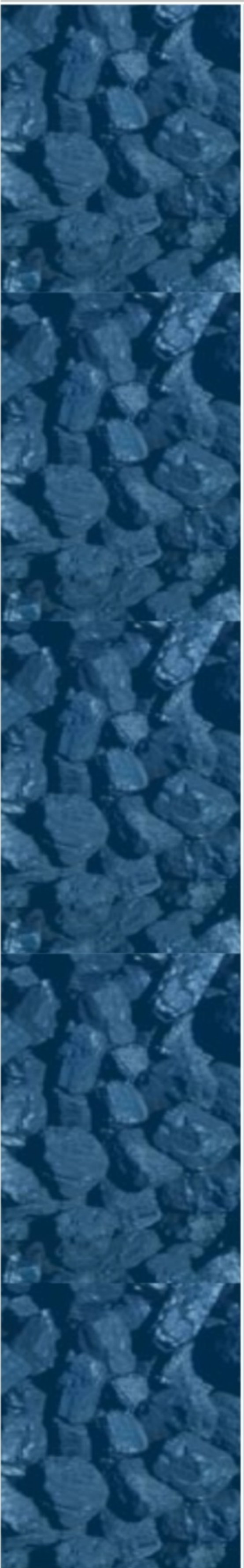
Adani Mining Pty Ltd



Carmichael Coal Mine and Rail Project SEIS

Report for Mine Waste Management Strategy

18 October 2013

This Carmichael Coal Mine and Rail Project SEIS: Tailings Management Strategy (the Report) has been prepared by GHD Pty Ltd (GHD) on behalf of and for Adani Mining Pty Ltd (Adani) in accordance with an agreement between GHD and Adani.

The Report may only be used and relied on by Adani for the purpose of informing environmental offset assessments and production for the proposed Carmichael Coal Mine and Rail Project and may not be used by, or relied on by any person other than Adani.

The services undertaken by GHD in connection with preparing the Report were limited to those specifically detailed in Section 1.2 of the Report.

The Report is based on conditions encountered and information reviewed, including assumptions made by GHD, at the time of preparing the Report.

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1. Introduction

1.1 Project overview

Adani Mining Pty Ltd (Adani, the Proponent), commenced an Environmental Impact Statement (EIS) process for the Carmichael Coal Mine and Rail Project (the Project) in 2010. On 26 November 2010, the Queensland (Qld) Office of the Coordinator General declared the Project a ‘significant project’ and the Project was referred to the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) (referral No. 2010/5736). The Project was assessed to be a controlled action on the 6 January 2011 under section 75 and section 87 of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The controlling provisions for the Project include:

- World Heritage properties (sections 12 & 15A)
- National Heritage places (sections 15B & 15C)
- Wetlands (Ramsar) (sections 16 & 17B)
- Listed threatened species and communities (sections 18 & 18A)
- Listed migratory species (sections 20 & 20A)
- The Great Barrier Reef Marine Park (GBRMP) (sections 24B & 24C)
- Protection of water resources (sections 24D & 24E)

The Qld Government’s EIS process has been accredited for the assessment under Part 8 of the EPBC Act in accordance with the bilateral agreement between the Commonwealth of Australia and the State of Queensland.

The Proponent prepared an EIS in accordance with the Terms of Reference (ToR) issued by the Qld Coordinator-General in May 2011 (Qld Government, 2011). The EIS process is managed under section 26(1) (a) of the *State Development and Public Works Act 1971* (SDPWO Act), which is administered by the Qld Government’s Department of State Development, Infrastructure and Planning (DSDIP).

The EIS, submitted in December 2012, assessed the environmental, social and economic impacts associated with developing a 60 million tonne (product) per annum (Mtpa) thermal coal mine in the northern Galilee Basin, approximately 160 kilometres (km) north-west of Clermont, Central Queensland, Australia. Coal from the Project will be transported by rail to the existing Goonyella and Newlands rail systems, operated by Aurizon Operations Limited (Aurizon). The coal will be exported via the Port of Hay Point and the Point of Abbot Point over the 60 year (90 years in the EIS) mine life.

Project components are as follows:

- The Project (Mine): a greenfield coal mine over EPC 1690 and the eastern portion of EPC 1080, which includes both open cut and underground mining, on mine infrastructure and associated mine processing facilities (the Mine) and the Mine (offsite) infrastructure including a workers accommodation village and associated facilities, a permanent airport site, an industrial area and water supply infrastructure

- The Project (Rail): a greenfield rail line connecting to mine to the existing Goonyella and Newlands rail systems to provide for the export of coal via the Port of Hay Point (Dudgeon Point expansion) and the Port of Abbot Point, respectively including:
  - Rail (west): a 120 km dual gauge portion running west from the Mine site east to Diamond Creek
  - Rail (east): a 69 km narrow gauge portion running east from Diamond Creek connecting to the Goonyella rail system south of Moranbah
  - Quarries: five local quarries to extract quarry materials for construction and operational purposes

1.2 Purpose, scope and related documents

This purpose of this Tailings Management Strategy is to provide high level conceptual assurance of the proposed on site tailings management strategy.

The scope of the report is to:

- Confirm the estimated volume of tailings over the life of mine based on the proposed mine plan, schedule and run of mine beneficiation
- Provide a conceptual level tailings management strategy, that includes the proposed long term on site tailings storage solution
- Provide concept level designs for the proposed engineered tailings management structures
- Assess at a high level any potential impacts to environmental and water values based on the proposed tailings management strategy

Documents related to this Tailings Management Strategy, and ones that therefore provide additional detail, include:

- SEIS Volume 4 Appendix K1: Mine Hydrogeology Report
- SEIS Volume 4 Appendix K2: Water Balance
- SEIS Volume 4 Appendix K3: Water Quality Report
- SEIS Volume 4 Appendix K5: Mine Hydrology Report
- SEIS Volume 4 Appendix O1: Mine Waste Characterisation Report

Note that this report discusses the mine waste products being generated as a result of the run of mine coal beneficiation process; being coarse rejects and fine rejects (tailings). The overburden waste management strategy is discussed in the Mine Waste Characterisation Report (refer SEIS Volume 4, Appendix O1).

2. ROM processing and tailings production volumes

2.1 ROM coal beneficiation

The ROM coal beneficiation process comprises the following:

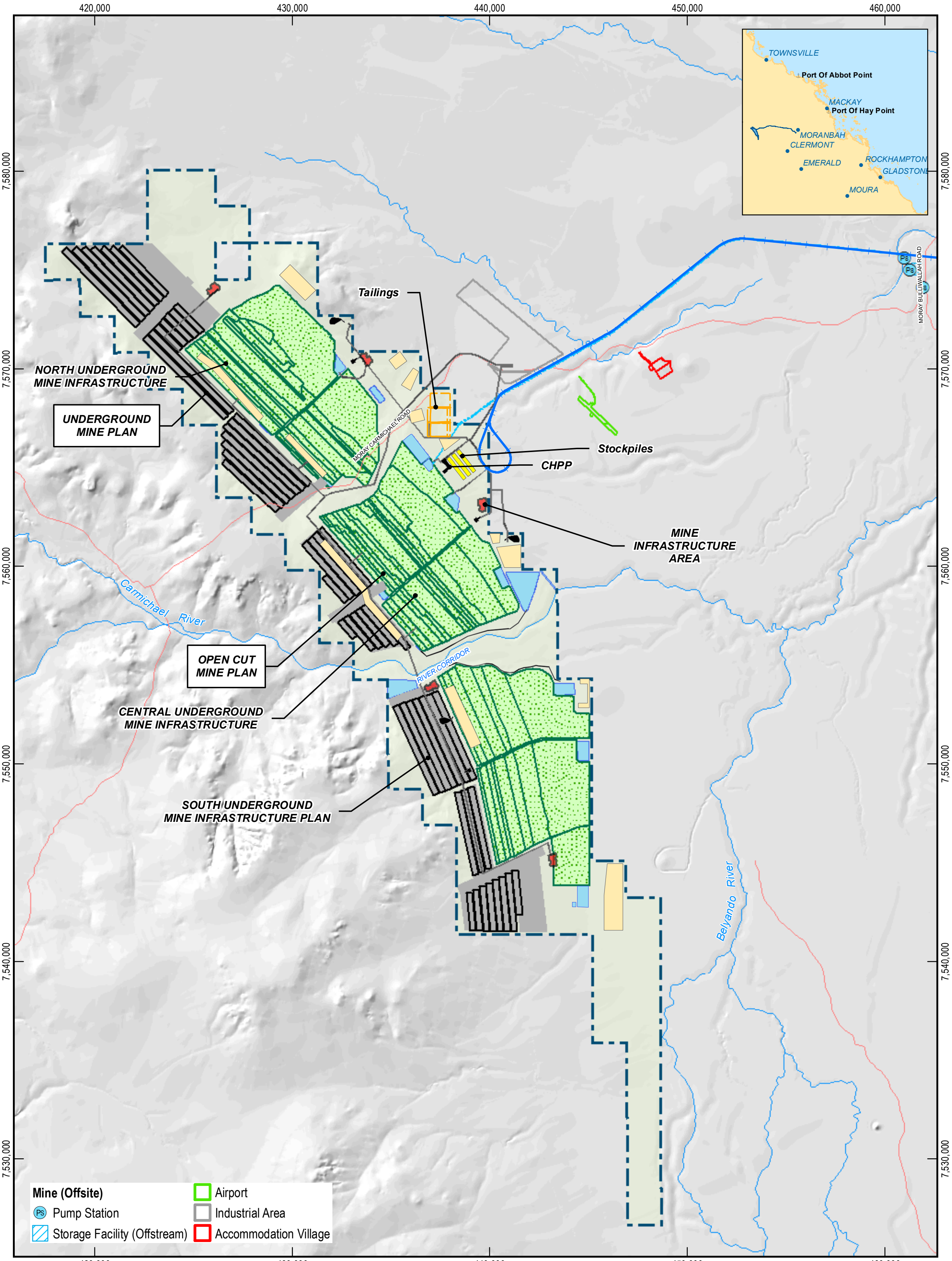
- Coal Handling and Preparation Plant (CHPP): which is terminology for the summation of the discrete coal handling plant (CHP) and coal preparation plant (CPP)
- CHP: which receives the ROM coal and sizes it to sub 50 mm via primary, secondary and tertiary crushers
- CPP: which receives and washes the sub 50 mm coal as processed in the CHP. It does this across a number of modules, each capable of washing 1,600 tonnes per hour

The Project's CHPP has been designed to receive and process a maximum throughput of 54.5 million tonnes per annum (Mtpa) run of mine (ROM) coal. The facility will operate 24 hours per day, seven days a week for a minimum of 7,200 hours per annum for the life of the mine.

There are two waste streams generated during the ROM beneficiation process within the CHPP; being:

- Coarse rejects: these will be conveyed to a truck loading bin northwest of the CHPP. From this bin, a dedicated fleet of haul trucks would place the rejects into the engineered tailings co-disposal cells in out of pit storage emplacements D and E (Figure 1)
- Fine rejects: known as tailings. The tailings would be managed as reported within this document

A schematic of the ROM coal life cycle for the Project as it relates to mine waste generation and fate is presented in Figure 2. A more detailed description of the ROM coal beneficiation process is provided in the Project Description, located in SEIS Volume 4 Appendix B.



LEGEND

- Local Road
- River / Watercourse
- Overland Conveyors
- Rail (West)
- Mine (Onsite)
- Open Cut Blocks
- Out of Pit Waste Dumps
- Water Management Dams
- Mine Infrastructure Area
- Mine Infrastructure
- Stockpiles
- Tailings Cell
- Top Soil Storage

Based on or contains data provided by the State of QLD (DERM) [2010]. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

1:275,000 (at A4)

0 2 4 6 8 10

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project SEIS

Job Number	41-26422
Revision	B
Date	18-10-2013

Project Mine Layout

Figure 1

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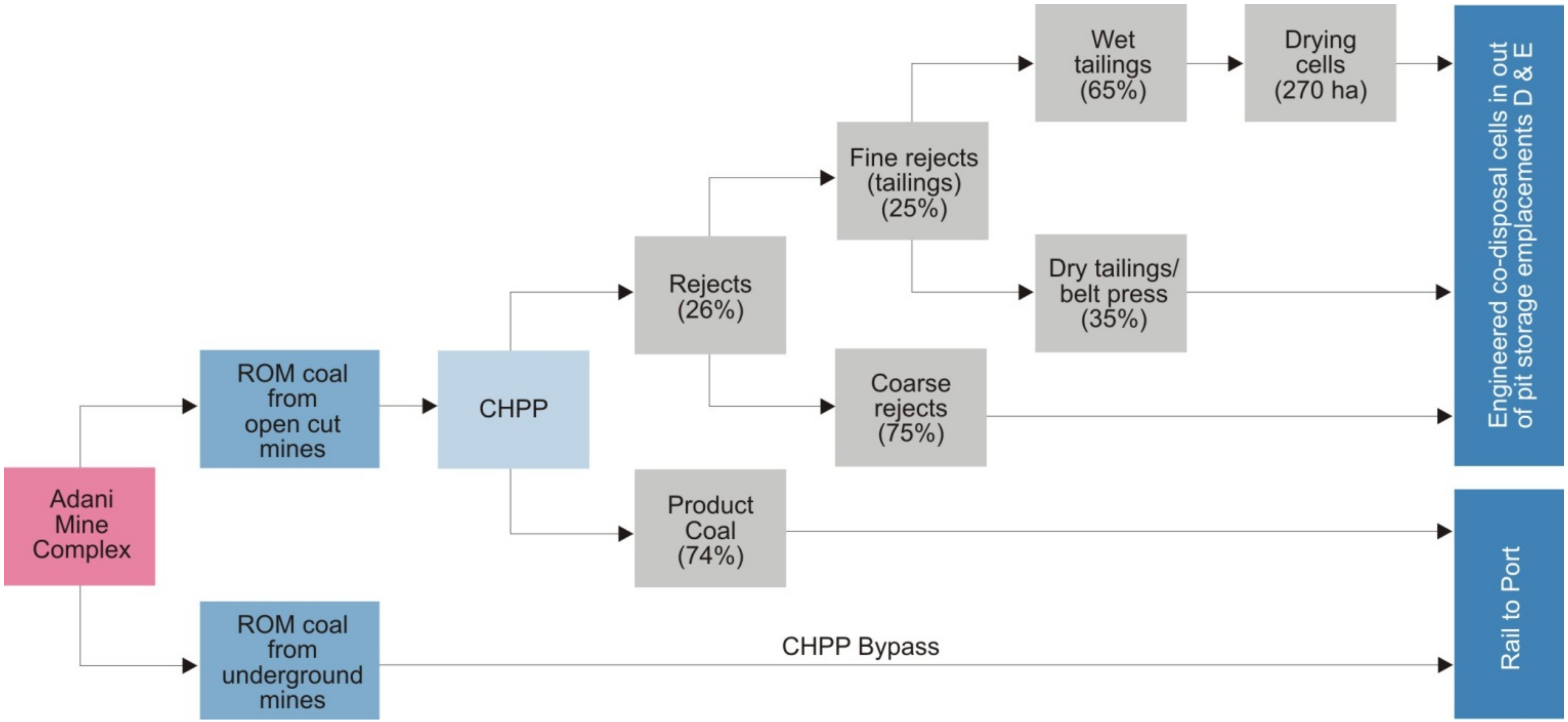
Data Source: GA: Road, River / Watercourse (2007); DME:EPC1690 (2010), EPC1080 (2011); Adani: Alignment, Offsite(2013), Mine Layout / Infrastructure (2013); Created by: MS

Figure 2 ROM coal life cycle and fate



2.2 Tailings production volumes

2.2.1 Overview

In order to establish a tailings management strategy within the overall context of a mineral waste management strategy incorporating waste rock, the volume of tailings produced over the life of mine must first be known. Accordingly, tailings volumes were calculated based on Adani's mine plan and mine schedule as summarised in Appendix A.

The method used to calculate the tailings volumes likely to be produced over the life of mine was by subtracting the product coal from the ROM coal, leaving a net volume that includes both coarse rejects and fines (tailings).

2.2.2 Assumptions

When calculating the estimates life of mine tailings volumes, the following assumptions were used:

- Only ROM coal from the open cut pits would be washed; none from the underground mines
- Both dry and wet CHPP rejects will ultimately be co-disposed in the out of pit storage emplacements at Pits D and E. A more detailed mine schedule would be developed in order to determine exact selective handling and replacement logistics

Additionally, the technical parameters supplied and confirmed by Adani as shown in Table 1 were also used when estimating the life of mine tailings volumes.

Table 1 Life of mine tailings volumetric assumptions

Assumption Criteria	Value
Percentage of fine reject (tailings) – refer Figure 2	24.6%
Percentage of coarse reject	75.4%
Percentage of traditional wet tailings (to drying cells)	65%
Percentage of dry tailings (from belt press)	35%
Density of reject	1.7 t/m^3
Swell and compaction factor	1.25

2.2.3 Methodology and final estimated volumes

As noted above in Section 2.2.1, the net of ROM and product coal over the life of mine was used to estimate the tailings volumes. A temporal aspect was also included to ensure the tailings management strategy could ultimately manage the volume of tailings produced in real time.

The following method was therefore used to calculate tailings volumes:

- Tonnage = ROM tonnes - Product tonnes (different moisture contents were not considered at this level of study); for an overall ratio of 74 percent;
- A density of 1.7 was used for both fine rejects (tailings) and coarse rejects to calculate volumes

- 24.6 percent of total reject volume was considered fine (65% of this will report to wet tailings)
- Both fine (tailings) and coarse reject volumes were added to the over and interburden waste volumes in the waste dumps to confirm total mine waste volumes, and therefore the required footprint area, with both a swell and compaction factor applied. For the purposes of this study, the same swell and compaction factor was applied to both the over and interburden waste and the reject; this will require a more detailed investigation during detailed design

Table 2 provides a summary of the total reject and waste volumes. A summary of total mine waste including over and interburden waste and the rejects is provided in Appendix B.

Table 2 Method 1 total reject and waste volume

Description	Value
Total fine rejects (tailings) (Mm [3])	59.16
Total Coarse + Fine Rejects (tailings) (Mbcm [1])	369.99
Total Reject to be Dumped (Mlcm [2])	462.49
Total Overburden Waste to be Dumped (Mlcm)	16,428.85
Total Waste Dumped (Total Reject + OB Waste) (Mm [3])	16,891.34

1: Million bank cubic metres

2: Million loose cubic metres. Includes net bulking factor (bulking factor – compaction factor)

3: Cubic metres is the same volume as Mlcm

3. Tailings management strategy

3.1 Introduction

Section 2.1 of this document provided a summary of the ROM processing at Carmichael, such that a considerable volume of tailings would be produced as described in Section 2.2.

The proposed method of tailings disposal has been developed considering the following constraints:

- the limited physical space within the mining lease to accommodate the volume of tailings produced during the life of mine
- mine plan and schedule
- requirement to minimise impact to the environment, surface water, and groundwater
- requirement to maximise water recovery from the tailings for beneficial reuse in future coal washing operations on site

3.2 Strategy overview

Figure 2 presented a schematic of the overall percentage of ROM coal that would ultimately report as tailings under the Project Description. Ultimately, 100 percent of the tailings and coarse rejects generated in the CHPP would report to the engineered co-disposal cells located within out of pit storage emplacements at Pits D and E.

From the schematic in Figure 2, it is proposed that the tailings be managed by:

- approximately 35 percent of the tailings being dewatered by passing them through a belt / filter press
- approximately 65 percent of the tailings being pumped as slurry and sub-aerially deposited into out of pit earth embankment tailings dams to dry. The tailings deposited into these dams would be placed in thin layers of a nominal maximum of approximately 150 mm to assist with the bleeding and consolidation of the tailings

The bleed water will be decanted off into adjacent storage ponds for reuse in the plant. Once the tailings have sufficiently dried out and consolidated, the consolidated tailings would be excavated from the tailings dams and transported to pre-constructed containment cells located within the out of pit storage emplacements at Pits D and E. Dried tailings 'cake' generated from the belt / filter press would also be placed into the pre-constructed containment cells located within out of pit storage emplacements at Pits D and E.

The containment cells located within out of pit storage emplacements at Pits D and E would be constructed with a suitably designed and engineered clay liner at the base and sides (Appendix C). When at capacity, the cells would be clay capped. This should effectively fully contain the tailings and minimise the risk of any contaminants entering the surrounding environment (refer Section 4.5). Appendix C shows the layout position of these cells in section through the overburden stockpile.

Adani has commissioned a specialist consultant to undertake slope stability research to inform sustainable final landform design parameters. Results are expected in August 213.

3.3 Design parameters, assumptions and limitations

Table 3 provides a summary of the design parameters used to calculate:

- the size of the tailings drying ponds
- the number of tailings drying ponds
- the size and number of permanent tailings containment cells in the out of pit storage emplacements

The design parameters listed in Table 3 have been derived from best available information at the time of writing and will be refined during the preliminary and final design stages.

Table 3 Design parameters for tailings disposal

Parameter	Value
Discharge solids content (wt/wt)	30%
After bleed solids content (wt/wt)	50%
Settled solids content (wt/wt)	70%
Specific gravity, Gs	2.0 t/m^3
Settled dry density	1.0 t/m^3
Settled bulk density	1.37 t/m^3
Initial bleed water per dry tonne	1.33 m^3/t
Bleed water after settling	0.57 m^3/t
Annual loading rate	25,000 t/ha/annum
Beach slope for tailings deposition	1V:200 H for 600 m then 1V:1000 H to decant structure

3.4 Tailings slurry management

The 65 percent of tailings not passing through the belt / filter press would be mixed with water to achieve a slurry of 30 percent solids by weight, and pumped to the tailings dams. The tailings dams would be constructed as above ground ‘turkey’s nest’ earth embankment structures using selected and compacted earth fill excavated from within the basin of the dams. The size and number of dams required would be dependent upon the rate at which water will bleed from the slurry deposited into the dams, thereby allowing the tailings to consolidate sufficiently for them to be excavated and transported to the containment cells located within out of pit storage emplacements Pits D and E.

Calculations using the estimated annual loading rates of tailings into the tailings dams show that at a peak annual tailings production of approximately 2.25 Mtpa, an area of approximately 90 ha. would be required.

For concept purposes, a six year rotation of the dams has been made such that sufficient operational contingency is built into the system for them to be filled for two years, allow the tailings to dry for the following two years, and for the removal of the dried tailings over the last 2 years of the period. To achieve this design capability, a total area of approximately 270 ha. (i.e. 90 ha. x 3 dams), or approximately 2.7 km^2 is required. The estimated cycle period would be refined during final design.

To further maximise the tailings slurry, it is proposed that the tailings dam be divided into a number of individual cells. The tailings would be deposited into each cell on a rotational basis via a feed pipeline placed along the basin edge of the embankment crest. Flow controlled spigot tee off's, placed at approximately 25 m intervals along the pipeline would allow the tailings to be deposited in the thin, uniform layers required within the cells.

The deposited tailings would form a natural beach sloping towards the end of each cell where a suitably constructed decant structure would collect the bleed water, together with any rainfall sourced run-off during the wet season. The decant water would then be pumped back to the CHPP for reuse, or be stored in decant water dams constructed proximal to the tailings dams.

Decant water return percentages from the tailings are estimated to be as follows:

- Dry tailings: 47 percent; and
- Wet tailings: 30 percent

The schematic in Appendix E illustrates the proposed layout of the tailing cells. To accommodate the tailings dams within the 270 ha footprint required, a total of twelve cells, each sized at 22.5 ha has been proposed within the mining lease. Such a design would allow for four cells to be filled for two years (at peak production) before moving onto the next four cells to allow the drying period to commence.

The floor of each individual cell would be gently graded towards the decant structure. Further, a series of slotted 'ag-pipes' would be laid in shallow sand filled trenches across the topographically lowest 200m area of cell floor, to assist with maximising vertical drainage of bleed water (Appendix D).

Appendix E shows the mine plan with the proposed position of the 12 tailings cells and the associated decant water dam.

3.5 Filter cake tailings management

The tailings filter cake removed from the belt / filter press, together with the dried tailings from the individual cells within the conventional tailings dams, would be permanently stored in the engineered containment cells constructed within the out of pit storage emplacements at Pits D and E.

To minimise the risk of any leachate migrating from the engineered containment cells, tailings would be emplaced within clay lined cells. The rectilinear cells would be constructed within selected over and interburden material in the out of pit storage emplacements, with a 5 m thick compacted clay liner on the sides and base to form a relatively impervious liner. The emplaced tailings would be compacted to achieve an in situ density of 1.7 t/m^3, with each completed containment cell to be clay capped.

4. Environmental values

4.1 Overview and environmental values

As a result of the proposed tailings management plan, there remains the potential to impact on environmental values, largely as they pertain to water quality. This section provides an overview of the mitigation measures that are planned to mitigate the risk on those environmental values.

A detailed assessment of the Project's water balance and strategy is provided in:

- SEIS Volume 4 Appendix K2: Water Balance
- SEIS Volume 4 Appendix K5: Mine Hydrology Report.

The Project is located within the upper reaches of the Burdekin River Basin. Key features of this catchment are the Burdekin River Gorge and falls, and the Burdekin Falls dam which lie downstream of the Study Area. The main basins within the catchment include the Upper Burdekin, Cape Campaspe, Belyando, Suttor, Bowen Broken Bogie and Lower Burdekin. The gorge falls and dam have influenced the ecology of the catchment by restricting movement from the eastern coastal area to the upper catchment areas.

The Project is located within the Belyando Basin of the Burdekin River catchment which is dominated by grazing on natural and introduced pastures. Widespread clearing has resulted in a decline in riparian habitat condition and occurrence over the past 30 years. Unlike the more undulating and wetter northern part of the Burdekin catchment, the Belyando basin is characterised by generally low relief floodplains drained by braided channels and surrounded by wide alluvial plains. The basin is predominantly under Kandosol soils, a fine sandy soil with moderate water holding capacity.

The main riverine feature of the Project area is the Carmichael River, which flows through Mine area and joins the Belyando River almost 20 km downstream of the eastern boundary of the Mine. The Belyando River converges with the Suttor River and the waterway eventually drains into the Burdekin River. As a result of the upstream location in the catchment and seasonality in rainfall, flows are expected to be restricted to the wetter months, November to March, with many streams and drainage channels drying entirely and larger rivers sustaining only pools or low flows by the winter months (June/July).

4.2 Water management objectives

As an overview, the key water management strategies to mitigate risk on environmental values for the Project are summarised as follows:

- ensure all legislative requirements with respect to water management are met
- ensure that adequate quantities of water are obtained to meet the requirements of water usage onsite
- ensure the separation of water on site into the following water categories:
  - process water - comprises returned water from the tailings dams and other sources in the CHPP

– mine affected water (MAW) – groundwater infiltration or rainfall runoff captured within the mine pit and/or specific water storage dams, which is potentially saline. Runoff from out of pit storage emplacements at Pits D and E are classed as MAW

– sediment affected water (SAW) – rainfall/runoff captured from the disturbed catchments, which is potentially sediment laden. Runoff from all out of pit storage emplacements with the exception of those at Pits D and E are classed as SAW

– raw water – clean water provided from onsite and offsite sources

– clean water – from upstream of the mine flows and is required to be diverted from mine operations and returned to downstream water systems

– potable water for human consumption

- preferentially use water on site in the order of (1) MAW, (2) sediment affected water (SAW) and (3) raw water
- ensure nil discharge of MAW and sediment affected water except within the guidelines and minimise the necessity to harvest clean water
- install and maintain appropriate sediment control structures to ensure any discharges from the sediment water catchments are kept to a minimum and comply with water quality criteria
- harvest SAW and MAW water runoff for mine use
- minimise erosion and sedimentation from all active mining and non-rehabilitated areas
- maximise gravity feed and minimise pumping for water transfer
- ensure minimal initial capital expenditure

4.3 Catchment areas and site drainage

As noted above, MAW catchment areas include the pit area and out of pit overburden storage areas D and E. As a general strategy, the catchment areas contributing runoff from the out of pit overburden storage areas to the pit will be minimised, such that the amount of MAW produced at the mine site is minimised.

Site drainage will compromise primarily of longitudinal 'v-shaped' drains channelling runoff into sediment ponds located onsite. Sediment ponds will be left to evaporate or alternatively, pumped to MAW storages where required. The MAW runoff will be pumped to the MAW storages for reuse. Within the mine infrastructure areas, runoff from the CHPP and tailings dams is considered MAW.

No MAW is to be discharged into the sediment dams, due to environmental requirements on storm containment.

4.4 Containment storages

MAW draining from out of pit overburden storage areas D and E would report to MAW Dam D and MAW Dam E respectively Table 4 provides the maximum volume and baseline dimensions of the two relevant MAW dams at out of pit overburden storage areas D and E. As these dams will need to collect runoff they will be constructed as in ground basins.

Modelling shows that overflows from these two MAW dams are unlikely as they are sized as per the design storage allowance under Queensland Government regulation. In addition, any MAW

entering these dams is pumped into the central MAW dams meaning that overflows are extremely unlikely considering pumping capacities of 100 L/s.

Table 4 Overburden MAW basins

	Required volume (m^3)	Footprint length (m)	Footprint width (m)	Footprint area (m^2)	Storage depth (m)	Water surface area (m^2)
MAW Pit - D	13,660,000	1035	600	621,000	20	621,000
MAW Pit - E	11,250,000	1500	400	600,000	20	600,000

4.5 Tailings acid generation potential

At the time of writing, no tailings samples were available for geochemical testing to ascertain the risk of acid and metalliferous drainage (AMD). Therefore, coal samples were assessed as a surrogate for the tailings; the logic being that all tailings content is derived from the coal, and therefore, the coal geochemistry is indicative of the tailings geochemistry.

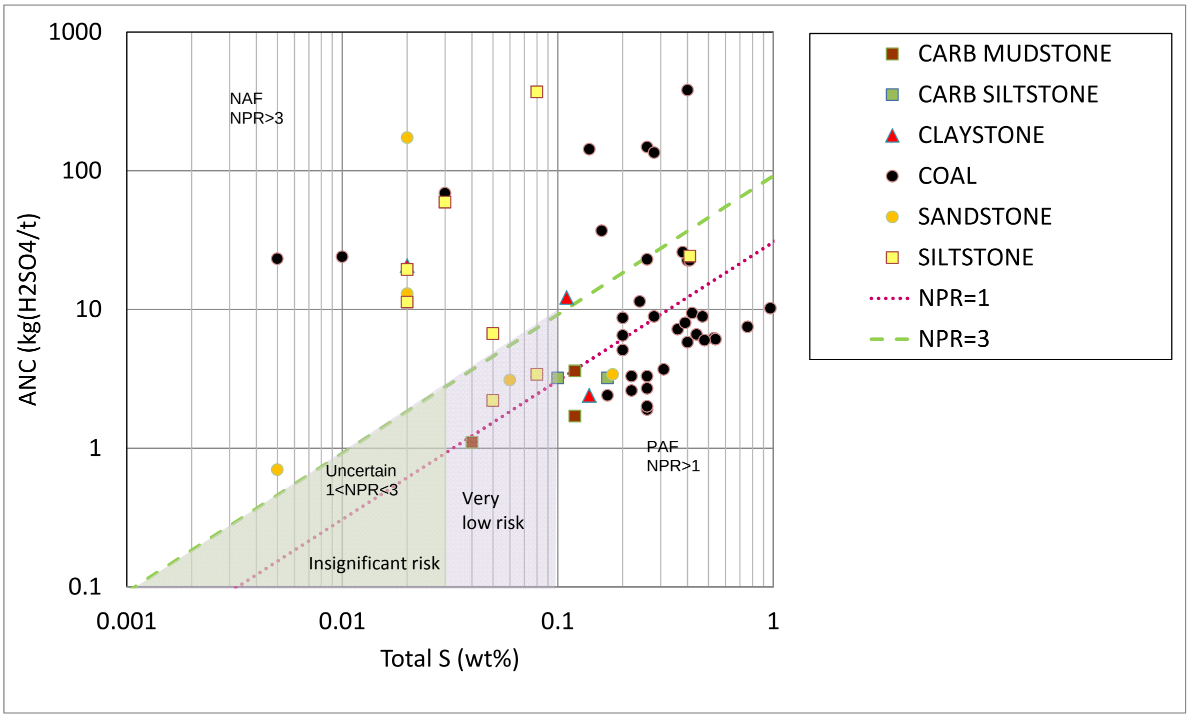
Accordingly, the Mine Waste Acid and Metalliferous Drainage and Dispersive Materials Assessment (refer SEIS Volume 4, Appendix O2) assessed the geochemistry of 470 samples; collected from 40 exploration drill holes. Of these 470 samples, 36 coal samples were assessed, which were assessed along with 21 coal seam roof and floor samples for reasons described below. The coal seam roof and floor materials comprised carbonaceous mudstone, carbonaceous siltstone, claystone, sandstone and/or siltstone.

Sulfide minerals which can oxidise to generate acid, often thereby liberating metals into solution, can form as a result of sulfate reduction during the formation of coal. Therefore, the potential for sulfides to be present in material in and adjacent to coal seams is significantly greater than the potential in the overlying bedrock and regolith. Such material may report to the coarse rejects bin during coal processing, and would ultimately therefore, report to the co-disposal cells within out of pit storage emplacements at Pits D and E.

A summary of the findings on the acid generating potential of the coal, and coal seam roof and floor samples, is reproduced below.

Figure 3 provides a plot of the acid neutralising capacity (ANC) versus total sulfur for the samples of coal, roof and floor material. The green dashed line in the plot differentiates samples with characteristics that are not acid forming (NAF) from those that are classified as uncertain (UC). The classification scheme is provided below. The dotted pink line differentiates the samples with potentially acid forming (PAF) characteristics from those that are UC. The samples below the dotted pink line also have a positive net acid production potential (NAPP); that is, they contain a net of more acid producing minerals (reduced sulfur) relative to acid neutralising minerals (carbonate).

Figure 3 Acid base accounting plot of coal, roof and floor samples



Sample classification is based on the acid generating and acid neutralisation potentials of a material. Whilst the neutralisation potential may be assessed using the NAPP, an alternative method is based on the neutralisation potential ratio (NPR). The NPR is defined as the ratio of ANC to maximum potential acidity (MPA); the latter being the percent reactive sulfur times 30.6, a number derived from reaction stoichiometry. The geochemical samples were classified using the NPR as follows:

- NPR < 1 – potentially acid forming (PAF)
- 1 < NPR < 3 – uncertain (UC) (materials may or may not be net acid forming)
- NPR > 3 – non-acid forming (NAF)
- Total S < 0.1 wt% – non-acid forming (net acid production is low (< 3 kg (H_2SO_4)/t).

Note the last criterion is not a part of the standard NPR method. It is adopted here because samples with acid potential values of less than 3 kg (H_2SO_4)/t have been assessed as low risk at other sites.

The results in Figure 3 indicate that a proportion of the coal would be expected to be acid generating. As much of this coal is saleable product (not waste), it is expected that it would only be stored on site for a short period of time, thus reducing the risk for generation of AMD on site. Waste reject from the coal handling and processing plant (CHPP), however, may pose a greater risk of generating AMD as this material would be disposed of on site. A proportion of the roof and floor material would also be expected to also be potentially acid forming.

Table 5 presents a summary of the coal, roof and floor sample classification. It shows that slightly over half of the coal samples are potentially acid forming. The NAPP statistics from the coal, roof and floor sample group showed a minimum of 0.2 kg H_2SO_4/tonne, a maximum of 29.7 kg H_2SO_4/tonne, and a median of 6.1 kg H_2SO_4/tonne.

Table 5 Roof, floor and coal sample classification (NPR method)

	Number of Samples				Percentage of Samples		
	NAF	UC	PAF	Totals	NAF	UC	PAF
Coal	8	8	20	36	22.2	22.2	55.6
Roof and floor	14	2	5	21	66.7	9.5	23.8
Totals	22	10	25	57	38.6	17.5	43.9

Kinetic testing on 10 leach columns that included seven of the higher risk units commenced in May 2013 and should be continued to determine the rates of oxidation, acid generation, acid neutralisation and metal leaching rates. The measured rates can then be used to complete water quality predictions and infer potential impacts on receiving water quality. These estimates would also be used to fine-tune the environmental management and mitigation measures that are provided below.

The proposed management strategy for the tailings is to place them in clay lined cells within out of pit overburden storage areas D and E (Appendix C). Clay cells would be designed to reduce the water flux into and out of the tailings thereby reducing the quantity of water passing through the tailings. Reduced water flux increases the potential for solubility control of dissolution of the metals and salts thereby reducing the load released from the cells, in addition to reducing oxygen ingress into the sulfidic wastes thereby lowering the oxidation and acid generation risk.

To reduce the possibility of desiccation of waste in the cells and to reduce the potential for transport of metals and salts to the surface of the out of pit overburden storage areas, the top level of the cells should be at least 5 m below the surface. During out of pit overburden storage area and cell construction, contact between UC, PAF and dispersive materials should be avoided. Further, dispersive materials should be placed below the surface and not be used for construction of cell linings.

Lower concentrations of sulfide minerals in the near surface unmined material indicate that this material is less likely to be acid forming in the long term. Near surface materials that are not dispersive and have low salinity and low concentrations of readily soluble salts could be used to cover on the top surface of the out of pit overburden storage areas to prevent run-off contamination. Stockpiling of near surface materials with these properties should be undertaken during mine development where possible.

4.6 Water demand

The water demand required to operate the CHPP at a rate commensurate with a life of mine tailings output as detailed herein in Section 2.2.3 is provided in the Mine Water Balance Report (SEIS Volume 4, Appendix K2). It found that washing and processing of the ROM coal to provide product coal is expected to require 240 L per ROM tonne[1]. This is the maximum figure as return water lowers the demand. This is discussed in the water balance document and varies for conventional tailings or dry tailings (belt press); refer Volume 4, Appendix K2. Only ROM from open cut mining will be processed at the CHPP as the underground coal mining is specifically targeting deposits that do not require washing. Table 6 shows water demand for the CHPP.

[1] Source: data provided by Adani 2013

The Mine Hydrology Report (SEIS Volume 4 Appendix K5) assessed the potential impacts from the proposed mine water supply sources.

Table 6 CHPP demand (ML/day)

Year	Total CHPP Demand	Year	Total CHPP Demand
2015	0.0	2045	35.5
2016	3.6	2046	35.5
2017	12.5	2047	35.5
2018	16.8	2048	35.5
2019	21.4	2049	35.5
2020	25.6	2050	34.8
2021	29.9	2051	33.9
2022	32.2	2052	32.2
2023	34.2	2053	31.1
2024	35.5	2054	26.6
2025	35.5	2055	26.6
2026	35.5	2056	26.6

4.7 Impact mitigation and management measures

Considering the above tailings management strategy, proposed impact mitigation and management measures include:

- Design and operation of the tailings storage facilities in accordance with appropriate legislation to minimise impacts to surface and groundwater resources
- Establishment and operation of a surface and groundwater monitoring network for the proposed tailings dams, and out of pit overburden storage areas
- Leach testing of tailings generated from coal washing proposed for disposal in cells in out of pit storage emplacements at pits D and E prior to the commencement of mining, in order to supplement the findings of the SRK acid and metalliferous drainage report (refer SEIS Volume 4, Appendix O2). Due to the unavailability of tailings at the SEIS stage, coal was used as a tailings surrogate. This will assist with the development and implementation of suitable treatment and, or, management measures to minimise impacts on surface and/or groundwater quality from tailings disposal
- Continuing with the geochemical kinetic leach column tests that commenced in May 2013 for a minimum of 6 months to assess the longer term risk of acid and metalliferous drainage generation from the higher risk lithological units
- Appropriately designed MAW dams at out of pit storage emplacements at pits D and E
- Recycling of recoverable MAW from the tailings back into the CHPP
- Disposal of tailings in engineered, clay lined containment cells within out of pit overburden storage areas D and E

  Post closure capping and rehabilitation of the out of pit overburden storage facilities. Additional work being undertaken by Landloch in July 2013 will add knowledge to determining stable final landform slopes at the Project, and would be incorporated into the conceptual rehabilitation strategy

5. Summary and conclusions

This purpose of this conceptual level Tailings Management Strategy was to provide high level assurance of the proposed tailings management strategy for the Project.

The scope of the report was to:

- Confirm the estimated volume of tailings over the life of mine based on the proposed mine plan, schedule and run of mine beneficiation.

This was confirmed using the most recent Adani mine plan at the time of writing. Mineral waste volumes, including the coarse rejects and tailings as generated from the on-site CHPP are provided herein in Table 2.

- Provide a conceptual level tailings management strategy that included the proposed long term on site tailings storage solution.

Section 3 provided an overview of the tailings management strategy considering operational constraints including the mine schedule and therefore, CHPP throughout; the tailings dewatering process, and the available footprint in which to dry the wet tailings prior to their ultimate encapsulation in engineered cells within out of pit overburden storage emplacements D and E.

- Provide concept level designs for the proposed engineered tailings management structures.

Three concept level design drawings have been included as Appendices C, D and E.

- Assess at a high level any potential impacts to environmental and water values based on the proposed tailings management strategy.

A consideration of potential impacts to environmental and water values based on the proposed tailings management strategy included considering the surface and groundwater, in addition to the tailings geochemistry. The proposed impact mitigation and management strategies were provided in Section 4.7.

In summary, based on the information available at the time of writing, the proposed tailings management strategy appears to be viable, with any potential impacts manageable.

Appendices

Appendix A – Summary of mine schedule

Adani Mine Schedule Report

Annual Product tonnages linked to the Adani Annual Schedule tonnages

			2015	2016	2017	2018	2019	2020-2024	2025-2029	2030-2034	2035-2039	2040-2044	2045-2049	2050-2054	2055-2059	2060-2064	2065-2069	2070-2074	TOTAL
OPENCUT																			
Pit B	TOTAL Waste	Mbcm	24.0	32.0	37.2	41.3	42.5	265	266	226	239	252	266	304	316	322	330	70	3,031
	ROM Coal	Mt	0.0	2.0	6.0	7.5	8.5	60	58	55	55	55	55	58	58	55	55	12	599
	Product Coal		0.0	1.5	4.4	5.5	6.3	44.40	43.29	40.70	40.70	40.70	40.70	42.55	42.55	40.70	40.70	8.69	443.44
Pit C	TOTAL Waste	Mbcm	0.0	25.0	34.0	31.5	42.0	238	195	176	178	181	187	39	-	-	-	-	1,327
	ROM Coal	Mt	0.0	0.0	2.0	3.5	6.0	43	40	35	34	32	32	7	-	-	-	-	234
	Product Coal		0.0	0.0	1.5	2.6	4.4	31.45	29.60	25.90	24.79	24.05	24.05	4.82	-	-	-	-	173.17
Pit D	TOTAL Waste	Mbcm	24.0	28.0	36.0	39.8	47.5	265.61	235.10	226.00	234.00	255.00	269.00	291.75	300.00	98.91	-	-	2,350.62
	ROM Coal	Mt	0.0	2.0	6.0	7.5	9.5	60.50	54.50	50.00	50.00	50.00	50.00	50.00	50.00	16.49	-	-	456.49
	Product Coal		0.0	1.5	4.4	5.5	7.0	44.77	40.33	37.00	37.00	37.00	37.00	37.00	37.00	12.20	-	-	337.80
Pit E	TOTAL Waste	Mbcm	22.5	24.0	33.0	38.5	39.1	243.00	228.80	207.40	241.25	266.14	261.00	194.22	-	-	-	-	1,798.91
	ROM Coal	Mt	0.0	1.5	5.0	7.0	8.5	51.50	47.50	42.50	44.00	45.00	43.50	32.37	-	-	-	-	328.37
	Product Coal		0.0	1.1	3.7	5.2	6.3	38.11	35.15	31.45	32.56	33.30	32.19	23.95	-	-	-	-	242.99
Pit F	TOTAL Waste	Mbcm	0.0	0.0	0.0	0.0	0.0	-	208.00	220.15	223.55	218.86	229.70	253.65	266.95	282.15	258.00	-	2,161.01
	ROM Coal	Mt	0.0	0.0	0.0	0.0	0.0	-	23.00	42.50	42.50	42.50	44.00	47.50	47.50	47.50	43.00	-	380.00
	Product Coal		0.0	0.0	0.0	0.0	0.0	-	17.02	31.45	31.45	31.45	32.56	35.15	35.15	35.15	31.82	-	281.20
Pit G	TOTAL Waste	Mbcm	0.0	0.0	0.0	0.0	0.0	243.00	247.55	240.30	239.40	238.50	252.90	280.34	285.00	285.00	162.41	-	2,474.40
	ROM Coal	Mt	0.0	0.0	0.0	0.0	0.0	25.00	46.50	45.00	45.00	45.00	45.00	47.50	47.50	47.50	27.07	-	421.07
	Product Coal		0.0	0.0	0.0	0.0	0.0	18.50	34.41	33.30	33.30	33.30	33.30	35.15	35.15	35.15	20.03	-	311.59
UNDERGROUND																			0
Mine 1	Development	Mt	-	-	-	2.50	2.83	8.37	0.48	-	-	-	-	-	-	-			14.17
	Longwall	Mt	-	-	-	0.27	15.99	88.57	59.10	2.46	-	-	-	-	-	-			166.38
	TOTAL Mine 1		-	-	-	2.76	18.82	96.93	59.57	2.46	-	-	-	-	-	-			180.55
Mine 2	Development	Mt	-	-	-	-	-	-	-	-	1.20	2.79	2.32	1.24	-	-			7.55
	Longwall	Mt	-	-	-	-	-	-	-	-	-	19.16	31.66	25.73	21.90	-			98.45
	TOTAL Mine 2		-	-	-	-	-	-	-	-	1.20	21.95	33.97	26.98	21.90	-			106.00
Mine 3	Development	Mt	-	-	-	-	-	-	0.65	3.89	3.00	0.49	-	-	-	-			8.02
	Longwall	Mt	-	-	-	-	-	-	-	-	26.83	27.25	35.21	7.24	-	-			96.53
	TOTAL Mine 3		-	-	-	-	-	-	0.65	3.89	29.82	27.74	35.21	7.24	-	-			104.55
Mine 4	Development	Mt	-	-	-	-	-	1.44	4.67	0.93	-	-	-	-	-	-			7.04
	Longwall	Mt	-	-	-	-	-	-	11.97	42.59	34.51	9.00	-	-	-	-			98.07
	TOTAL Mine 4		-	-	-	-	-	1.44	16.64	43.52	34.51	9.00	-	-	-	-			105.11
Mine 5	Development	Mt	-	-	-	-	-	1.28	5.00	2.83	0.37	-	-	-	-	-			9.48
	Longwall	Mt	-	-	-	-	-	-	18.98	45.05	28.72	22.51	0.67	-	-	-			115.93
	TOTAL Mine 5		-	-	-	-	-	1.28	23.98	47.88	29.09	22.51	0.67	-	-	-			125.40
OVERALL TOTAL																			
	ROM COAL	Mt	-	5.50	19.00	28.26	51.32	339.16	370.84	367.74	364.62	351.20	339.86	275.60	224.40	166.49	125.07	11.74	3,040.79
	Product COAL	Mt	-	4.07	14.06	21.63	42.87	276.89	300.64	297.54	294.42	281.00	269.66	212.84	171.75	123.20	92.55	8.69	2,411.80

Appendix B – Summary of life of mine waste volumes

GHD Calculations

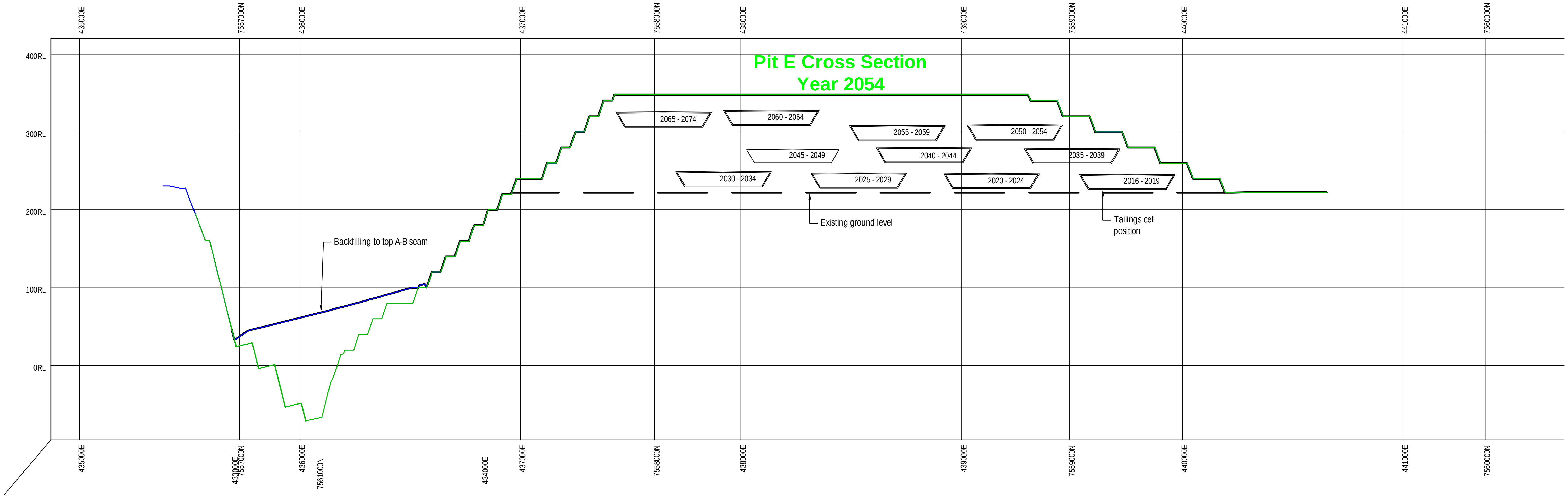
Method1				2015	2016	2017	2018	2019	2020-2024	2025-2029	2030-2034	2035-2039	2040-2044	2045-2049	2050-2054	2055-2059	2060-2064	2065-2069	2070-2074	TOTAL
Product Coal/ROM Coal(%)				-	74.0%	74.0%	74.0%	74.0%	74.0%	74.0%	74.0%	74.0%	74.0%	74.0%	74.0%	74.0%	74.0%	74.0%	74.0%	74.0%
Incremental Reject Volumes			Density																	
Reject (tonnes)= ROM-Product (OC Coal Only)	Mt			0.00	1.43	4.94	6.63	8.45	62.27	70.20	70.20	70.20	70.20	70.20	62.76	52.65	43.29	32.52	3.05	628.99
Reject(Mbcm)	Coarse Reject	75.4%	**1.7**	-	0.63	2.19	2.94	3.75	27.62	31.14	31.14	31.14	31.14	31.14	27.84	23.35	19.20	14.42	1.35	278.97
	Fine Reject	24.6%	**1.7**	-	0.21	0.71	0.96	1.22	9.01	10.16	10.16	10.16	10.16	10.16	9.08	7.62	6.26	4.71	0.44	91.02
% of Fine Reject to Tailings	Mm^3	65%		-	0.13	0.46	0.62	0.79	5.86	6.60	6.60	6.60	6.60	6.60	5.90	4.95	4.07	3.06	0.29	59.16
Total Reject to be Dumped	Mlcm	Swell	**1.25**	-	-	-	9.56	6.21	45.79	51.62	51.62	51.62	51.62	51.62	46.15	38.71	31.83	23.91	2.24	462.49
OB Waste -Insitu(Schedule Volumes)	Mbcm			70.50	109.00	140.20	151.00	171.10	1,254.27	1,380.53	1,295.05	1,355.05	1,411.11	1,466.00	1,362.65	1,168.20	987.60	750.41	70.43	13,143.08
OB Waste -to be Dumped	Mlcm	Swell	**1.25**	88.13	136.25	175.25	188.75	213.87	1,567.83	1,725.66	1,618.81	1,693.81	1,763.88	1,832.50	1,703.31	1,460.25	1,234.50	938.02	88.03	16,428.85
Total Waste Dumped (Dry+Wet Reject+OB Waste)*	**Mlcm**			88.13	136.25	175.25	198.31	220.09	1,613.62	1,777.27	1,670.43	1,745.43	1,815.50	1,884.12	1,749.45	1,498.96	1,266.32	961.93	90.28	16,891.34

Incremental total waste volumes are indicative only, as they are inclusive of reject volumes.Detailed reject and tailings schedule is required to reflect a more realistic time representation of dumping reject volumes in waste dumps.

		2015	2016	2017	2018	2019	2020-2024	2025-2029	2030-2034	2035-2039	2040-2044	2045-2049	2050-2054	2055-2059	2060-2064	2065-2069	2070-2074	TOTAL
Open Cut	**ROM Coal**	-	5.50	19.00	25.50	32.50	239.50	270.00	270.00	270.00	270.00	270.00	241.39	202.50	166.49	125.07	11.74	2,419.18
	Product Coal	-	4.07	14.06	18.87	24.05	177.23	199.80	199.80	199.80	199.80	199.80	178.63	149.85	123.20	92.55	8.69	1,790.19
Underground	Development	-	-	-	2.50	2.83	11.09	10.79	7.64	4.57	3.28	2.32	1.24	-	-	-	-	46.26
	Longwall	-	-	-	0.27	15.99	88.57	90.05	90.10	90.05	77.92	67.54	32.97	21.90	-	-	-	575.35
	Total	-	-	-	2.76	18.82	99.66	100.84	97.74	94.62	81.20	69.86	34.21	21.90	-	-	-	621.61

Total Coarse +Fine Reject (Mbcm)	369.99
% of Fine Reject to Tailings (Mm^3)	59.16
Total Reject to be Dumped (Mlcm)	462.49
Total OB Waste to be Dumped (Mlcm)	16,428.85
Total Waste Dumped (Total Reject+OB Waste) (Mm^3)	16,891.34

Appendix C – Schematic of cells within out of pit storage emplacements at Pit E

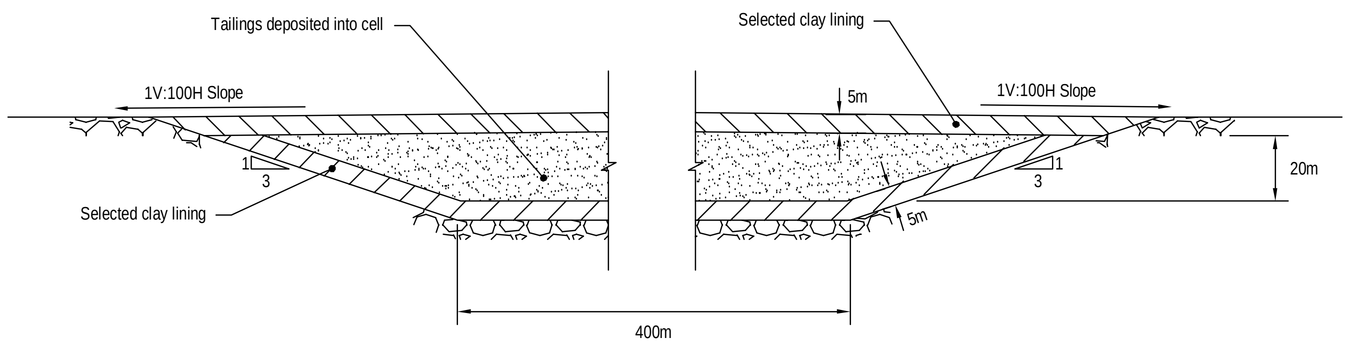


TYPICAL SECTION THROUGH PIT E AT 90° TO HIGH WALL INDICATING POTENTIAL POSITION OF TAILINGS CELLS INCORPORATED INTO OVERBURDEN STOCKPILE

H/V Ratio: 4

0 100 200 300 400 500m

SCALE 1:10,000 AT ORIGINAL SIZE



SECTION THROUGH TAILINGS "CELL"

PRELIMINARY

rev	description	app'd	date
B	CHANGE TO PIT E		
A	INITIAL ISSUE		

ADANI MINES - CARMICHAEL COAL MINE
SEIS

OVERBURDEN OF PIT E
TYPICAL SECTION

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scale 1:10000 for A1 job no. 41-26766
date JULY 2013 rev no. B

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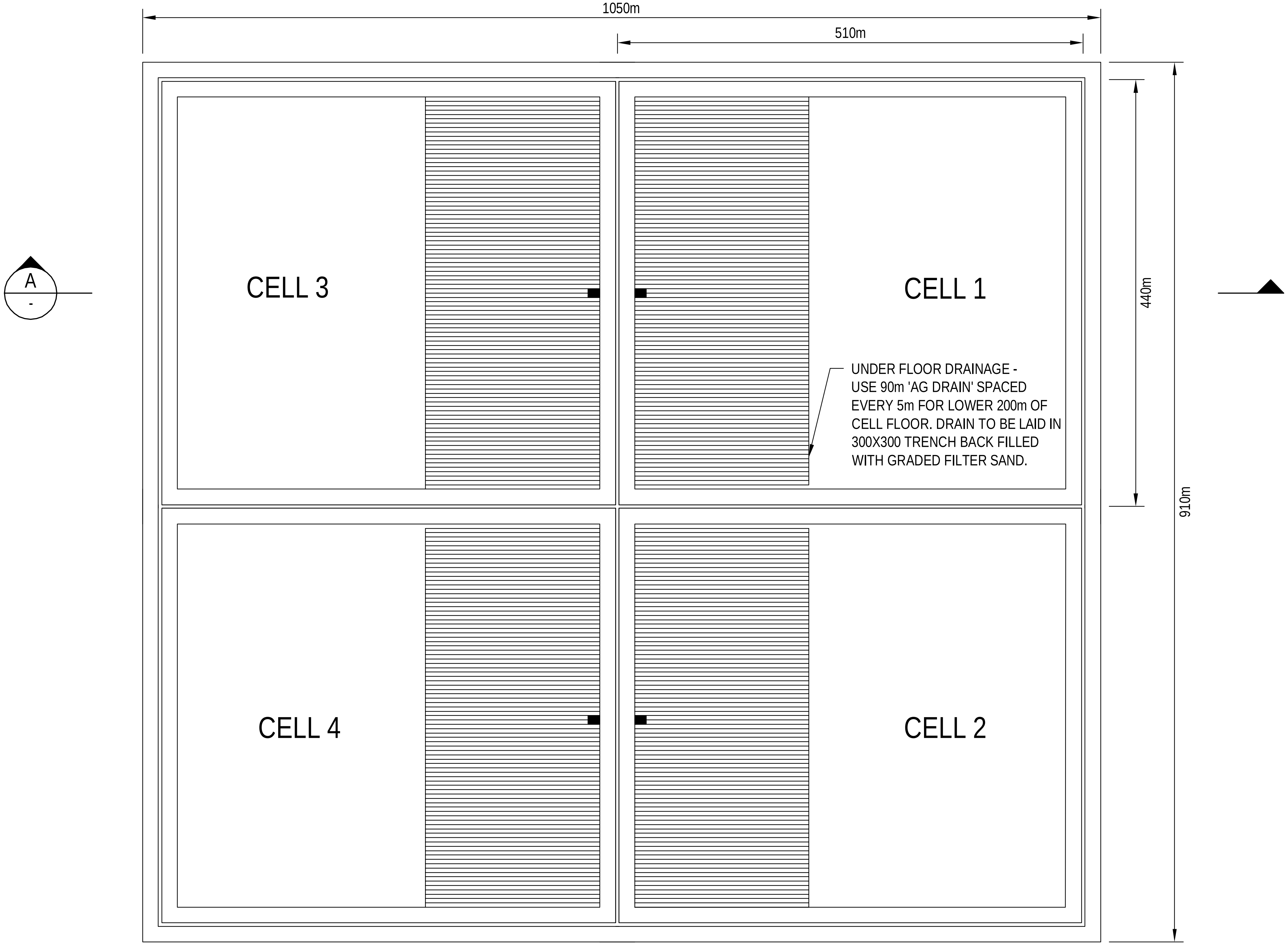
APPENDIX "A"

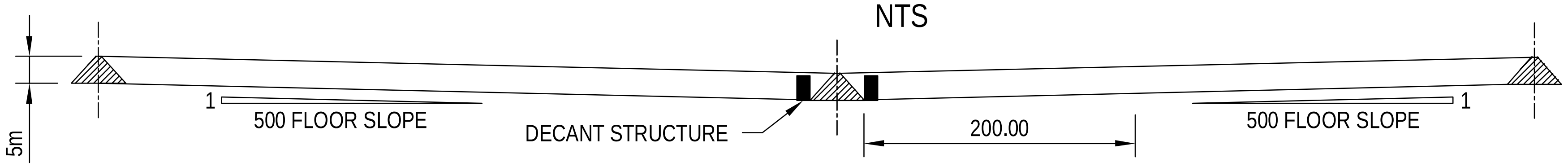
Plot Date: 31 July 2013 - 6:17 PM Plotted by: Octaviano Paraiso Cad File No: G:\41\26766\CADD\Drawings\PitE_CrossSection_Year2069.dwg

Appendix D – Plan view schematic of an individual tailings dam cell



PLAN OF TAILING DAM

NTS



A SECTION

-

NTS

PRELIMINARY

rev	description	app'd	date
A	INITIAL ISSUE		

ADANI MINES - CARMICHAEL COAL MINE
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TAILING DAM
PLAN AND SECTION OF CELLS

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APPENDIX "D"

Appendix E – Plan view schematic of tailings drying cell configeration

LEGEND

2	TAILINGS CELL (TYP.)

0 500 1000 1500 2000 2500m

SCALE 1:50,000 AT ORIGINAL SIZE

PRELIMINARY

rev	description	app'd	date
A	INITIAL ISSUE		

ADANI MINES - CARMICHAEL COAL MINE SEIS

TAILINGS CELLS PROPOSED LOCATIONS

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APPENDIX "E"

Plot Date: 31 July 2013 - 6:11 PM Plotted by: Andrew Malden Cad File No: G:\41\26766\CADD\Drawings\41-26766-SK001.dwg

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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
A	N Mohtaj, S Hein, N Forbes	S Winchester	DRAFT	J Keane	DRAFT	30/07/2013
0	N Mohtaj	S Winchester	On file	J Keane	On file	01/08/2013
1	M Goodall	J Keane		J Keane		18/10/2013

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