Base Plan Sources: Geo-Spectrum (Australia) Pty Ltd 2008 & 2009

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Rocglen Coal Mine Extension Project
Recommended Topsoil Stripping Depths

FIGURE 16

Adherence to the recommended stripping depths, and allowing for a 10% handling loss, will yield approximately 559,400 cubic metres (m^3) of topsoil material suitable for topdressing and 480,200 m^3 of subsoil material suitable for intermediate layering between the overburden and topdressing. Based on these volumes, sufficient material will be available to enable effective intermediate layering and topdressing for the rehabilitation of the Rocglen site.

5.4.2 Erosion Potential

All soil samples collected by GSSE (2010a) were laboratory tested for dispersion, using the Emerson Aggregate Test (EAT), and sodicity using the Exchangeable Sodium Percentage (ESP). These tests indicate the susceptibility of a soil to losing its structure and binding capacity when wet, and therefore the erosion potential of the soil. The results showed the Sodic Brown Alluvial Clay (Unit 3 - Brown Dermosol) to have an ESP of 7.9, 12.6 and 6.5 in layers 1, 2 and 3, respectively. The other sites were determined to have non-sodic topsoil and non-sodic to sodic subsoil.

While appropriate erosion and sediment control measures will be put in place prior to surface disturbance for all soils, GSSE (2010a) recommends that particular attention be given to the Sodic Brown Alluvial Clays as the risk of erosion may be high once the subsoil is exposed. GSSE (2010a) further recommends that the sodic subsoils be placed in the overburden emplacement in areas where they are unlikely to be exposed as a result of rainfall and/or drainage for long periods of time. The use of non-sodic subsoil as an intermediate layer keyed in between the overburden and the topdressing is current practice on-site and will continue.

5.4.3 Potential Acid Generating Material

GSSE (2010a) considers the potential for acid generation from regolith material (topsoil and subsoil) within the Project Site to be low. Acid Sulphate Soils (ASS), which are the main cause of acid generation within the soil mantle, are commonly found less than 5 metres above sea level, particularly in low-lying coastal areas such as mangroves, salt marshes, floodplains, swamps, wetlands, estuaries and brackish or tidal lakes. There has been little history of acid generation from regolith material in the Gunnedah or Boggabri areas, which are significantly removed from coastal areas.

5.4.4 Stripping and Stockpiling Methods

Soil materials within the Project Site should be stripped, handled and stockpiled in a manner that minimises the potential for soil loss and structural deterioration. Topsoil and subsoil will continue to be stripped separately using open bowl scrapers to the depths recommended by GSSE (2010a) summarised in **Section 5.4**. As is the current practice, the material will be transported in the open bowl scrapers and placed either:

- Directly onto reshaped emplacement areas awaiting rehabilitation; or
- In designated topsoil and subsoil stockpile areas adjacent to the areas of surface disturbance.

The designated Eastern and Western Soil Stockpile Areas (see **Figure 6**) have been sited on available and already disturbed land within the Project Site, with consideration in the annual mine sequencing given to minimising the haul distances for placement and subsequent respreading. As committed to in the approved Rocglen operation (PA 06_0198), windrows will be positioned along the realigned Wean Road to assist in visually screening the mining operations.

GSSE (2010a) recommends topsoil stockpiles be established to a maximum height of 3 metres. While there is generally no strict requirement on limiting the height of subsoil stockpiles, GSSE states that a maximum height of 3 metres is good practice.

The Eastern and Western Soil Stockpile Areas will comprise approximately 10 and 4 hectares, respectively, and will provide a combined soil storage volume of approximately 420,000 m^3 (based on 3 metre stockpile heights). It is noted that the boundaries of these stockpile areas are indicative and minor adjustments may be necessary to enable effective utilisation. If the stripped soil material exceeds the available storage volume at any point in time, the soil material will be either directly placed on completed reshaped areas for rehabilitation or temporarily stockpiled on the completed reshaped areas prior to re-spreading as additional areas become available for rehabilitation.

Topsoil and subsoil from the sites of water management structures (for example, sediment basins) will be pushed to the side of the structure to enable construction, and, on completion of construction, will be replaced on the completed surfaces and revegetated.

As recommended by GSSE (2010a), Whitehaven will implement the following additional handling techniques to minimise soil deterioration:

- Soil material will be maintained in a slightly moist condition during stripping, and will not be stripped in either an excessively dry or wet condition.
- If mining sequencing, equipment scheduling and weather conditions permit, stripped material will be placed directly onto reshaped emplacement areas and spread immediately to avoid the requirement for stockpiling.
- The surface of soil stockpiles will be left coarsely textured in order to promote infiltration and minimise erosion until vegetation is established, as well as to prevent anaerobic zones forming.
- Where long-term stockpiling is planned (that is, greater than 3 months) the stockpiles will be seeded and fertilised as soon as possible. An annual cover crop that produces sterile florets or seeds will be sown. A rapid growing and healthy annual pasture sward provides sufficient competition to minimise the emergence of undesirable weed species. The annual pasture species will not persist in the rehabilitation areas but will provide sufficient competition for emerging weed species and enhance the desirable micro-organism activity in the soil.
- Prior to re-spreading stockpiled material onto completed mining or overburden emplacement area, an assessment of weed infestation on stockpiles will be undertaken to determine if individual stockpiles require herbicide application and/or ‘scalping’ of weed species prior to spreading.
- A soil inventory will be maintained to ensure adequate material is available for planned rehabilitation activities.
- Where natural protection from surface runoff flows is not available or achievable, protective earthworks, such as contour banks, and/or straw bale protection will be installed. Silt fencing (or similar) will be installed immediately downslope of any stockpile area potentially susceptible to erosion and maintained until the stockpile is considered stable with an effective vegetation cover.

5.4.5 Soil Re-Spreading

As stated above, if mining sequencing, equipment scheduling and weather conditions permit, Whitehaven proposes to place stripped soil material directly onto reshaped emplacement areas and spread immediately to avoid the requirement for stockpiling. Whitehaven has adopted the general practice of including an intermediate layer of subsoil between the overburden material and the topdressing, which improves the water holding capacity of the rehabilitated landform and reinstates a more natural soil profile. This practice is proposed to be continued using appropriate subsoil and targeting areas being rehabilitated to pasture. For areas being rehabilitated to bushland, Whitehaven may preferentially reduce the subsoil replacement depth and/or exclude subsoil replacement in selected areas to establish trial areas to monitor bushland development in different soil profiles.

Where resources allow, topsoil and subsoil will each be spread to a nominal depth of between 100 to 150 millimetres (mm), giving a combined depth of soil material on the rehabilitated landform of between 200 and 300 mm. Stripped soil material should be spread, treated with fertiliser and seeded in one consecutive operation in order to reduce the potential for soil loss to wind and water erosion.

5.5 Expanded Northern Emplacement Area

The removal of overburden and interburden is currently, and will continue to be, one of the main activities undertaken within the Project Site. As summarised in **Section 4.5**, Whitehaven will continue to adopt the mining method of ripping, blasting, excavation and transportation of the overburden to either out-of-pit or in-pit emplacement areas as is currently undertaken on-site and approved under PA 06_0198.

With both the current approved Northern and Western Emplacement Areas nearing capacity, it is proposed to expand the approved footprint and height of the Northern Emplacement Area to accommodate a maximum of 12 Mbcm of overburden. With a maximum anticipated swell factor of approximately 25%, the expanded emplacement area will hold approximately 15 Mlcm of overburden.

Figure 6 shows the location and area of the Northern Emplacement Area as proposed to be expanded. While the illustrated footprint is considered indicative, it represents the maximum extent of area that will be required in the Northern Emplacement Area for the life of the mine.

The location and configuration of the proposed expanded Northern Emplacement Area has been developed and refined in order to minimise haul lengths and ensure the entire footprint is maintained within land owned by Whitehaven, as well as ensure that the post-mining landform of the emplacement area is consistent with the height of the adjacent ridge to the west of the Project Site.

The expanded Northern Emplacement Area will be developed using overburden extracted from the open cut mining pit in Years 1, 2, 3 and 5 of the expanded operation. Early re-shaping and revegetation of the external batter slopes of the emplacement area will be undertaken in Years 1 and 2 of the expanded operation to minimise visual impacts, limit erosion and downstream sedimentation, and minimise the projection of noise from overburden transportation and emplacement activities towards privately owned residences located to the north and north-east later in the mine life.

Overburden will be progressively dumped inside of the established extremities of the emplacement footprint using lifts to gradually raise it to its design height. By Year 6, dumping in the expanded Northern Emplacement Area will be completed and the landform will be reshaped, topdressed and revegetated.

The footprint of the Northern Emplacement will expand to approximately 75 hectares. While the majority of this land has been disturbed by historic land clearing, agricultural production and/or mining-related activities (soil stockpiling), establishment of the expanded emplacement area will necessitate the removal of some of the currently approved Western Biodiversity Offset Area (see **Section 5.8**).

The topsoil that is currently stockpiled within the approved Northern Stockpile Area will be relocated to the proposed Eastern Soil Stockpile Area or, where possible, placed directly onto completed reshaped areas available for rehabilitation. While all of the topsoil will be relocated, the subsoil in this area will remain and will be covered with overburden due to there being sufficient subsoil material available for rehabilitation from the expanded operations.

The elevation of the Northern Emplacement Area will increase to a maximum of 50 metres above pre-mining landform. As stated above, this has been planned so that the post-mining mining landform is consistent with the height of the adjacent ridge to the west of the Project Site at around 340 metres AHD. The batter slopes will be maintained at a vertical to horizontal ratio of approximately 1 to 6 (1V:6H), which is approximately 10 degrees.

5.6 Expanded Open Cut Pit

5.6.1 General

Whitehaven will continue to extract coal using the open cut mining methods currently used at the site and approved under PA 06_0198. As outlined in the above sections, this involves the extraction of three separate coal seams, being the Upper Glenroc, Lower Glenroc and Belmont Seams, within the open cut pit using haulback mining methods at a production rate of 1.5 Mtpa. As sufficient coal is exposed, it is ripped, excavated and transported to the ROM pad within the on-site coal handling and processing area. The only change to current mining methods will be the addition of one 1250 excavator, which will be added to the mining fleet to enable cleaner and more efficient mining of coal from within the expanded pit area. This is the only proposed change to the current earthmoving and mining equipment used on-site (see **Section 4.13**).

In order to access up to an additional 5 Mt of coal not previously considered in the life of mine plan, it is proposed to expand the open cut pit design limit by approximately 50 hectares to a total open cut mined area of approximately 164 hectares. This will increase coal recovery at Rocglen by close to 30 percent.

The proposed areas of pit expansion are identified on **Figure 6.** While the majority of this land has been disturbed by historic land clearing, agricultural production and/or mining-related activities, expansion of the pit will necessitate the removal of some of the Western and Jaeger Lane Biodiversity Offset Areas approved under PA 06_0198 (see **Section 5.8**).

5.6.2 Geotechnical Stability

GE Holt & Associates (GHA 2010) prepared a geotechnical report assessing the stability of the eastern highwall of the proposed expanded open cut pit adjacent to the approved Wean Road realignment. A copy of GHA's report is contained within **Appendix I**. The report discusses the issues involved in ensuring a safe and stable highwall design, analyses the likely stability of the final highwall adjacent to the road and provides recommendations to ensure the permanent integrity of Wean Road.

Geology
Generally the mine is developed on top of an anticline with the western limb steeper than the eastern. The eastern limb is interrupted by the Belmont Fault, which is a significant thrust fault. It tips the eastern dipping coal sequence up vertically, and has a deeply weathered fault breccia zone. In addition, there is a thick sequence of poorly consolidated clay and sand alluvials overlying the Permian coal measures.

The alluvials, deeply weathered rock and the Belmont fault zone will have a major influence on final wall stability. The location of the fault has been delineated more accurately by recent drilling, which has shown that the thrust is not a straight line from the northwest to southeast, rather it meanders along an irregular path in this direction and may have offshoots. It effectively cuts off the thick Belmont Seam so the pit limit has been set close to the fault structure.

Stability of Highwall
In order to maximise extraction of the coal contained in the Belmont Seam it will be necessary to push the highwall further to the east, from where the Belmont Fault cuts off the coal, to develop a stable highwall.

As indicated on Figure 2 in the geotechnical report (GHA 2011) in **Appendix I**, drilling indicates that the Belmont Fault will intersect the proposed eastern highwall at a very acute angle. This will necessitate cutback or flattening of the wall to ensure stability. Limitations of land ownership and the relocation limits for Wean Road mean that realigning Wean Road further to the east to accommodate a flattened highwall is not possible. Economic factors in excavating considerable quantities of fault affected overburden also affect such a consideration.

According to GHA (2011), the most stable orientation for a fault intersecting a highwall is when the fault is close to right angles to the wall, or at least intersects it at a very high angle. This reduces the area of instability to a little more than the width of the fault zone, and consequently it is a much simpler mining exercise to maintain stability. One possible way of achieving this is shown on Figure 3 of the geotechnical report (GHA 2011) in **Appendix I**. The actual point at which this will be necessary will become clearer as the pit is developed and the nature of the fault structure is more accurately know.

It is recommended that the eastern highwall be turned westward so that it intersects the fault zone at close to right angles allowing the turned highwall to be cut back until stability is achieved in the crushed rock and alluvium, without impacting on Wean Road. There would be a notch developed in the highwall. Once the turned highwall encounters sound rock, as it continues to the west, it can be turned again to develop parallel to the Belmont Fault until it reaches the planned pit limit. The width of unmined rock required to hold the Belmont Fault stable can be determined when the final layout of the highwall is being determined.

This sort of approach ensures that within 150 metres of Wean Road the Belmont Fault is buttressed by solid rock to the west, is stabilised within the pit crest and therefore cannot affect Wean Road. If there is no faulting in the highwall then mine development can continue to the crest limit, which is proposed to be approximately 50 metres from Wean Road.

As discussed in the geotechnical report (GHA 2011) within **Appendix I**, the open pit limits can be adjusted to ensure there is solid unmined ground to prevent the fault structures collapsing the ground in a manner that could affect Wean Road. Such adjustments will allow some flexibility if the fault structure changes location from that suspected at present.

In summary, the stability recommendations to be adopted by Whitehaven are:

(a) When the Belmont Fault (or fault zone) is more than 150 metres from Wean Road, operations will mine through the Belmont Fault. The uppermost alluvial material and weathered rock on the eastern side of the fault will have individual face angles no steeper than 45 degrees;

(b) Benching will be adopted at a maximum interval of 25 metres in alluvial, weathered rock and brecciated rock;

(c) In fresh strata face angles will designed at 75 degrees to pit bottom. If in following the upturned Belmont Seam down to pit bottom the floor rock is strong and competent, then the face will be developed on the dip slope without the need for benches in rock beneath the Belmont Seam;

(d) The eastern end wall will be turned at right angles to the west when the eastern limit of the Belmont Fault zone reaches 150 metres from Wean Road;

(e) The turned highwall in the fault zone will be notched to achieve a stable face. This notch will not approach Wean Road any closer than 150 metres without geotechnical advice;

(f) A block of unmined ground will be left to contain the Belmont Fault zone and prevent it causing collapse back towards Wean Road. The size of this block of unmined ground will be determined by geotechnical investigation by the time a change in highwall direction is required; and

(g) If the highwall is free of faulting mining will resume southeast towards the currently planned pit limit. Such mining will cease when the pit crest reaches 50 metres from Wean Road. If additional faulting is detected in this advancing face then the relevance of such structure on highwall stability will be investigated before continuation of highwall development.

Alterations to a mine plan are not uncommon in any mining operation affected by geology and sufficient flexibility is needed in the mine plan (and approval process) to accommodate changes in geological conditions. GHA (2011) states that this can be achieved by including trigger points for action in the MOP. It will be some years before the pit crest approaches within 150 metres of the realigned Wean Road providing time to monitor and amend highwall design should any other stability issues arise, without affecting land beyond the proposed pit shell. It is on this basis that Whitehaven will commit to undertaking progressive stability reviews and monitoring of geological conditions once the pit moves within 250 metres of the realigned Wean Road to ensure geotechnical stability and safe conditions. If any unfavourable conditions are observed or detected, a detailed assessment will be undertaken by a suitably qualified geotechnical engineer before mining is allowed to continue towards Wean Road. The exact location and nature of the Belmont Fault, the location of the Belmont Seam in relation to the fault and the stability of the highwall are just some of the issues that will become more accurately known as mining advances.

5.7 Rehabilitation and Decommissioning

While the major portion of rehabilitation and decommissioning activities will occur close to the cessation of mining, Whitehaven will continue to adopt a progressive approach to rehabilitation throughout the life of the mine. The rehabilitation and final land use approved under PA 06_0198 at Rocglen is briefly outlined in **Section 4.16.**

To assist Whitehaven address mine decommissioning, final landform design, rehabilitation and post-mining land use for the Rocglen Extension Project, GSSE has prepared a *Rehabilitation and Decommissioning Strategy* (2011). Consideration has been given to the commitments made in the original EA, and the objectives and methodology are consistent with the principles approved for the current operation.

The *Rehabilitation and Decommissioning Strategy*, which is contained within **Appendix J,** is considered a dynamic document that will continually be reviewed and updated throughout the life of the Project. Within five years of the planned mine closure, a more detailed *Rehabilitation and Decommissioning Strategy* will be prepared.

The following sections outline Whitehaven's rehabilitation objectives and the primary components of rehabilitation necessary to achieve the desired final landform on completion of all mining and mining-related activities associated with the Rocglen Extension Project. The full *Rehabilitation and Decommissioning Strategy* (GSSE 2011) in **Appendix J** should be referred to for further detail.

5.7.1 General Rehabilitation Principles and Objectives

Whitehaven is committed to ensuring progressive rehabilitation of areas of disturbance (and sequencing activities to enable earliest revegetation consistent with operational requirements) within the Project Site. This is in order to minimise the areas of exposure and hence reduce the potential air quality impacts, erosion and sedimentation, and visibility of mining operations from surrounding residences and publically available vantage points.

It is proposed that progressive rehabilitation be undertaken on the site, with disturbed areas generally undergoing rehabilitation within one year of overburden placement and subsequently being re-profiled to the final landform. Rehabilitation of disturbed areas will involve the reshaping of the mining landforms, topdressing (including intermediate layering of subsoil where appropriate), installation of appropriate water management works and establishment of areas of native vegetation and pasture species as required to achieve the preferred post-mining land uses (see **Section 5.7.9**).

Short-term rehabilitation objectives include:-

- Minimise clearing/vegetation disturbance consistent with operational requirements;

- Schedule operations including overburden emplacement and shaping and revegetation to minimise visual exposure;
- Rehabilitate all areas of disturbance no longer required for mining-related operations;
- Apply appropriate soil material (topsoil/subsoil) to the final landform based on material availability and post-mining land use (see **Section 5.4**);
- Stabilise all earthworks, drainage lines and disturbed areas in order to minimise erosion and sedimentation; and
- Control vermin, feral animals and noxious weeds.

The overall long term mine rehabilitation objective is to provide a low maintenance, geotechnically stable and safe landform that blends in with the surrounding topography and provides a mixture of rehabilitated bushland with areas of grazing consistent with the pre-mining conditions. Specific long-term objectives include:

- Re-establishing land to either pasture or bushland over the areas disturbed by the mine;
- Increasing the area of land allocated to bushland through the revegetation of those areas disturbed by the mine and the maintenance of remnant and degraded native vegetation and/or habitat corridors on the mine site;
- Provide habitat for fauna and corridors for fauna movement within the final landform;
- Develop and implement a long-term and regionally integrated *Biodiversity Offset Strategy*; and
- Monitor rehabilitation success in terms of physical and biological parameters.

5.7.2 Decommissioning and Mine Closure

The *Rehabilitation and Decommissioning Strategy* (GSSE 2011) contained within **Appendix J** outlines the key aspects relating to the decommissioning and closure of the Rocglen site and should be referred to for further detail in this regard.

The principal objectives of mine closure planning considered include:

- Providing an overall framework for mine closure including rehabilitation and decommissioning strategies that are consistent with the current mine closure plan and the expectations of the I&I NSW;
- Establishing clear and agreed criteria, which can be used to provide the standard against which the final mine rehabilitation and post mining land use can be assessed;
- Reducing or eliminating adverse environmental effects once the mine ceases operation;
- Ensuring closure is completed in accordance with good industry practice; and
- Ensuring the closed mine does not pose an unacceptable risk to public health and safety.

Specific assessments and methodologies have been included for:

- Decommissioning of infrastructure, plant and buildings
- Bulk earthworks and rehabilitation of the site; and
- Post-mining land use (land capability and agricultural suitability).

5.7.3 Progressive Rehabilitation

Whitehaven will continue to adopt a progressive approach to the rehabilitation of disturbed areas within the Project Site to ensure that, where practicable, completed mining and overburden emplacement areas are quickly shaped, topdressed and vegetated to provide a stable landform. The progressive formation of the post-mining landform and the establishment of a vegetative cover will reduce the amount of disturbed land at any one time and also reduce the visibility of mine-related activities from surrounding properties and roads. Early reshaping and revegetation of the external batter slopes of the emplacement areas is particularly important and has been targeted as a priority.

It is proposed that disturbed areas generally undergo rehabilitation within one year of overburden emplacement and reshaping. **Table 13** summarises the progressive rehabilitation of the site on an annual basis, and **Figures 17** to **20** illustrate this annual sequencing.

Table 13 – Progressive Annual Rehabilitation Schedule

Year Rehabilitation to be Undertaken	Area (ha)
Year 1 of Expanded Operation	Rehabilitation commences
Year 2 of Expanded Operation	33
Year 3 of Expanded Operation	14
Year 4 of Expanded Operation	11
Year 5 of Expanded Operation	14
Year 6 of Expanded Operation	26
Year 7 of Expanded Operation	13
Year 8 of Expanded Operation	26
Year 9 of Expanded Operation	11
Year 10 of Expanded Operation	25
Year 11 of Expanded Operation	11
End of Mine Life	174
Total	**358**

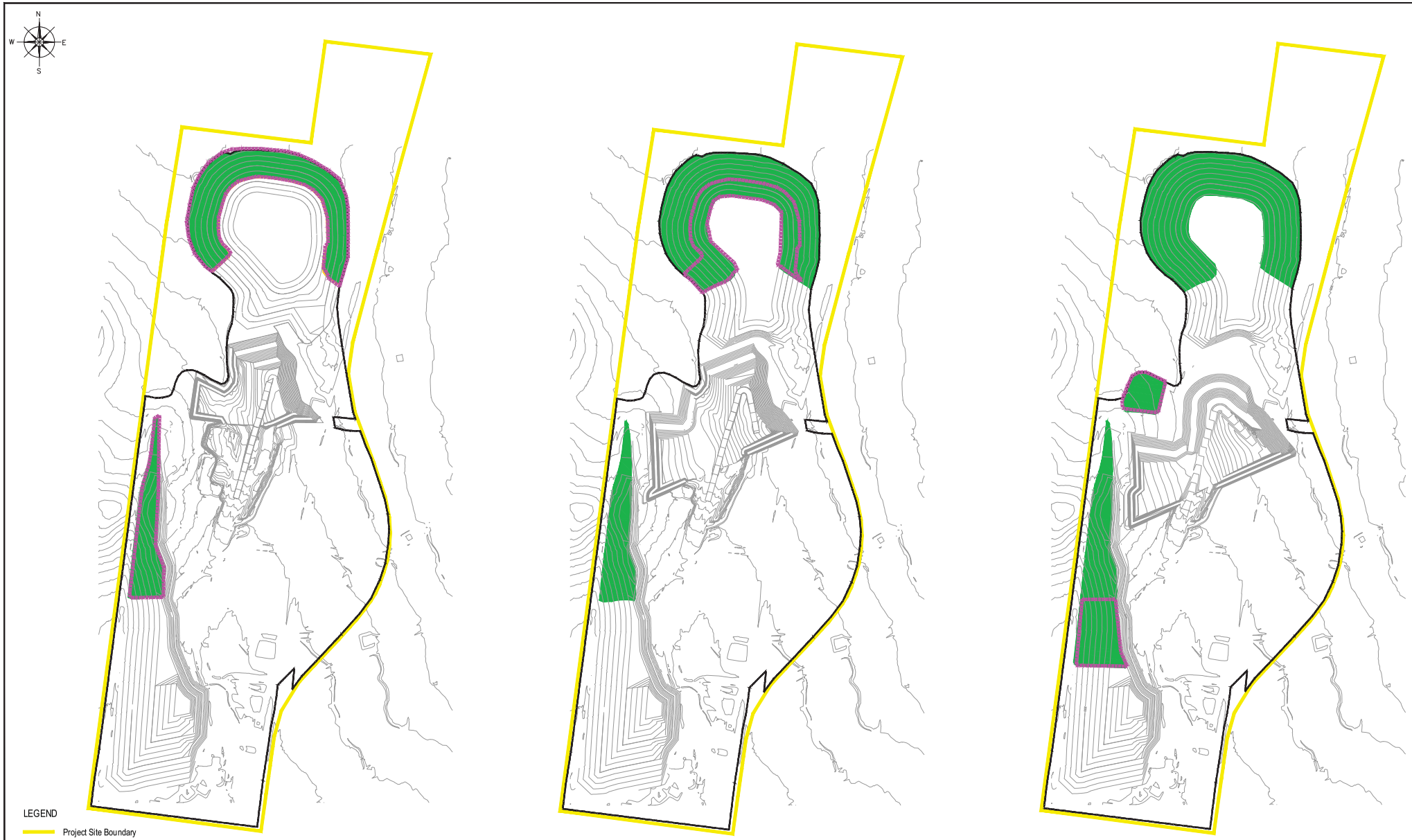
5.7.4 Revegetation

The revegetation approach to be adopted for each component area within the Project Site is based on the successful rehabilitation already undertaken at Rocglen and other Whitehaven mines. Additional site-specific input in terms of flora, fauna, soil and surface water management has been sourced from the specialist consultants engaged to investigate and report on these issues for the Rocglen Extension Project.

Overburden Placement and Shaping

Placement and shaping of overburden to the nominated area at slopes with gradients around 10 degrees will be undertaken in a manner which, wherever practicable, ensures that any friable or weathered materials are placed below the subsoil and topsoil layers in order to provide a cover of more competent material and avoid the exposure of large rocks on the final surface. Any coarse coal rejects placed in the mine void will be covered with at least 3 metres of overburden material.

An initial assessment of overburden materials did not identify any risk of acid generation or soluble salt formation, and as such no specific handling or storage requirements are considered necessary.



Base Plan Source: MMG Civil P/L

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Environmental, Land and Project Management Consultants

Rocglen Coal Mine Extension Project
Progressive Rehabilitation Years 2 - 4

FIGURE 17