately 24 hours.

The aerated sludge (Mixed Liquor Suspended Solids (MLSS)) moves on to the settling chamber via a flow regulating device, where clarification takes place. The settled sludge is returned to the inlet end of the plant to continue the treatment process. The clarified effluent would be discharged to the chemical drains and directed to the ash plant for ash conditioning (coal fired option) or pumped to the Bayswater Brine Concentrator Pond (BC Pond) (gas fired option).

The waste sludge (2% inflow) would be collected in the waste sludge tank and transferred to ash plant for disposal (coal fired option) or Bayswater BC Pond (gas fired option).

11.2.10 Water Cycle Balance

Water Usage

Average annual water demands for Bayswater B have been estimated by WorleyParsons (22 July 2009) and are summarised in **Table 11-2** below.

Table 11-2: Average Annual Water Demands and Usage (GL pa)

Service	Gas Fired + ACC	Coal Fired + ACC
Treated Raw Water [1]	1.62	2.40
Potential drains recovery [2]	0.22	0.59
Service Water [3]	0.58	1.16
Demineralised Water [4]	0.16	0.65
Domestic Water [4]	0.01	0.01
Aux Cooling Tower Make-up [3]	0.27	0.23
ACC Sprays [4]	0.83	0.51
CCGT Evap. Cooling [4]	0.12	-

1: Supplied from Bayswater Fresh Water Dam (lime softened); all other listed items are derived from this water supply

2: Recovery of clean drains, dirty water drains, and contaminated drains returned to Plashett Dam

3: From treated raw water storage tank

4: From Filtered Water System

Raw Water Supply Availability

Sufficient water is available for use by Bayswater B from within MacGen's existing water entitlements. The water used by MacGen for the existing Bayswater and Liddell power stations is 'Major Utility Water' (with the highest level of security) and supplementary water (from high river flows, including those from an entitlement in the Barnard River). These components of MacGen's existing water entitlements would not be available for use at Bayswater B because they are needed for operation of the existing power stations.

Over the past few years, MacGen has purchased an additional 4.64 GL of water out of the marketplace with the intention that it would be available for either a future power station such as Bayswater B and/or to increase MacGen's level of water security for the existing Bayswater and Liddell power stations. Of the 4.64 GL, 1.75 GL (38%) is high security water, while 2.89 GL (62%) is general security water.

To date, MacGen have been drawing the 4.64 GL water entitlement and pumping this into the Bayswater and Liddell water storages to assist in recovering from drought, and also to improve the salinity levels in Lake Liddell. While this water has been useful for these purposes, it is supplementary to the operational needs of the existing power stations. In addition, the 4.64 GL of entitlement has not been included in the current long term planning (modelling) of the existing power stations' water requirements. Therefore the use of this water for Bayswater B would not alter drought planning for the existing power stations. MacGen have committed to making the 4.64 GL available for Bayswater B because this is surplus to their requirements. In addition, the Proponent for Bayswater B could purchase additional water or seek alternative water sources if required.

Drought Contingency Planning

The 'worst case drought' scenario for the Upper Hunter Region is based on that which occurred in the area in the late 1930s to late 1940s. Modelling has demonstrated that during a worst case drought, the existing Bayswater and Liddell power stations could operate at 80% capacity utilising the water storages in Lake Liddell and Plashett Dam, along with their Major Utility Water (which is very high security) and any supplementary water. As Bayswater B would be reliant on lower security water (general security and high security) it would therefore not have this same level of certainty, as this water supply would be subject to the same restrictions as any other general security and/or high security water.

Under the Hunter River Water Sharing Plan there is a protocol for application of restrictions during drought periods – this protocol would apply to the 4.64 GL committed to Bayswater B and to any other water entitlements to the Hunter River (including associated water storage facilities such as Glenbawn Dam). Under this protocol, when the water level in Glenbawm Dam is below a certain capacity, this may result in restrictions to general security water use. If the level of Glenbawm Dam reduces further, this may place restrictions on high security water. The Minister has the jurisdiction to decide when the protocol and restrictions would be applied.

Of the 4.64 GL committed to Bayswater B, the 1.75 GL of high security water would be expected to be available for all but a negligible amount of the time, even within a worst case drought situation. The 2.89 GL of general security water would be obtained when available and would be expected to be available on average about half of the time. At times when this general security water is available, any excess water would be used to fill water storages. Given the above, the water storages would contain sufficient water to support the proposed Project through a worst case drought situation. Further drought contingency planning along with modelling of long term water availability would be undertaken at a later stage of project planning for Bayswater B.

Other potential actions and alternative water sources to obtain additional water security (if further analysis indicates that it is required) and to avoid impacts of drought on Bayswater B may include:

- Monitoring of the water entitlements market to purchase additional general and/or high security water entitlements when these are available.
- Development of additional onsite water storage for use by Bayswater B.
- Conversion of some or all of the 4.64 GL of general and/or high security water to Major Utility Water (which has a higher security level).
- Monitoring the availability of other potential water sources, for example the purchase and/or use of tertiary treated water from towns. (Tertiary treated water is sewage effluent that has been treated to as standard that although not suitable for drinking water is suitable for industrial applications).

Therefore the raw water requirements for dry cooling of both the gas fired and coal fired options would be met in both average and drought situations, using water entitlements which have already been considered within the Water Sharing Plan, and possibly through the recovery of small quantities of treated sewage effluent. Consequently, there would be no significant or discernable impacts on Hunter River flows from the proposed Bayswater B water use.

Waste Water Generation

Wastewater and sludges of various quantities and characteristics would be produced by the proposed Bayswater B plant. The flow rates and approximate annual volumes of the main forms of wastewater generated for each option is summarised in **Table 11-3**.

Table 11-3: Wastewater Flows and Disposal

	Gas Fired Option		Coal Fired Option	
	Disposal Location	**Anticipated Quantities**	**Disposal Location**	**Anticipated Quantities**
Clean Drains[1]	Plashett Dam	-	Plashett Dam	-
Dirty Drains	Plashett Dam	3.6 L/s	Plashett Dam	10.4 L/s
Contaminated Drains	Plashett Dam	3.9 L/s	Plashett Dam	9.9 L/s
Sub total		**7.5 L/s (0.23 GL pa)**		**20.3 L/s (0.64 GL pa)**
Chemical Drains Sewerage Effluent	Bayswater BC Pond	0.2 L/s	Ash Plant	0.2 L/s
Chemical Drains Demin and Polisher Regeneration Plants	Bayswater BC Pond	0.3 L/s	Ash Plant	1.3 L/s
Chemical Drains Auxiliary Cooling Tower Blowdown	Bayswater BC Pond	1.9 L/s	Ash Plant	1.6 L/s
Liquid Sludge Filtered Water Treatment	Bayswater BC Pond	1.1 L/s	Ash Plant	1.3 L/s
Sub total		**3.5 L/s (0.30 ML/day or 0.11 GL pa)**		**4.4 L/s (0.38 ML/day or 0.14 GL pa)**
TOTAL		**0.34 GL pa**		**0.78 GL pa**

[1] Clean drains collect only stormwater flows, no process or waste water.

11.3 Potential Impacts

11.3.1 Construction

Construction of the facility would require extensive earthworks and civil works, particularly in the site establishment and site preparation phases, construction of the plant foundations and underground services, and construction of plant buildings and structures.

Areas of disturbed land if left unmanaged, may be subject to erosion and downstream transport of mobilised sediment. If allowed to enter the natural waterway system, this sediment would affect water quality, particularly turbidity, cause sedimentation and affect aquatic life.

Disturbance during construction would not be limited to the power station site itself but would also be required for the construction of:

- Construction facilities including laydown area, construction compound and site office
- Connecting access roads and waterway crossings (i.e. culverts)
- Connecting pipelines and utilities
- Construction of electricity transmission infrastructure, including support towers and construction/maintenance access roads.

The soil landscape (refer to **Chapter 12**) includes some characteristics that have the potential to impact on water quality during construction. These include sheet and gully erosion hazards, soil erodibility and salinity. The management of potential soil issues and impacts is provided in Chapter 12 **Land Capability**.

The construction would require the establishment of a temporary concrete batching plant on site. Batching plants generate waste slurry and wastewater which would have the potential to affect soils and local waterways if not controlled appropriately.

Construction is also likely to include the storage and use of potential water contaminants on site, such as fuels, oils, and other chemicals. Liquid spills could potentially occur whilst being stored or used on site or during transit if no controls are put in place.

Water supply would be required during the construction phase. Total volumes of water required would depend on personnel levels and stage of construction, and would be needed to supply the following:

- Concrete batching plant
- Wet trades during construction (bricklaying/blocklaying, rendering if required)
- Fire fighting
- Truck wash
- Dust suppression.

It is anticipated that water for these construction purposes would be sourced from the Bayswater Fresh Water Dam. No additional external water would be required during these construction activities. In additional to the above, the establishment of any new accommodation facilities would also require an adequate water supply.

Detail on proposed construction soil and water management mitigation measures to be employed during construction is provided in **Chapter 12**. The implementation of these measures would significantly reduce or avoid the above impacts and therefore avoid the degradation of site soils and downstream waterways. It is also noted that all water from the site during construction discharges to Plashett Dam and would not be released offsite to the Hunter River. Water from Plashett Dam is used for process water within the Bayswater and Liddell Power Stations.

Construction activities would not impact downstream off-site waterways, and in particular would not have a negative impact on downstream sensitive wetlands or estuaries or water users.

11.3.2 Operation

Water Supply

The integrated nature of the water management systems for Bayswater and Liddell Power Stations means that MacGen can allocate the available water across its power stations to meet its operational and commercial objectives. The projected raw water consumption for Bayswater B options (gas fired and coal fired) is within MacGen's existing licensed water entitlements. Therefore, no additional water would need to be sourced or obtained from the Hunter River as a result of the project and no other water users would be affected. Of the two options being considered, the gas fired option has a lower overall raw water demand (about 1.62 GL pa) compared to the coal fired option (some 2.40 GL pa).

Waste Water

The two options would result in the generation of the following volumes of wastewater:

- Gas fired 0.32 GLpa (72% of which can be recycled to Plashett Dam)
- Coal fired 0.72 GLpa (89% of which can be recycled to Plashett Dam)

Of this wastewater, the majority would be treated using the systems described in this chapter with clean water discharged to Plashett Dam for reuse. The bulk of water within Plashett Dam is pumped from the Hunter River under MacGen's existing licence entitlements. Water levels in the dam can therefore be managed to significantly reduce the frequency and volume of overflow discharge from the dam to the Hunter River. Further, Bayswater B would only be discharging clean, treated water to Plashett Dam to ensure that it is suitable for reuse within its operations.

Smaller volumes of contaminated water would be sent to either the Bayswater Brine Concentrator Pond (gas fired option) for treatment or filtered and used for conditioning of ash to be disposed of in a nearby mine void (coal fired option) Volumes of contaminated water that cannot be reused and recycled are relatively similar for both options (about 0.11 and 0.14 GL pa for gas fired and coal fired respectively).

Hunter River Water Sharing Plan 2004

The site lies within the extent of the Hunter River covered by the *Water Sharing Plan for the Hunter Regulated River Water Source*. The vision of the plan states:

> *The vision for this Plan is to achieve a healthy, diverse and productive regulated river water source providing sustainable management of the water source for the community, environment, towns agriculture and industry.*

The Water Sharing Plan establishes the rules for sharing water between the environmental needs of the river and water users, and also between different types of water users such as town supply, rural domestic supply, stock watering, industry and irrigation.

As noted above, the projected water supply requirements can be accommodated within MacGen's current entitlements and purchases and no other water users would be affected. Therefore, there would be no impact from the development on water sharing in the Hunter River.

Hunter River Salinity Trading Scheme

The *Hunter River Salinity Trading Scheme* (HRSTS) objectives are to:

- Manage saline water discharges to minimise their impact on irrigation and other water uses, and on the aquatic environment of the Hunter River catchment.
- To achieve this at the least overall cost to the community, in an equitable and flexible way that provides ongoing financial incentives to further reduce pollution through saline water discharges.

The scheme generally aims to maintain salinity levels in the Hunter river below a target of 600 µS/cm at Denman and 900 µS/cm at the Glennies Creek/Hunter River junction and at Singleton. This is achieved by limiting discharges of saline wastewater from coal mines and power stations to periods of high flow in the Hunter River, therefore minimising impacts through dilution. This system is managed through a system of licensing and discharge credits.

MacGen has existing entitlements to discharge saline water under the HRSTS. Discharges occur from Lake Liddell into Bayswater Creek. No discharge under the HRSTS from Bayswater Power Station occurred during the last reporting year (year end 30th June 2008).

It is not anticipated that additional entitlements to discharge saline water to the Hunter River would be required for the proposed Bayswater B development. Therefore, no additional credits under the HRSTS for the additional discharge of saline water would be required as a result of the project.

Hunter River Catchment Action Plan

The *Hunter River Catchment Action Plan* contains a set of guiding principles that provide direction for natural resource managers to achieve Ecologically Sustainable Development (ESD) and allow organisations to align their activities so that they are compatible with the CAP. In particular, there are five sets of guiding principles that outline appropriate ways of managing natural resources through land-use planning, integrated water cycle management, current best practice, managing mining and extractive operations and economic tools.

The guiding principles that are of relevance to the proposal and water management are listed below along with comments on the performance of the proposed Bayswater B Project

Table 11-4: Guiding Principles

Guiding Principle	Project Performance
Land – minimising soil erosion: • Erosion of all soils should be minimised; • Developers must submit and *Erosion and Sediment Control Plan* to local government for approval for all new developments.	Mitigation measures outlined in **Section 11.4.1** include the preparation of a Soil and Water Management Plan (SWMP) for the development, and the project is therefore consistent with this principle.
Land – managing salinity: • Current best practice should be used by all industries that release saline waters into the environment to minimise the negative impact on natural resources;	No increase in soil salinity is predicted as a result of the proposed works. The project would result in the generation of saline water. This water would be sent to Bayswater

Guiding Principle	Project Performance
• The cumulative effects of development and farming practices must be taken into consideration in planning for salinity management.	Power Station for treatment and no additional saline water would be discharged to the Hunter River as a result of the project.
Rivers and Freshwater Wetlands – maintaining or improving water quality: • Land should be appropriately managed to minimise pollution; • Current best practices should be universally and equitably applied and must be continually reviewed and adjusted; • Current best practice should be used to manage point source pollution; • Any activity or regulatory control should not compromise the community agreed environmental objectives of the water source; • New and existing developments should consider the opportunities to enhance water quality; • The trading of water rights should improve, or at least not degrade, ecological processes in water sources.	The Bayswater B project has been designed to minimise land pollution through the provision of sealed surfaces and lining of surface water storages. Current best practice management would be applied through the design and environmental management systems to avoid manage potential pollution as identified in **Section 11.4.2**. The water source would not be impacted by the proposal. No additional water rights would be required for the development and therefore there it would not impact on ecological processes in water sources.
Rivers and Freshwater Wetlands – maintaining or improving aquatic habitat • Development in environments upstream of wetlands should also put measures in place that protect wetlands; • If wetland habitat is degraded or disturbed by development, even where that impact is not on the development site, offset areas should be protected or enhanced by developers.	Clean, treated water would be discharged to Plashett Dam for recycling/reuse. No impacts to wetland habitat would occur as a result of the project.
Rivers and Freshwater Wetlands – reducing the impact of thermal pollution • Power generator discharges should minimise their thermal impacts on the local environment.	No water would be discharged from the site directly to the receiving environment. The proposed Bayswater B Project is designed to avoid the need to manage large volumes of heated water.
Rivers and Freshwater Wetlands – managing point source pollution • All industries that release point source pollution should use current best practice to minimise (and where possible eliminate) pollution entering rivers and estuaries.	As no water would be discharged directly to rivers or estuaries, there would not be a point source of water pollution. Cleaned/treated water would be discharged to Plashett Dam for reuse.

Guiding Principle	Project Performance
Estuary and Marine – maintain or improve water quality • It is important that planning for any development upstream from estuary and marine areas takes into account negative impacts that might occur in downstream water quality; • Stormwater pollution should be minimised using current best practice stormwater management (e.g. water sensitive urban design).	As no water would be discharged directly to rivers or estuaries, there would not be a point source of water pollution. Cleaned/treated water would be discharged to Plashett Dam for reuse. As part of the detailed design phase the Proponent would further investigate opportunities or minimise stormwater pollution.
Estuary and Marine – manage water flow: • The extraction of water from rivers should be managed so that the effects on downstream estuary ecosystems are considered and minimised.	No additional water extraction from the Hunter River would be required.

The project is therefore considered to be consistent with the objectives and principles of the *Hunter River Catchment Action Plan.*

11.4 Management and Mitigation

11.4.1 Construction

Construction of access roads or pipelines to the proposal and connecting roads/infrastructure would require a controlled activity approval under Clause 91 of the *Water Management Act 2000* for crossings of, or works near, watercourses (for example, Saltwater Creek).

All construction works would be undertaken in a manner that minimises the potential for soil erosion and sedimentation through the development and implementation of a Soil and Water Management Plan. These measures would form part of the Construction Environmental Management Plan (CEMP). As an overview, the SWMP would be prepared in compliance with the *Blue Book* (Landcom 2004), and include the following:

- Minimising area of disturbance required at any one time through careful construction staging and progressive rehabilitation of completed areas;
- Minimising the volumes of water required to be handled by diverting clean water around all disturbed areas;
- Best-practice management and recycling of slurry / wastewater from the concrete batching plant with no offsite discharge of water;
- Treating the surface of all areas required for construction traffic, parking, storage and amenities to provide adequate drainage and prevent soil loss (i.e. temporary seal or gravel pavement);
- Provision of truck wash facilities to remove soil from vehicle wheels and undercarriage with water directed to an oil-grit trap and subsequently a sediment basin prior to discharge;
- Provision of sedimentation basins, traps, and fencing to capture and treat runoff from disturbed areas, including a regime for inspection and removal of accumulated sediment;

- Storage of potential contaminants (i.e. fuels, oils or chemicals) within bunded, covered and lined areas;
- Plant would be refuelled in a designated bunded area at least 10m away from watercourses or drains, with repair and maintenance work to plant and vehicles subjected to the same controls;
- Work procedures to minimise the risk of accidental release of pollutants and development of spill preparedness and emergency response procedures for accidental spills; and
- Avoidance where possible of disturbance to watercourses. Where works are necessary, special precautions would be implemented to reduce erosion and sediment impacts, and would be completed in the shortest timeframe possible and in dry, fine conditions.

The SWMP and CEMP would apply to all construction activities, including the construction of access roads and connection of utilities and pipelines to the site.

It should be noted that if the gas fired option is chosen, detailed design would confirm the extent of watercourse crossings by the proposed gas pipeline, which would be assessed as part of further approvals. The CEMP for the gas fired option would then incorporate specific measures with respect to soil and water management along the pipeline route.

11.4.2 Operation

The EARs require the proponent to "*review further opportunities to re-use and recycle water to supplement raw water needs during the detailed design phase*." To reduce the impact of raw water demand, the design of each of the proposed options (gas and coal fired) includes water recycling and efficiency where possible. Stormwater and washdown water captured on site would be treated and directed to Plashett Dam for reuse within Bayswater B or within the existing Bayswater Power Station. This includes treated water from the following:

- Clean catchments (rooves)
- Dirty catchments (road pavements and external hardstand areas, coal stockpiles)
- Contaminated catchments (wash down, process water, transformer bunds)

These systems would therefore achieve recovery of some of the service water used on site and also provide additional runoff (i.e. from roof drains and stormwater from impervious surfaces) into Plashett Dam for recycling/reuse within Bayswater B or Bayswater Power Station.

By reusing and recycling water discharged from the site, no water from the site would be discharged directly to the "external environment". That is, outside the raw water dam system. Treated stormwater may be discharged directly or indirectly to Plashett Dam. However, all wastewater would be contained on site. Wastewater from chemical drains would be used for ash conditioning to avoid discharging contaminated water to the environment and reduce the consumption of higher quality water.

The proposal would not require additional water from the Hunter River and would not discharge contaminated stormwater or waste water to the Hunter River. Therefore, there would be no downstream impacts to river flows or water quality as a result of the project. This includes:

- No impact to downstream Hunter River water quality or flows; and
- No impact to nearby or downstream areas supporting aquatic ecology and biodiversity such as wetlands (either Ramsar listed or otherwise).

The management of water impacts during operations would be primarily addressed during the design phase. These measures have been discussed above, but are summarised in the table below.

Table 11-5: Design Measures to Address Potential Impacts

Aspect	Impact	Proposed Mitigation/Management Measure
Raw water	Increased water demand	Proposed design maximises reuse opportunities within the development. All suitable water would be sent to Plashett Dam for reuse. No increase in external water demand would occur as a result of the development.
Wastewater	Disposal	Volumes of contaminated water to be disposed of would be minimised in the design through covering of chemical storage and handling areas. Water collected from chemical drains would be used for ash conditioning (coal fired option) and thereby reduce the demand for service water. Liquid sludge would also be used for ash conditioning. Alternatively, these waste waters would be sent to Bayswater BC Pond for treatment (gas fired option).
	Storage and handling	All hazardous liquids or contaminated wastewater storage vessels, transfer and storage areas would be designed to mitigate the risk of accidental release or spills into the environment as described in **Section 11.2.7**.
Stormwater	Increased peak discharge of rainfall runoff	Stormwater would be collected and piped to a detention basin prior to discharge towards Plashett Dam.
	Impacts to natural drainage pathways	The site layout would be designed to divert external drainage safely around the site within stable vegetated diversion drains.
		All crossings of waterways or drainage depressions for access roads or other infrastructure would be designed to provide sufficient hydraulic capacity beneath the crossing (i.e. in pipe culverts or similar) in accordance with relevant engineering standards. Overflows over culverts would be designed to safely carry the 1 in 100 year event. Scour protection would be employed where required to prevent erosion of the waterway.
		All access roads would be constructed to provide adequate cross drainage where required. Such stormwater infrastructure would be designed and constructed in accordance with relevant engineering standards.
		Stormwater from the site entry access roads would be treated using a series of small water quality basins designed for the removal of particulates and hydrocarbons.

Aspect	Impact	Proposed Mitigation/Management Measure
		Scour protection would be used at outlets to drainage lines and alterations/diversions of natural drainage lines to prevent erosion.
	Contamination and water quality	Stormwater catchments would be designed so that runoff can be separated into clean, dirty and contaminated water with areas sealed to contain and direct flows to a buried stormwater pipe network.
		Dirty catchments would be directed to the first flush pond for the capture and treatment of potential contaminants. Alternatively catchments that involve the handling of coal fines or ash would be directed to settling ponds to allow the removal of fines.
		Contaminated water from areas which may generate oily water would be directed to an oil catch tank prior to discharge to the first flush pond for further oil removal using the plate separator.
		Transformers would be contained within a sealed and bunded area and drained via an Oil Catch Tank.

Other mitigation measures would be implemented to address residual risks and impacts, such as the following:

- All unsealed areas, drainage and site landscaping would be regularly inspected and maintained to ensure no ongoing erosion is occurring and protect the site soils from degradation and erosion;
- A water quality monitoring program would be established for the site detention basin, settling ponds and first flush pond to confirm they are achieving appropriate water quality treatment prior to discharge to Plashett Dam; and

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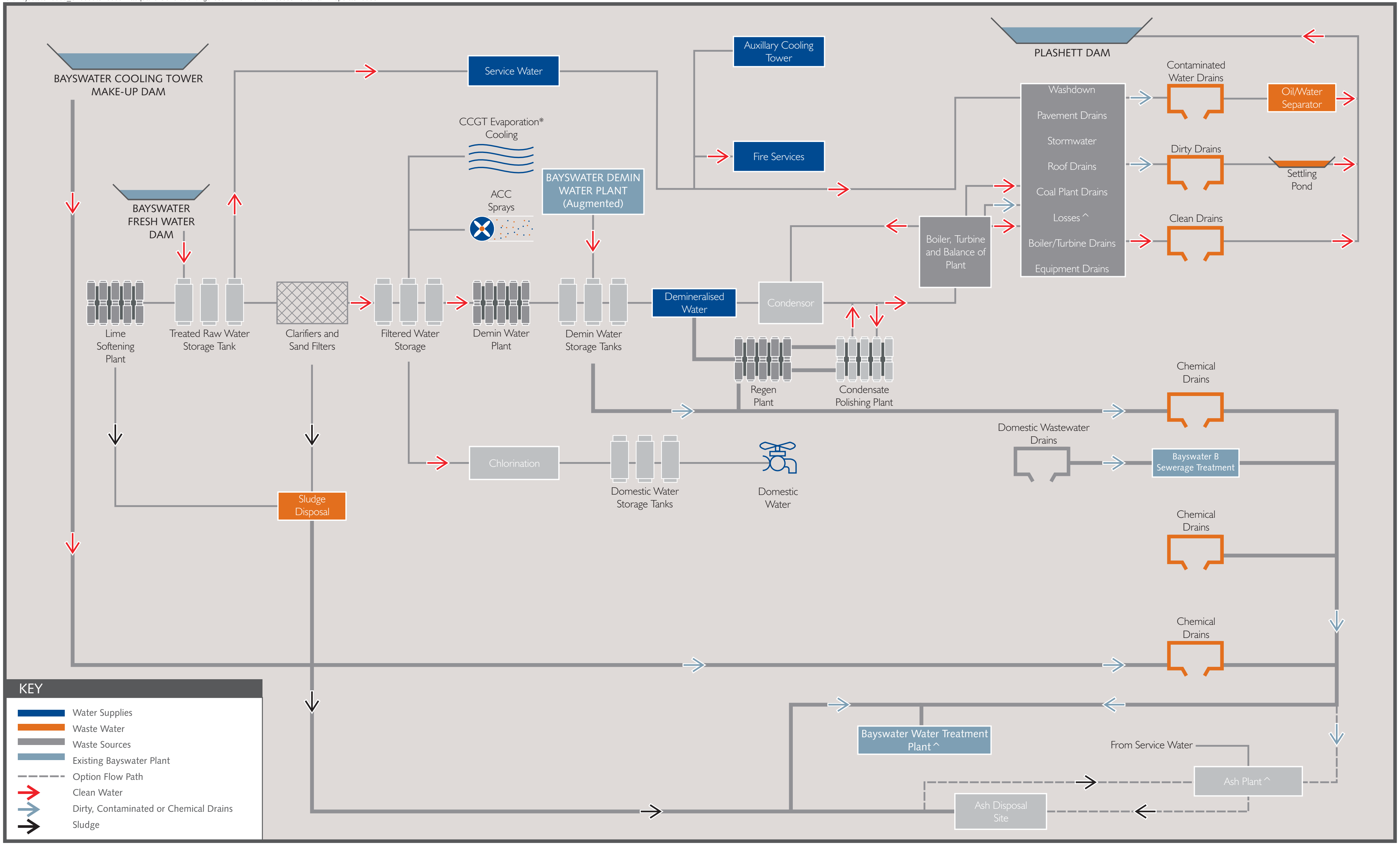

AECOM

Note:
* Gas specific items
^ Coal specific items

WATER MANAGEMENT
Environmental Assessment
Bayswater B Power Station

Figure 11.1

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12.0 Land Capability

This Chapter provides information on the soils geology and land capability of the subject site. This discussion then provides a basis for understanding potential impacts during construction and management of potential effects to have minimal impact on the natural environment.

12.1 Regional Context

The proposed Bayswater B Project site lies within the Hunter – Central Rivers Region of NSW in the vicinity of Muswellbrook and Singleton townships.

The Hunter Region has a subtropical climate with temperatures tending to be higher inland and frost increasing with distance from the coast. Snow can fall in winter in certain parts of the Hunter Region and rainfall tends to be highest in coastal areas.

Climate data for the Singleton water board weather station, which is located approximately 40km south east of the Bayswater B Project, identifies average temperatures in the locality as 24.8ºC (maximum) and 11.1ºC (minimum). The summer months experience the highest temperatures averaging around 30ºC and the winter months are the lowest at approximately 18ºC.

Average Annual Rainfall is approximately 650mm peaking in the summer months, up to over 100mm in February.

The terrain in the Hunter-Central Rivers Region is varied. The west and the northwest of the region are bounded by the Great Dividing Range. The Barrington Tops is the major mountain range (up to 1586 m) occurring on the western part of the Lower North Coast and the Hunter River Catchment. The Liverpool Range also borders the Hunter Catchment to the northwest.

Eastward of these steeper slopes the terrain is more undulating, decreasing in elevation until it joins the wide floodplain of the Lower Hunter and the coastal fringe with its many estuaries and coastal lakes.

12.2 Existing Environment

12.2.1 Existing Land Use

The Project Site exhibits a good cover of grasses with minimal trees and shrubs on the site with the exception of the drainage lines and creeks in the vicinity which have several mature trees along their banks.

Land suitability and capability of the project area has been determined using the Soil Conservation Service of NSW's *Land Capability Classification.* This classification is used to evaluate rural land and consists of eight classes which were developed based on an assessment of the biophysical characteristics of the land and the extent to which these would place limitations upon land use. Limitations are based on the soil erosion hazards associated with particular land uses, such as cultivation and grazing.

The Project Site has land capability classifications of V, VI (Refer to **Table 12-1**) based on the soil properties within the proposed development footprint. The soil classifications identify the types of land management practices required to prevent soil erosion and to maintain the productivity of the land.

Table 12-1: Land Capability Descriptions

Land Classification	Management Practices	Interpretations and Implications
V (Lands with moderate to high limitations)	Structural soil conservation works such as absorption banks, diversion banks and contour ripping, maintaining good groundcover, establishment of permanent pasture.	Land not suitable for cultivation on a regular basis owing to considerable limitations of slope gradient, soil erosion, shallowness or rockiness, climate or a combination of these factors. Soil erosion factors are often severe. Production is generally lower than for grazing lands in. Can be cultivated for an occasional crop, particularly a fodder crop or for pasture renewal. Land is generally suitable for moderate to low intensity grazing.
VI (Lands with a high degree of limitation)	Soil conservation practices including limitation of stock, broadcasting of seed and fertiliser, prevention of fire and destruction of vermin. May include some isolated structural works.	Productivity would vary due to the soil depth and the soil fertility. Comprises the less productive grazing lands. If used for 'hobby farms', adequate provision should be made for water supply, effluent disposal, and selection of safe building sites and access roads. Not suitable for cultivation. Not capable of supporting high or medium impact land uses due to extreme difficulty in removing or reversing degradation and associated off-site impacts. Low productivity agricultural land capable of light grazing or nature conservation.

Source: adapted from Emery, 1986

Based on this classification, cultivation of the land on a regular basis should be avoided where possible and grazing should be limited.

12.2.2 Landform

Landform in the vicinity of the Project Site is dominated by low rolling to undulating hills and the broad floodplain of Saltwater Creek (refer to **Figure 12-1** , Plate 1). Elevations range from approximately 140m to 320m AHD. The highest elevations are located to the north and north west of the proposed development site with drainage tending a south to south westerly direction via Saltwater Creek.

12.2.3 Vegetation

Native vegetation at the site would have been open woodland of narrow-leaved ironbark, yellow box, white box, and spotted gum with some blakeys red gum, rough barked apple and Kurrajong. Bull oak and swamp oak would also have been common (Kovac and Lawrie1991). Much of the native vegetation of the site has been previously cleared for agricultural practices and the only remnant native vegetation that exists on the site is located in the vicinity of creek lines.

Due to extensive clearing much of the remnant vegetation in the Hunter Central Rivers Region is considered threatened. The Region is believed to support 116 threatened species and 13 endangered ecological communities.

12.2.4 Surrounding Areas

The surrounding areas of the Project Site are similar in landform characteristics to the development footprint and are dominated by agricultural practices, power generation and mining activities. The existing Bayswater Power generation site is located approximately 4km northeast of the site. Mining sites in the locality include Mount Arthur Operations, Drayton Coal Mine, Cumnock Coal Mine, Hunter Valley Operations, Liddell Coal Mine, Ravensworth-Narama, Ashton, Ravensworth East, Mount Owen, Bengalla and ash dams and manmade lakes associated with electricity generation.

Plashett Dam is located approximately 4km south of the proposed development site and gathers water from the Hunter River. Saltwater Creek, which runs north to south through the site, is the main water course in the vicinity of the Project Site. Saltwater Creek transfers water in a southerly direction toward the Hunter River and Plashett Dam

The townships of Muswellbrook, Singleton and Jerry's Plains are the urban areas closest to the development site which are approximately 17km to the north, 30km to the south east and 11km to the south respectively

12.2.5 Topography

The Project Site lies in a landscape of undulating low hills. Specifically the development footprint sits on the floodplain and mid slopes of the Saltwater Creek Catchment area, which lies in the larger Hunter River Catchment area. Elevations of the Project Site and its immediate surrounds have been identified as being from 140 – 325 m AHD by Douglas Partners (2008) with the majority of the proposed Bayswater B project at approximately 140 – 160 m AHD. Key landscape topographic features include a single hill to the immediate north west of the development footprint and Saltwater Creek which runs in a north south direction on the eastern portion of the development footprint.

Slopes

Slope classes across the Project Site and surrounding area are gentle to undulating and vary between 3 and 15 degrees (Douglas Partners 2008) with some localised steeper slopes. A hill up to approximately 360m AHD is located immediately north west of the Project Site. As no steep or very steep slopes occur within the proposed Bayswater B project footprint, it can be concluded that slopes are not a constraint to the proposed development.

Subsidence

The Mining Subsidence Board have confirmed that mining does not occur below the project area and there are no areas of subsidence that have been identified in the project area.. The project area is not within a Mine Subsidence area, therefore there is no risk of subsidence. No subsidence claims have been recorded within the project area.

12.2.6 Regional Geology

The proposed development footprint lies within the Hunter Region Coalfields on Branxton Formation and Greta Coal Measures. These formations are of Early to Middle Permian period (approximately 250 million years before present). These formations lie on riverine alluvial fans and upper delta flats of the region and comprise conglomerate, sandstone and siltstone, with coal seams in the Greta Coal Measures.

Parent rock material includes lithic sandstone, shale and coal seams. Parent soil material is derived from *in situ* weathered parent rock material and some derived colluvium with isolated intrusions.

12.2.7 Soils

A review of the soil landscapes occurring at the site was undertaken with reference to *Soil Landscapes of the Singleton 1:250 000 Sheet (*Soil Conservation Service of NSW, Sydney, Kovac, M. and Lawrie, J.W. (1991)).

Based on this information, the Project Site occurs on two main Soil Landscapes:

- Liddell Soil Landscape
- Brays Hill Soil Landscape

The majority of the proposed development footprint including the Project Site, access roads and the switchyard occur on the Liddell Soil Landscape, while the Brays Hill Soil Landscape lies to the immediate west of the proposed development footprint which borders the proposed location of the coal areas.

Liddell Soil Landscape

Within the Liddell Soil Landscape the main soil types include weathered parent materials and buried soils. Yellow Soloths are on slopes with some yellow Solodic Soils on concave slopes. Depositional and deeper topsoils and alluvial deposits such as Earthy and Siliceous Sands are found on mid to lower slopes where the parent material is sandier. Some Red Soloths, Red Solodic Soils and Red Podzolic Soils also occur in the landscape (Kovac and Lawrie 1991).

Minor to severe sheet erosion is common in the landscape, with some minor rill erosion. Moderate gully erosion (to 1.5m) occurs in drainage lines where salinity may be a feature.

Soil Structure: Field observations at the Project Site identified the main soil types as being Yellow Solodic and Soloth Soils with some isolated areas of Earthy Sands and Siliceous Sands which are discussed below.

Yellow Soloths: These soils occur in areas where drainage is impeded and leaching occurs resulting in acid reactions. Surface horizons are mainly hardsetting and consist of brown loamy sand to sandy loam, single grained at the surface and massive below, with a pH of 6.0. This overlies bleached, light grey or dull yellow orange sandy loam or sandy clay loam to a depth of 25 cm. The subsoil has a clear change to bright brown or dull orange sandy clay, with weak or strong structure and distinct brown or orange mottles. The pH is 6.0 – 6.5 (Kovac and Lawrie 1991).

These soils may have a weak to moderately developed structure and are mainly used for unimproved pastures. They are highly erodible when disturbed.

Yellow Solodic Soils: These soils occur in the lower slopes and depressions of the landscape and exhibit hardsetting surface horizons. The topsoil comprises dark brown sandy loam to loam with a weak (massive) structure and a pH of 6.5. This overlies a bleached, dull orange clay loam with weak structure to a depth of 20 cm. The subsoil is distinguished by a clear change to bright reddish brown light clay with a strong angular blocky structure. At greater depths, the subsoil becomes more yellowish brown with orange and grey mottles (Kovac and Lawrie 1991).

The soils are mainly used for unimproved pastures and have a low fertility. Gully erosion is a common feature of the landscape.

Earthy Sands: These soils are formed in weathered conglomerate, quartz and lithic sandstone and can occur on any slope position. They can be either hardsetting or loose and may have a gravelly surface (Kovac and Lawrie 1991).

The topsoil goes to a depth of approximately 40 cm and is a dark brown sandy loam, single grained at the surface and massive below. The subsoil is represented by a gradual change to dull yellowish brown sandy loam (Kovac and Lawrie 1991).

Siliceous Sands: These soils are usually found on coarse grained sandstone and usually exhibit a loose surface but may be hardsetting in proximity to clay soils. The topsoil is usually acidic and comprises brown sand to loamy sand and goes to a depth of approximately 40 cm. The subsoil is represented by a gradual change to light brown loamy sand (Kovac and Lawrie 1991).

Brays Hill Soil Landscape

In the Brays Hill Soil Landscape the main soil types are Red Clays on mid to upper slopes, Black Earths and Grey Clays on mid to lower slopes that commonly have linear gilgai running parallel to the slopes. Brown Clays may also occur on mid slopes with Yellow Solodic Soils on the lower slopes and Alluvial Soils in drainage depressions. Red Brown Earths occur on some crests and upper slopes with Rendzinas, Red Clays and Black Earths. The Black Earths are common on the steeper slopes, and the Solodic Soils on non-calcareous parent material (Kovac and Lawrie 1991).

Soil Structure: Field observations at the Project Site identified the main soil types as being Yellow Solodic Soils and Black Earths which are discussed below. Several outcrops and Basalt floaters were identified adjacent to the boundary of the Liddell Soil Landscape.

Yellow Solodic Soils: These soils occur in the lower slopes and depressions of the landscape and exhibit hardsetting surface horizons. The topsoil comprises a dullish reddish brown light sandy clay loam to loam with a weak (massive) structure and a pH of 6.0. This overlies a bleached, dull brown light sandy clay with a massive structure to a depth of 15 cm. The subsoil is distinguished by a sharp change to bright brown light clay with a strong structure and a pH of 7 (Kovac and Lawrie 1991).

The soils are mainly used for unimproved pastures and have a low fertility. Gully erosion is a common feature of the landscape.

Black Earths: These soils occur on mid to lower slopes and are formed in older alluvium. The topsoils are seasonally cracking or friable and comprise colluvial brownish black silty clay with moderate structure and a pH of 8.5. This overlies black medium clay with a strong structure and carbonate nodules and streaks present. Soil consistency is hard when dry but may become sticky when wet. Subsoils gradually change to brownish black medium clay with a strong structure with carbonate nodules and streaks present. Subsoils become increasingly brown with depth and may have yellow or brown mottles up to 10% and smooth faced peds (Kovac and Lawrie 1991).

These soils have a high water holding capacity and a high shrink swell potential. They are extensively used for farming and both improved and unimproved pasture.

12.2.8 Soil Salinity

Soil salinity refers to the availability and solubility of salts in the soil landscape. The defining character of saline soils is regarded as 4 dS/m at 25ºC, at which point there is an adverse impact on plant growth and land use. Soil salinity is present in both the Liddell and Brays Hill Soil Landscapes with visible salting, impacts to plant growth and soil degradation.

It is estimated, based on currently mapped areas, that there are approximately 90,000 ha of identified salinity impacted areas in the Hunter-Central Rivers Region (*Hunter-Central Rivers Catchment Action Plan,* 2006). Furthermore, the *Integrated Catchment Management Plan for the Hunter Catchment* (DLWC 2002) identifies the Project Site as a priority salinity catchment for the management of salinity related erosion.

Salinity is the result of increased levels of salt in the soil and water. Salt accumulation can affect on developments, causing damage to building foundations, the breaking up of road pavements, and the corrosion of pipes and underground services. Erosion hazard increases through high levels of salts in the soil changing soil structural characteristics, thereby preventing water infiltration and leading to increased levels of runoff. Costs associated with increasing salinity include loss of productive land, lack of suitable water for irrigation, and increased costs for industry.

Dryland salinity occurs naturally but is increased when there are not enough deep-rooted perennial trees, shrubs and grasses (due to clearing, overgrazing and erosion) to use up excess water on the ground's surface (through evapotranspiration). Instead the water filters down to the groundwater (or 'recharge areas') which causes groundwater to rise to the surface, where it evaporates and concentrates near rivers, causing an increase in the salt levels of river water.

This means that only the more salt tolerant species of plants are able to survive. If salinity is severe, the soil may be unsuitable for any vegetation and soils are at a greater risk of erosion.

Within the Project Site, Saltwater Creek has been significantly impacted by saline gullies and erosion at several points along its length. Saline gullies are steep-sided creeks with streambanks that have been severely eroded beneath the groundwater level. This means that salty groundwater is released directly into the stream. The combined erosion and salinity pollutes stream waters and degrades habitat within the stream (Hunter-Central Rivers Catchment Action Plan, 2006)

12.2.9 Erosion and Sediment

There are approximately 1.8 million ha of landscapes with highly erodible soils in the Hunter-Central Rivers Region and approximately 52% (95,000 ha) of these landscapes exhibit signs of moderate or greater active erosion (DNR soil erosion mapping). The landscapes identified for the Project Site are considered to show signs of active erosion within the Hunter-Central Rivers Region.

The Sodic Soil types on the Project Site are highly susceptible to surface sheet and rill erosion when disturbed by development, cultivation or excessive grazing. It is recommended, by the *Hunter- Central Rivers Catchment Action Plan* (2006), that a vegetative groundcover of greater than 70% should be maintained on land with Sodic Soils, to provide a stable soil structure and resist the forces of erosion. Increasing vegetation cover is one of the most effective ways of preventing soil erosion, as the roots of plants help to bind the soil together and the above ground vegetation protects the soil surface from wind and rain. Where this does not occur, streams downslope of eroding areas are potentially subject to sedimentation, turbidity and water quality problems. The *Integrated Catchment Management Plan for the Hunter Catchment* (DLWC 2002) identifies the proposed development site land as high priority for management of erodible soils within isolated areas and boundaries common with severe erosion outbreaks on highly erodible soils.

12.2.10 Acid Sulphate Soils

ASS maps generated for the state by the DNR indicate that there is no known occurrence of ASS in the vicinity of the proposed development site. Furthermore, due to the elevations of the site and the distance from coastal waters, it is considered unlikely that the ASS would be present in the vicinity of the proposed development.

12.2.11 Soil Contamination

Soil contamination can result from the actions associated with previous land uses where chemical concentrations have accumulated over time and pose significant health risks to potential new occupiers and to the environment.

A search of the EPA Contaminated Lands register records for known sites of contamination and previous studies for historical background information has revealed no occurrence of contamination on the Project Site that has required remediation or clean up. There is the potential that contamination may be uncovered or encountered during the construction activities that stems from historical use of the land including intensive agriculture, spills, previous development and unrecorded disposal.

12.3 Drainage

The Project Site is located in the Hunter River Basin, which covers an area of approximately 21 500 square kilometres. Development in the Hunter Region has resulted in significant changes to the drainage in the Hunter Basin including increased pollution sources, altered drainage lines and vegetation patterns, impediments to flows and damming of creek lines, and increased impermeable surfaces affecting quantity of flows.

In the vicinity of the Project Site, these altered drainage lines and patterns are a result of mining and power station development. Saltwater Creek lies to the immediate west of the Project Site and travels from north to south towards Plashett Dam, a constructed water body in the locality.

Saltwater Creek in the vicinity of the Project Site is severely degraded with significant erosion features present (refer to **Figure 12-1**, Plate 2). These include areas of sheet, rill and gully erosion and expanding drainage lines due to the highly mobile nature of the soils and extensive clearing.

It was noted that Saltwater Creek experiences significant flows in the vicinity of the Project Site. This is evident through layering in the creek bed soils which vary in thickness. No flood-outs or areas of overflow areas from Saltwater Creek were observed at the time of inspection. .

The proposed development site is well elevated above Saltwater Creek on gently sloping land that tends south east toward Saltwater Creek. The proposed project site is also well elevated and is above the 1% average recurrence interval (ARI) or 1 in 100 year flood level. Therefore, it is considered that the proposal site is not subject to inundation by either Hunter River or Saltwater Creek flooding.

12.3.1 Riparian Zones

Large areas of native riparian vegetation have been removed or degraded in the Hunter Central Rivers Region, including riparian vegetation of the Project Site. This has lead to instability and significant erosion impacts along the majority of creek lines and drainage areas in the locality (refer to **Figure 12-1**, Plate 3). The riparian zones of the Project Site are considered to be in a poor condition with significant erosion and water quality impacts. These issues can be attributed to the lack of suitable riparian vegetation on the banks of waterways.

Regeneration of native stream bank vegetation increases the stability of the stream bank. The roots of stream bank vegetation hold together the deeper soil and the parts of the plant above the ground protect the soil surface from the impacts of rain and wind. Stream bank vegetation also acts as a filter for runoff which carry with it sediment, nutrients and pollutants which decrease water quality in the stream.

12.4 Potential Impacts

12.4.1 Soils

Soil limitations identified by Kovac and Lawrie (1991) in the Liddell and Brays Hill Soil Landscapes that may have implications for the construction of the proposed Bayswater B project include:

- Structural degradation hazard (both soil landscapes);
- Erosion hazard (both soil landscapes);
- Erodibility (both soil landscapes);
- Soil salinity (both soil landscapes);
- Shrink swell potential (Brays Hill Soil Landscape only);
- Localised poor drainage (Liddell Soil Landscape only);
- Hardsetting surfaces (both soil landscapes); and
- Acidity (Liddell Soil Landscape only).

These soil limitations and the relevance to the proposed development are detailed in **Table 12-2.**

Table 12-2: Summary Soil Limitations and Implications for the Development

Soil Limitation	Liddell Soil Landscape	Brays Hill Soil Landscape
Structural Degradation Hazard This is the soils susceptibility to break down as a result of cultivation and may be present as surface crusting, hardsetting clods or formation of plough pans.	Within the Liddell Soil Landscape, the structural degradation classification is moderate to high. As a result of this classification, the proposed works may result in degradation of the soils and a reduction in load bearing capacity to a state which is unable to adequately support structures without suitable improvement or management. This may require measures such as piles and importation of fill material to ensure suitable foundations can be achieved. Observations at the site have identified a potential decreased load bearing capacity, through weakly pedal subsoils and high erosion potential. It is considered likely that the sodic soils located in the area of the Project Site pose a structural degradation hazard to the proposed development that would need to be managed through appropriate engineering to prevent mass movement of slab failure.	Within the Brays Hill Soil Landscape, the structural degradation classification is moderate to high on Solodic Soils. As a result of this classification, the proposed works may result in degradation of the soils and a reduction in load bearing capacity to a state which is unable to adequately support structures without suitable improvement or management. This may require measures such as piles and importation of fill material, to ensure suitable foundations can be achieved.

Soil Limitation	Liddell Soil Landscape	Brays Hill Soil Landscape
Erosion Hazard This refers to the susceptibility of the land to prevailing agents of erosion and is dependant on factors such as climate, landform, land use, soils and management activities.	Within the Liddell Soil Landscape the key erosion types are sheet, gully and rill erosion. They occur at differing scales across the Project Site and have the potential to impact on the usability of the land. Within the proposed development site, several occurrences of sheet and gully erosion were identified, mainly on the lowers lopes and flats (refer to **Figure 12-1**, Plate 4 and **Figure 12-2**, Plate 5). The majority of gully erosion occurs at the banks of the creek and drainage lines to the east and south of the development site. Sheet erosion is present on the floodplains and lower slopes within the development footprint, and in the vicinity of drainage lines. The majority of the landscape was not impacted by erosion features due to a good groundcover of grasses that reduce rainfall erosion and aid the infiltration of runoff The creek banks are generally in a poor condition with moderate to severe active gully erosion impacts along the majority of drainage lines in and around the development site (refer to **Figure 12-2**, Plate 6).	The implications for this on the development are the requirement for adequate erosion management plans and conservation measure to ensure no damage occurs to the development as a result of poorly managed soil erosion. This would include ongoing measure to minimise continued maintenance and monitor soil erosion at the site.

Soil Limitation	Liddell Soil Landscape	Brays Hill Soil Landscape
Erodibility *This refers to the susceptibility of the soil to detach and be transported as sediment through erosive agents*.	The proposed development site and surrounds has several areas of sediment deposition in the drainage channels and is likely to convey significant sediment loads in flood and high flow events. Site soil observations noted highly mobile surface and subsurface soils and sediment layering in Saltwater Creek shows significant deposition from upstream locations (refer to **Figure 12-2**, Plate 7). Several areas in the locality exhibit severe erosion due to highly erodible and highly mobile soils of the Liddell Soil Landscape. Unmanaged soil erodibility may lead to factors such as sheet erosion, sedimentation, undercutting of buildings and loss of topsoil material. Soils were identified as highly erodible when disturbed and mid slopes, lower slopes and drainage depressions contain highly dispersible soils. There was no evidence of mass movement during the site inspection and elevations and slopes were not indicative of landslips with no steep slopes present in the proposed development footprint	Within the Brays Hill Soil Landscape this is classified as low to moderate for Black Earths and moderate to high for Solodic Soils. This classification has implications for the construction and ongoing management of soils and would require inclusion of appropriate erosion and sediment control devices. Unmanaged soil erodibility may lead to factors such as sheet erosion, sedimentation, undercutting of buildings and loss of topsoil material.

Soil Limitation	Liddell Soil Landscape	Brays Hill Soil Landscape
Shrink Swell Soils	Not applicable for this soil landscape.	Shrink Swell Soils within the Brays Hill Soil Landscape are related to the Black Earths occurring on the development site and are a measure of the volume soil changes with a change in water content. The Black Earth Soils of the Brays Hill Soil Landscape are classified as high shrink swell potential, which means a variability in soil volume in the order of 17%-22% linear shrinkage (based on water content). Shrink Swell Soils may cause issues for foundations and soil conservation structures as a result of soil movement and hence cracking or pressure from soil expansion and contraction. Given the high potential for shrink swell occurrence in these soils, construction of infrastructure and buildings in the vicinity of Brays Hill Soil Landscape should be carefully engineered. The proposed structures in the vicinity of these soil types may include the coal stockpile area and conveyor.
Salinity *This refers to the availability and solubility of salts in the soil landscape. 4 dS/m at 25C is regarded as the defining characteristic of saline soils to adversely impact plant growth and land use.*	Within the Liddell Soil Landscape, salinity is evident through visible salting, impacts to plant growth and soil degradation. Soil salinity primarily related to dryland salinity are present at the Project Site and Saltwater Creek, which have resulted in adverse impacts to the soil structure and nearby creek lines (refer to **Figure 12-2**, Plate 8). Site observations noted mottling and salting precipitation in subsurface layers, vegetation impacts and soil degradation in and around the Project Site. It is considered highly likely that the majority of erosion at the site is related to soil salinity. The proposed development area has been identified as an area susceptible to salinity due to the nature of the soils and subsoils, and because of active salinity erosion.	Site observations noted mottling and salting precipitation in subsurface layers, vegetation impacts and soil degradation in and around the Project Site. It is considered highly likely that the majority of erosion at the site is related to soil salinity..

Soil Limitation	Liddell Soil Landscape	Brays Hill Soil Landscape
Localised Poor Drainage	*This refers to surface drainage impediments and can result in pooling and additional overland flows. This can impact development through water logging and excess water.* No occurrences of poor drainage were observed during the site inspection however, at the time of the site inspection it was noted that no significant rainfall had occurred in the preceding weeks and that the presence of groundcover at the site somewhat impeded identification of excess water or surface depressions. It is considered that there is the potential for some areas of localised poor drainage within the vicinity of the proposed development.	Not applicable for this soil landscape.
Hardsetting Surfaces *This is a condition of a dry surface where a hard compact pedal condition prevails. Due to this condition, excess runoff can occur and clods can result which usually retain structure until completely broken down by further tillage or erosion factors.*	Site observations noted isolated areas of hardsetting surface at the site, mainly associated with exposed surface areas. The presence of groundcover limited the visibility of the surface soils and as such there may be other areas of hardsetting surface soils at the site that have not been identified. The implications of this on site development may include excess overland flows and stormwater related impacts.	The implications of this on site development may include excess overland flows and stormwater related impacts. Management of soils and stormwater is an integral part of the proposed Bayswater B project and would be designed to minimise impacts on infrastructure and development on the landform. Compacted areas would require ripping to promote rehabilitation.
Acidity *Soils of the Liddell Soil Landscape can experience low pH levels (<5.3) which is termed acidity or acid soil. In acid soils problems such as aluminium toxicity, manganese toxicity and calcium deficiency may occur.*	This may impact plant growth and root nodulation resulting in declining plant and groundcover presence and increasing the potential for erosion and exposed soils. Correction of these issues is usually undertaken through the application of lime to increase soil pH levels. Implications for the development include increased erosion potential, loss of vegetative cover, and toxicity effects. These issues can alter management practices of the landscape and affect erosion and stormwater controls.	Not applicable for this soil landscape.

Soil Limitation	Liddell Soil Landscape	Brays Hill Soil Landscape
Other Factors	No instances of soil wet bearing strength, shrink swell soils or stony soils have been observed at the Project Site, nor have they been recorded in the Liddell Soil Landscape. However, it should be noted that the presence of stony soils is commonly linked to conglomerates which are present in the area and in adjacent soil landscapes. As such there is the potential for isolated areas of stony soils, particularly in the western boundaries of the Liddell Soil Landscape where it meets the Brays Hill Soil Landscape. This may result in impacts to engineering strength and requirements for design characteristics to accommodate movement in infrastructure.	Shrink swell soils have been recorded in the adjacent Brays Hill Soil Landscape which may influence activities along this soil landscape boundary through impediments to excavation and altered soil structure. Impacts of wet bearing strength, shrink swell soils and stony soils may occur along the eastern boundary of the Brays Hill Soil Landscape where it meets the Liddell Soil Landscape. This may result in impacts to engineering strength and requirements for design characteristics to accommodate movement in infrastructure.

12.5 Management and Mitigation

The potential impacts of the site preparation, construction and operation activities on the soils and landscape of the subject site include potential soil erosion, soil compaction, changes to runoff and drainage patterns, potential increases to salinity, weeds and modification to land use. These potential impacts result from activities such as removal of vegetation and topsoil and subsoil materials, earthworks, stockpiling of materials, riparian crossings and the movement of heavy vehicles, and can be exacerbated by factors such as wind and rainfall.

Mitigation of potential construction impacts is primarily associated with the management of erosion and sedimentation at the site and minimising potential disturbances to soils.

Impervious surfaces would increase as a result of the proposed project, thereby increasing the potential for soil erosion to occur from altered runoff patterns. Access roads, stockpile areas and switchyards may result in impediments to flows and may therefore result in additional salinity discharge sites .

Following the completion of construction the Project Site and surrounding areas would be landscaped and the development footprint managed to minimise soil sediment and erosion impacts. Given the appropriate implementation of standard soil and erosion mitigations measures and site rehabilitation works, it is considered that the operational phase of the proposed project would not significantly affect the short term soil and stability of the area; however ongoing monitoring and land management activities would be required to address issues such as acidity and soil salinity in the area.

12.5.1 Soils

Impacts associated with construction of the proposal on existing soils and landscape are able to be managed through appropriate planning and engineering, and with adequate mitigation measures including:

- Implementation of the principals of soil and water management for erosion and sediment control as outlined in Landcom (2004) during development;
- Preparation of a long term management plan to address potential issues such as salinity, erosion and acidity.

12.5.2 Soil Salinity

Sodic Soils are common in the Project Site and are identified as a key soil type for the impacts of salinity. These soils can be treated chemically by the addition of organic matter and by changing cropping practices to minimise the potential impacts of salinity. However, when saline-Sodic Soils are treated for salinity and salts are removed from the soil, the soil can become dispersive (DECC 2008).

To avoid dispersion of soils Book 4: Dryland Salinity (DECC 2008) indicates the treatment of these soils should be as follows:

- The soil electrical conductivity (EC) needs to be maintained by the addition of gypsum at 1.5 - 2.5 tonnes per hectare. Gypsum also improves soil structure and reduces soil crusting. In some cases, small amounts of gypsum can be added on a regular basis, for example, 0.5 - 1 tonnes per hectare per year.
- Lime can also be used to maintain soil EC but is less effective because its solubility is lower than that of gypsum, although it does last longer in the soil. Soils with high clay content require higher levels of lime or gypsum.
- Do not mix subsoil with topsoil;
- Reduce tillage and maintain surface cover.

Other management options for the Project Site would include a rehabilitation plan and revegetation which may reduce the occurrence of salinity outbreaks, and decrease the amount of available salt in the groundwater.

12.5.3 Erosion and Sediment

Management measures that would be implemented as part of the proposed development include the restriction and management of works in the vicinity of drainage lines and creek areas, implementation of adequate erosion and sedimentation controls including construction and operational phases and rehabilitation where required. A Soil and Water Management Plan (SWMP) would be prepared and implemented for both the construction and operation phases of the Project.

Given the nature of Sodic Soils on the site, disturbance should be minimised wherever possible to retain soil structure and foundation integrity. Where erosional impacts can be attributed to a specific soil related factor (such as salinity, acidity, shrink swell soils, etc) management measures should be targeted at the source of the issue to prevent recurrence and long term management issues.

For the purposes of this assessment the general principals of soil and water management in Landcom (2004) are considered appropriate to guide future development in the area. These include:

- Assess the soil and water implications of development planning stage, including those relating to ecologically sustainable development (ESD). Investigate the salinity and the acid sulfate potentials of the soils where their disturbance is likely to expose and/or exacerbate the problem;
- Plan for erosion and sediment control concurrently with engineering design and before earthworks begin, ensuring proper assessment of site constraints and integration of the various components. A Soil and Water Management Plan would be required addressing soil erosion and sediment pollution, including a calculation as to the need for a sediment basin;
- Minimise the area of soil disturbed and exposed to erosion; Conserve topsoil for later site rehabilitation/revegetation;
- Control water flow from the top of, and through the development area; Work associated with drainage areas should be undertaken during the period of less intense rainfall (generally 1 June –15 November)
- Rehabilitate disturbed lands quickly; Including temporary erosion control earthworks and revegetation, and
- Maintain soil and water management measures appropriately during the construction phase, including during periods of both wet and dry weather.

12.5.4 Rehabilitation

A programme of rehabilitation is proposed as part of the project to ensure that pre-operational land uses are restored following completion of works. Rehabilitation works would primarily be undertaken to restore the landscape on completion of construction and for activities in the vicinity of drainage or creek lines. The aim of the rehabilitation works would be to minimise the potential for erosion and sedimentation impacts, to restore the visual appearance of the landforms to that of the pre-development phase and to manage potential impacts associated with sodic and saline soils.

Environmental safeguards would be implemented during all phases of rehabilitation to minimise potential impacts on the environment. Environmental safeguards would form part of a Rehabilitation Management Plan which could be incorporated into an Environmental Management Plan to be implemented for the proposed works, and would generally include the following:

- Ground disturbance during rehabilitation would be minimised as far as practicable;
- Installation and maintenance of sediment and erosion control measures, such as silt fencing surrounding exposed areas and stockpiles;
- Soil and mulched vegetation would be stockpiled during the construction period where possible to be reused during the initial rehabilitation phase. Topsoil and subsoil would be replaced in an appropriate order;
- Surfaces would be re-contoured to match the surrounding land and natural drainage lines would be re-instated;
- Where revegetation is to be undertaken, native endemic species would be utilised.
- Where surrounding land use is agricultural, consultation would be undertaken with the land owner to determine the appropriate level of crop cover for the rehabilitated area.

It should be noted that if the gas fired option were chosen, detailed design would confirm the extent of watercourse crossings by the proposed gas pipeline, which would be assessed as part of further approvals. The CEMP for the gas fired option would then incorporate specific measures with respect to soil and water management along the pipeline route.

12.5.5 Rehabilitation of Watercourse Crossings

Watercourses affected by the construction would be rehabilitated as soon as possible following disturbance to near original condition and provided with scour and erosion protection. During construction, stabilisation requirements for banks and beds would be determined on a site specific basis. Local consideration of hydrology, soil type, land use and riparian vegetation would be undertaken to determine the most appropriate method. The following measures would be observed:

- Watercourse banks would be restored to their original profiles following construction;
- Stabilisation techniques such as the placement of rip rap, sand bags or gabion along the banks and bed at watercourse crossings shall be implemented as required to reinstate near original conditions;
- Fencing would be installed where required to prevent access to restored sites to assist site recovery;
- Site specific requirements for additional sediment and erosion control measures during and following rehabilitation may include terracing and surface water diversion berms, silt and sediment fences, re-seeding and replanting, application stabilisation materials such as mulch, jute matting or other geotextile, minimising access, and application of appropriate soil management controls; and
- Topsoil excavated during construction would be stockpiled appropriately on site and reused along banks during rehabilitation to assist in bank stabilisation.

12.5.6 Drainage lines

Where possible, construction activities would avoid drainage lines and Saltwater Creek due to the highly dispersible nature of the soils and the increased potential for erosion and foundation instability in these areas. This would include the creek bed and banks as well as the associate riparian areas of the drainage line / creek line.

12.6 Conclusion

If all mitigation and management measures are observed, there would be no residual impacts affecting the land capability or natural environment (from secondary or down stream impacts).

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1. Landform of the Project Site

2. Erosion at the Project Site

3. Deposition in Saltwater Creek

4. Salinity impacts in nearby Creeklines

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LAND CAPABILITY PHOTOGRAPHS (1 - 4) OF THE PROJECT SITE

Environmental Assessment

Bayswater B Power Station

Figure 12.1

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5. Sheet Erosion

6. Gully Erosion in Creeklines

7. Saltwater Creek

8. Erosion in Creeklines

AECOM

LAND CAPABILITY PHOTOGRAPHS (5 - 8) OF THE PROJECT SITE

Environmental Assessment

Bayswater B Power Station

Figure 12.2

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