HANCOCK PROSPECTING PTY LTD

Alpha Coal Project Environmental Impact Statement

16 Waste

Section 16 Waste

16.1 Introduction

This section of the Environmental Impact Statement (EIS) provides details about waste streams, waste quantities, and management practices to be implemented to protect environmental (biophysical and social) values from the impacts of waste generation throughout the life of the Alpha Coal Project (Mine) (referred to as the Project), including the construction and operational phases of the Project. This section is divided into two components: general waste and mine waste (waste rock, both rejects and tailings).

Waste management associated with construction and operation of the Rail Loop is discussed in Volume 3, Section 16 of the EIS.

16.2 General Waste Management

16.2.1 Regulatory Requirements

The regulatory requirements relevant to management of general waste in Queensland are discussed in the following sections.

16.2.1.1 Commonwealth Requirements

Annual reporting of Project waste emissions to land, air and water will be conducted in accordance with the National Pollutant Inventory (NPI) Guide managed by the Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) (DEWHA, 2010). The NPI framework establishes a 'trigger' threshold for usage of various substances. If more than the trigger amount of a substance is used, then emissions of that substance must be reported under the NPI.

Reporting on relevant Project activities will be conducted in accordance with the most current relevant Emission Estimation Technique Manuals for specific activities. Emissions will be reported to DSEWPC and be made publicly available on the NPI database at www.npi.gov.au.

Reporting requirements under the *National Greenhouse and Energy Reporting Act 2007* (NGER Act) are discussed in Volume 2, Section 14.

16.2.1.2 State Requirements

Waste management in Queensland is governed by the Environmental Protection Policies (EPP) and Regulations under the *Environmental Protection Act 1994* (EP Act). Specific waste management legislation includes the *Environmental Protection (Waste Management) Policy 2000* (EPP [Waste]) and the *Environmental Protection (Waste Management) Regulation 2000* (Waste Regulation). Together with the *Environmental Protection Regulation 2008* (EPR) and the *Environmental Protection (Water) Policy 2009* (EPP [Water]), these provide the legal and strategic framework for managing waste in Queensland.

The EPP (Waste) provides a strategic framework for managing wastes by establishing a waste management hierarchy that identifies the following waste management practices in the preferred order of adoption. This hierarchy includes:

- Waste avoidance;
- Waste re-use;
- Waste recycling;
- Energy recovery from waste; and
- Waste disposal.

The EPP (Waste) also requires that *'cleaner production'* be considered in determining how waste is managed. A cleaner production program is defined in the EPP (Waste) to identify and implement ways of improving a production process so that the process:

- Uses less energy, water or another input; or
- Generates less waste; or
- Generates waste that is less environmentally harmful.

Certain waste management activities including disposal and transport of waste are considered to be environmentally relevant activities (ERA) and require approval of the Queensland Department of Environment and Resource Management (DERM) and local government. The Waste Regulation also contains requirements for handling specific waste streams.

Certain "regulated wastes" are considered 'trackable wastes' (Section 17 of the Waste Regulation). The Waste Regulation provides a process to allow such wastes to be tracked from the point of generation to the point of final processing, recycling or disposal. Examples of such waste include:

- Organic solvents, other than halogenated solvents;
- Oil and water mixtures or emulsions, or hydrocarbons and water mixtures or emulsions;
- Tyres; and
- Waste of an explosive nature, other than an explosive within the meaning of the *Explosives Act 1999*.

16.2.1.2.1 Waste Definition

The EP Act (Section 13) defines 'waste' as anything that is:

- Left over, or an unwanted by-product, from an industrial, commercial, domestic or other activity; and
- Surplus to the industrial, commercial, domestic or other activity generating wastes.

The EPR defines 'general waste' as waste other than "regulated" waste. Section 65 of the EPR defines 'Regulated waste' as waste that:

i. Uses less energy, water or another input is commercial or industrial waste, whether or not it has been immobilised or treated; and
ii. Is of a type, or contains a constituent of a type, mentioned in schedule 7 (of EPR).

16.2.1.3 Local Authority Requirements

The Project area is located within the Barcaldine Regional Council (BRC) Local Government Area. Prior to Queensland's local government amalgamations on 15 March 2008, it was under the jurisdiction of Jericho Shire Council (JSC). Requirements of the JSC Planning Scheme 2006 have been considered with regards to the development of the Project's waste management strategy.

16.2.2 Project Waste Streams

The characterisation of waste streams for the Project was based on the current design of the various Project components, ranging from the site preparation phases through to the construction and operational phases.

The characteristics of general waste streams were determined on the basis of current Project requirements and on similar construction works and operations undertaken on projects of this type and scale.

16.2.2.1 Early Works and Construction Phase

The description of the Project (refer to Volume 2, Section 2) discusses the planned activities during early works, site preparation and construction phases.

Waste generated during the early works phase will primarily be associated with works relating to construction of the initial construction accommodation village. Waste from any early works and the initial construction activities will be segregated for recycling and/or reuse purposes wherever possible, with the balance disposed of at the existing BRC landfill facility. An on-site landfill will be established at the start of the construction phase following grant of the mining lease.

Waste generated during the site preparation phase will be associated with works inside and immediately adjacent to the mining lease area, including:

- Construction of the accommodation village;
- Removal, relocation or demolition of existing structures;
- Vegetation clearing;
- Bulk earthworks; construction of the mine access to the accommodation village and Mining Infrastructure Area (MIA);
- Provision of water, wastewater, power and communications services; and
- Construction of security facilities.

Wastes generated during the construction phase will be from civil earthworks, concrete batching, structural components, general waste, packaging and structural fit-out.

The quantity of site preparation and construction waste for the main construction period of approximately two years was quantified through application of the following methods and data sources:

- Self-assessed wastage rates for building services (Queensland Environmental Protection Agency [EPA], 2002) as a percentage of the incoming construction materials for the Project allowing for defects, damage during transportation, off-cuts, etc.
- Composition of construction waste for the housing sector (EPA, 2002) and adjusted to reflect that some waste materials will be diverted from the Project waste stream and managed on-site, including earthen fill and green waste, and other materials generated at lower levels compared to the housing sector, including bricks, pavers and plasterboard.

- Publicly available waste data for similar large mines.

The quantities, presented in Table 16-1, provide a preliminary estimate of waste quantities during the construction phase of the Project. Not all waste is expected to require landfill disposal due to on-site reuse/recycling and disposal initiatives, with Table 16-2 indicating management options for various waste streams. Off-site prefabrication of most concrete and metallic structures is expected to further reduce wastage rates from the Project site.

16.2.2.2 Early Works Waste Inventory

Wastes will be generated during the early works phase (approximately one year) prior to grant of the mining lease. The envisaged waste streams generated during this phase are described below.

16.2.2.2.1 Green waste

Green waste includes all vegetation cleared. The volume generated is expected to be low as much of the land has been significantly cleared by past land uses (agriculture and cattle grazing). Potential impacts related to the generation of green waste from clearing of native vegetation are discussed in Volume 2, Section 9 (Terrestrial Ecology). Vegetation cleared during early works will follow requirements set out in the Project-specific Environmental Management Plan (refer to Volume 2, Section 26) in order to minimise vegetation loss and therefore the amount of green waste produced.

16.2.2.2.2 Building wastes

Construction of the initial construction accommodation village is expected to generate concrete, metals, timber and other general building wastes. It is intended that the initial construction accommodation village components will be modularised and pre-fabricated and therefore unlikely to generate significant amounts of waste.

16.2.2.2.3 General municipal wastes

There are not expected to be large quantities of general municipal wastes generated during early works. Storage of waste will be in skips or other suitable containment prior to disposal to the BRC landfill. Where feasible, wastes will be segregated to facilitate recycling.

16.2.2.2.4 Sewage effluent

Sewage generated during early works will be collected from the portable units using a temporary pipe system and stored in an underground tank (similar to a septic tank), pumped out into a truck-mounted tank for transportation and discharge to an existing BRC township sewage treatment works located at Alpha or Jericho.

16.2.2.2.5 Hazardous waste

Hazardous waste materials will be identified by audit and investigation prior to the upgrading or demolition of existing structures. Waste materials deemed hazardous will be isolated and removed off-site by licensed contractors.

Table 16-1: Construction waste inventory for total construction period

Waste material	Waste sources	Basis of calculation	Units	Estimated Quantity*	Management Strategy
Green waste	Clearing of vegetation during early works and construction phase of mine	Total vegetation to be cleared, including remnant and regrowth vegetation, during early works and construction is approximately 4,500 ha (refer to Volume 2, Section 9 Terrestrial Ecology). Assumed 20% of total disturbance area occurs during this phase. Biomass per ha = 180 tonnes, including above and below ground (Westman & Rogers, 1977).	tonnes	810,000	Suitable material to be used on-site to provide fauna habitat. Remaining material to be chipped and mulched for reuse during progressive rehabilitation and revegetation. Burning of green wastes will only occur as a last resort, subject to obtaining necessary permits and approvals.
Cardboard and paper	Construction activities, contractor crib rooms, offices, accommodation facilities	Includes construction paper and cardboard. Assume 10-15% mass equivalent of total construction waste stream, based on composition of residential and construction waste (EPA, 2002) and adjusted for the Project.	tonnes	2,200	Segregation of paper and cardboard for removal off-site for recycling where possible by a licensed recycling or waste contractor.

Waste material	Waste sources	Basis of calculation	Units	Estimated Quantity*	Management Strategy
Plastics	Contractor crib rooms, offices, accommodation facilities, construction activities	Assume 5% mass equivalent of total construction waste stream, based on composition of residential and construction waste (EPA, 2002) and adjusted for the Project.	tonnes	720	Segregation of plastics for removal off-site for recycling where possible by a licensed recycling or waste contractor.
Glass	Contractor crib rooms, offices, accommodation facilities, construction activities	Assume 2% mass equivalent of total construction waste stream, based on composition of residential and construction waste (EPA, 2002) and adjusted for the Project.	tonnes	235	Segregation of glass for removal off-site for recycling where possible by a licensed recycling or waste contractor.
Metals	Construction of structures for the mine industrial area and accommodation facilities	Assumes upper limit of 10% mass equivalent of total on-site construction metal materials, based on self-assessed wastage rates for building services (EPA, 2002).	tonnes	800	Segregation for reuse on-site, otherwise removal off-site to a recycling facility or disposal at a licensed waste disposal facility by a licensed recycling or waste contractor.
Processed timber and wood	Left-over from new construction and deconstruction of existing structures and temporary construction phase structures	Assume 15-20% mass equivalent of total construction waste stream, based on composition of residential and construction waste (EPA, 2002) and adjusted for the Project.	tonnes	2,600	Reused if possible, either on- or off-site. Where reuse is not possible, processed timber and wood to be disposed of to the on-site landfill. If hazardous materials are present, such as lead-based paints, asbestos or timber treatment chemicals, specialist handling and off-site disposal will be undertaken.

Waste material	Waste sources	Basis of calculation	Units	Estimated Quantity*	Management Strategy
Concrete materials, bricks and pavers	Left-over from new construction and deconstruction of temporary construction phase structures	Assume 0.5% mass equivalent of total on-site construction concrete materials, based on self-assessed wastage rates for concrete trades (EPA, 2002). Assumes one tonne (t) of cement equates to 6 t of concrete.	tonnes	2,950	Concrete and other masonry material to be used as clean fill or removed from site for clean fill or crushed aggregate recycling if possible, otherwise disposed of to the on-site landfill.
Electrical wastes	Contractor crib rooms, offices, accommodation facilities, and mine, CHPP and infrastructure facilities	Assume 2% mass equivalent of total construction waste.	tonnes	725	Segregation of electrical wastes for removal off-site for recycling or reprocessing where possible by the waste contractor.
General putrescible wastes	Contractor crib rooms, offices, accommodation facilities	Data sourced from other operating coal mines and scaled for the Project based on size of the construction workforce (adopted average of 1,400 per month) plus 25% to allow for potential inefficiencies in recyclable waste segregation.	tonnes	10,400	General refuse to be collected in covered bins and removed at least once a week to the on-site landfill during construction phase.
Batteries	Mobile phones, radios, vehicles, equipment, etc.	Data sourced from other operating coal mines and scaled for the Project based on the size of the construction workforce.	tonnes	330	Mobile phone, radio and other batteries to be segregated and then collected by a licensed waste contractor for reuse, reprocessing, recycling or disposal.

Waste material	Waste sources	Basis of calculation	Units	Estimated Quantity*	Management Strategy
Oils (synthetic and mineral)	Routine servicing of vehicles and equipment at designated hardstand areas near the construction office facilities. Construction and assembly of draglines and other mining equipment, and first fuel for CHPP equipment.	Data sourced from operating coal mines and scaled for the Project based on size of the construction workforce.	tonnes	9,000	Waste oil to be removed from machinery in workshops using pneumatic pumps and oil transferred to bunded waste oil holding tank for collection by a licensed contractor for reuse, reprocessing, recycling or disposal.
Other hydrocarbon and hydrocarbon contaminated materials	Routine servicing of vehicles and equipment at designated hardstand areas near the construction office facilities. Construction and assembly of the draglines and other mining equipment.	Data sourced from other operating coal mines and scaled for the Project based on size of the construction workforce. Assumed to include regulated waste.	tonnes	9,200	Stored in bunded areas then removed by licensed contractor for reuse, reprocessing, recycling or disposal.
Empty waste oil containers	Small and bulk drums and containers that typically contained oils and greases				Empty drums to be stored in a covered, sealed and bunded area with enclosures in place for periodic collection by a licensed waste contractor for reuse, reprocessing, recycling or disposal.

Waste material	Waste sources	Basis of calculation	Units	Estimated Quantity*	Management Strategy
Sealants, resins, solvents and paint materials	Construction of the MIA, accommodation facilities and conveyors, assembly and maintenance of vehicles and equipment. Construction and assembly of draglines, other mining and CHPP equipment.				Stored in bunded areas then removed by licensed contractor for reuse, reprocessing, recycling or disposal.
Other regulated waste	Deconstruction, maintenance and construction activities				All regulated wastes will be collected and removed by a specialised licensed waste contractor/s or specialist maintenance personnel. Tracking of all regulated wastes will be undertaken.
Asbestos	Deconstruction of existing structures	Presence of existing materials to be identified by audit and investigation in advance of upgrade or demolition works.	tonnes	TBD	Asbestos will be removed and disposed of by a specialist contractor.
Tyres	Maintenance of vehicles	Assume construction vehicle fleet comprises 56 heavy vehicles requiring annual tyre change.	Number	770	Tyres will be removed by the tyre supplier for reprocessing, otherwise tyres will be stored and appropriately disposed of once mining operations commence by burying in the mine overburden in a designated location which will be identified on the EMR managed by DERM.
		Assume construction vehicle fleet comprises 210 light vehicles requiring tyre change once every two years.	Number	980	

Waste material	Waste sources	Basis of calculation	Units	Estimated Quantity*	Management Strategy
Sewage effluent	Contractor offices, crib room, accommodation facilities	Assumed 24 months construction using projected wastewater generation by the Project construction personnel.	kilolitres	283,900	Provision of dedicated WWTP facilities during construction (pump-out system) until pipeline connection to permanent WWTP is made available.
WWTP sludge	WWTP	Volumetric fraction of solids in the sewage effluent for the WWTP, assuming 24 months of construction using projected sludge generation by the Project construction personnel.	tonnes	85	Sludge to be collected by a licensed waste contractor and taken to a licensed waste disposal facility.

Provided by the Proponent, (from Parsons Brinkerhoff, 2010)

16.2.2.3 Construction Phase Waste Inventory

The following wastes are likely to be generated during the construction phase (approximately two years), which will commence following the grant of the mining lease.

16.2.2.3.1 Green waste

Green waste includes all vegetation cleared across the mining lease area associated with Project construction. The quantity of green waste generated is expected to be low as the land has been significantly cleared by past land use practices. The potential impacts of green waste are discussed in Section 16.2.2.2.1.

16.2.2.3.2 Building wastes

Construction of the MIA and other Project buildings is expected to create concrete, masonry, metals, timber and other general building wastes. Whilst it is intended that most accommodation village components will be modularised and pre-fabricated and therefore unlikely to generate significant wastes, building wastes generated as a result of total Project construction requirements are conservatively estimated, for the purposes of the EIS, as equating to approximately 10 percent of the total building materials required, allowing for defects, damage during transportation and off-cuts.

16.2.2.3.3 General municipal wastes

General municipal wastes will be generated from the construction accommodation village; mechanical, electrical and structural material handling equipment; piping; and management facilities, and will typically comprise food scraps, paper and cardboard, glass, aluminium cans, plastics and packaging. Where feasible, these wastes will be segregated to facilitate recycling, by the provision of recycling bins around the construction accommodation village, site offices and amenities. Residual (non-recyclable) waste would be disposed of to the on-site landfill.

16.2.2.3.4 Sewage effluent

Sewage will be generated from the construction management facilities and construction accommodation village. During construction of these facilities, sewage will be discharged to a temporary package Wastewater Treatment Plant (WWTP), which will be decommissioned at the end of the Project’s construction stage.

All sewage waste generated during the Project is to be collected and treated to Class A effluent quality on-site. Waste from the MIA, Coal Handling and Preparation Plant (CHPP) and accommodation village will be collected and conveyed to the WWTP and the effluent disposed of on-site by recycling or possibly irrigation. Waste from the remote dragline construction site, train load-out facility (TLO) and ammonium nitrate fuel oil (ANFO) facility will be collected in septic tank systems and the effluent disposed of by trickle irrigation or evapo-transpiration trenches. Solids from septic tank systems will be removed by a contractor on a regular basis to a BRC township sewage treatment works located at Alpha or Jericho.

16.2.2.3.5 Hydrocarbon waste

Hydrocarbon contaminated wastes during construction will be limited and will comprise used solvents, oils and lubricants produced from dragline, mobile equipment and CHPP construction, minor vehicle maintenance and (possibly) minor leaks from refuelling operations. Hydrocarbon wastes are generally regulated and are discussed in Section 16.2.2.3.6.

16.2.2.3.6 Regulated waste

Some minor vehicle and earthmoving equipment maintenance activities will occur on-site as required during the construction stage.

"Regulated waste" may include used or surplus:

- Tyres;
- Hydrocarbons (principally lubrication oils);
- Oil filters;
- Batteries; and
- Solvents and paints.

These wastes will be disposed of as follows:

- Tyres will be either removed by the tyre supplier for reprocessing, or stored and appropriately disposed of once mining operations commence by burying in the mine overburden in a designated location that will be identified on the Environmental Management Register (EMR) managed by the Department of Environment and Resource Management (DERM).
- Hydrocarbon wastes, including filters, solvents and paints, will be collected into suitably bunded waste storage tanks or other suitable containment devices and disposed of off-site by a licensed contractor for reprocessing, recycling or final disposal.
- Batteries will be stored in a central bunded facility, and collected and disposed of off-site by a licensed contractor for reprocessing, recycling or final disposal.

The Proponent will keep detail records of waste removed from site. Documentation will include final waste processing including recycling or final disposal.

16.2.2.4 Operational Phase Waste Inventory

General operations will require continual clearing of vegetation, earthworks associated with ongoing mine development, maintenance of mobile and fixed plant, administration activities, operation of the accommodation village, operation of water treatment plant, operation of sewage treatment plant, operation of CHPP, blasting, rehabilitation, and maintenance of associated infrastructure. The Project Description in Volume 2, Section 2 describes the planned activities during the operational phase over the 30-year Project life.

The indicative quantities of operational stage wastes were estimated generally in accordance with the sources outlined in the following sections and are presented in Table 16-2. Other data sources are referenced where relevant. These data were unitised on the basis of Run of Mine (ROM) coal tonnes and then scaled for the Project, i.e. 41 million tonnes ROM per annum (Mtpa) coal.

The figures presented in Table 16-2 provide a conservative estimate of waste quantities during the operational phase of the Project, as not all waste is expected to require off-site disposal due to on-site reuse/recycling and disposal initiatives. Management options for various waste streams are also indicated.

16.2.2.4.1 Green Waste

Some further clearing resulting from ongoing construction activities will be undertaken, particularly associated with construction of supporting infrastructure, such as heavy vehicle roads. The volume of green waste generated is expected to be relatively low as the land has been cleared by past land use practices. The potential impacts of green waste are discussed in Section 16.2.2.2.1.

In particular, large vegetation materials such as hollow logs and hollow-bearing trees will be stockpiled for use in rehabilitation activities or placed in adjoining bushland.

16.2.2.4.2 Sewage Effluent

Sewage will be generated from the operational management facilities and accommodation village. Sewage waste will be collected and treated as described in Section 16.2.2.3.4.

16.2.2.4.3 Hydrocarbon Waste

Hydrocarbon contaminated wastes will comprise used solvents, oils and lubricants produced from the vehicle and dragline maintenance workshops, vehicle washdown, and minor leaks from refuelling operations.

16.2.2.4.4 Regulated Waste

“Regulated waste” generated during the operation of the Project will be similar to that generated during construction and managed accordingly, as described in Section 16.2.2.3.6.

Laboratory testing and process measurement wastes will also be generated during the operation phase. These wastes will be handled in accordance with recognised industry best practices, typically by designated maintenance contractors, and stored, handled and disposed of to a designated licensed waste facility for reprocessing, recycling or final disposal.

16.2.2.5 Decommissioning Phase Waste Inventory

Decommissioning of the site would involve deconstruction and removal of unsafe buildings, and ensuring any structures which remain on-site are suitable for their final intended use. Conservatively, the decommissioning phase was assumed to take up to two years – the actual timing would be confirmed with regulators prior to the decommissioning works being carried out.

At this stage in the Project, the quantity of waste materials likely to be generated during this phase is uncertain given the number of buildings and associated structures to be removed or that will remain on-site is unknown. For the purposes of the EIS, it has been assumed that the waste types, quantity and associated waste management measures during the decommissioning phase, would be the same as the construction phase as described in Section 16.1.1.1.

Prior to the decommissioning works being carried out a detailed waste management plan would be prepared to confirm the estimated types, quantities and waste management measures implemented during this stage.

Table 16-2: Operational phase waste inventory (annualised)

Waste material	Waste sources	Basis of calculation	Units	Quantity/ annum	Management Strategy
Green waste	Clearing of vegetation for ongoing development of the mine	Total cleared vegetation, including remnant and regrowth vegetation, less construction phase clearance = 18,000 ha or 600 ha/annum (refer to Volume 2, Section 9 Terrestrial Ecology) Biomass per ha = 180 t, including above and below ground (Westman & Rogers, 1977).	tonnes per year	108,000	Suitable material to be reused on-site to provide fauna habitat. Remaining material to be chipped and mulched for reuse during progressive rehabilitation and revegetation. Burning of green waste will only occur as a last resort, subject to obtaining permits and approvals.
General and putrescible wastes	Contractor crib rooms, accommodation facilities, administration building, warehouse, workshops, CHPP	Data sourced from operating coal mines and scaled for the Project.	tonnes per year	6,200	General refuse to be collected in covered bins and removed to the on-site landfill at least once a week.
Non-hazardous waste	Contractor crib rooms, accommodation facilities, administration building, warehouse, workshops, CHPP	Includes paper and cardboard, glass and recyclable plastics. Data sourced from operating coal mines and scaled for the Project.	tonnes per year	1,300	Segregation of paper and cardboard, glass and recyclable plastics for removal off-site for recycling by waste contractor where possible.
Scrap metal recycled	Contractor crib rooms, accommodation facilities, administration building, warehouse, workshops, CHPP, maintenance and fabrication of machines and equipment and the replacement of machinery parts.	Data sourced from operating coal mines and scaled for the Project.	tonnes per year	2,000	Metal will be segregated using marked bins for metal and aluminium; bin sizing would depend on location. Bins will be regularly monitored and serviced by the recycling contractor.

Waste material	Waste sources	Basis of calculation	Units	Quantity/ annum	Management Strategy
Batteries	Mobile phones, radios, vehicles, equipment, etc	Data sourced from operating coal mines and scaled for the Project.	tonnes per year	105	Mobile phone, radio and other batteries to be segregated and then collected by a licensed waste contractor for reuse, reprocessing, recycling or disposal.
Oils (synthetic and mineral)	Routine servicing and shutdown overhaul of vehicles and equipment in workshops, including synthetic and mineral oils	Data sourced from operating coal mines and scaled for the Project.	tonnes per year	2,850	Waste oil will be evacuated from machinery in the workshop using pneumatic pumps and the oil will be transferred to waste oil holding tanks. These tanks will be in a bunded area. The waste oil will be reprocessed by a licensed contractor.
Grease	Waste grease from the accommodation facility kitchens, workshop, shutdowns and dragline maintenance			Not available	Waste grease will be placed in a bunded storage container. Waste grease will be collected periodically by a licensed waste contractor for reuse, reprocessing, recycling or disposal.
Hydrocarbons and hydrocarbon contaminated materials	Routine servicing and shutdown overhaul of vehicles and equipment in workshops and maintenance facilities, refuelling and fuel storage facilities. Construction and assembly of draglines and other mining equipment.	Data sourced from operating coal mines and scaled for the Project. Assumed to include regulated waste.	tonnes per year	2,900	Stored in bunded areas then removed by licensed contractor for reuse, reprocessing, recycling or disposal.
Empty waste oil containers	Small and bulk drums and containers that typically contain oils and greases.				Empty drums to be stored in a covered, sealed and bunded area with enclosures in place for periodic collection by a licensed waste contractor for reuse, reprocessing, recycling or disposal.

Waste material	Waste sources	Basis of calculation	Units	Quantity/ annum	Management Strategy
Sealants, resins, solvents and paint materials	Routine servicing and shutdown overhaul of vehicles and equipment in workshops, operation and maintenance of conveyors, draglines and other mining equipment.				Stored in containers in bunded areas then removed by licensed contractor for reuse, reprocessing, recycling or disposal.
Oil and air filters	Routine servicing and shutdown overhaul of equipment in the workshop.				Stored in containers in bunded areas then removed by licensed contractor for reuse, reprocessing, recycling or disposal.
Blasting residue (from use of ANFO explosive, boosters and detonator)	Blasting of overburden	Quantity of ANFO sourced from Proponents' design calculations for the Project. Assume 40% mass equivalent of explosive forms waste residue (Kelleher, 2002).	tonnes per year	27,500 average	Fragments to be buried in overburden stockpiles.
Tailings (including process water)	Coal handling, preparation and processing	Refer to Section 16.3.	tonnes per year	2.5 million	Fine particulates from the coal processing will be disposed of to the tailings dam in slurry form. Tailings will be capped following suitable drying of materials. The area of the tailings dam will then be rehabilitated and revegetated. After a period of operation, in-pit disposal options will be investigated in discussion with regulator.
Coarse rejects	Coal handling, preparation and processing	Refer to Section 16.3.	tonnes per year	6.6 million	Disposal will be into designated in pit emplacement above groundwater level. If possible, some coarse rejects may be used for civil works, such as haul road construction depending on the characteristics of the coarse rejects.

Waste material	Waste sources	Basis of calculation	Units	Quantity/ annum	Management Strategy
Discharge from vehicle washdown	Vehicle washdown facilities at MIA	Assume daily discharge from washdown facilities: • Heavy vehicle = 810 kL; and • Light vehicle = 140 kL.	kilolitres per year	346,750	Vehicle washdown water and associated contaminants will be collected and put through a hydrocarbon separator. Hydrocarbon emulsion will be disposed of by a licensed contractor as a regulated waste, clarified waters will be discharged to a holding dam, and sediments will be disposed of to the tailings dam.
Tyres	Maintenance of vehicles	Assume wheeled operational vehicle fleet of 230 heavy and medium vehicles requiring annual tyre change. Assume operational vehicle fleet of 123 light vehicles requiring tyre change once every two years.	number per year number per year	1,450 230	If possible, tyres will be removed by the tyre supplier for reprocessing; otherwise tyres will be stored and appropriately disposed of by burying in the mine overburden in a designated location which will be identified on the EMR managed by DERM.
Sewage and wastewater	Contractor crib rooms, accommodation facilities, administration building, warehouse, workshops, CHPP	Projected wastewater contribution to WWTP.	kilolitres per year	130,700	Continued disposal per existing licensing requirements with potential beneficial reuse options investigated during detailed design.
WWTP sludge	WWTP	Volumetric fraction of solids in the sewage effluent into the WWTP.	tonnes per year	40	Continued disposal per existing licensing requirements with potential beneficial reuse options investigated during detailed design.

* Provided by the Proponent, (from Parsons Brinkerhoff, 2010).

16.2.3 Waste Management Strategy

Waste management strategies will apply over the Project life, including early works, site preparation, construction, operation and decommissioning.

The principal objective of the waste management strategy for the Project is to minimise the impacts on land resources, water quality, and air quality, and to manage waste in a manner that avoids any direct or indirect impacts on the environment or health of people working at the mine and the community.

The main strategies that will be adopted for the Project include waste minimisation (including waste segregation for re-use or recycling), cleaner production, and ensuring wastes are disposed of safely at appropriate facilities.

16.2.3.1 Waste Minimisation

Waste minimisation has been considered throughout the initial planning and conceptual design stages of the Project and will continue during detailed design, construction and operation. The waste management hierarchy has been considered when selecting the waste management strategies for each waste stream.

16.2.3.2 Cleaner Production

Cleaner production is designed to provide environmental, economic and other, less tangible benefits. It forms an important component of the continual improvement approach to management adopted by the Proponent. Cleaner production focuses on implementing ways to improve a production process (or processes) in order to:

- Reduce the use of energy, water and other material resources, and/or;
- Generate less waste in the production process, and/or;
- Generate waste that is less environmentally harmful.

In general, cleaner production can be achieved through a selection of one or more of the following techniques:

- Input substitution - this is not readily applicable to this Project.
- Product reformulation - this is not readily applicable to this Project.
- Production process modification - selection of the best available practicable technologies.
- Improved operation and maintenance - this refers to the selection and use of the most appropriate processes and equipment.
- Reuse of resources that are otherwise wastes.
- Closed-loop recycling – where a product is recycled and used again in the same form.

The following significant aspects of the Project demonstrate adoption of these cleaner production principles:

- The adoption of the waste management hierarchy as the cornerstone of waste management strategies.

- Selection of the best available practicable technology for coal extraction (fixed and mobile plant and equipment) to ensure appropriate energy intensity and production efficiency of ROM coal.
- Selection of the best available practicable technology for the CHPP to ensure efficient and optimum water and energy use, minimum dust emissions and waste minimisation.
- Location of the mining and infrastructure areas to minimise the clearing of vegetation.
- Recycling of process water through the coal processing phases, including recycling of tailings water back into the CHPP.
- Recycle water from sewage treatment to processing.

The development and implementation of a comprehensive dragline and machinery maintenance program will ensure optimum performance and energy efficiency for all mechanical equipment used on-site and will help to generate less waste and less environmentally harmful wastes. Contracts with construction companies will be prepared to encourage all contractors to adopt best practice waste minimisation procedures. This includes the purchase of materials cut to standard sizes, reuse of concrete formwork where practicable and source separation and segregation of all recoverable materials. Separate skips will be provided to maintain segregation and maximise economic reuse and recycling in preference to disposal to landfill.

16.2.4 Waste Handling, Storage, Collection and Disposal

Considering the waste management hierarchy, materials will be segregated during handling and storage on-site. If materials such as metals, solvents, oils, and wood products can be re-used, then this will occur where practicable.

Storage of wastes will differ according to the specific waste type and is discussed further in the following sections. Flammable and combustible liquid wastes will be stored within facilities designed to Australian Standard (AS) 1940, The Storage and Handling of Flammable and Combustible Liquids, to prevent contamination of land, surface water and groundwater.

If waste materials cannot be reused or disposed of on-site then they will be collected for off-site reuse, reprocessing, recycling or final off-site disposal. Market demand at the time will determine the ultimate rate of recycling of recovered materials. Final disposal of wastes will be to a licensed waste facility that is suitable for the type and quantity of waste. The proposed on-site landfill (refer to Section 16.2.5), would be designed to accept non-recyclable general waste. Any recyclable, regulated or hazardous waste would be sent off-site for recycling or final disposal.

Development of a new on-site waste segregation and disposal facility will consider all relevant legislation and guidance associated with site selection, design and associated impact assessment, so as to minimise the potential impact on soils, groundwater, surface water, visual amenity, air quality, noise, ecological health and human health. Further details of the proposed on-site disposal facility are provided in the following section.

16.2.5 On-site Landfill

The scale of the Project relative to the surrounding community requires development of a suitable landfill to effectively handle and manage the volume of waste that will be generated throughout the life of the mine.

The following three options were considered in respect to landfill facilities to handle the relevant waste streams generated from the Project:

- Establishment of a self-managed on-site facility (relevant approvals will be included as part of the Project EIS);
- Establishment of an off-site facility, under the ownership and management of a third-party waste contractor (relevant approvals will be obtained by the successful third-party); and
- Assist BRC with the potential development of a regional municipal waste and recycling facility in close proximity to the Project site (BRC to obtain relevant approvals).

The preferred option, as assessed in this EIS (within Alternatives of the Project in Volume 2, Section 1.7.7.6), is to establish and manage an on-site landfill. The location of the landfill is illustrated on Figure 1-2 of Volume 2, Section 1.

The waste disposal facility, incorporating the on-site landfill, will be developed at the start of the construction phase in strict accordance with regulatory requirements. The on-site facility would be used for disposal of all non-recyclable and non-regulated waste streams generated during construction and operation. Off-site disposal will occur via licensed contractors in accordance with legislative requirements.

The proposed on-site landfill would be designed and operated in accordance with Queensland EPA Environmental Guidelines for Landfill Siting, Design, Operation and Rehabilitation (EPA, 2008). Key details of the proposed design are provided in the following section.

16.2.5.1 Landfill Capacity

The proposed on-site landfill must accommodate waste generation during three primary phases of the Project, being mine construction, operation and closure / decommissioning. An estimate of the waste generation and landfill waste disposal capacity for those stages is presented in Table 16-3.

Table 16-3: Landfill Waste Capacity Estimate

Phase	Duration (years)	Average Waste Generation Rate (tonnes/annum) *	Average Waste Generation Rate (m^3/annum) **	Total Waste Generation for Phase (m^3)	Total Waste Generation (m3) with FS=1.25
Construction	2	5,000	14,800	29,600	37,000
Operations	30	10,000	16,700	501,000	626,000
Decommissioning	2	5,000	14,800	29,600	37,000
Total, All Phases	34	n/a	46,300	560,200	700,000

* Waste generation rate estimates are 15,000 t over maximum 2-year peak construction and 2-year decommissioning periods and 10,000 tpa for the operational life of the mine.

** Volume estimates are in-situ volume estimates for compacted waste in the landfill. FS = Factor of safety.

Other components of landfilling, which comprise the total volume of the landfill, include the base liner, leachate drainage / collection layer, daily and intermediate cover and the final capping layers. Each of these components consumes volume in the total capacity requirement for the landfill. Table 16-4 summarises an estimate of the volume of each component within the total landfill structure.

Table 16-4: Soil Requirement Estimate

Feature	Area (m^2)	Thickness (m)	Volume (m^3)
Base Liner	97,100	0.60	58,000
Daily & Intermediate Cover *			246,000
Final Capping Layers	97,100	2.00	194,000
Soil need for other works **			25,000
Leachate Drainage Layer ***	65,000	0.30	20,000
Total Volume, All Features			543,000

* The basis for the volume estimate of daily and intermediate soil cover is a ratio of 3 parts waste to 1 part soil on the total waste volume of 738,000 m^3 of waste.

**The basis of soil need for other associated works (roads, drainage, etc.) is an allowance of 5% of the gross soil need for landfill construction.

*** The leachate drainage layer is typically a coarse and durable, non-carbonate aggregate.

The total capacity of the landfill, including all waste disposal, liner, cover soil, capping soil and imported drainage aggregate is the sum of the waste disposal capacity and the soil requirements, being approximately 1,281,000 cubic metres (m^3). This volume gives the landfill a capacity (e.g. life span) estimate of 34 years, comprising 2 years for construction, 30 years for mine operation and 2 years of facility decommissioning.

16.2.5.2 Key Design Features

Primary features of a solid waste landfill include:

- Waste disposal cells;
- Cell construction;
- Daily and intermediate cover material (typically soil);
- A groundwater monitoring system;
- A leachate management system;
- A final capping system;
- A landfill gas management system;
- A surface water management system;
- Dust management; and
- Site security.

The following sub-sections address the preferred approach to each of these design features for the proposed on-site landfill.

16.2.5.2.1 Waste Disposal Cells

Cell Construction

As described earlier, the total capacity estimate of the landfill is about 1.3 million cubic metres, which will fill with waste and soil over a 30-year period. Landfill construction would occur in stages, every three to five years, giving adequate capacity to manage waste disposal over significant time without unduly exposing the landfill lining features to the environment and potential damage and deterioration. The construction process systematically installs the liner and drainage layers, and integrates subsequent cell construction with previous / adjacent cell construction.

Daily Cover

Waste fill and compaction in each cell would occur periodically (typically daily), after which each period's waste receives a cover of soil or alternative cover. Daily cover may be sourced from spoil from landfill cell excavation or alternatively, a synthetic material may be used. The thickness of a daily soil cover is typically 150 millimetres (mm) to 300 mm, and may vary with soil availability and local environmental conditions. Appropriate heavy machinery will compact each deposit of waste to optimise the use of the landfill space and spread the soil covering over the waste. The soil cover serves to inhibit:

- Wind-blown litter;
- Introduction of surface water / rain to the waste profile;
- Release of odours from the waste; and
- Infestations of rodents, insects and feral animals.

The waste filling would occur in an orderly fashion to fill each waste cell in horizontal layers across the cell, and then vertically in layers until the waste cell reaches its capacity.

Intermediate Cover

After disposal of a significant quantity of waste and when a waste fill area might remain inactive for extended periods (more than three months), the waste fill receives an intermediate layer of soil cover (typically 400 mm or more). The intermediate cover serves as medium to long-term protection of the waste fill against the risks of the occurrences listed above.

Areas that receive intermediate cover also frequently receive a treatment of surface stabilisation with mulch and / or grass seeding to help inhibit surface erosion due to wind and rain events.

Prior to filling over an area with intermediate cover, removal of the cover regains landfill capacity and preserves the supply of soil available for future daily cover or intermediate cover.

16.2.5.3 Landfill Environmental Management System

Environmental management and monitoring of a landfill begins before the first deposition of waste and continues for many years after the completion of waste fill and final capping of the waste fill surface. Figure 16-1 illustrates the overall conceptual design of the landfill and Figures 16-2 and 16-3 illustrate conceptual schematics and details of primary environmental management system features. Primary objectives of the system are to:

- "Fingerprint" the baseline environmental conditions (especially groundwater) before start-up of waste disposal operations;
- Assess the environmental performance and stability of the landfill during waste fill operations and during the post-closure period;
- Provide data for the ongoing revision and improvement of the system toward maintaining acceptable environmental performance; and

- Ultimately, provide data that reflects a stable facility to mark the end of post-closure monitoring activities.

The typical life span of a landfill environmental management system is facility life plus 10 to 30 years post closure monitoring.

16.2.5.3.1 Groundwater Management System

DERM guidelines for landfill management dictate that a waste disposal facility must have a site-specific groundwater monitoring system to assess environmental performance of the landfill in the immediate vicinity of the facility.

A groundwater monitoring (GWM) system is necessary to assess the environmental character of groundwater around the landfill facility before beginning of waste filling operations (baseline “fingerprinting”), and to assess the environmental performance of the leachate capture system. For the on-site landfill, the proposed GWM system includes three wells around the landfill and associated works. One well has an up-gradient position with regard to waste fill and the other two have down-gradient positions (refer to Figure 16-1).

Baseline hydrochemistry through groundwater sampling on a regular, quarterly basis, will be initiated prior to landfill operations. Once landfilling operations begin, a comparison of further groundwater sampling results from those wells against the baseline results will allow for an indication of the environmental performance of the leachate capture system. Also, comparison of groundwater quality in down-gradient wells compared to the up-gradient well will allow for an assessment of impact on groundwater quality. If future assessments indicate a deterioration of groundwater quality, landfill operations and groundwater quality might require further assessment and investigation to determine the cause of the changing groundwater quality.

Precise determination of number, location and depth of GWM wells requires a hydrogeological investigation of the site. The investigation determines soil stratification and classifications, aquifer locations, groundwater flow rate and direction, and basic physical and chemical groundwater characteristics. All these data, and possibly other biophysical factors, influence the final design of the GWM system. These investigations would be carried out during the detail design stage of the landfill.

16.2.5.3.2 Leachate Management System

The proposed leachate management system includes several features:

- A base landfill liner;
- A drainage medium for the collection of leachate along the top of the liner (to reduce the head);
- One or more collection points for the leachate;
- A leachate extraction system and transmission system; and
- A means of treating and reusing, discharging, or otherwise safely disposing of the collected leachate.

Base Liner

The base liner of a landfill serves two primary functions:

- To collect leachate that drains from waste fill; and

- To inhibit the migration of landfill gas and leachate from the waste fill into the surrounding environment.

Detail 1 on Figure 16-2 illustrates a concept of the base liner cross section. The construction of a base liner for a solid waste landfill typically comprises compacted clay with a characteristic maximum hydraulic conductivity of 10^{-9} m/s, per Queensland landfill guidelines (EPA, 2008). The guideline specifies a minimum compacted clay liner thickness of 0.6 m. The clay liner is installed to cover the sidewalls and base of waste cells, reducing leachate and landfill gas migration potential.

Ideally, the source of clayey soil is from on-site excavations of the waste disposal cell(s); however, importation of suitable soils or use of synthetic lining materials is also common.

The base liner contour is typically toward one or more leachate collection points in the base of the landfill. Excavation sidewalls form a four-to-one gradient. The base slopes at 3 percent to a central drainage line in the centre of the landfill. The central drainage line slopes at 1.5 percent to a leachate collection sump at the lowest point in the waste cell excavation. The on-site landfill concept includes one leachate collection sump.

In such case when suitable clayey soil is not available for liner construction, the liner system might comprise only synthetic layers, and this scenario will remain unknown until the detail design of the proposed landfill.

Drainage Medium

The drainage medium is most typically a hard, durable, non-carbonaceous coarse aggregate that allows free drainage of liquids that collect in the bottom of the landfill. The EPA (2002) guideline dictates a 300 mm thick drainage layer. The drainage medium covers the base of the landfill and offers an open flow path for leachate to reach the collection sump at a single lowest point of the waste disposal unit.

Leachate Collection Sump and Pump

Once leachate reaches the lowest point in the landfill base, extraction of the leachate is necessary to maintain accumulation to acceptable levels within the landfill. At the low point of the landfill (the leachate collection sump), a riser pipe installed at the sump location serves as an access point to pump leachate from the landfill. The sump riser and pump configuration might vary, depending on availability of materials, depth of sump and other factors. For the on-site landfill, the assumption is that the riser will be a vertical riser of 1.2 m diameter and a total vertical length of approximately 14 m to exposure at the landfill surface. Leachate extraction will occur by means of a fixed (permanent) pump with on / off automation and discharge lines that connect to a transmission pipe, which discharges to a leachate treatment reed bed.

Leachate Treatment

The current concept for leachate treatment at the on-site landfill includes a leachate holding tank, a natural vegetation reed bed of a coarse drainage medium and reeds (Monto vetiver grass) planted in the drainage medium, an effluent holding dam and a recirculation pumping system. Leachate from the landfill will flow into the leachate holding tank. The holding tank will discharge pre-determined batch volumes of leachate into the reed bed, filter the leachate through the reeds and drainage medium, and discharge into the collection dam. A recirculation pump within the dam will pump reed bed effluent back to the top of the reed bed for re-filtering, as necessary. Recirculation and refiltering occurs until the effluent quality is of satisfactory quality for on-site beneficial reuse (e.g. dust control, irrigation) or other appropriate disposal method. Figure 16-3 provides a schematic cross section of the leachate treatment system.

16.2.5.3.3 Final Capping System

When the waste fill reaches the outer limits of the waste disposal cell, construction of a final capping system occurs on those exterior surfaces over the top of the final waste fill. This final capping system is the ultimate encapsulation layer for the waste fill, and provides long-term protection to the surrounding environment and a stable surface that inhibits:

- Exposure of humans to the waste fill;
- Exposure of waste to the external environment, and thus, contact of surface runoff (rain) with the waste fill;
- Surface erosion due to wind and rain;
- Wind-blown litter;
- Introduction of surface water / rain to the waste profile;
- Release of odours and landfill gas from the waste; and
- Infestations of rodents, insects and feral animals.

Traditionally, final cap layers have comprised a low-permeability clay soil barrier layer, a general fill protection layer over the barrier layer, and a surface growing medium layer. These types of final capping systems are difficult and costly to construct, and significant maintenance is crucial to maintaining the integrity of the capping system and protection of the environment. The traditional capping system typically ranges in thickness from 1 to 1.5 m.

The concept for the on-site landfill incorporates a phyto-capping system. This type of system helps to minimise the potential for surface water infiltration and leachate generation. The overall cost of a phyto-cap is typically lower than a traditional cap due to lower quality assurance construction requirements, lower soil unit costs and less long-term maintenance of the complete surface. The current concept for the phyto-cap comprises about 1.8 m of clean general fill overlaid by about 200 mm of a reasonable growing medium (topsoil). The surface vegetation would likely comprise a mix of local and introduced grass, shrub and tree species to optimise evapotranspiration. Phyto-caps are much more conducive to encourage propagation of native fauna species than traditional grassed capping systems and phyto-caps return the area to a much more natural-looking environment. Detail 2 on Figure 16-2 illustrates a concept of the final capping system cross section.

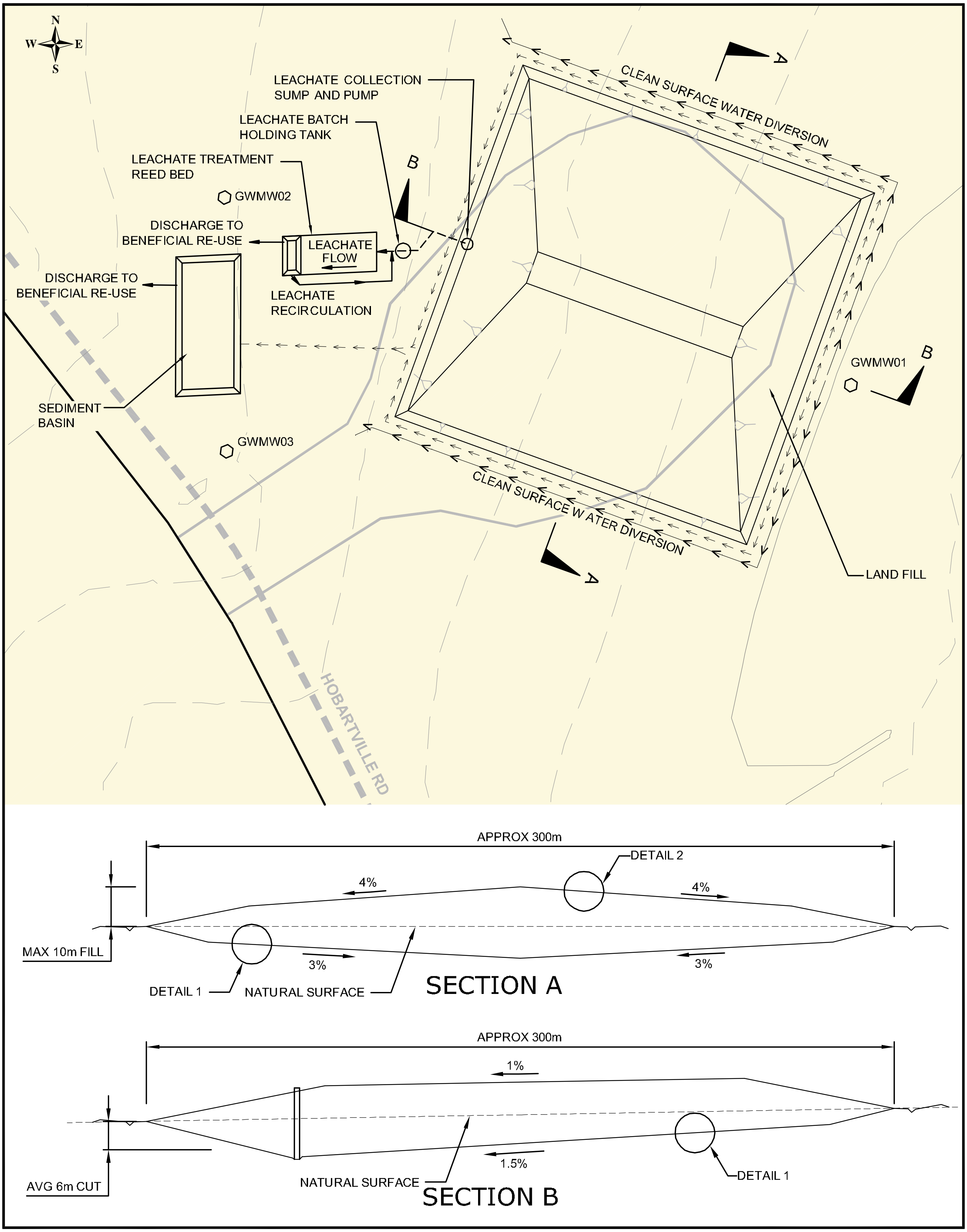
16.2.5.3.4 Landfill Gas Management System

Landfill gas (LFG), primarily methane, carbon dioxide and sulphide gases, is a by-product of anaerobic decomposition of organic matter. LFG is a high carbon value greenhouse gas (GHG) and its treatment is an important component in managing the overall carbon footprint of the Project site.

In the scale of solid waste landfills, the on-site landfill is a small disposal facility and the commercial beneficial use of LFG from the site will likely be unfeasible.

The most practical management method for LFG at the on-site landfill will likely include LFG collection, flaring, and perimeter migration monitoring. The collection component will likely comprise a manifolded system of LFG collection pipes within the waste fill, installed progressively as the waste fill progresses. The manifolded collection system will feed to a flare or generator for LFG burning and GHG reduction, or power generation and on-site beneficial use of the generated power. The monitoring system must comprise a series of shallow wells around the perimeter of the landfill. The primary intent of the wells is to detect horizontal LFG migration from the landfill, should that occur. Refer to Figure 16-4, for a schematic diagram of the LFG management system.

Results of geotechnical and / or hydrogeological site investigations will dictate the locations and depths of LFG monitoring wells.



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NOT TO SCALE Datum: GDA94, MGA Zone55	HANCOCK PROSPECTING PTY LTD Alpha Coal Project Environmental Impact Statement	ALPHA LANDFILL CONCEPTUAL PLAN AND SECTIONS	Job Number 4262 6580 Revision B Date 24-09-2010 Figure: 16-1

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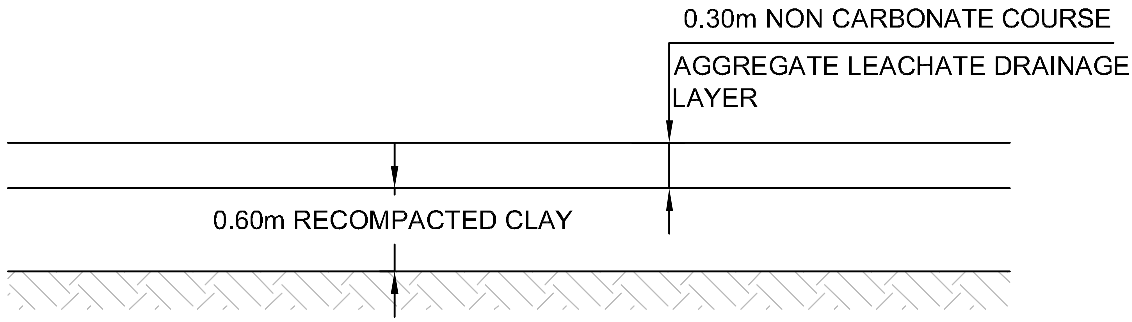
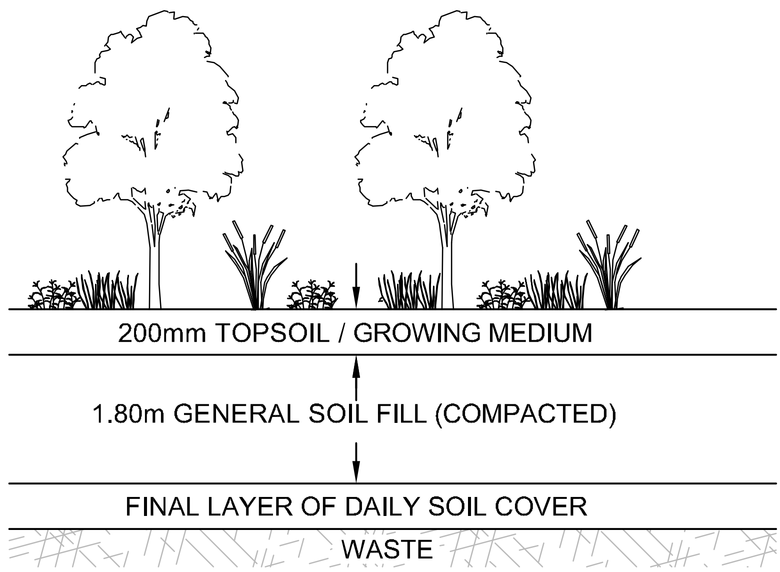


DETAIL 1
LANDFILL LINER AND LEACHATE DRAINAGE CONCEPT



DETAIL 2
LANDFILL PHYTO-CAP CONCEPT

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Alpha Coal Project
Environmental Impact Statement

ALPHA LANDFILL
CAP AND LINER
CONCEPT DETAILS

Job Number 4262 6580
Revision A
Date 24-09-2010

Figure: 16-2

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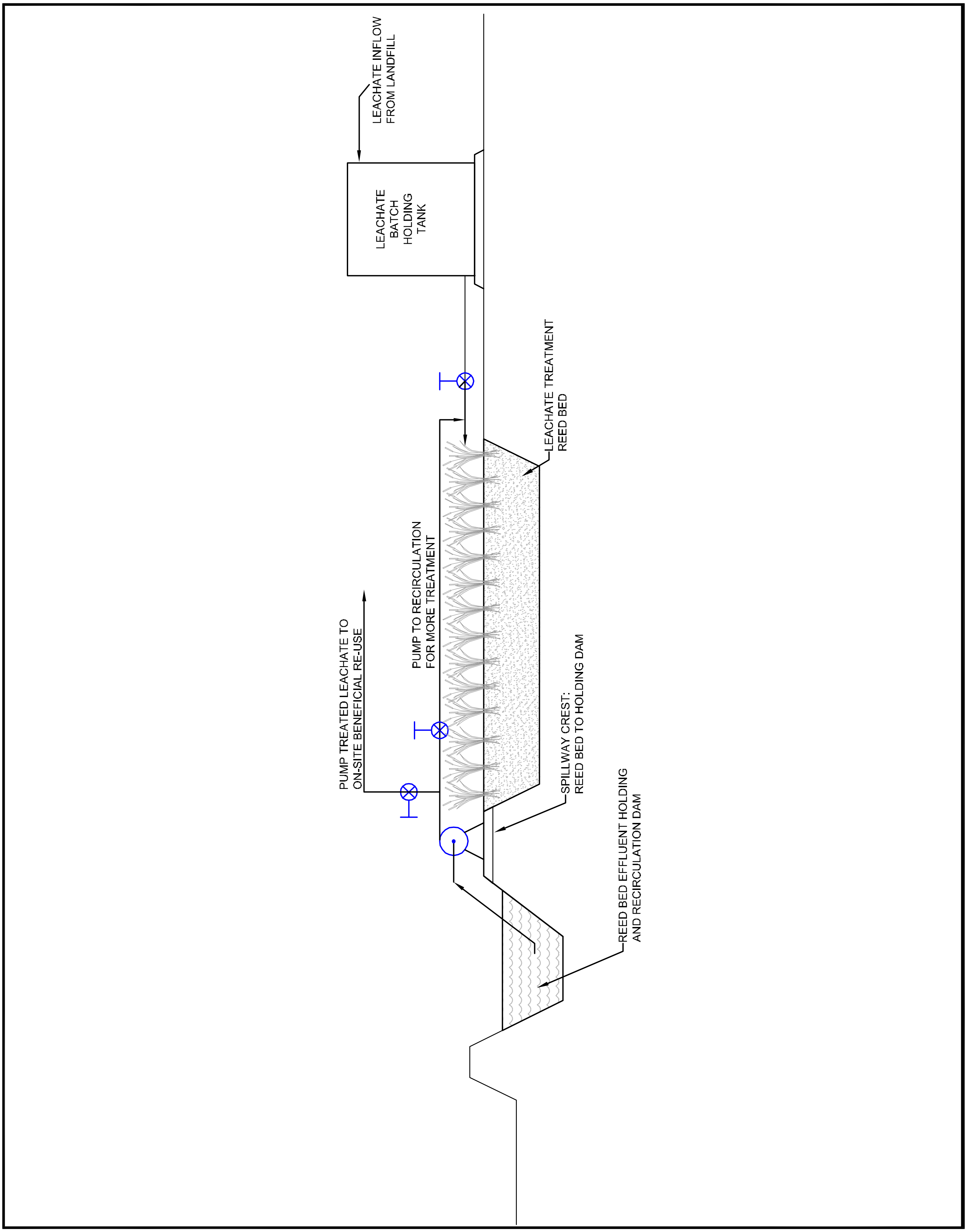

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NOT TO SCALE Datum: GDA94, MGA Zone55	N / W E / S	HANCOCK PROSPECTING PTY LTD Alpha Coal Project Environmental Impact Statement	ALPHA LANDFILL SCHEMATIC DIAGRAM LEACHATE TREATMENT SYSTEM	Job Number Revision Date	4262 6580 A 24-09-2010
				Figure: 16-3	

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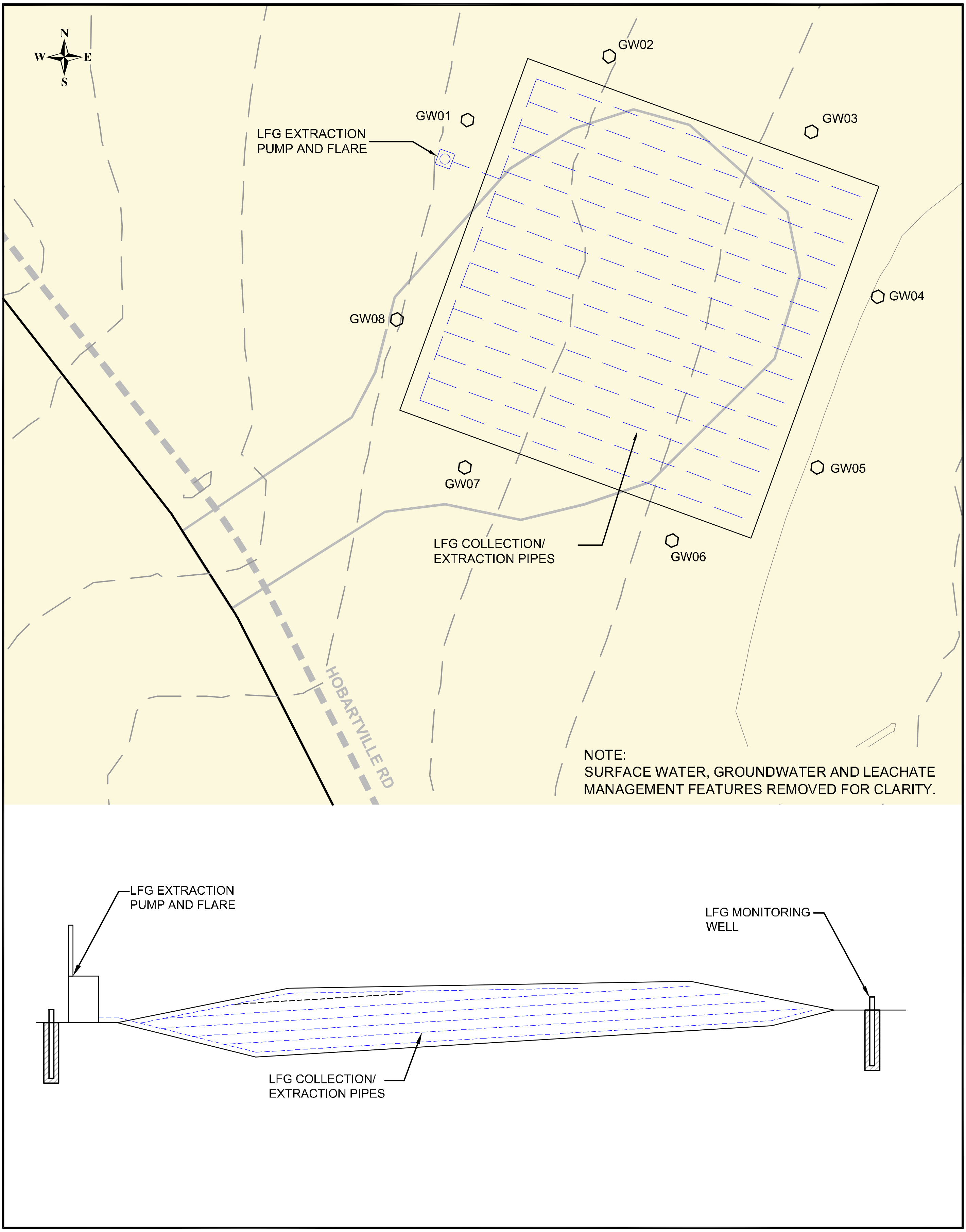

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NOT TO SCALE Datum: GDA94, MGA Zone55	N W E S	HANCOCK PROSPECTING PTY LTD Alpha Coal Project Environmental Impact Statement	ALPHA LANDFILL SCHEMATIC DIAGRAM LANDFILL GAS MANAGEMENT SYSTEM	Job Number 4262 6580 Revision A Date 24-09-2010 Figure: 16-4

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16.2.5.3.5 Surface Water Management System

The surface water management system of the on-site landfill is to incorporate a dual perimeter drainage system. The system will divert 'clean' surface water that flows toward the site from up-gradient areas and contain and treat 'dirty' sediment-laden surface water from active and operational areas of the landfill.

The system will require portable pumps to transmit water from excavations and other non-disposal areas that collect water to the sediment dam for treatment before release. The current sediment dam concept considers treatment by natural settlement of sediments from water. Further treatment requirements (e.g. flocculation) will require assessment of soil types at the landfill facility location and a final design will reflect the relevant need.

The overall objectives of the surface water management system are to:

- Control surface water flows rates and velocities to the extent practical;
- Maintain continuity of landfilling operations during inclement / rainy weather;
- Prevent unacceptable levels of soil erosion and sedimentation on the site; and
- Prevent unauthorised release of sediment and poor quality runoff from the site to the surrounding environment.

Achievement of these objectives will require regular review of and revision to the surface water management system after each significant rain event, and as the drainage patterns of the site change with developing waste disposal activities. Figure 16-1 schematically illustrates the surface water management system.

16.2.5.3.6 Dust Management

Nuisance dust can pose a health and safety risk to personnel on and around the landfill facility. To combat nuisance dust emissions, the following measures will be implemented:

- Designation of traffic routes;
- Driving speed limits;
- Track maintenance;
- Periodic watering of tracks to subdue emissions, as required; and
- Maintenance of vegetation on non-traffic areas.

These dust management techniques apply to construction, operation and closure phases of the landfill development. Dust management must be an integral component of the overall site maintenance program. As appropriate, site personnel, contractors and visitors will utilise appropriate Personal Protective Equipment (PPE) to protect themselves against the hazards of fugitive dust emissions.

16.2.5.4 Site Security

The landfill design will include a perimeter security fence and one primary access / egress point. The primary access is the first point of control for all traffic (vehicular and pedestrian) into and out of the site. The fence also serves as a secondary control to capture wind-blown litter and to prevent the ingress of feral animals and unauthorised persons. The security fence is typically secure (locked) when the site is unattended.

16.2.5.5 Personnel and Major Plant and Equipment

Over the life of the on-site landfill, the highest daily waste intake rates will likely occur during the operational phase of the mine site. Those peak times will form the basis of equipment requirements for the life of the landfill.

Estimates of waste intake at the landfill during the operational phase include:

- An average of 40 tonnes per day, on a 7-day working week; and
- A peak of 80 to 90 tonnes per day.

An estimate of personnel, plant and equipment to manage these waste loads during the operation phase of the mine site include:

- 1 x equivalent Caterpillar D4 track dozer or 939 track loader;
- 1 x equivalent Caterpillar 816 waste compactor;
- 1 x tipper truck of 10 to 15 cubic metre capacity (part-time);
- 1 x 15 to 20 tonne excavator (part-time);
- 1 x portable lighting plant (on stand-by);
- 2 portable pumps (1 x 40 mm and 1 x 75 mm);
- 1 x full-time equipment operator; and
- 1 x full-time site assistant/operator/labourer.

Note that during construction and decommissioning phases, personnel requirements might reduce to part-time.

Coordination of landfill equipment needs with other aspects of the mine site development and operation will assist in reducing duplication of personnel and equipment and reduce the overall operating and maintenance cost of the facility.

16.2.5.6 Landfill Construction

The construction of the on-site landfill will occur in a staged fashion with sub-cells of the overall landfill having capacities of about three to six years.

The on-site landfill will include construction of six to eight sub-cells to form the entire landfill over a 30-year period. Each sub-cell will include liner, leachate management and LFG management features and eventually form a continuous systems within the overall landfill.

16.2.5.7 Waste Filling Operation

Waste transport vehicles will enter the landfill and the site attendant will record vehicle and waste load data, and then direct the vehicle to the disposal area to discharge the load. The equipment operator will spread and compact waste load deliveries across the active waste sub-cell through the day and cover the waste fill (typically 200 mm of soil) at end of the day’s operations.

Fill will progress in horizontal layers across the sub-cell until waste fill covers the floor of the sub-cell. Waste fill will continue in subsequent horizontal layers over the first layer until the sub-cell is as full as is practical.

When a sub-cell is near capacity, construction begins on the next sub-cell. Filling continues in the next sub-cell when that new cell is ready, and waste filling operations progress in a similar fashion until fill levels in the adjacent sub-cells are near equal. Fill layers continue to fill in horizontal levels across the adjacent cells and then upward in new layers. When the available filling area nears capacity, construction on the next sub-cell begins, and so continues the process until the entire landfill reaches its waste disposal capacity.

Landfill operators must maintain similar processes of spreading, compacting and covering of waste throughout the entire process to ensure consistency in landfilling effort and optimisation of the available filling capacity of the landfill.

During appropriate stages of waste filling and in accordance with the LFG management plan, installation of LFG management system components will occur.

16.2.5.8 Landfill Closure and Post-Closure

16.2.5.8.1 Landfill Closure Activities

Landfill closure activities begin as soon as significant areas of the landfill reach the outer extremities of waste fill limits. At that time, the application of the final capping system begins. The capping layer includes placement and compaction of a thick layer of general soil fill, a growing medium layer and the planting of prescribed vegetation on the surface. As more areas of the landfill reach the outer extremities of waste fill, construction of the capping system extends across those areas until the entire landfill has a complete and homogeneous capping layer. As appropriate, installation of LFG management system components occurs as the landfill cap progresses.

Where practical, the surface water flow from complete and stable areas of the landfill will discharge to the natural environment (i.e. away from the landfill sediment dam). The ultimate goal for surface stabilisation is to create a stable ground surface that inhibits erosion and allows surface water infiltration that yields surface water quality suitable for discharge to the natural environment.

16.2.5.8.2 Landfill Post-Closure Activities

Post-closure begins after the completion of the final capping system. Post-closure activities typically comprise site maintenance, monitoring and reporting activities and might include monitoring and maintenance of and reporting on the following site features and systems:

- Vegetation;
- Waste fill settlement (with a goal of preventing accumulations of surface water);
- Leachate and landfill gas;
- Groundwater;
- Surface water;
- Erosion and sediment control; and
- Insect, vermin and feral animal infestations / colonisations; and
- Site security.

Post-closure activities might last between 10 and 30 years, with cessation of maintenance and monitoring activities occurring once environmental stability of the waste facility has been demonstrated and approved by the local regulatory authority.

16.2.6 Other On-Site Waste Management Measures

Where practical, tyres will be removed by the tyre supplier for recycling, or used on-site for road barriers and demarcation. Otherwise tyres can be disposed of by burying in the mine overburden in designated locations, in accordance with the following principles (EPA, 2006):

- Tyres awaiting disposal or transport for take-back will be stockpiled in volumes less than 3 m in height and 200 m^2 in area. Fire precautions will include removal of grass and other flammable materials within a 10 m radius of the tyre store. Tyres will be stored in a manner that prevents water retention and minimises mosquito breeding events;
- Scrap tyres may be disposed of in spoil emplacements where tyres are placed as deep in the spoil as possible but not directly on the pit floor. Placement will ensure scrap tyres do not impede saturated aquifers and do not compromise the stability of the final landform; and
- Scrap tyre disposal sites will be recorded on the DERM's EMR.

Per EPA's Operation Policy titled 'Licensing requirements for construction and demolition wastes' (2002), if construction and demolition waste is separated into its constituent parts, the inert parts may be used as clean fill. Under the Policy, inert waste may include bricks/pavers/ceramics, concrete, and clean earthen fill.

Green waste will be burned as a last resort, in accordance with the following principles:

- Ensuring appropriate buffer distances and fire breaks around asset protection zones, including Hancock Prospecting Pty Ltd (HPPL), public and other privately owned assets, and protected areas, including important vegetation communities and habitats;
- Under favourable wind conditions to minimise risk of harm to sensitive receptors; and
- Prior and informed notice provided to adjacent landowners.

The burning of vegetation will be done with the approval of the Queensland Fire and Rescue Service and in accordance with an agreed fire management plan.

Under the EP Act, sites used for a notifiable activity such as waste disposal must be listed on the EMR, which includes notifiable activities occurring on mining leases. All items of waste buried on-site that are classed as notifiable activities will be identified on the EMR managed by DERM. Post-mining, potential future landowners could find out about the location and details of any tyre disposal sites through a search of the EMR as part of the conveyancing process when purchasing property.

Land can only be removed from the EMR following an investigation by a member of a prescribed organisation, as listed in the EPR, and the preparation of a report that satisfies the DERM that the land is not contaminated.

16.2.7 Waste Tracking

Certain waste management activities including disposal and transport of waste, are considered to be ERAs and require approval under the Waste Regulation. The Waste Regulation also contains requirements for handling specific waste streams.

Certain regulated wastes are considered trackable wastes under Section 17 of the Waste Regulation. This provides a process to allow such wastes to be tracked from the point of generation to the point of final processing, recycling or disposal.

A waste management plan will be implemented during construction and operations. For waste tracking, the waste management plan will address the following:

- Training of all personnel on procedures concerning waste minimisation, handling, storage, reuse, segregation, collection and disposal;
- Waste removal and transport from site to be by appropriately licensed contractor/s with disposal only to licensed reprocessors, recyclers, or waste disposal facilities;
- Transport of any hazardous or regulated waste to comply with all relevant legislation including waste tracking requirements; and
- Compare Project waste quantities with actual waste produced to improve estimates and provide more reliable figures for future waste management plans.

16.2.8 Waste Management Plan (Construction)

A detailed Waste Management Plan (Construction) will be prepared as part of the Project-specific Environmental Management Plan (EM Plan) prior to the commencement of construction. The Waste Management Plan (Construction) will address the following:

- Identification of waste streams;
- Consideration of the waste management hierarchy when selecting waste management strategies, with emphasis on minimising any hazardous waste;
- Identification of solid, liquid or hazardous waste collection, storage and or disposal strategies;
- Training of all personnel on procedures concerning waste minimisation, handling, storage, reuse, segregation, collection and disposal;
- Concept design of proposed on-site landfill for non-regulated and non-recyclable waste;
- Waste not suitable for on-site disposal to be removed and transported from site by appropriately licensed contractor/s with disposal only to licensed reprocessors, recyclers, or waste disposal facilities;
- Transport of any hazardous or regulated waste to comply with all relevant legislation including waste tracking requirements; and
- Monitoring of waste streams and auditing against the Waste Management Plan (Construction) to ensure overall objectives are being met.

All construction wastes will be managed in accordance with the Waste Management Plan (Construction).

16.2.9 Waste Management Plan (Operations)

A detailed Waste Management Plan (Operations) will be prepared as part of the Project-specific Environmental Management Plan (EM Plan) and Plan of Operations prior to the commencement of operations, and updated annually to reflect the current activities of the Project. The Waste Management Plan (Operations) will address the following:

- Identification of waste streams and establishment of a baseline measurement for each stream;
- Consideration of the waste management hierarchy when selecting waste management strategies, with emphasis on minimising waste;
- Identification of solid, liquid or hazardous waste collection, storage and or disposal strategies;
- Training of all personnel on procedures concerning waste minimisation, handling, storage, reuse, segregation, collection and disposal;
- Waste removal and transport from site to be by appropriately licensed contractors with disposal only to licensed reprocessing, recycling or waste disposal facilities;
- Transport of any hazardous or regulated waste to comply with all relevant legislation including waste tracking requirements;
- Monitoring waste streams and identifying opportunities for reduction and reuse of wastes; and
- Auditing against the Waste Management Plan (Operations) to ensure waste management strategy objectives are being met.

All operational wastes will be managed in accordance with the Waste Management Plan (Operations).

16.2.10 Decommissioning

At the end of the mine life, any remaining infrastructure will be decommissioned and removed from the site in accordance with the Waste Management Plan. Volume 2, Section 25 of the EIS (Rehabilitation and Decommissioning) describes the conceptual decommissioning and rehabilitation strategies developed for the Project, including performance indicators to ensure minimal residual impacts to the surrounding environment.

16.2.11 Residual Impacts

Provided that the requirements of the relevant Waste Management Plans are complied with, potential environmental impacts arising from waste materials associated with the Project are expected to be minor to negligible.

Areas identified on-site as needing to be listed on DERM’s Contaminated Land Register (CLR) or EMR, such as areas subjected to contaminating activities (existing or future) and a tyre disposal area, will be identified, listed and remediated where possible.

16.2.12 Conclusions

The reporting and management of wastes associated with the construction, operation and decommissioning of the Project will be undertaken in accordance with best practice, relevant legislation, guidelines and the Project Waste Management Plans. It is expected that Project-generated waste will be managed at a suitably located on-site waste disposal and segregation facility managed by the Proponent, or off-site by a licensed waste contractor as appropriate depending on the waste type.

16.3 Mine Waste Management

16.3.1 Introduction

Alpha Coal Project (Mine) waste generated through mining activities (overburden) and coal processing (coarse rejects and fine tailings) has been defined for the EIS as mining waste. This section provides an assessment of the geochemical characteristics of the Project mining wastes and the required management with a detailed geochemical report provided in Volume 5, Appendix J. A detailed description of mining and coal processing is provided in Volume 2, Section 2. In addition to the above mentioned waste materials, both raw and washed coal have been included in the geochemical assessment as these materials will be managed on site, albeit for only a relatively short time frame.

Coal is deposited within environments that typically have some potential to produce sulphides within the sediments. The sedimentary genesis of these coal deposits and presence of carbonaceous materials in a reducing environment means that concentrations of sulphides are typically limited to the coal seams and immediate roof and floor materials. Sulphides can also be present in uneconomic coal seams and specific carbonaceous rock types, such as mudstone and claystone. In contrast, bulk non-carbonaceous over- and inter-burden materials (such as sandstone and siltstone) generally have very low sulphide content.

The removal of the overburden materials and the mining of coal can result in the oxidation of sulphides when these materials are exposed to air and water. The oxidation of these sulphides can result in the generation of poor quality leachate, which can be acidic with elevated metal and sulphate salt concentrations. Accordingly, a geochemical assessment of coal and mining waste materials includes the analysis of the sulphide content to determine the presence of any contained sulphides and whether these materials have the potential to oxidise and overcome any natural inherent buffering, commonly measured in the laboratory as Acid Neutralising Capacity (ANC).

The coal and mining waste materials, characterised as part of this EIS, are considered to be representative of the coal, overburden, and reject materials projected to be generated at the mine and thus allow a qualified assessment of the potential to generate poor quality leachate. Should the project progress then the generated coal and mining waste materials will continue to be assessed to verify their geochemical characteristics and confirm the adopted management strategies including site rehabilitation. It is planned that following development of the initial open pit boxcut area in Year 1, all coarse rejects will be stored within in-pit spoil piles. Similarly, tailings will be stored in mined out pit voids as storage becomes available, although these materials will need to be placed into an engineered ex-pit tailings storage facility (TSF) for project start up and the first years of operation.

Initially, the overburden produced by mining the boxcut area will be stored at an out-of-pit spoil emplacement area adjacent to the low walls on the eastern side of the open pit (refer to Figures 2-7 to 2-18 in Volume 2, Section 2). Some of the overburden has the potential to be saline and/or sodic (refer to Section 16.7) and any out-of-pit overburden will be managed to ensure that saline and/or sodic materials do not report to final top and bench surfaces and batters. During the first year of operation, coarse rejects will be encapsulated in the out-of-pit spoil pile. This out-of-pit spoil will comprise approximately 200 million tonnes of overburden (spoil) mined from the box-cut and will cover an area of approximately 475 ha. When sufficient space is created within the mine areas, subsequent overburden will remain in the open pit.

Details of surface water and groundwater management issues associated with coal and mine wastes and stockpile/emplacement areas are provided in Volume 2, Section 11; Volume 5, Appendices F and J; and Volume 2, Section 12, Volume 5, Appendices G and J, respectively. Air emissions associated with coal and mine wastes and stockpile/emplacement areas are provided in Volume 2, Section 13.

The objective of the Project geochemical assessment was to determine the following:

- The potential for acid and metalliferous drainage (AMD);
- The concentrations of trace metals in the spoil, and potential for contamination; and
- The feasibility of using the spoil material for site rehabilitation.

16.3.2 Geology

The Alpha Coal Project (Mine) deposit lies on the eastern side of the Galilee Basin, which is characterised by near horizontal undeformed sediments. These are structurally simple and have an absence of intrusions and significant faults. The geology consists of gently westerly dipping sediments of Permian age, overlain by Tertiary and Quaternary sediments. The geology of the deposit reflects consistent, correlatable lithologies and is well understood having been characterised using a geological model.

The genesis of the deposit follows a typical coal and sedimentary rock profile. Both historical and recent borehole data shows that the thickness of Tertiary and Quaternary sediments varies from greater than 60 m in places to less than 20 m, in the north and south of the mining lease application (MLA) 70426 (the Project site). In addition to the Tertiary and Quaternary sediments, a variable thickness of weathered Permian material is also commonly present. Figure 16-5 shows a schematic cross-section through sediments and the coal seams mapped on site.

A more detailed geology discussion is provided in Volume 2, Section 4.

Age	Lithology	Stratigraphic Unit	Thickness	Comments
Triassic	Green brown-purple mudstone, siltstone and labile sandstone	Rewan Group		Only present in far west
Late Permian	Sandstone	Bandanna Formation	10 – 30 m	Increasingly argillaceous
	Coal – Seam A. Seam contains thin stone bands that thicken from south to north.		1 – 2.5 m	
	Labile sandstone, siltstone and mudstone		10 m	
	Coal – Seam B. Seam contains numerous dirt bands that comprise between 15% to 30% of seam. Variable in quality.		6 – 8 m	
	Labile sandstone, siltstone and mudstone		70– 90 m	
	Coal – Seam C. Coal seam thins northward and splits apart	Colinlea Sandstone	2 – 3m	Increasingly arenaceous
	Labile sandstone, siltstone and mudstone		5 – 20m	
	Coal – Seam D. Stone bands present within seam thicken westward, upper section splits off main seam to north west		4.5 – 6m	
	Labile sandstone, siltstone and mudstone		15m	
	Coal – Seam E. Thin (0.2m) clean coal bands, usually 2 bands E1 & E2		0.1-0.4m	
	Labile sandstone, siltstone and mudstone		15-20m	
	Coal Seam F, localised thick geological section, no working section		0.5-5m	
	Labile sandstone, siltstone and mudstone		Unknown	
Early Permian	Labile and quartz sandstone	Undefined	Transition to Joe Joe Fm	

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Datum: GDA94, MGA Zone55

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Alpha Coal Project
Environmental Impact Statement

STRATIGRAPHIC COLUMN

Job Number | 4262 6580
Revision | A
Date | 24-09-2010

Figures: 16-5

File No: 42626580-g-2091.cdr

16.4 Mining Waste

16.4.1 Coal and Mining Waste Quantities

As described in the Project Description (Volume 2, Section 2) and summarised in Table 16-5, the Project is expected to mine 41 million tonnes per annum (Mtpa) Run of Mine (ROM) coal generating 30 Mtpa of product coal from an open cut pit with a projected 30 year life of mine (LOM). The final mining footprint will cover an area of approximately 24 km by 7 km and the total mined overburden volume is estimated at approximately 16 billion tonnes over a 30-year mine life. That is, approximately 530 million tonnes per year.

In addition to the overburden, coal reject material will be generated by the Project. Coal reject material is segregated into two categories, coarse reject and fine tailings. The coarse reject comprises the larger pieces of overburden and coal that are not suitable for product sale. The tailings material is the fine component of this waste material. Both coarse rejects and tailings are segregated from the coal product in the Coal Handling and Preparation Plant (CHPP).

Table 16-5: Project annual and life of mine waste quantities

	Annual Production	Life of Mine (30 years)	Percentage of ROM coal
ROM Coal	41 Mtpa	1,230 Mt	
Product (washed) Coal	30 Mtpa	856 Mt	
Overburden	530 Mtpa	16,000 Mt	
Coarse Rejects	6.6 Mtpa	197 Mt	16%
Fine Rejects (Tailings)	2.5 Mtpa	74 Mt	6%

The Project coal rejects (coarse and fine) are expected to comprise in the order of 1.7% of all mining waste produced by the Project. The proportion of coal rejects to overburden for the Project is less than similar coal mines in the nearby Bowen Basin, which typically average about 5% of overburden. Details of the mining waste storage strategy are discussed in the following section; also refer to Volume 5, Appendix J. Plans showing the proposed location, site suitability and volume of overburden and coal reject emplacement areas and measures to ensure stability are described in the Project Description (Volume 2, Section 2).

16.4.2 Coal and Mining Waste Storage

16.4.2.1 Coal

Raw coal will be trucked from the pits to one of two ROM facilities where, after primary crushing, it will be transported via conveyor to the CHPP where it will be processed (washed). It is expected that product coal will be stockpiled before being loaded into trains for transport to port facilities for export.

The main environmental management activities at the product coal stockpiles will be the capture of potentially poor quality surface runoff water in sediment control dams.

16.4.2.2 Overburden

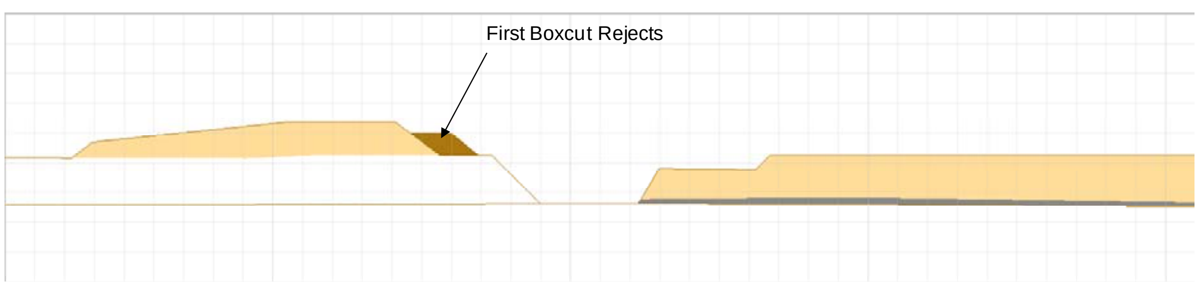
Overburden is the waste rock material overlying the coal seams, which must be removed to access these seams. Material located in between the coal seams (interburden) is also called overburden for the purposes of this discussion. When overburden has been disturbed through mining activities, at coal mines it is called spoil. At the mine, the spoil material will predominantly be stored within the open pit, although an out-of-pit spoil emplacement area will be constructed parallel to the eastern edge of the initial open pit using a truck-shovel operation to accommodate material from the box-cut developed during the first year of mining. The out-of-pit spoil emplacement area will comprise approximately 320 million tonnes (approximately 2%) of the total overburden mined over the 30 year mine life. Mining will evolve into a dragline stripping operation with truck-shovel pre-strip.

The main environmental management activities for spoil materials generated from overburden removal will be placement of any saline and/or sodic materials within the core of the spoil pile before covering with more benign materials, reshaping and adding topsoil and vegetation as part of rehabilitation. Consideration of placement of coarse material at the base of the spoil will be given to assist in spoil drainage. Some rock mulching may be required on final batters to limit potential erosion from surface runoff and any requirement for this approach will be assessed during rehabilitation field trials. Information on the project rehabilitation strategy is presented in Volume 2, Section 25.

16.4.2.3 Coarse Rejects

The coarse rejects generated from the CHPP will be dewatered and discharged onto the CHPP rejects conveyor, which reports to the rejects bin. During the first year of mining, the coarse rejects (containing approximately 23% moisture) will be truck-hauled and placed adjacent to the edge of the boxcut area as shown in Figure 16.6a. Development of the Project mine plan identified the most appropriate reject placement area to be adjacent to the CHPP. The reject emplacement area will have a 4 km strike length parallel to the low walls and will be in close proximity to the proposed reject bin location.

Figure 16-6a: Placement of coarse reject materials at the Alpha project



All coarse reject materials will be paddock dumped and compacted in approximate 1-2 m layers using dozing and vibrating or square roller equipment. Crushed limestone dosing of compacted coarse reject layers may also be considered depending on the results of ongoing kinetic leach column testing of representative coarse rejects and bulk sample testing prior to operations. During the first years of mining, coarse rejects placed at the low wall edge of the boxcut area will be clay encapsulated before being further encapsulated with spoil.

From around Year 2 to end of mine life, the coarse reject material is planned to be placed in the in-pit voids between the dragline spoil. These placement areas are below the natural ground surface and extend to a depth of 10-20 m below ground level, which is above the predicted depth of the dewatered groundwater table. Truck-shovel pre-strip spoil materials will be used to cap the reject areas. Coarse reject placement will be sequenced such that capping of the rejects will be completed progressively as the working face progresses down dip. Figures 16.6b to 16.6e depict the coarse reject placement strategy.

Figure 16-6b: Placement of coarse reject materials at the Alpha project

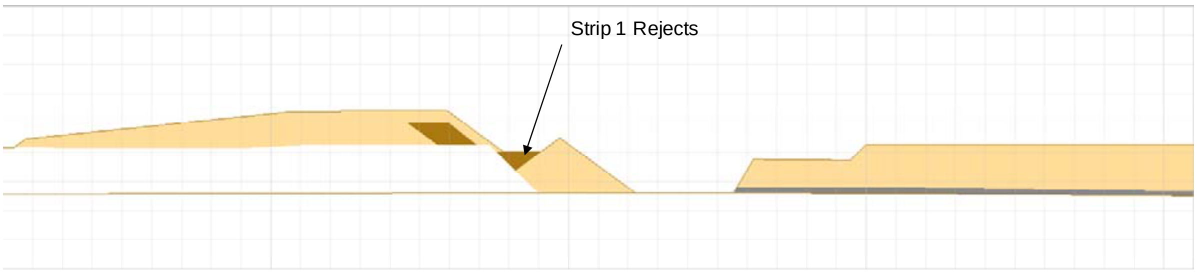


Figure 16-6c: Placement of coarse reject materials at the Alpha project

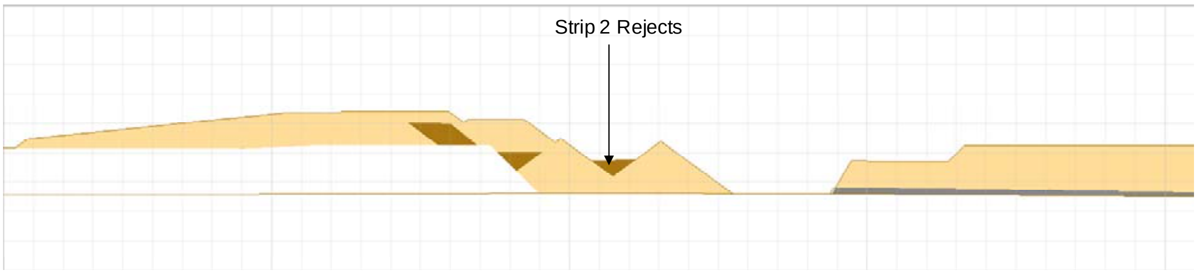


Figure 16-6d: Placement of coarse reject materials at the Alpha project

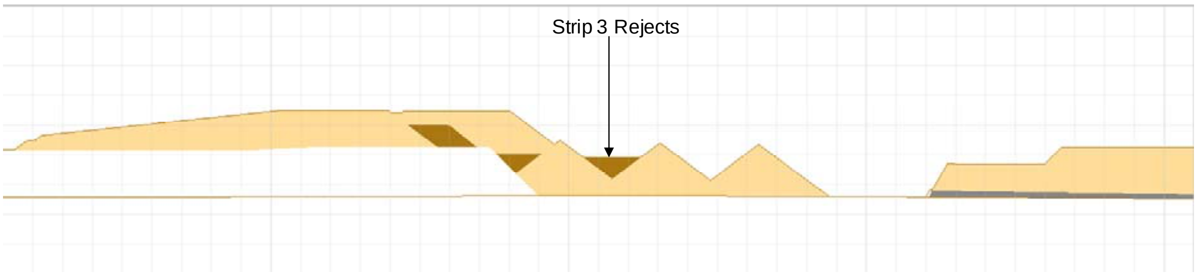
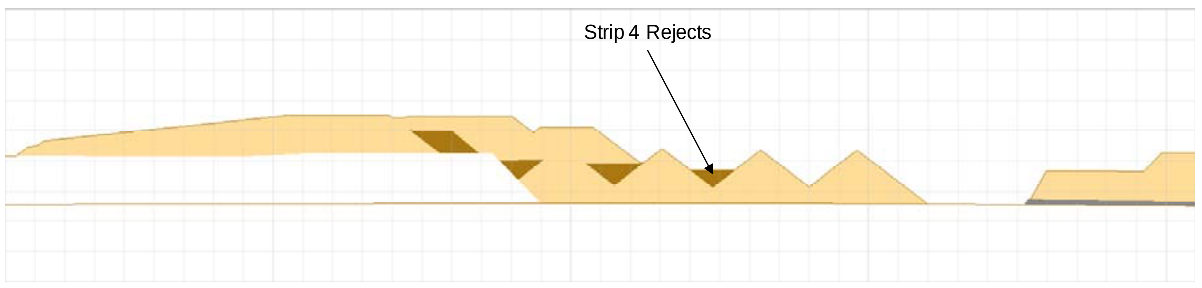


Figure 16-6e: Placement of coarse reject materials at the Alpha project

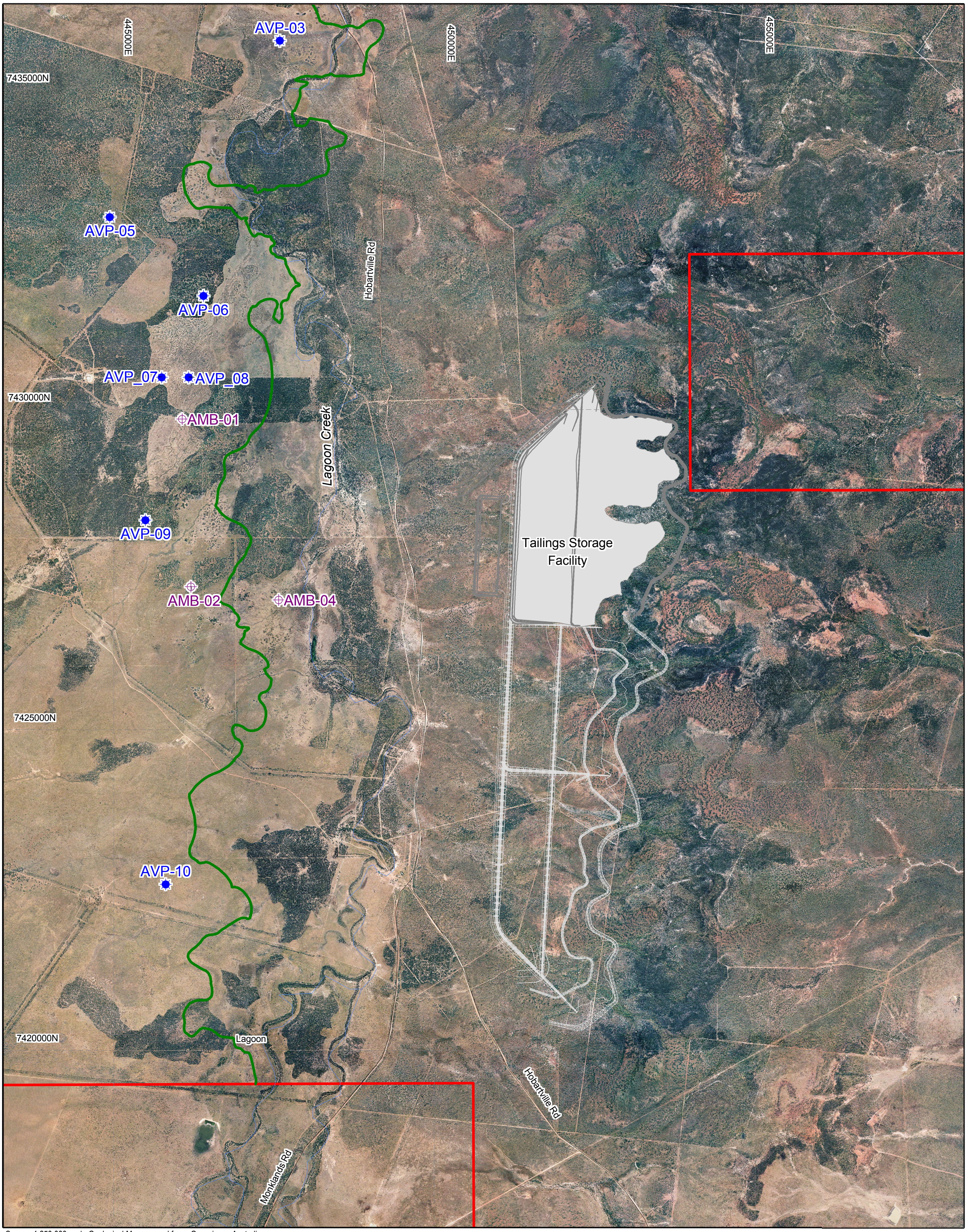


Coarse reject material placed in the in-pit voids between the dragline spoil will also be compacted in 1-2 m layers and capped with a clay cover prior to covering with at least 10 m of spoil material. Crushed limestone addition to compacted layers may also be considered, depending on the results of ongoing kinetic leach column testing of representative coarse reject samples and bulk sample testing prior to and during operations. Topsoil will be placed onto the re-profiled slopes. Details of the final landforms are contained within Volume 2, Section 25.

16.4.2.4 Tailings

Tailings will report to a purpose built tailings storage facility (TSF) located to the east of the open pit as shown on Figure 16-7. The construction, operation and closure of the TSF is described in detail in Volume 5, Appendix J. The Proponent is currently investigating the feasibility of accommodating tailings materials in the open pit after Year 5, when the mine plan allows and sufficient storage capacity becomes available. The placement of tailings material in-pit, if proven viable, would significantly reduce the size of the required out-of-pit TSF footprint.

Tailings will report to the TSF in a slurry form containing approximately 30% solids and excess water will be recycled from the TSF using a decant system for reuse at the CHPP. Given the arid climate of the region, the tailings surface is expected to dry out relatively quickly and form a dense compact solid material, which will facilitate a cover placement and rehabilitation at the end of mine life. A cover system will be required utilised for TSF closure and topsoil will be placed onto the reprofiled final landform slopes. Details of the final TSF landform are provided at Volume 2, Section 25.



Source; 1:250,000 scale Geological Map sourced from Geoscience Australia

Mining Lease Application (MLA70426) Boundary

Subcrop of D Seam Floor

AVP-03 Vibrating Wire Piezometer (VWP) Bore Site

AMB-01 Standpipe Monitoring Bore

Source: See Copyright Details below and for full disclosure Please Refer to the EIS *Volume 4 - References*

0 1 2km

Scale 1:80 000 (A4)

Datum: GDA94, MGA Zone55

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Alpha Coal Project
Environmental Impact Statement

TAILINGS STORAGE FACILITY
AND BORE HOLE LOCATIONS

Job Number	4262 6580
Revision	A
Date	24-09-2010

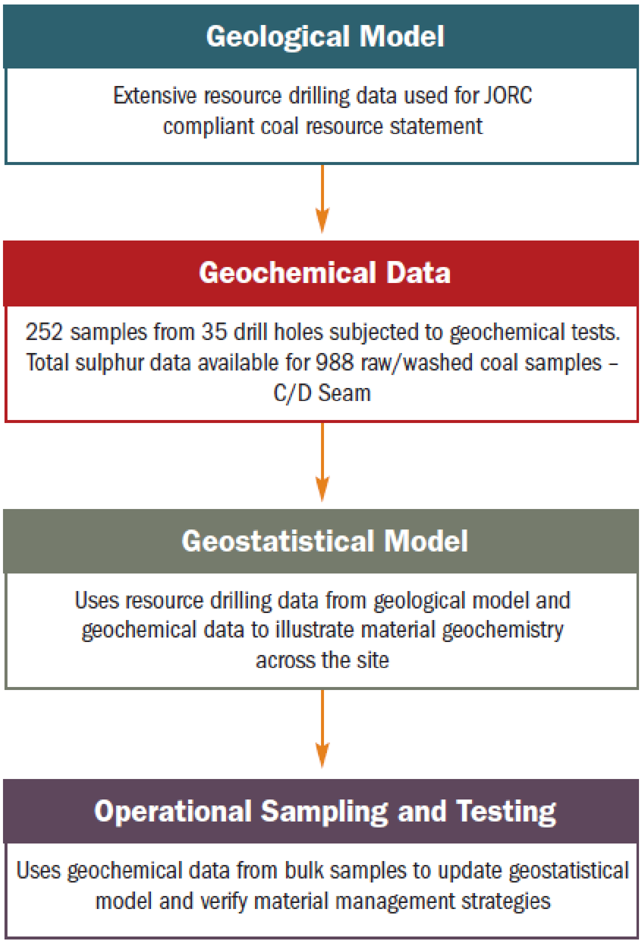
Figure:16-7

File No: 42626580-g-2104.wor

16.5 Coal and Mining Waste Characterisation

16.5.1 Overview of approach

The primary guidance document for geochemical sampling and testing of mine related mining waste material in Queensland is the Assessment and Management of Acid Drainage (DME, 1995). The following flow chart is a graphic representation of the steps taken by the Project to understand and confirm the consistency of the site geology and the corresponding geochemical characteristics of the mining waste materials.



16.5.2 Geological Model

The Project geological model provides a very good understanding of the Project geology/stratigraphy, which has been found synonymous with that of typical of coal and sedimentary rock genesis. A detailed description of the Project site geology is presented in Volume 2, Section 4.

16.5.3 Geochemical Data - Sampling Strategy

The 1995 Queensland Department of Mines and Energy (DME) guidelines advocate accurate characterisation of the "*nature, distribution and variability of critical parameters in each material type ideally based on accepted statistical procedures*" and "*discussion of the sampling program with the Department prior to implementation*". This includes:

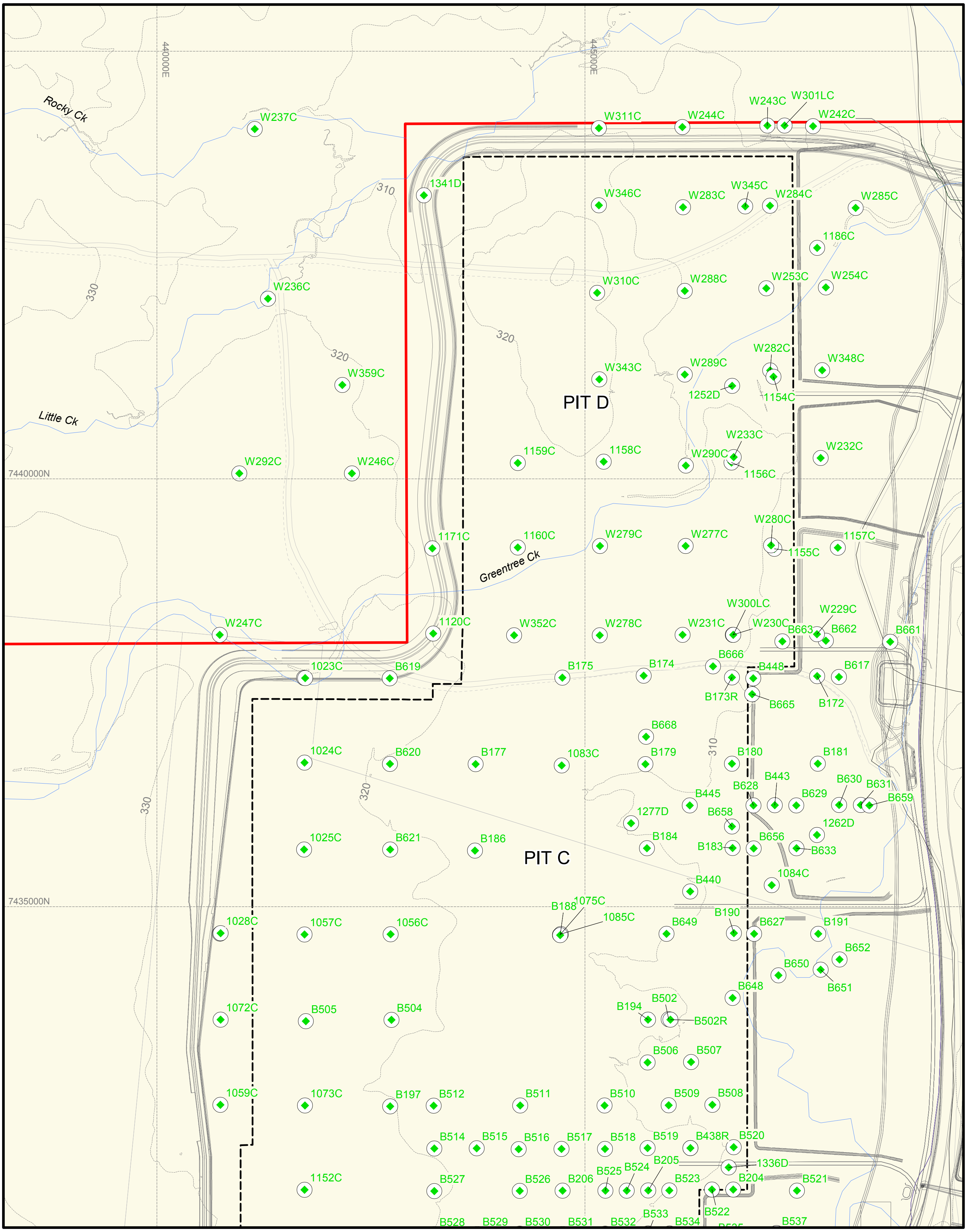
- Geological variability and complexity in rock types;
- Information/experience from geologically comparable mine sites;
- Potential for significant environmental or health impacts;
- Size of operation and volume of rock types;
- Statistical requirements which ensure samples are representative;
- Level of confidence in predictive ability; and
- Relative costs.

The DME guidelines suggest collecting a minimum number of samples of each rock/overburden type during initial sampling based on a prescriptive amount of material, but also state that the actual number of samples should be project specific. The guidelines allow for grouping of samples based on the results of initial geochemical testing and geological information to reduce the number of samples required for more detailed testing. The stated aim is to "*bias the sampling process to select samples that are more likely to be potentially adverse to health and the environment*".

The sampling component of the geochemical assessment process suggested in the DME guidelines is targeted towards hard rock metalliferous mines, where the geology is significantly more complex and the geochemistry of materials can change significantly within a distance of a few metres. This is not the case at coal mines where the lateral geology (and geochemistry) of most overburden materials may not change significantly for several hundred metres (or even several kilometres), as shown in the Alpha geological and geostatistical models.

As part of the Project, a selection of 281 drill core samples from 35 drill holes across the Project area were collected for geochemical assessment and represent coal, overburden, coal seam roof and floor materials. The sampling strategy was developed to address DME guidelines, but also utilised information from more recent guidelines (DITR, 2007 and INAP, 2009). The sampling strategy also complements the existing geochemical and lithological database available from the geological model obtained for 988 samples from 252 drill holes across the site (as shown in Figures 16-8a and 16-8b). Sample selection also included raw and washed coal, and coarse and fine reject samples generated from processing large diameter drill core material. The number of samples and the drill hole intensity across the Project site compares favourably with the sampling strategies used for recent EIS programs for approved coal mining operations in Queensland. A representation of the lateral coverage of drill holes across the Project site for the 2010 drilling, sampling and geochemical and lithological testing program is provided in Figure 16.9.

Overall, the existing data and new sampling, testing and geostatistical modelling approach undertaken for the Project provides a high level of confidence that the occurrence and distribution of the coal and mining waste types likely to be generated at the Project have been adequately reflected in the sampling program. The Proponent will continue to complete sampling and geochemical testing programs for representative samples of coal and mining waste materials as the Project progresses and has already commenced an additional infill drilling program focussing on sampling coal and mining waste materials from the area likely to be mined in the first five years of operation.



Mining Lease Application (MLA70426) Boundary

Contour (10m interval)

Pit Outline

Drill Hole Location

Source: See Copyright Details below and for full disclosure Please Refer to the EIS *Volume 4 - References*

0 750 1500m

Scale 1:60 000 (A4)

Datum: GDA94, MGA Zone55

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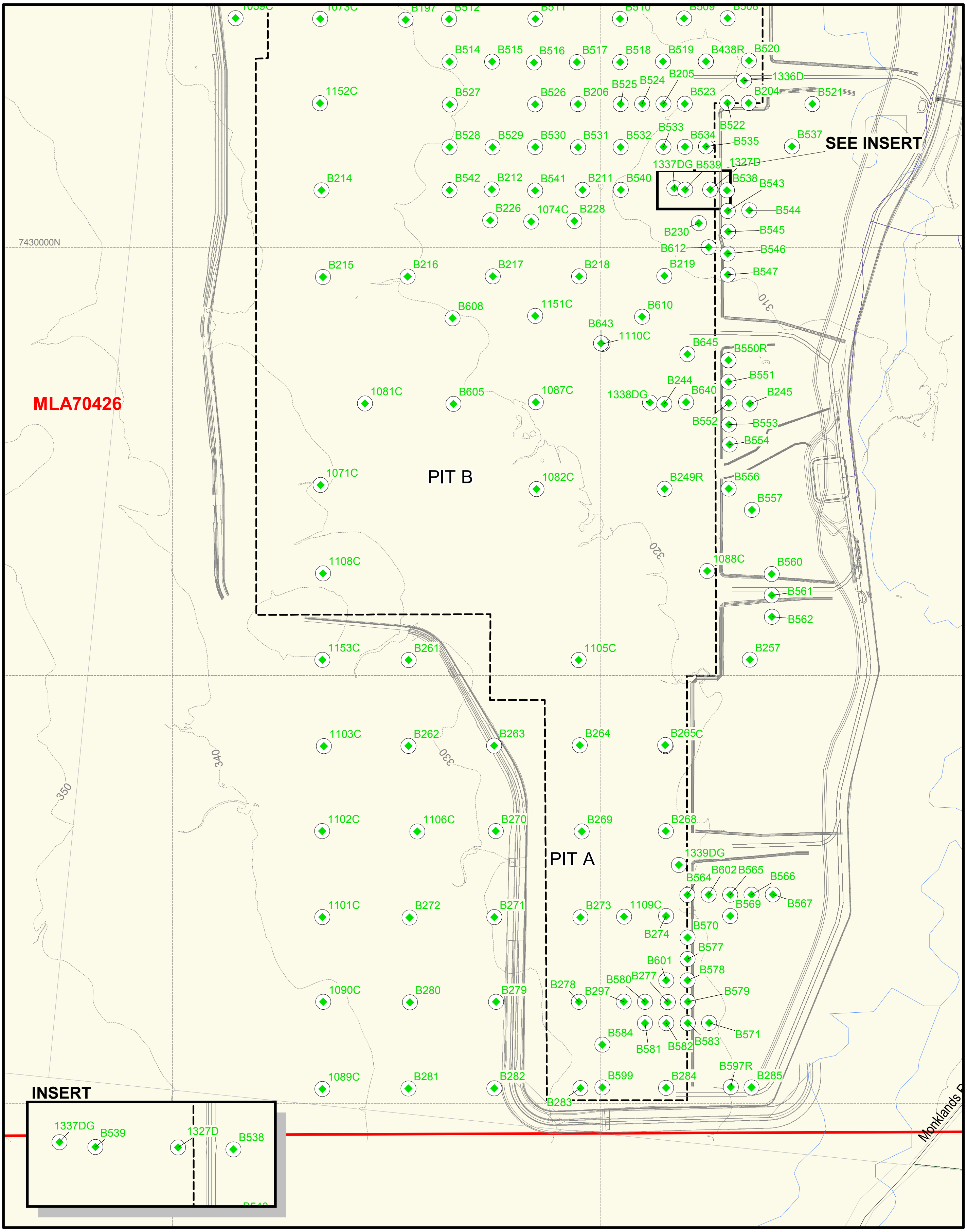
Alpha Coal Project
Environmental Impact Statement

EXISTING DRILL HOLE LOCATIONS - NORTH SECTION

Job Number	4262 6580
Revision	A
Date	24-09-2010

Figure: 16-8a

File No: 42626580-g-2031.wor



Mining Lease Application (MLA70426) Boundary
Contour (10m interval)
Pit Outline
Drill Hole Location

Source: See Copyright Details below and for full disclosure Please Refer to the EIS *Volume 4 - References*

0 750 1500m
Scale 1:60 000 (A4)

Datum: GDA94, MGA Zone55

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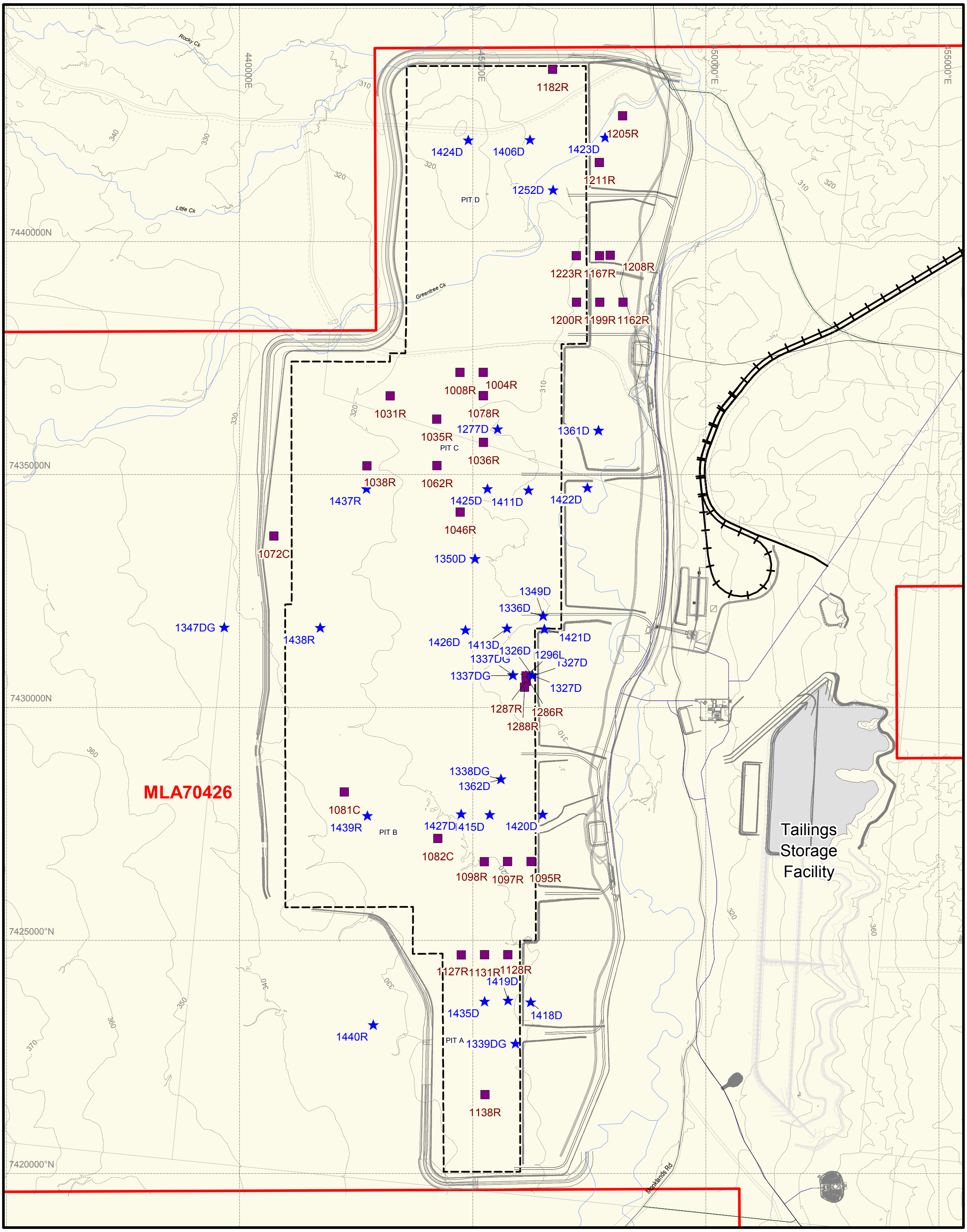
Alpha Coal Project
Environmental Impact Statement

EXISTING DRILL HOLE LOCATIONS
- SOUTH SECTION

Job Number 4262 6580
Revision A
Date 24-09-2010

Figure: 16-8b

File No: 42626580-g-2031.wor



Mining Lease Application (MLA70426) Boundary

Contour (10m interval)

Pit Outline

Additional Drill Hole Location

HyChips Hole Location

Source: See Copyright Details below and for full disclosure Please Refer to the EIS *Volume 4 - References*

0 1.25 2.5km

Scale 1:110 000 (A4)

Datum: GDA94, MGA Zone55

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Alpha Coal Project
Environmental Impact Statement

NEW DRILL HOLES
WITH GEOCHEMICAL AND LITHOLOGICAL
INFORMATION AT ALPHA

Job Number	4262 6580
Revision	A
Date	24-09-2010

Figure: 16-9

File No: 42626580-g-2032.wor

16.5.4 Geochemical characterisation

The geochemical characterisation program for coal and mining waste materials from the Project essentially follows the 1995 DME guidelines in that all samples were screened for:

- Paste pH;
- Electrical Conductivity (EC);
- Total sulfur;
- ANC;
- Net Acid Producing Potential (NAPP); and
- Total metals.

Screening was undertaken at a National Association of Testing Authorities (NATA) certified laboratory in Brisbane. In addition, a series of more specialised static geochemical tests were undertaken on selected samples to reflect more recent knowledge (ACARP, 2008) and Australian and International guidelines applicable to the Project (DITR, 2007 and INAP, 2010). These tests included:

- Net Acid Generation (NAG);
- Carbon and sulphur speciation;
- Acid Buffering Characterisation Curve (ABCC);
- Metal leachability;
- Cation exchange capacity (CEC);
- Exchangeable sodium percentage (ESP); and
- Emmerson Aggregate tests.

Kinetic leach column (KLC) tests generally follow static tests on a small number of selected samples where there is some tangible risk of leaching of poor quality leachate. For the Project, it was decided to bring forward the KLC test program for selected coal, coal rejects, coal tailings, and coal seam roof and floor materials to generate kinetic geochemical data for the Project EIS. Again, this approach compares favourably with the geochemical testing strategies used for recent EIS programs for approved coal mining operations in Queensland.

Details of the overall geochemical sampling and testing methodology utilised for coal and mining waste materials from the Project and results obtained are described in some detail in the EIS geochemical assessment technical report (Volume 5, Appendix J).

16.5.5 Geostatistical Modelling

As part of Project geochemical assessment, geostatistical modelling was used to further evaluate the extent and variability of any acid generation potential, total metal and metal leaching properties of coal, and mining waste materials. This additional geostatistical modelling process is commonly used in natural resource assessments, but has not previously been completed at the EIS stage of a proposed coal mining operation in Australia.

The distribution of the mining waste samples (in terms of rock type) reflects the distribution of the mining waste rock types likely be generated on the Alpha Coal Project (Mine). Geostatistical modelling has found that the uniform geology and stratigraphy at the Project site is reflected by the predictable geochemical characteristics of materials at the Project site (Volume 5, Appendix J).

16.5.6 Comparison with similar case histories

The 1995 DME guidelines state that a comparison of mining projects with similar case histories *"is more applicable to stratigraphically continuous coal mines in sedimentary sequence than to non-coal operations*". This statement reflects the fact that most coal mines in Queensland have relatively uniform stratigraphic profiles with potentially sulphidic materials generally concentrated close to seams (including uneconomic seams) or in specific rock types (e.g. carbonaceous mudstone).

In the nearest comparable coal fields of the Bowen Basin in Queensland, most overburden is typically Non-Acid Forming (NAF), but can potentially be saline and/or sodic. These material properties are addressed through appropriate material management and rehabilitation strategies. At selected coal mines in the Bowen Basin, some coal reject and tailings materials have some capacity to generate acid, salts and metals. These materials are generally managed in above ground containment facilities, although more recently the trend has been to store these materials in final voids where there is a low risk of resource sterilisation and/or marked surface and groundwater impacts.

On the Project, the aim is to store coal reject and tailings materials in below ground in-pit storage facilities as soon as sufficient capacity becomes available to achieve this outcome. Material compaction, encapsulation and alkaline amendment will be used, where beneficial, to manage these materials and generate an improved environmental outcome. Again, this approach compares favourably with the management strategies used to manage coal rejects and tailings materials contained in EIS programs for approved coal mining operations in Queensland.

In recent years there have not been major issues with acid leaching or salinity from coal mine tailings dams in Queensland containing low concentrations of pyritic sulphur. Most Bowen Basin coal mines have low total sulphur content coals (< 0.7%) and the Project is no exception (0.6%). In addition, the proportion of organic sulphur in the Project coal and subsequently tailings is relatively high (0.32%) and pyritic sulphur content relatively low (0.27%), which will also significantly limit the risk of acid generation from coal and tailings materials.

16.5.7 Operational Sampling and Testing

As stated in Section 16.6.3 above, the current geochemical characterisation and assessment approach undertaken for the Project by the Proponent provides a high level of confidence that the occurrence and distribution of the coal and mining waste types likely to be generated on the Project have been adequately reflected in the sampling program. The Proponent will continue to complete sampling and geochemical testing programs for representative samples of coal and mining waste materials as the Project progresses and has already commenced an additional drilling program focussing on sampling coal and mining waste materials from the area likely to be mined in the first five years of operation.

16.6 Geochemical Nature of Coal and Mining Waste Materials

16.6.1 Acid Generating Potential

The available existing geochemical data on the Project coal and mining waste materials from the static and kinetic geochemical test programs on these materials is described in this section for specific material types.

16.6.1.1 Coal

Significant existing data is available on the Project coal materials including total sulphur (and total metal) results for 988 raw and washed coal samples from 252 drill holes spread across the deposit area. A figure showing the location of the drill holes, from which this information is available, is provided in Figure 16.8a and 16.8b.

The results from these samples indicate that the total sulphur content of the coal materials is typically 0.6%, with approximately half of this total sulphur content present as non-acid generating organic sulphur. However, more recent data indicates that the ANC of the coal is also quite low (approximately 5 kg H_2SO_4/t) therefore there is some uncertainty regarding the acid generating nature of the coal material. Notwithstanding, the capacity of coal materials to generate acid is likely to be low. As a precautionary measure, water will be managed at the ROM and product coal stockpile areas to contain surface runoff from coal materials.

Raw and washed coal may be stored at the site for a relatively short period of time (weeks) compared to mining waste materials, which will be stored at the site in perpetuity. Management practices are therefore different for coal and for mining waste materials.

16.6.1.2 Overburden / Waste Rock

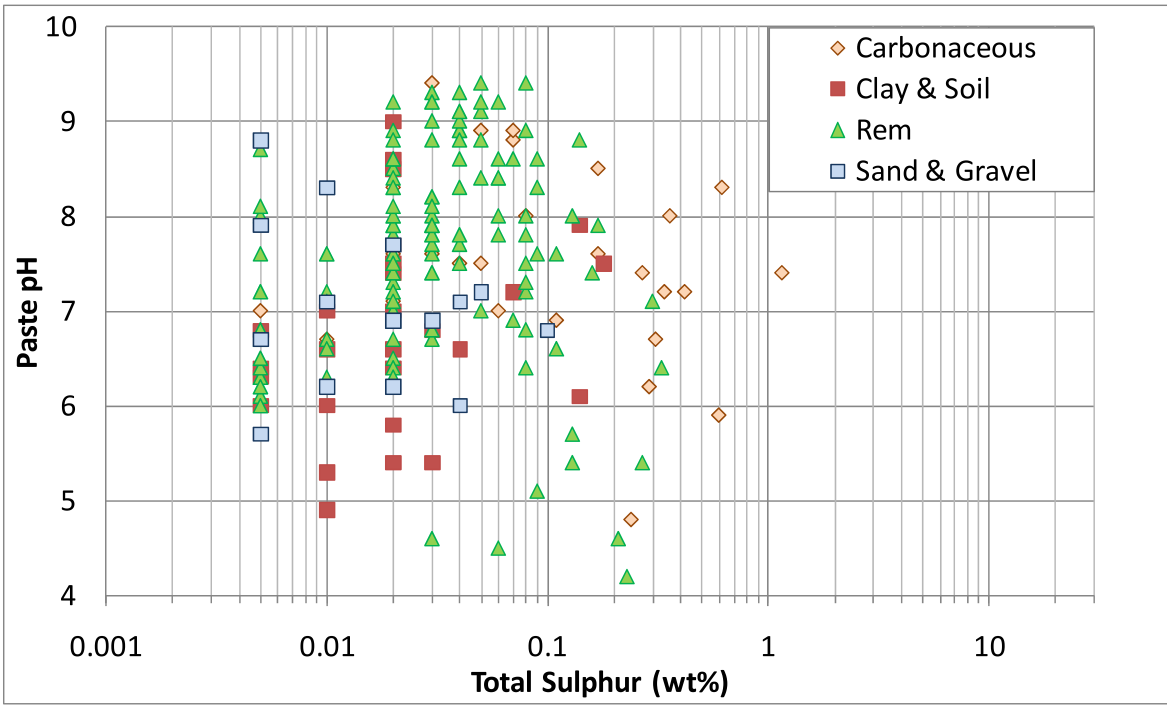
As described in Section 16.3 above, the sedimentary genesis of the Project coal deposit and information contained in the geological model indicates that the majority of overburden materials are likely to have negligible sulphide content and be NAF. The only exceptions could be visually distinguishable small pockets of any uneconomic coal seams or specific carbonaceous rock types such as some mudstone and claystone. Such materials would typically be retained in the open pit and covered with at least 10 m of spoil materials.

The very low sulphide content and NAF nature of the overburden materials on the Project is confirmed by the results of the 2010 geochemical test program (Volume 5, Appendix J). Figure 16.10 shows a plot of Total Sulphur versus Paste pH for 281 overburden samples, which illustrates the very low total sulfur content of the overburden samples. Many samples have a total sulphur content at or below the average crustal abundance for sulphur (0.03%), and most have a total sulphur content less than 0.1 % and hence are essentially barren of sulphur.

A low proportion (8) of the 281 overburden samples have slightly elevated (but still very low) total sulphur content (>0.3%) and these represent minor and visually distinguishable stoney coal and coaly mudstone (carbonaceous) rock types. A proportion of this total sulphur content is also likely to be present as non-acid producing organic sulphur or sulphate sulphur, as described in Volume 5 Appendix J, and hence total sulphur data presents a worst case scenario.

The overburden units taken as a whole have an excess of ANC and will produce a neutral pH leachate. Hence, from a potential acid generation viewpoint, overburden materials have a high factor of safety and spoil piles pose negligible risk to the immediate and downstream environment.

Figure 16-10: Plot of total sulphur versus paste pH for overburden samples at Alpha project



The comparatively elevated ANC of many of the samples combined with the very low sulphur concentrations indicates there would be excess alkalinity to buffer the extremely small quantity of acid that could potentially be produced by a very small proportion of the likely mining waste materials. This is highlighted by the ratio of ANC to maximum potential acidity (MPA).

The purpose of the ANC/MPA ratio is to provide an indication of the relative margin of safety (or lack thereof) within a material with regard to acid generation potential. An ANC/MPA value of 2 or greater is (according to the International guidelines (INAP, 2009)) an indication a low potential for acid generation. ANC/MPA values significantly higher than 2 are generally evident in alkaline materials. As a general rule, an ANC/MPA ratio of 2 or more signifies that there is a high factor of safety and a high probability that the material will remain circum-neutral in pH and thereby should not be problematic with respect to acid generation. The mean ANC/MPA ratio for the Project overburden samples tested is 6.1 including carbonaceous materials and 8.4 excluding carbonaceous materials.

16.6.1.3 Coal Seam Roof and Floor Materials

Based on samples tested to date, a proportion of the immediate roof and floor materials in the Project coal seams may have elevated total sulphur content and low ANC and may therefore pose a risk of developing acid conditions. A portion of these materials will report (as dilution) with coal to the CHPP and will ultimately become part of the coal reject stream.

As a precautionary measure, the Proponent will ensure that any roof and floor materials within 1 m of the coal seams not extracted as coal dilution will stay in the open pit and be managed in a similar fashion to coarse rejects.

Should any uneconomic coal seam material be extracted from the open pit, this will preferentially be managed within the open pit voids in a similar fashion to coarse rejects previously described in Section 16.5.2.3.

16.6.1.4 Coarse Rejects

Based on samples tested to date, a proportion of the coarse reject materials generated by the Project may have elevated total sulphur content and little ANC and therefore will be carefully managed. The intention is to return all coarse rejects back to the open pit from the CHPP around the start of Year 2 and store within the in-pit spoil piles with compaction and encapsulation with spoil as described in detail in Section 16.5.2.3 above. Some consideration may also be given to amendment of compacted coarse reject material with finely crushed limestone or equivalent alkaline material, depending on the result of ongoing kinetic leach column tests on representative coarse reject samples. In Year 1 the coarse rejects will report to an above ground storage emplacement area at the low wall of the boxcut area.

16.6.1.5 Fine Rejects (Tailings)

Fine reject materials (tailings) generated by the Project was tested to have slightly elevated total sulphur content (0.6 - 0.7%), although as much as 50% of this occurs in the non-acid producing organic sulphur form.

The tailings material also has low ANC values (approximately 5 kg H_2SO_4/t). Notwithstanding, the capacity of tailings materials to generate acid is likely to be low. Preliminary kinetic leach column test results for tailings indicate this material is unlikely to generate acid leachate in the short-term; however, leachate may be moderately saline and therefore any seepage water at the TSF will be managed as described in Volume 5 Appendix J.

The intention is to return all tailings materials back to the open pit from the CHPP after approximately Year 5 and store these within the in-pit spoil piles (along with coarse rejects) with encapsulation using spoil as described for coarse rejects in Section 16.5.2.3. Some consideration may also be given to amendment of tailings material with finely crushed limestone or equivalent alkaline material, depending on the result of ongoing kinetic leach column tests on representative tailing samples.

16.6.2 Multi-Element Composition and Water Quality

A selection of individual and composite coal and mining waste samples were subjected to total and water-soluble metals analysis as described in Volume 5, Appendix J. The results show that, as expected given the genesis of the deposit and well understood geology, there is no significant metal enrichment exhibited by these materials. The tests indicate that the metals are sparingly soluble at the natural pH. Water extracts from these materials generate leachate with median soluble metal concentrations within Australian Drinking Water Guidelines (NHMRC, 2004)) and median pH in the target range (6.5-8.5).

Soluble metals concentrations are low at the natural pH of these materials, however, the solubility of some metals is dependent on pH and this issue will be closely monitored in any runoff and seepage from any PAF materials generated at the Project, such as coarse rejects.

For mining waste materials, some salinity (1:2 paste EC) levels were found to be elevated in some overburden materials (e.g. clays), but low in others (e.g. sandstone). This issue will be managed at the spoil areas by ensuring that any materials with elevated salinity are stored in the core of the spoil storage areas and that lower salinity materials are used for the final surface layers.

For coal and coal reject materials, salinity levels were generally found to be low to moderate, however the salinity levels of the coal reject materials has the potential to increase if these materials are exposed to oxidising conditions. This issue will be managed by employing compaction, clay capping, potential alkaline amendment, and spoil encapsulation methods for coarse reject materials as described at Section 16.5.2.3. These material management measures will help to minimise any risk of migration of salt load towards the surrounding environment.

16.6.3 Mining Waste Mitigation and Management Measures

16.6.3.1 Use of Overburden/Spoil Materials for Re-vegetation/Rehabilitation

The discussion below focuses on the geochemical characteristics that need to be considered as part of rehabilitation of the Project site. The proposed rehabilitation plan for the site is discussed in more detail in Volume 2, Section 25. The proposed mining waste strategy is to return the majority of coal rejects and overburden materials back into the open pit. Some quantity of overburden materials will be used for rehabilitation and re-vegetation of the covered coal rejects areas. Also, a small proportion of overburden (< 2% of the overall total) and coarse rejects at the start of Year 1 will be integrated into an out-of-pit emplacement along the eastern edge of the open pit boxcut area. To aid in confirming the Project re-vegetation and rehabilitation decisions, the physical/chemical suitability of the overburden/spoil materials was investigated.

A selection of overburden materials were tested for:

- Sodicity;
- CEC;
- ESP; and
- Emmerson Aggregate Tests.

The results indicate that overburden materials comprise a range of potentially sodic and dispersive (e.g. clay) and non-dispersive (e.g. sandstone) materials.

Ideally, sodic and dispersive materials will be identified and placed within the core of spoil piles away from final surfaces, or returned to voids during mining. Treatment of any sodic overburden will be required if it is used as part of a vegetation growth medium.

16.6.3.2 Summary of Management Measures

The ongoing management of mining waste (overburden and potential reject materials) will consider the geochemistry of materials with respect to their potential risk to cause harm to the environment and their suitability for use in revegetation. The design of a mining waste management strategy for the project will focus on:

- Placement of mining waste materials to minimise run-off, erosion and potential seepage; and
- Preferential placement of mining waste materials in open pit void areas, when sufficient capacity becomes available.

16.6.3.3 Ongoing Geochemical Sampling and Analysis

The distribution of drill holes used for geochemical sampling (Figure 16-9) shows that the geochemical information to date provides good coverage of the proposed open pit area. Geostatistical modelling has found that the uniform geology and stratigraphy at the Project site is reflected by the predictable geochemical characteristics of materials at the Project site.

The geochemical characteristics of the coal and mining waste materials are adequately characterised by the existing geochemical testing program data. The Proponent will, however, continue ongoing operational geochemical characterisation of coal and mining waste materials from the Project area to verify the predicted geochemical characteristics of these materials.

This data will be used to optimise the management strategies of coal and mining waste materials. For future work, in addition to standard acid-base and metals testing (static tests) and kinetic leach column tests, geochemical characterisation will include assessing the general soil properties (sodicity, exchangeable cations) of selected mined waste materials to confirm their suitability for use in surface revegetation and rehabilitation activities.

16.6.3.4 Water Quality Management and Monitoring

Surface water and leachate derived from, or in contact with, coal and mining waste materials will be monitored to ensure that water quality is being managed and not significantly compromised by proposed site management practices. Potentially impacted surface waters will be primarily managed by retaining water on-site. This water will be reused in the site water management system. This will be particularly important in the CHPP and open pit areas where stored materials may produce brackish run-off water. Further information regarding surface water quality and surface water management is provided in Volume 2, Section 11.

Coal and mining waste materials will be monitored for geochemical characteristics (pH, EC, acidity, alkalinity, sulphur species (total, organic, sulphide and sulphate) and ANC) on a monthly basis until such time as the variability of the geochemical characteristics of these materials is well defined (approximately 12 months).

Surface and seepage water at coal and mining waste storage areas will also be monitored on a monthly basis and tested for pH, EC, Total Dissolved Solids (TDS), acidity and alkalinity. Major anions (sulphate, chloride, fluoride), major cations (calcium, magnesium, sodium and potassium) and trace metals (aluminium, arsenic, antimony, boron, cadmium, chromium, cobalt, copper, iron, lead, manganese, molybdenum, nickel, selenium, silver, uranium, vanadium and zinc) will be included in the range of parameters tested in these water samples, initially on a quarterly basis (for 12 months) and then on an annual basis throughout the life of mine. Should the pH of the TSF seepage water decrease below pH 5.5 or the EC increase by more than 100% from typical background values, the full range of parameters described above will be included in the test suite.

16.7 Tailings Disposal Alternative

It is recognised that an out-of-pit TSF is required almost universally at all coal mine operations for at least the first period of mining operations. Due to the lack of a free mine pit void early in the mine life, disposal of tailings is often tasked to a purpose built impoundment, either of a co-disposal type or a conventional tailings impoundment. A move to in-pit disposal is often made once a suitable pit void is available.

This philosophy is generally accepted as standard practice for many Queensland coal mine developments and is the preference of the Proponent if proven viable for the Alpha Coal Project (Mine). At the time of writing, uncertainties exist regarding a move to in-pit tailings disposal. It is considered that the fully engineered and controlled out-of-pit arrangement currently proposed provides the lowest risk, most conservative solution for the Project.

However, as stated previously, a shift to in-pit disposal sometime early in the mine life is the preferred philosophy. With regard to this, an out-of-pit storage facility is currently presumed to cater for the first five years of tailings production, with a move to in-pit disposal thereafter. The Proponent will expedite this alternative if proven viable through further hands-on experience, ongoing testing and engineering investigation. Work is currently underway to progress this proposal, with the main input being the experience soon to be gained from the bulk sample test pit operation – underway at the time of writing. Further mine planning, testing on tailings rheology and tailings geochemistry is also in progress to further access the viability of in-pit disposal.

Further information about the TSF and the alternative in-pit tailings disposal option is contained in the Alpha Coal Project TSF Concept Design Report (Volume 5, Appendix J).