Soils and Rehabilitation Assessment

BYLONG COAL PROJECT
Supplementary Information

Hansen Bailey
ENVIRONMENTAL CONSULTANTS

BYLONG COAL PROJECT

Revision to Mine Plan
Soils and Rehabilitation Assessment

Prepared for: Hansen Bailey Pty Ltd

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with the Client. Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

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DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
634.10072-R04-v0.1	10 July 2018	Clayton Richards	Rod Masters	Clayton Richards
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1 Introduction

SLR Consulting Australia (SLR) has been involved in Bylong Coal Project (the Project) environmental assessment process as technical specialists in the areas of soils, land capability and mine rehabilitation.

SLR undertook the Environmental Impact Statement (EIS) technical studies for soils and land capability and the rehabilitation strategy. SLR prepared technical material, which was submitted as part of the Project Response to Submissions (RTS). SLR also attended the Planning Assessment Commission (PAC) (now referred to as the Independent Planning Commission (IPC)) site visit and was on hand to answer questions on soils, land capability or mine rehabilitation, and presented at the PAC public hearing on the technical aspects of mine rehabilitation.

In light of advice received from the PAC and the Heritage Council of NSW, Department of Planning and Environment (DPE) has requested KEPCO provide information in relation to the potential environmental impacts of contracting the open cut mining footprint of the Project to remain off the Tarwyn Park property as well as other requirements. In relation to the Revised Project Layout, DPE has requested KEPCO provide an understanding on the revised area of impacts to Biophysical Strategic Agricultural Land (BSAL), and Land and Soil Capability (LSC) classes, an indication of the reinstatement of BSAL on rehabilitated land and a revised soils inventory.

Hansen Bailey Pty Ltd (Hansen Bailey) engaged SLR to address DPE's requests in relation to soils, land capability and revised rehabilitation strategy and assess the impact of contracting the open cut footprint on these matters. This report details the findings of an updated assessment completed in relation to the impacts to the soils and proposed rehabilitation activities associated with the Revised Project Layout as requested by DPE. This assessment has been prepared with reference to the previous soils and rehabilitation assessments undertaken for the Project.

1.1 Report Aim and Scope

The aim of this revised soil and rehabilitation report is to review the Revised Project Layout, Revised Project Disturbance Boundary and the Conceptual Final Landform design and provide a focussed assessment of the relevant impacts to soil resources and the rehabilitation strategy.

The key objectives of this assessment are listed below:

1. Detail the revised areas of BSAL within the Revised Project Disturbance Boundary in comparison to the previous assessments;

2. Provide a slope analysis of Conceptual Final Landform designs showing areas that are available for the re-instatement of BSAL quality soil profiles, on both the base case mine plan and a macro-relief example of the final landform. Furthermore, confirm adequate areas are available, on the post mining landform, to meet the commitment requirements of no permanent net impact on the overall area of BSAL within the Revised Project Disturbance Boundary;

3. Detail the revised areas of LSC classes for the Revised Project Disturbance Boundary;

4. Calculate the areas on the post mining landform, which are capable of re-instating specific LSC class land, and present a LSC balance of the overall impact of the Project;

5. Undertake a soil balance for pre and post mining BSAL and LSC commitments, indicating the volumes of soil resources available and required to meet the desired soil depth levels;

6. Provide a review and update of the key rehabilitation strategy aspects which may be modified as a result of the Revised Project Disturbance Boundary and the Conceptual Final Landform design; and

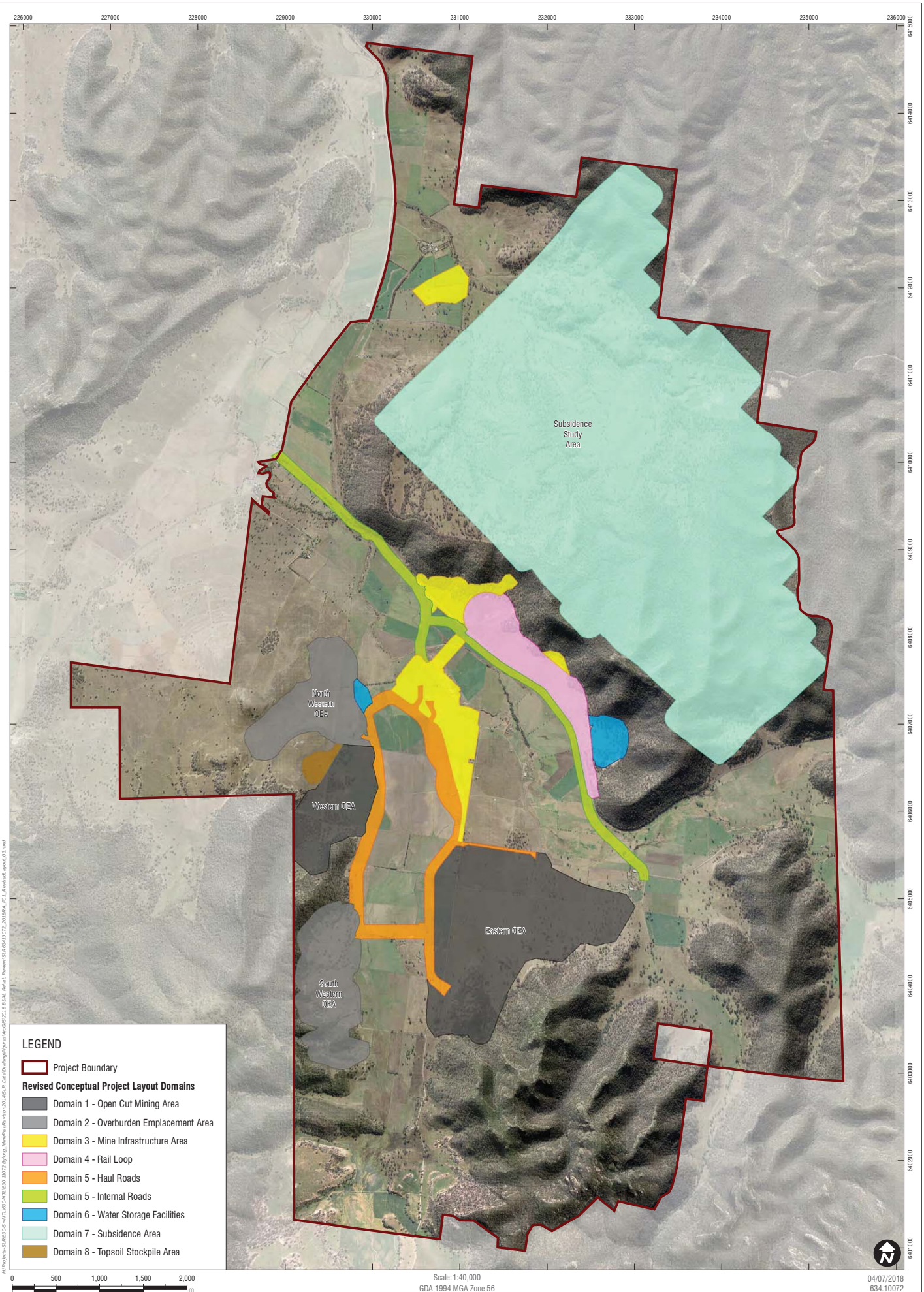
7. Provide a summary of the rehabilitation landform design objectives, rehabilitation sequencing and the final land use on Conceptual Final Landform.

2 Revision to Project Open Cut Mine Plan

The Revised Project Layout has resulted in a reduction in the footprint for open cut mining operations. The Revised Project Disturbance Boundary has reduced by approximately 113 ha to 1,047.95 ha (or a 10.8% reduction in disturbance from the 1,160 ha assessed within the EIS and associated approvals documents). The requested contraction to the open cut mine plan does not result in any changes to the underground mining operations. Accordingly, the Subsidence Study Area which was assessed within the EIS and associated approvals documents remains at approximately 1,714.20 ha. The Revised Project Disturbance Footprint (Revised Project Disturbance Boundary and the Subsidence Study Area) is approximately 2,762.15 ha.

Figure 1 shows the Revised Project Disturbance Boundary in relation to the Project Disturbance Boundary which has been assessed within the EIS and associated approvals documents. The Revised Project Disturbance Boundary no longer includes the north eastern extent of the Eastern Open Cut (on the south western portion of the Tarwyn Park property) and also excludes the south eastern portion of the Western Open Cut mining area. Some minor adjustments within the Revised Project Disturbance Boundary are proposed to internal haul roads and some mine infrastructure within the Revised Project Layout. The contraction to the open cut mining footprint has resulted in the open cut mining activities no longer being proposed on the Tarwyn Park property. The south eastern corner of the Western Open Cut Mining area has also been removed to facilitate a reduced impact on the landscape.

Figure 1 shows the EIS Project Disturbance Boundary in relation to the Revised Project Layout and the associated Revised Project Disturbance Boundary.



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Revised Conceptual Project Layout

FIGURE 1

3 BSAL Revisions

3.1 Pre-mining BSAL Areas

The Revised Project Disturbance Boundary associated with the contracted open cut mining footprint for the Project has resulted in a reduction of mapped BSAL to be directly disturbed from 423.1 ha to 400.4 ha (or a 22.7 ha (5.4%) reduction in direct disturbance). The BSAL mapping is based on that presented within the Response to Submissions (RTS) for the Project. **Figure 2** shows the extent of the BSAL areas, which are located within the Revised Project Disturbance Footprint.

The key change is the reduction of approximately 22.7 ha of BSAL within the Revised Project Disturbance Boundary which is located within the Tarwyn Park property, which has now been removed from the Project Disturbance Footprint. **Table 1** shows the areas of BSAL and Non BSAL within the specific Project domains associated with the Revised Project Disturbance Boundary compared with the Project Disturbance Boundary subject of the EIS and associated approvals documents.

Table 1 Comparison of Pre-Mining BSAL and Non BSAL Areas for Revised Project Layout

		Project Disturbance Footprint (RTS, 2016)			Revised Project Disturbance Footprint			
	Key Areas	Non BSAL (ha)	BSAL (ha)	Total Area (ha)	Non BSAL (ha)	BSAL (ha)	Total Area (ha)	Change in Total Area (%)
1	Open Cut Mining Area	438.20	319.51	757.70	235.87	158.10	393.97	
2	Overburden Emplacement Area				147.08	78.78	225.86	
3	Mine Infrastructure	299.10	103.55	402.70	92.70	30.97	123.67	
4	Rail Loop				77.00	11.34	88.34	
5	Haul Roads & Internal Roads				65.96	111.71	177.67	
6	Water Storage Facilities				25.95	1.35	27.30	
8	Soil Stockpile				2.96	8.18	11.14	
	Totals	**1037.30**	**423.06**	**1160.40**	**647.53**	**400.43**	**1047.95**	**-9.7%**
7	Subsidence Study Area	1,542.44	171.75	1714.20	1542.44	171.75	1714.20	0%

3.2 Post Mining BSAL Areas and Locations

The Revised Project Disturbance Boundary (excluding the Subsidence Study Area) has been used to develop a final landform design which maximises potential agricultural use as well as a final landform design which includes macro relief. These two landform designs provide adequate areas, which have a slope less than or equal to 10% and minimum of 20 ha contiguous area, on which there is potential to re-establish BSAL quality soil profiles. The landform design which incorporates macro relief provides limited, albeit adequate, suitable BSAL landforms, when compared to the base case landform. Therefore, the post mining landform will be a balance between a macro-relief landform and a 'simple' landform which allows for the practicalities of agricultural use. The aim of the rehabilitation program for the Project as described within the EIS and associated approvals documents is to preserve or re-establish the equivalent area of BSAL quality of land, to that which is to be disturbed. The required area to be verified as BSAL post mining, within the Revised Project Disturbance Boundary is 400.43 ha.

The purpose of the Interim Protocol for the Verification and Mapping of BSAL (OEH & OAS&FS, 2013) (BSAL protocol) is to assist proponents and landholders understand what is required to identify the existence of BSAL and outline the technical requirements for the on-site identification and mapping of BSAL. Essentially the BSAL verification protocol involves a list of 12 criteria, which are applied to a landform and soil profiles. Each of the BSAL criteria is measurable and evidence based, which allows the results to be reviewed and critiqued to ensure accuracy.

KEPCO's proposal to reinstate BSAL on the post mining landform, as was assessed and identified on the pre-mining landform, includes the same measurable evidence based parameters. That is, the BSAL protocol used to identify and map the pre-mining BSAL area will be used to verify the post mining BSAL area. The suggestion by the PAC that additional parameters (function and productivity) should be imposed to verify BSAL on the post mining landform does not align with any scientifically sound concepts of assessment consistency and is not supported by KEPCO or its technical specialists. Further, the additional parameters suggested by the PAC do not presently exist within the BSAL verification protocol utilised to verify whether a soil is BSAL or not.

The one exception to the criteria from the BSAL protocol will be the fertility criteria. Within the BSAL protocol, the criteria are based on the in situ soil types. Once the soil material is stripped, salvaged and respread onto a new landform, the soil type is referred to as an Anthroposol (or man-made soil). Even though the soil material is the same, the physical arrangement of that material will have changed. Anthroposols are not ranked in the fertility criteria of the BSAL protocol due to the potential for high variability of these soils. Therefore, KEPCO has proposed the following techniques to ensure the 'inherent' fertility is adequately assessed:

1. Identification and tracking of the original in situ 'parent' soil material; and

2. The analytical testing in the laboratory for Cation Exchange Capacity.

These two parameters best reflect the potential match of the soil material to the BSAL fertility criteria. In a meeting in Tamworth on 17 June 2016, the NSW Department of Primary Industries (DPI) – Agriculture agreed that replacement fertility parameters be implemented to assess BSAL. NSW DPI - Agriculture provided in principle support for these parameters which are to be proposed in the Rehabilitation Management Plan and will be prepared in consultation with the NSW DPI - Agriculture.

The assessment which identifies and maps BSAL on post mining landforms is a stand-alone assessment, which is only targeted at verifying BSAL-equivalent land as per Schedule 4, Condition 65 of the Recommended Development Consent conditions.

The areas targeted for the rehabilitation of BSAL quality land shall be located adjacent to or within close proximity to undisturbed BSAL quality land, and/or within larger contiguous areas of suitable landforms, which satisfy the relevant slope and contiguous land criteria. This includes those areas mapped as BSAL pre-mining such as the alluvial areas of Lee Creek and the Bylong River where infrastructure and haul roads are proposed. There are adequate areas available within the Overburden Emplacement Areas (OEA) and Open Cut rehabilitation areas to re-establish the equivalent area of BSAL to that of pre-mining BSAL disturbed within these domains. Furthermore, there are areas of pre-mining non BSAL located within the areas proposed for infrastructure, which will have final landform slopes suitable to re-establish BSAL quality soils by utilising soil resources salvaged from the OEA's and Open Cut mining footprints.

Figure 3a and Figure 3b shows the priority areas for the potential reinstatement of the 400.43 ha of BSAL quality land on the Conceptual Final Landforms. **Table 2** shows the areas available on the Conceptual Final Landform which are suitable to the re-establishment of BSAL quality soil profiles.

Table 2 Post mining areas suitable for BSAL Reinstatement (macro-relief example)

	Key Areas	Not Suitable for BSAL Reinstatement (ha)	%	Suitable for BSAL Reinstatement (ha)	%	Total Area (ha)
1	Open Cut Mining Area	188.61	47.87	205.36	52.13	393.97
2	Overburden Emplacement Area	179.54	79.49	46.32	20.51	225.86
3	Mine Infrastructure	50.98	41.22	72.69	58.78	123.67
4	Rail Loop	88.34	100.00	0.00	0.00	88.34
5	Haul Roads & Internal Roads	78.51	44.19	99.16	55.81	177.67
6	Water Storage Facilities	21.76	79.71	5.54	20.29	27.30
8	Soil Stockpile	3.99	35.82	7.15	64.18	11.14
	Totals	**611.72**	**58.37**	**436.23**	**41.63**	**1,047.95**

Table 2 shows there are adequate areas available on the conceptual macro-relief example of final landform, on which to establish BSAL quality soil profiles. Furthermore, in **Figure 2** and **Table 2**, the areas less than 10% slope, which are non-contiguous and less than 20 ha, have been considered not suitable to the establishment of BSAL. The table above includes the areas associated with the infrastructure area (Domain 3) where previously in the EIS and RTS Domain 3 was assumed to be rehabilitated to the areas of pre-mining BSAL or Non BSAL, however some areas have been identified for potential improvement or additional soil resources which make it possible to create BSAL quality land on previously non BSAL land within the infrastructure area.

3.3 Case Studies of Mine Rehabilitation to Agricultural Use

There are several examples of mine sites in the Hunter Valley and throughout Australia and the world, which have undertaken mine rehabilitation to a targeted agricultural land use or capability class for that land to be used for agriculture. The examples provided below are shown to have either achieved an agricultural productivity level comparable to surrounding land or have reinstated the landform and soil profile to a land capability class which allows highly productive agricultural uses.

3.3.1 Coal and Allied – Alluvial Lands Project

As detailed in Nelson and Stewart (2007), project approval granted in 1993 for Coal & Allied's Hunter Valley Operations Mine enabled the mining of 34 million tonnes of coal from 165 hectares of flood prone alluvial land within its mining lease adjacent to the Hunter River. Prior to mining some of the land was considered to have a

Class 1 & 2 land capability as per the Soil Conservation Service Land Capability Classification System which identified it as being suitable for cropping.

Development consent for the mining project required completion of open cut mining to be followed up with rehabilitation and reinstatement of 63 hectares of land to Class 1 & 2 cropping capacity with the remainder of the area to be returned to Class 4 classification. Rehabilitation completion criteria included a requirement to achieve Class 1 & 2 capability by growing a lucerne crop and harvesting it at district average production levels of hay for three consecutive years.

The target level was nominated at 15 tonnes / year. DPI–Agriculture was nominated to provide verification of the lucerne species, productivity measurement and agronomic practices.

A three year trial of the rehabilitation methods was monitored and completed prior to commencing the main rehabilitation project. The operations required selective handling and reinstatement of 630,000 cubic metres of subsoil to a depth of one metre, along with 252,000 cubic metres of topsoil to 0.4 m depth

The entire process followed particular rigour with tolerance for the final land surface set to be within half a metre of the pre-mining survey. The alluvial lands area was progressively back filled with overburden material after completion of mining. Then topsoil and subsoil was placed onto a basement constructed 1.4 metres below the designed surface level. A series of legume based 'green manure' crops were sown on the area and cultivated into the soil to improve organic matter levels prior to sowing lucerne.

Regular inspections and meetings with officers from NSW DPI's Environmental Sustainability Branch and the NSW DPI's regional agronomist have demonstrated Coal & Allied's compliance with yield, quality and monitoring requirements for reinstatement to Class 1 & 2 land capability.

Whilst no BSAL assessment has been undertaken on this land, the rehabilitated land has been classified as Land Capability Class 1 and 2 which is reflective of its high to very high agricultural productivity. It should also be noted that the Hunter Valley alluvial lands are trigger mapped as BSAL according to NSW Government.

3.3.2 Bengalla Reinstatement of BSAL Quality Soil Profiles

As reported in the Bengalla Mining Company 2017Annual Review (BMC 2018) SLR Consulting undertook a BSAL verification assessment on mine rehabilitation at Bengalla Mine, with results concluding that adequate sampled sites satisfied the BSAL Criteria and that BSAL quality land has been established on mine rehabilitation. Bengalla Mining Company (BMC) gained approval for the stripping and restoration of rural land capability Class III land. BMC established an area of approximately 5.7 ha of an existing Class III land where slopes are less than 3% and Black Vertosol soils have been applied to create a soil profile approximately 1.4 m deep (BMC, 2012).

Four sites were assessed against BSAL criteria. Three out of the four sites assessed were verified BSAL. Site 3 sample 65-75cm had a 4.9dS/m ECe result which exceeded the BSAL criteria for salinity (ECe 4.0dS/m) within the top 75cm of the soil profile. Hence this site was not considered BSAL. However, the effective rooting depth was observed in the field at Site 3 to be down to 1.0m. Whilst it is acknowledged that Site 3 was not considered BSAL, it is also acknowledged that the slightly elevated ECe, whilst trending higher in the lower layers across the four sites, was an isolated result with no spatial, landform based pattern observed.

The preparation requirements of the BSAL status map are clearly stated in the Interim Protocol section 9.6.3 as stated below:

2. BSAL status is determined on the dominant soil type within a soil map unit. The dominant soil type must comprise greater than 70% of the soils comprising a soil map unit.

Therefore, the overall assessment of the BSAL status of the study area is based on the dominant soil type, namely Spolic Anthroposol, consisting of original material from Brown Vertosols. 75% of the sites assessed were verified BSAL which satisfies the abovementioned mapping requirement for BSAL status, and therefore the evidence shows that soil within the study area of rehabilitated mined land are considered BSAL quality land (BMC 2018).

This case study of rehabilitation to BSAL quality land at Bengalla Mine has recently been nominated as a finalist for a 2018 NSW Minerals Council - Environmental Excellence Awards.

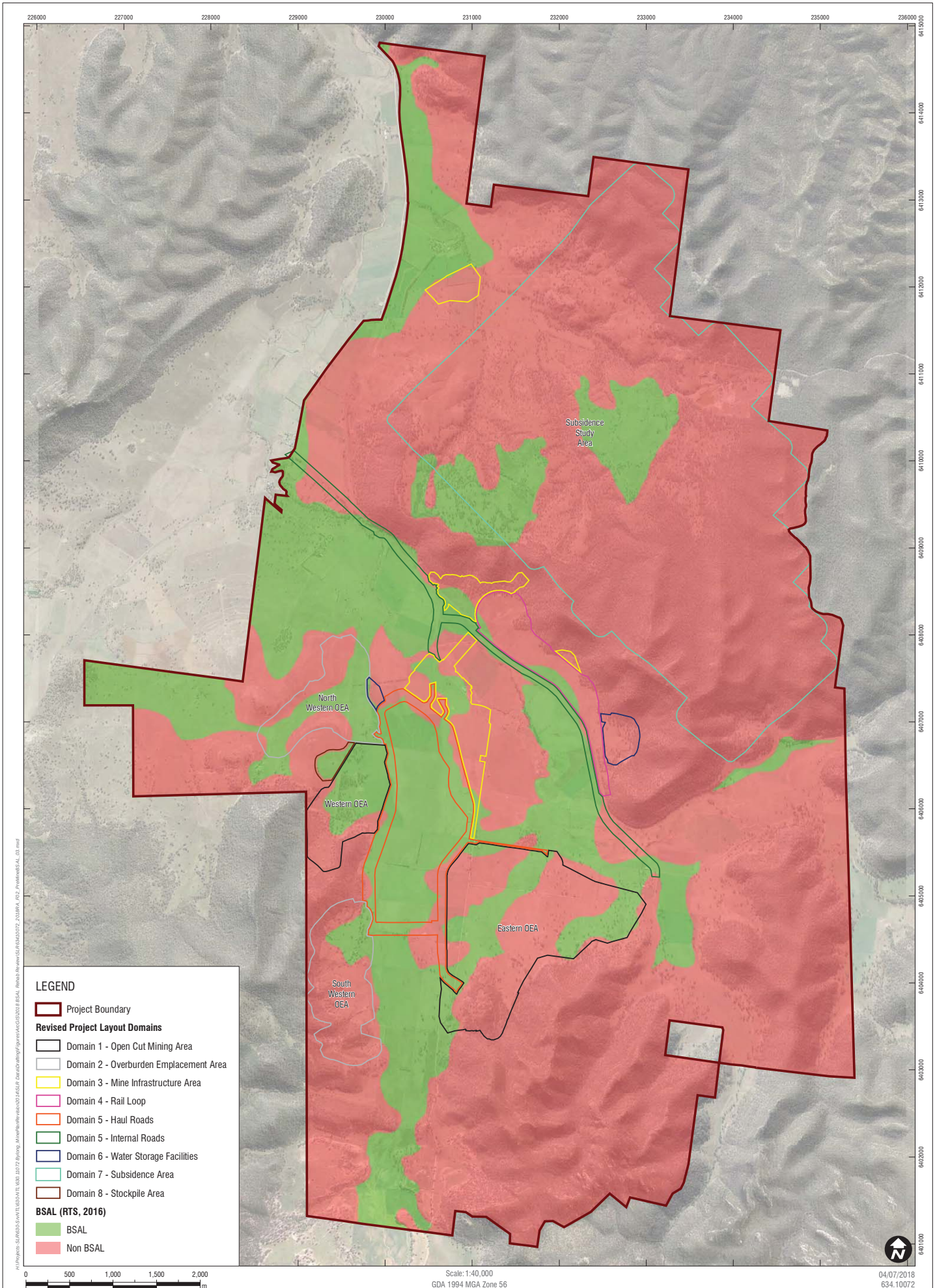
3.3.3 Upper Hunter Mine Rehabilitation Grazing Study

A Study of Sustainability and Profitability of Grazing on Mine Rehabilitated Land in the Upper Hunter NSW (ACARP Project C23053) by Griffiths and Rose (2018), was undertaken over a four-year period investigating the effects of cattle grazing on rehabilitated mine land and whether it can sustainably support productive and profitable grazing livestock. The project is being managed by the NSW DPI in collaboration with Upper Hunter Mining Dialogue's joint working group on Land Management. The group is made up of representatives from local grazing and community groups, government and mining companies.

The final weigh in occurred on 1st June 2017, where it was confirmed that steers reared on mine rehabilitation were found to be 100 kilograms heavier on average than cattle grazed on unmined farming land. In summary, this demonstrates there is clear precedence of mine rehabilitation being suitable for agricultural production. The study is continuing and will be closely monitored for further evidence of the creation of productive agricultural land post mining.

3.3.4 Liddell Grazing Trial

In December 2012, Glencore Coal Assets Australia commenced a cattle grazing trial at Liddell Open Cut Coal Mine located in the Upper Hunter (GCAA, undated). The trial objectives were to assess and compare performance of a rehabilitation grazing site against an adjoining un-mined grazing site. The results of the trial demonstrated that over the first 18 months of the trial the 'rehabilitation' cattle grew significantly quicker and overall average weight difference at the end of this period was rehabilitation cattle +68.5kg over cattle grazing unmined pastures. Stocking rates were maintained over the duration of the trial without feed supplements. Improved weight gain and condition of cattle coming off rehabilitation pastures translated to a greater financial return of $220 per head on average for the carcases, which is nearly 25% greater return than was achieved by cattle grazing natural pastures sold into the same market.



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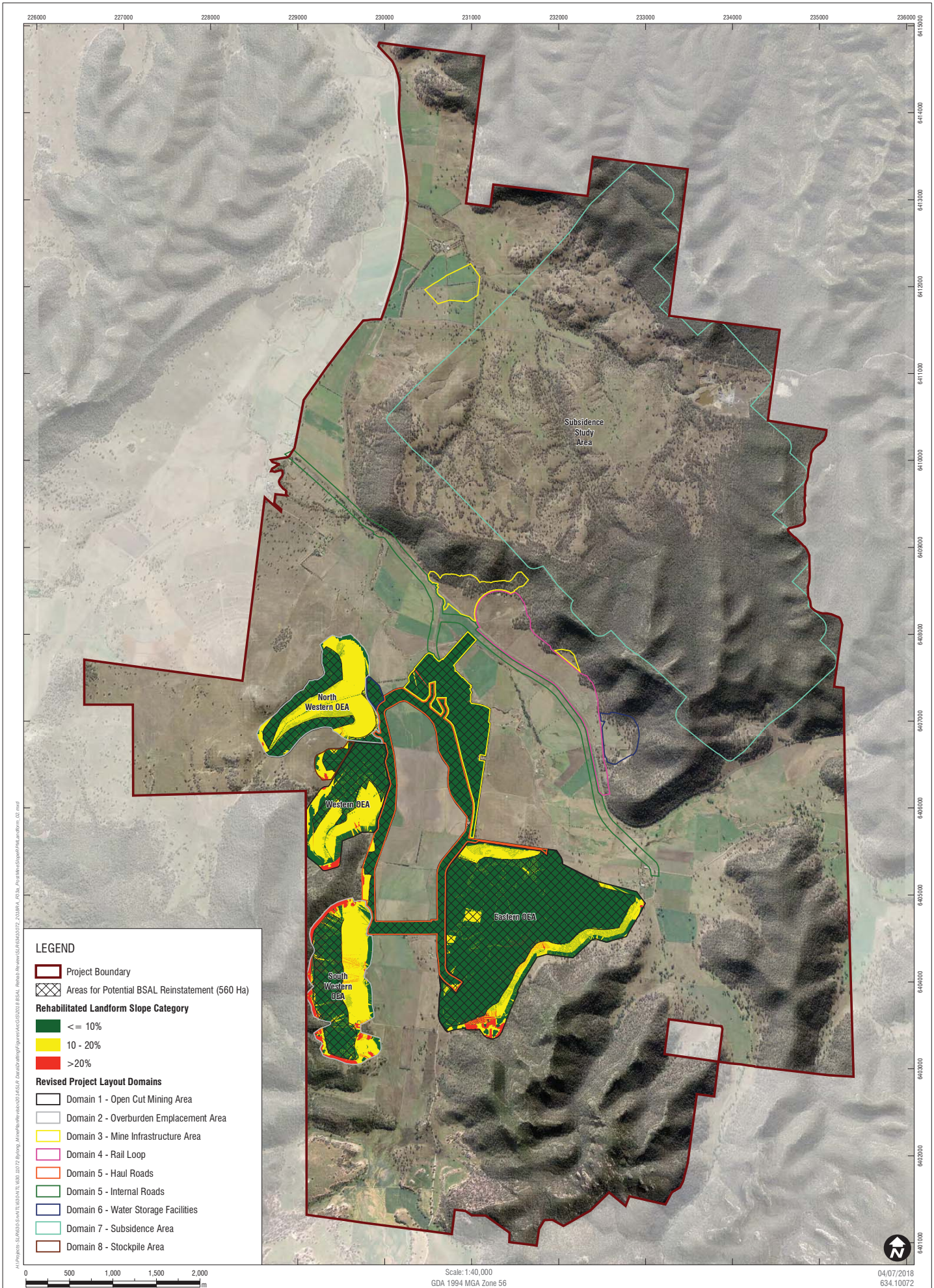
Pre-mining BSAL

FIGURE 2



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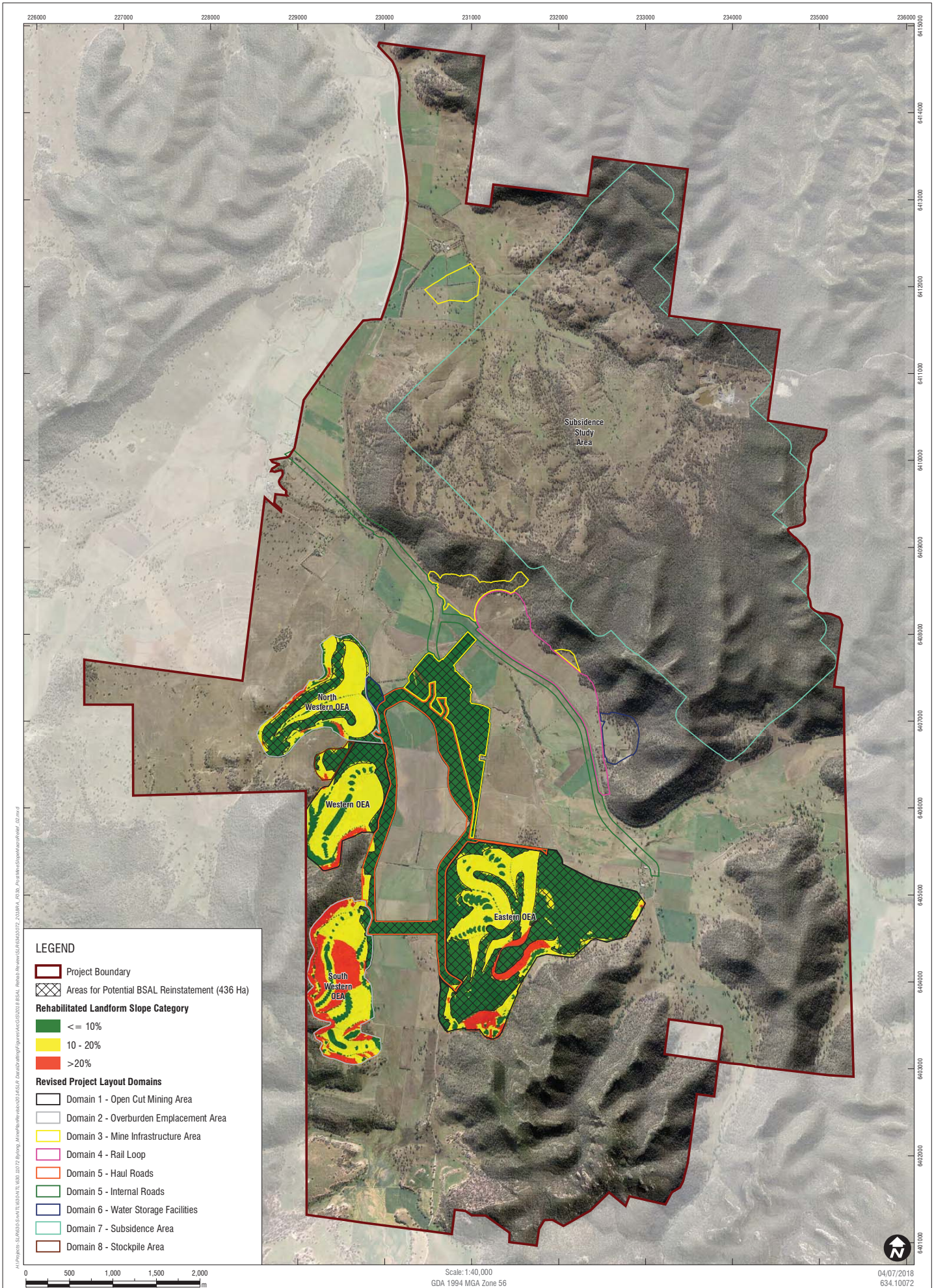
Post-Mining Slope Analysis & Potential BSAL Reinstatement Base Case Landform Option

FIGURE 3a



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Post-Mining Slope Analysis & Potential BSAL Reinstatement Macro Relief Landform Option

FIGURE 3b

4 Land and Soil Capability Revisions

4.1 Pre-mining LSC Areas

The Revised Project Disturbance Boundary has resulted in some changes to the pre- mining LSC areas to be disturbed. The mapping used is based on the LSC areas as presented in the EIS. **Figure 4** shows the extent of the various LSC classes within the Revised Project Disturbance footprint (including Revised Project Disturbance Boundary). **Table 3** below presents the breakdown of pre-mining LSC Classes.

4.2 Post Mining LSC Areas and Locations

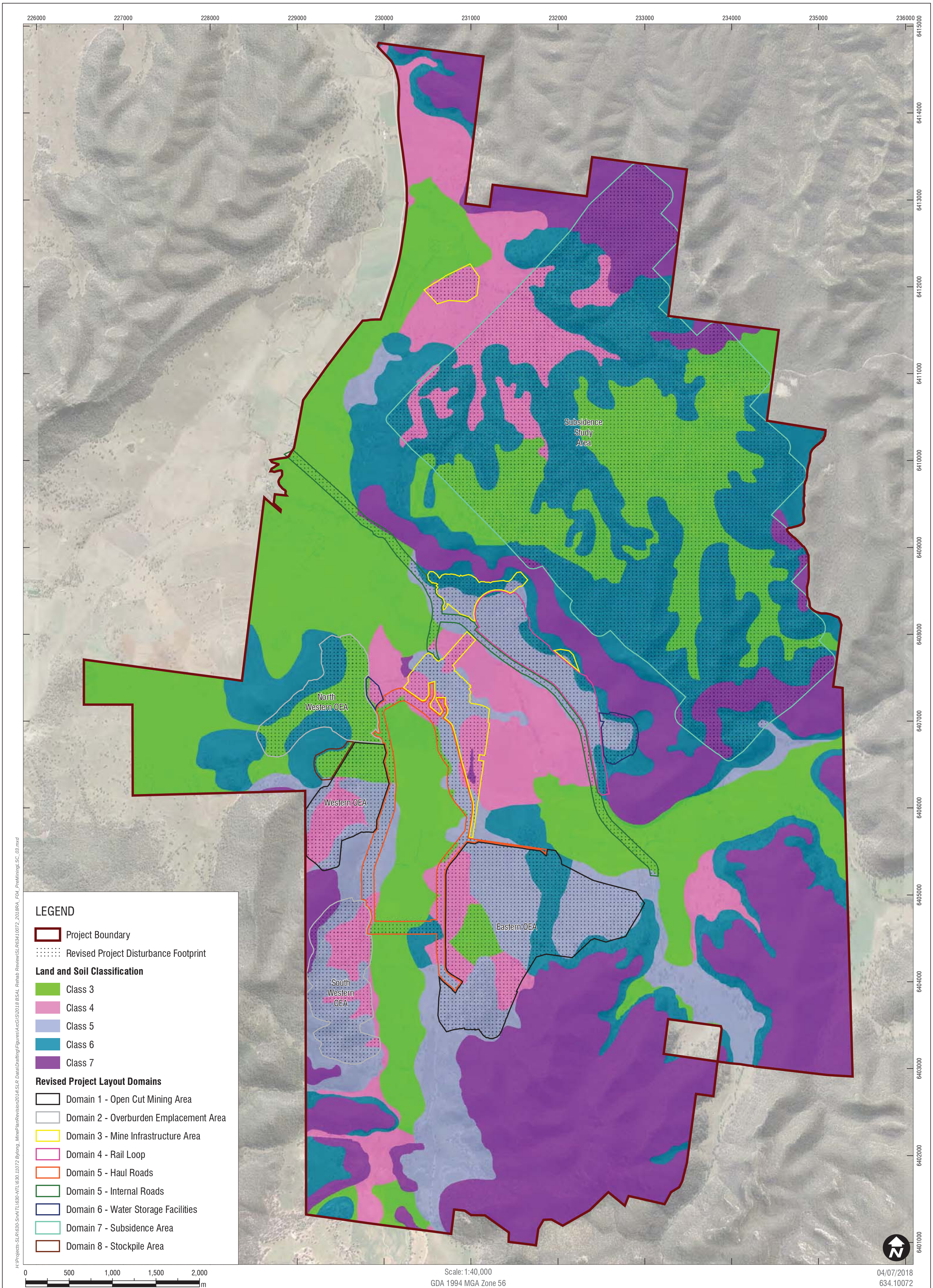
The Conceptual Final Landform provides approximately 436.79 ha, which have slope less than 10% which is the first criteria for LSC Class 3 land. Therefore, a minimum of 176.47 ha of this land will be returned as Class 3 land. However, the requirement for the reinstatement of BSAL land is 400.43 ha, which will be located within the 436.79 ha available with suitable slopes. The aim of the rehabilitation program is to re-establish the equivalent area of the better LSC areas of land to that which is to be disturbed.

Figure 5 shows the proposed priority areas for the reinstatement of the specific LSC Classes on the post mining landform. **Table 3** shows the Pre and Post mining LSC areas within the Revised Project Disturbance Boundary.

Table 3 Pre and Post mining LSC

	EIS Project Disturbance Boundary			Revised Project Disturbance Boundary			
LSC	Pre Mining Area (ha)	Post Mining Area (ha)	Change (ha)	Pre Mining Area (ha)	Post Mining Area* (ha)	Change (ha)	Change (%) in Pre mining LSC
LSC 3	178.90	264.00	85.10	176.47	436.79	260.32	-1.36
LSC 4	271.60	341.70	70.10	218.86	435.49	-282.33	-19.42
LSC 5	526.60	317.90	-208.70	498.96			-5.25
LSC 6	167.70	51.00	-116.70	140.85	80.16	-73.51	-16.01
LSC 7	15.60	24.00	8.40	12.82			-17.82
LSC 8	0.00	0.00	0.00	0.00	21.57	21.57	0
Retained Infrastructure	0.00	161.80	161.80	0.00	73.93	73.93	0
Total	**1,160.40**	**1,160.40**	**0.00**	**1047.95**	**1047.95**	**0.00**	**-9.69**

* Macro-Relief conceptual landform design example (Limited agriculture areas)



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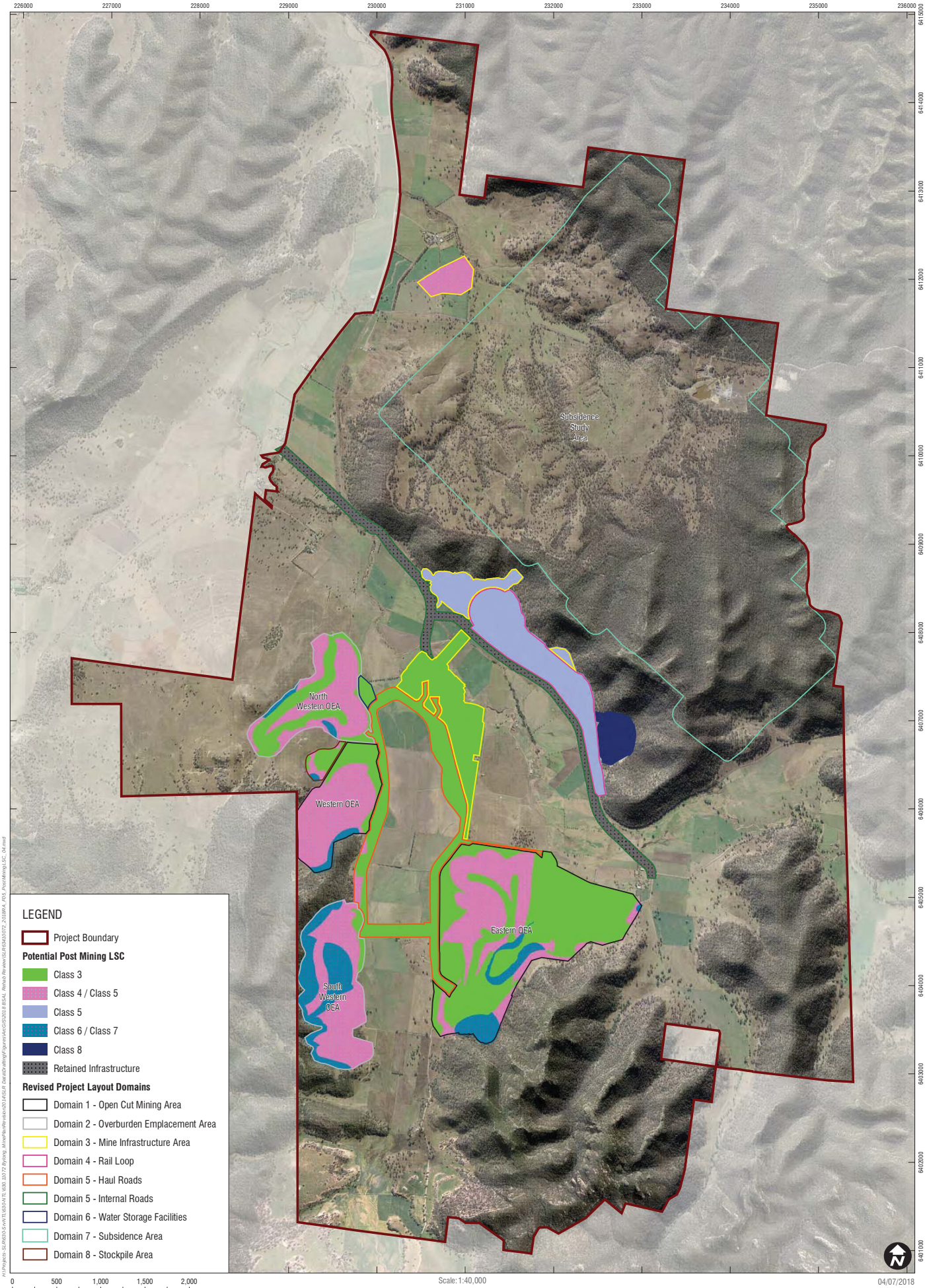
Pre-Mining LSC (EIS Mapping)

FIGURE 4



Potential Post-Mining LSC

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FIGURE 5

5 Revised Soil Balance for Rehabilitation

5.1.1 Soil Stripping Volumes

The recommended soil stripping depths have been calculated and mapped during the EIS process and refined for the RTS. The soil stripping depths have been calculated to provide overall soil volumes as shown in **Table 4**. These stripping depths are estimations based on in field soil test pits and profile assessment, which have been extrapolated based on geomorphology and soil toposequence assessment. It is important to appreciate that local variations in soil type and soil depth are possible and indeed expected to be encountered during the stripping program. The approach required for stripping is essentially to salvage all suitable soil material (topsoil and subsoil) during the initial clearing and stripping activities. As such, in accordance with the commitments provided within the EIS, on ground assessments during active stripping is required by suitably qualified personnel to identify the "suitable soil material" which is available.

The RTS and Supplementary RTS provided a soil balance for the stripping and rehabilitation of Domains 1 and 2. It was proposed that for Domain 3 Infrastructure Area, the soil resources in situ would be used to reinstate the profile post decommissioning and closure. Given the proposed changes and example of final landform changes that are possible, the soil balance and rehabilitation area now includes Domains 1, 2 and 3. **Table 4** provides the soil balance for these domains.

Table 4 Available soil resources based on assessed stripping depths

Area (ha)	Available Topsoil (MCM*)	Available Subsoil (MCM*)	Total Available (MCM*)
1047.95	2.63	4.79	7.42

*Million Cubic Metres

5.1.2 Soil Balance

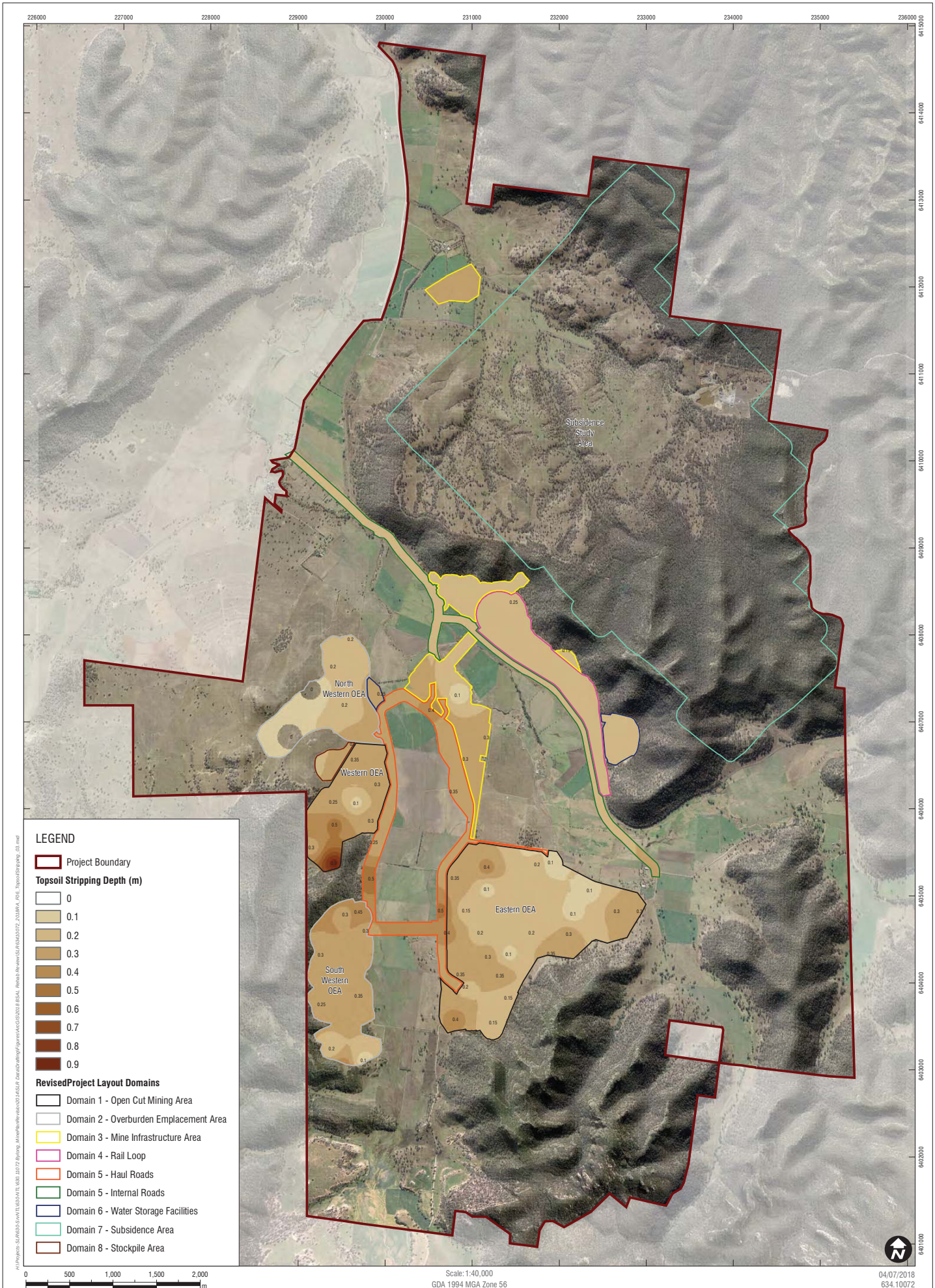
Based on the recovery of soil volumes listed above, the following volumes and soil balance, shown in **Table 5**, has been calculated based on the post mining requirements for soil depths of BSAL and LSC Classes. These depths are derived from the criteria for each LSC class and the BSAL protocol, with adequate buffer to allow for settling consolidating over time.

Table 5 Required soil resources based on reinstatement depths

BSAL and LSC Class	Reinstatement Depths (m)		Soil Volume Requirements			
	Topsoil	Subsoil	Area (ha)	Topsoil (Primary media) (MCM)	Subsoil (Secondary media) (MCM)	Total (MCM)
BSAL/Class 3	0.3	0.6	436.79	1.31	2.62	3.93
Class 4/5	0.2	0.4	435.49	0.87	1.74	2.61
Class 6/7	0.2	0.2	80.16	0.16	0.16	0.32
Class 8	0	0.2	21.57	0.00	0.04	0.04
Retained Infrastructure	0	0	73.93	0.00	0.00	0.00
Total			**1,047.94**	**2.34**	**4.57**	**6.91**

The estimated volume of suitable topsoil available from the disturbance areas is 2.63 MCM. The required volume of suitable topsoil to achieve the post mining BSAL and LSC target areas is 2.34 MCM. **Figure 6** and **Figure 7** show the spatial distribution of stripping depths of soil suitable for re-use as Topsoil and Subsoil respectively. Therefore, there is an estimated surplus volume of topsoil resources, including a buffer or excess of 12%. The estimated volume of suitable intermediate subsoil available from the mining areas is 4.79 MCM. The required volume of suitable subsoil to achieve the post mining BSAL and LSC target areas is 4.57 MCM. Therefore, there is an estimated surplus volume of subsoil resources, including a buffer or excess of 4.8%. It is noted that depth of subsoil below the in-situ measurement of 1.0 m was not included in the calculations, and it is expected that additional subsoil resources may be available below this depth in some soils.

To achieve the desired post mining land capability, the total volume of material required for rehabilitation (topsoil and subsoil) is 6.91 MCM. The total volume of suitable material available for reuse in rehabilitation is 7.42 MCM, which results in a surplus of 0.51 MCM (or 7.4%). The estimated excess calculated in the RTS was approximately 8.3%, however this proposed to only reinstate what existed pre-mining within the Infrastructure areas. This surplus material will be stored as a contingency, if required, to improve rehabilitation or rectify areas where maintenance is required.



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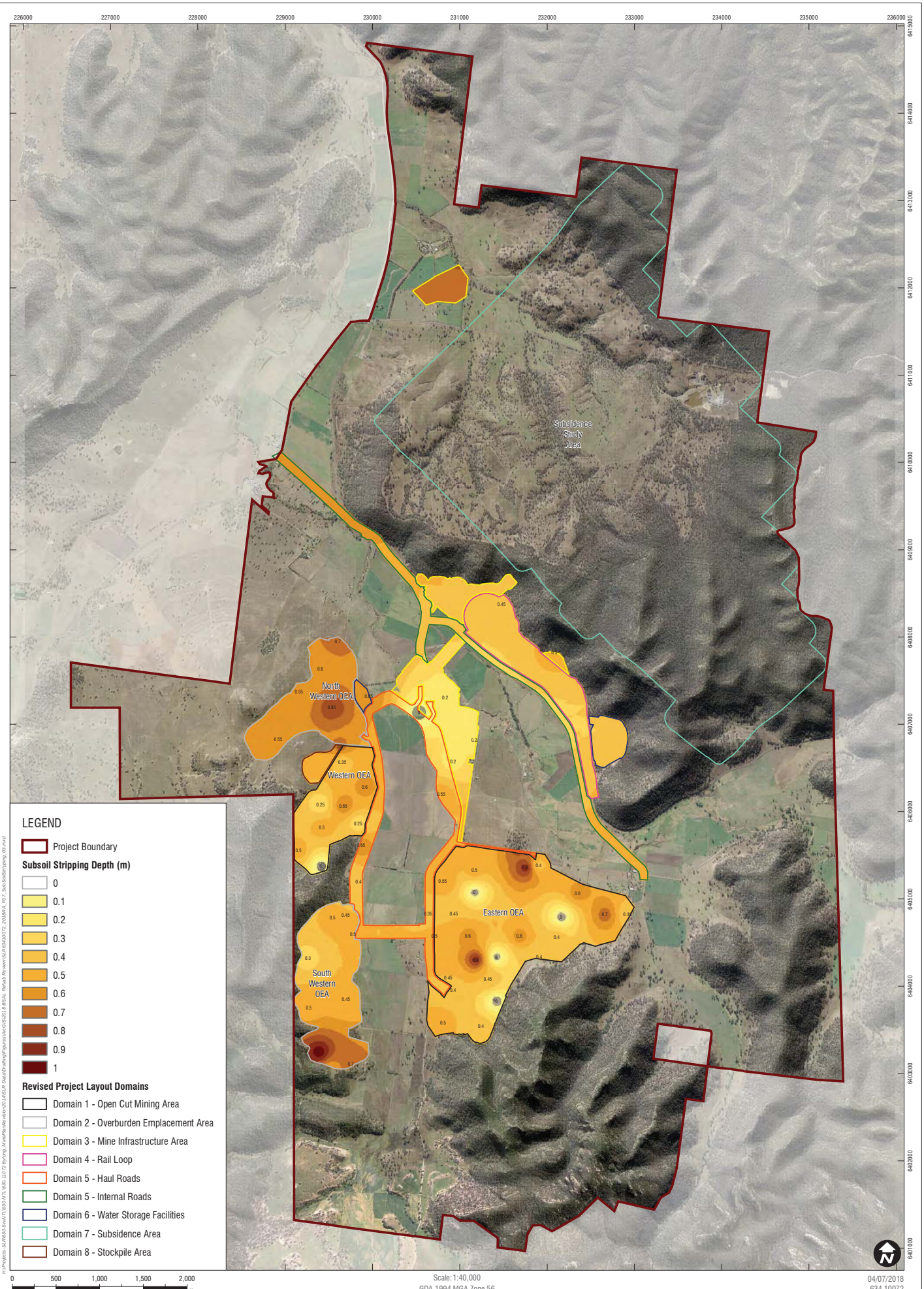
Proposed Topsoil Stripping Depths

FIGURE 6



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Proposed Subsoil Stripping Depths

FIGURE 7

6 Rehabilitation Strategy

6.1 Rehabilitation Objectives

As described within the EIS (2015), RTS (2017), Supplementary RTS (2017) and Response to PAC Review Report (2018) for the Project, the overarching rehabilitation objectives for the Project are:

- Rehabilitation will comply with the relevant regulatory requirements, and regulatory consensus will be attained on the successful closure and rehabilitation of the Project;
- The rehabilitated final landforms will be stable, with soils and ecosystems having maintenance needs no greater than those of the comparable surrounding land;
- Appropriately recover, store and re-handle suitable soil resources for future rehabilitation;
- Undertake progressive rehabilitation as soon as areas become available;
- Undertake temporary rehabilitation measures on stockpiles or disturbed areas which would otherwise remain so for greater than 6 months;
- Establish healthy and self-sustaining soil profiles and vegetation cover for future land use on re-contoured mined lands;
- Create a post-mining landform consistent with that which existed prior to mining, blends into the surrounding landscape, and which enables agricultural land use and areas of native vegetation;
- Conduct maintenance (e.g. weed control, follow-up fertiliser, reseeding, erosion repair etc.) until rehabilitation is sustainable; and
- Monitor and manage rehabilitation areas to facilitate the process of achieving sign-off on pre-determined completion criteria.

6.1.1 The Domain Approach

The Bylong Project mine plan was developed using mine planning principles with consideration for the environment. Throughout the EIS phase the mine planning was reviewed and revised following preliminary findings to ensure the potential impact on the soil and agricultural resources was minimised. This Conceptual Mine Plan forms the basis of the project for which approval is sort. The rehabilitation objectives outline that further detailed landform design work will be completed with due process in the early stages of the Project. The Rehabilitation Management Plan (RMP) and the Mining Operations Plan (MOP) form the two key detailed documents which will ensure a suitable and approved landform is developed which blends within the surrounding natural topography.

In light of the concerns from regulatory authorities in the recent stages of the government approvals process, KEPCO has developed (by way of an example only) a Conceptual Final Landform design which incorporates macro-relief. The concept of macro-relief entails reviewing natural landscape features and forms and incorporating this into the landform design (with consideration of operational constraints). In this regard, KEPCO is seeking approval for the Conceptual Final Landform design which is based on simple mine planning principles, however with the overall rehabilitation objective of designing the final landform to best blend in with the surrounding topography. The macro-relief example illustrates a possible approach to this landform design.

Rehabilitation of the final landform within the Project will be undertaken on a domain basis, which represent land management units, discrete rehabilitation areas or post-mining landforms that will be rehabilitated using varying techniques suited to the type of disturbance and the proposed post-mining land use. The domains are listed below in **Table 6** and illustrated in **Figure 1**.

Table 6 Project Domains

Primary Domain		Description	Area (ha)
1	Open Cut Mining Area	• Western Open Cut • Eastern Open Cut	393.97
2	Overburden Emplacement Area (OEA)	• South-western OEA • North-western OEA	225.86
3	Mine Infrastructure Area	• Employee & materials drift • Overland Conveyor • Run of Mine (ROM) coal pad • Main access • Administration buildings	123.67
4	Rail Loop	• Rail Loop, associated rail load out and Coal Handling and Preparation Plant (CHPP)	88.34
5	Roads	• Haul Roads • Internal Roads	178.07
6	Water Storage Facilities	• Raw water storage • Dirty water storage	27.30
7	Subsidence Study Area	• Angle of draw for the Subsidence Study Area within the Study Area boundary	1,714.20
8	Stockpile Area	• Land nominated for storage and management of stripped soil resources	11.14
9	Temporary Construction Disturbance Areas	• Land disturbed in construction of operational areas and support infrastructure	*
Total			**2,762.55**

*Areas identified as Temporary Construction Disturbance are included within the other noted Domains Areas (total ha). The Domain has been separated to ensure land disturbed by construction activities is adequately rehabilitated within a practicable timeframe.

The remaining area within the Project Boundary will be maintained in its existing condition with only minor disturbances from ancillary facilities associated with mining or construction activities. The Project seeks to minimise risks to agricultural resources and to minimise long-term impacts.

6.1.2 Final Landform

Landform design and planning takes into account four main components as outlined below:

- Landform stability;
- Erosion minimisation;
- Landform compatibility with the surrounding environment having regard to the landscape; and
- Post mining landuse criteria.

Consideration is also given to the DPE, Recommended Development Consent Condition 64, which lists key aspects of rehabilitation and specific targets. Rehabilitation has been designed to achieve a stable final

landform compatible with the surrounding environment. Pells Sullivan Meynink (2014) conducted a geotechnical study to determine stable slope design criteria for the mining area excavation slopes, OEAs and mining area slopes. This design was used in the EIS approach to landform design as well as the Conceptual Final Landform which proposes the maximum areas for agricultural use. All finished slopes and drainage lines are designed to safe and stable angles. The final landform may incorporate natural inspired drainage systems to be installed during the rehabilitation process. This will involve shaping the completed OEAs and mining areas to landforms as shown in **Figure 3a and Figure 3b**.

The following considerations have been applied to the Conceptual Final Landform designs during the project design and approval process:

- The OEAs located in the northern part of the Eastern Open Cut have reduced;
- The Western Open Cut reduced to retain a natural ridgeline in the south-eastern area to minimise impacts to the existing landscape;
- The North Western OEA has been redesigned to retain a valley system within the conceptual design to minimise visual impact to locations within the Upper Bylong Valley; and
- The South-Western OEA has been redesigned with a reduced maximum height in order to alleviate the steeper slopes on the western side of this OEA.

Further to this, KEPCO has provided an example of the Conceptual Final Landform Design which incorporates macro-relief which demonstrates how a landform can be established to better blend in with the surrounding topography. Whilst the final design may vary from this example, the concepts utilised to establish this landform will be further detailed within the RMP and MOP for the Project.

Ongoing mine planning will limit the total area of disturbance at any one time, considering both clearance in advance of operations and rehabilitation of areas disturbed. This will reduce the potential for wind-blown dust, visual impact and sediment-laden run-off. Any treed vegetation along the toe of rehabilitation areas will not be cleared unless an unacceptable safety or erosion risk remains.

6.1.3 Infrastructure Areas

The temporary disturbance upon the landscape, for infrastructure associated with mining activities, will be rehabilitated to similar slopes and landforms post decommissioning and closure. The general intention of landform shaping of infrastructure areas is to reinstate a free draining gently sloping landform consistent with surrounding topography. There will be flat areas such as hardstands and CHPP which may require some final shaping to facilitate drainage prior to reinstating the soil profile. Whilst the aim of rehabilitation for infrastructure areas is to re-instate the equivalent land quality post mining, the areas of non BSAL within the footprint may be rehabilitated with additional soil resources sourced from the mining areas to enhance the final soil profiles in these areas to BSAL quality soil.

6.1.4 Mining Areas

The main objective of re-grading the overburden is to produce drainage lines, slope angles, lengths and shapes that are stable, not prone to an unacceptable rate of erosion, compatible with the surrounding landforms and compatible with the proposed final land use. Integrated with this is a drainage pattern that is capable of conveying runoff from the newly created catchments whilst minimising the risk of erosion and sedimentation. Final slope gradient should not exceed 10 degrees for majority of the final landform. Some allowances are required in order to achieve the revised 'like natural' landform design.

The final landform which best blends into the landscape will be developed to ensure that surface flows are controlled to minimise erosion potentials on disturbed and rehabilitated areas. The final landform design may incorporate design features which may be developed based on the study of the development of landforms over time, from youthful, actively eroding landforms to mature, 'stable' landforms. The approach has critical input factors that measurements integrate the effects of local variation in climate, earth materials, and vegetation that define local landform stability against erosion. By collecting empirical measurements from stable landforms in the area of interest and using these as inputs to the design, the designer can have a high degree of certainty that the designed landform will perform similarly to the stable, natural landform. One major advantage of this design technique is the natural appearance of the landform.

Contour ripping across the grade is by far the most common form of structural erosion control on mine sites as it simultaneously provides some measure of erosion protection and cultivates the surface in readiness for sowing. Contour ripping will be applied to all landforms. Overburden should be left in a rough state to maximise infiltration of rain and to minimise surface erosion prior to the placement of the soil profile.

6.1.5 Domain Specific Landform

6.1.5.1 Domains 1 & 2 (Open Cut Mining Areas and OEAs)

The land to be directly and permanently disturbed by the open cut mining and OEAs will be backfilled with overburden and reshaped in accordance with the landform design. Reshaping will ensure that final slopes are generally 10 degrees or less, excluding some slopes associated with drainage lines and around the margin, where the landform integrates into the surrounding mountainous terrain. This landform will differ from its pre-mining state, however is proposed to be developed to incorporate landform design features which are consistent with the surrounding landscape.

The conceptual designs may include some of the following features, as provided in the example of the rehabilitated landforms.

The reshaped South-Western OEA may be an elevated ridgeline landform with incised drainage lines which blend into the surrounding landscape. There are some areas with steeper slopes where the reshaped landform abuts the adjacent steep topography to the west. These have been minimised within the Conceptual Final Landform Revised Project Layout.

The Eastern Open Cut may contain an elevated ‘like natural’ multi ridge landform largely composed of moderately inclined land grading to ridge plateaus generally running north south. A large area of flat to gently inclined land may be created in the east (consistent with the existing landform in this area) and to the south of the central elevated landform. There are steeper fringing slopes where the rehabilitated landform abuts the existing rugged topography associated with Tal Tal Mountain to the south.

The contracted mining footprint within the Western Open Cut retains the existing wooded ridgeline within the south eastern portion of the former mining area. The re-shaped Western Open Cut may be a ‘like natural’ elevated ridgeline landform largely composed of moderately inclined land with some fringing steeper slopes to the south, where it abuts the existing rugged topography.

All final landforms will be developed to incorporate some micro-relief and integrate with the surrounding natural landform patterns.

6.1.5.2 Domains 3, 4, 6, 7 and 8

All land covered by main infrastructure components, rail loop, water dams and stockpile areas will be returned to the approximate pre-mining landform or similar natural landform and will be capable of supporting pre-mining land uses. Where large areas of pre-mining non BSAL land occurred, there is opportunity to enhance these areas with additional soil resources from Domains 1 and 2 to create BSAL quality land, ensuring equivalent areas of BSAL quality land are re-created within the Revised Project Disturbance Boundary.

6.1.5.3 Domains 5

It is proposed that all upgraded and realigned roads including the Upper Bylong Road upgrade, realignment of Upper Bylong Road (East Link Road), will be retained at closure. This landform will therefore differ from its pre-mining shape within this Domain.

6.1.5.4 Temporary Construction Disturbance

All land temporarily disturbed in the construction of the above noted Domains will be rehabilitated where possible to pre-mining landform or similar natural landform and capable of supporting pre-mining land uses. Rehabilitation will occur in a reasonable timeframe at completion of the relevant construction activity.

6.1.6 Visual Outlook of Landform

The Conceptual Final Landform has been designed to achieve a stable final landform compatible with the surrounding environment and consistent with the landscape elements of this part of the Bylong Valley. **Plate 1** and **Plate 2** below show the images of the project from the North East Pre Mining and North East Final Landform, respectively. **Plate 3** and **Plate 4** below show the images of the project from the South Pre mining and South Final landform, respectively. As can be seen from these plates, the final land uses blend into the surrounding environment.

6.1.7 Specific Post Mining Landuse

KEPCO will implement an integrated approach to the future rehabilitation and management of the land within the Project Disturbance Boundary to facilitate the establishment of native woodland communities and agricultural land for ongoing production. Specific landuse objectives are outlined below.

6.1.7.1 Agricultural Land and BSAL

The re-instatement of agricultural land and BSAL will compensate for the temporary loss of available agricultural land as a result of the Project. Within the proposed preserved and/or re-instated agricultural land, KEPCO will preserve or re-instate 400.43 ha of BSAL equivalent land within the Revised Project Disturbance Boundary. Reinstated BSAL will be located proximal to the existing agricultural lands with consideration for road infrastructure and paddock size economies of scale. Upon completion, this land will be dedicated for agricultural purposes and integrated with the existing KEPCO agricultural enterprise. The rehabilitated agricultural areas will also be suitable for Equine CIC in the future.

KEPCO will continue to manage all company owned land for agricultural purposes in accordance with the Bylong Farm Management Plan, which was included in the Response to the PAC Review Report. KEPCO has prepared the Farm Management Plan to assist with the management of the land. The Farm Management Plan details strategies for the ongoing land use for grazing and cropping management, erosion and sediment controls and weed and pest controls. The rehabilitated agricultural land will be progressively released back to being managed under the Farm Management Plan to minimise the time the land is out of agricultural production. KEPCO has a dedicated Farm Manager to facilitate these activities as identified within the Farm Management Plan. This commitment ensures the continued productivity of agricultural land not directly impacted by the Project.

6.1.7.2 Native woodland

The rehabilitation of native woodland areas will, facilitate a self-sustaining post-mining landscape that resembles the original open woodland communities. Revegetation efforts will in the long term aim to support a diverse range of viable flora and fauna populations, link remnant native vegetation and maximise conservation of biodiversity values. As such, it will focus on the establishment of ecological communities as detailed in the EIS, including White Box Grassy Woodland and Yellow Box Grassy Woodland.

6.1.8 Rehabilitation Sequencing

The sequencing of rehabilitation is detailed in a RMP and MOP which is progressively updated over the life of the mine. **Figures 8 to 12** show the Conceptual stage plans for the Revised Project Layout which provide an indication of the general sequencing of mine rehabilitation activities throughout the life of the open cut mine.

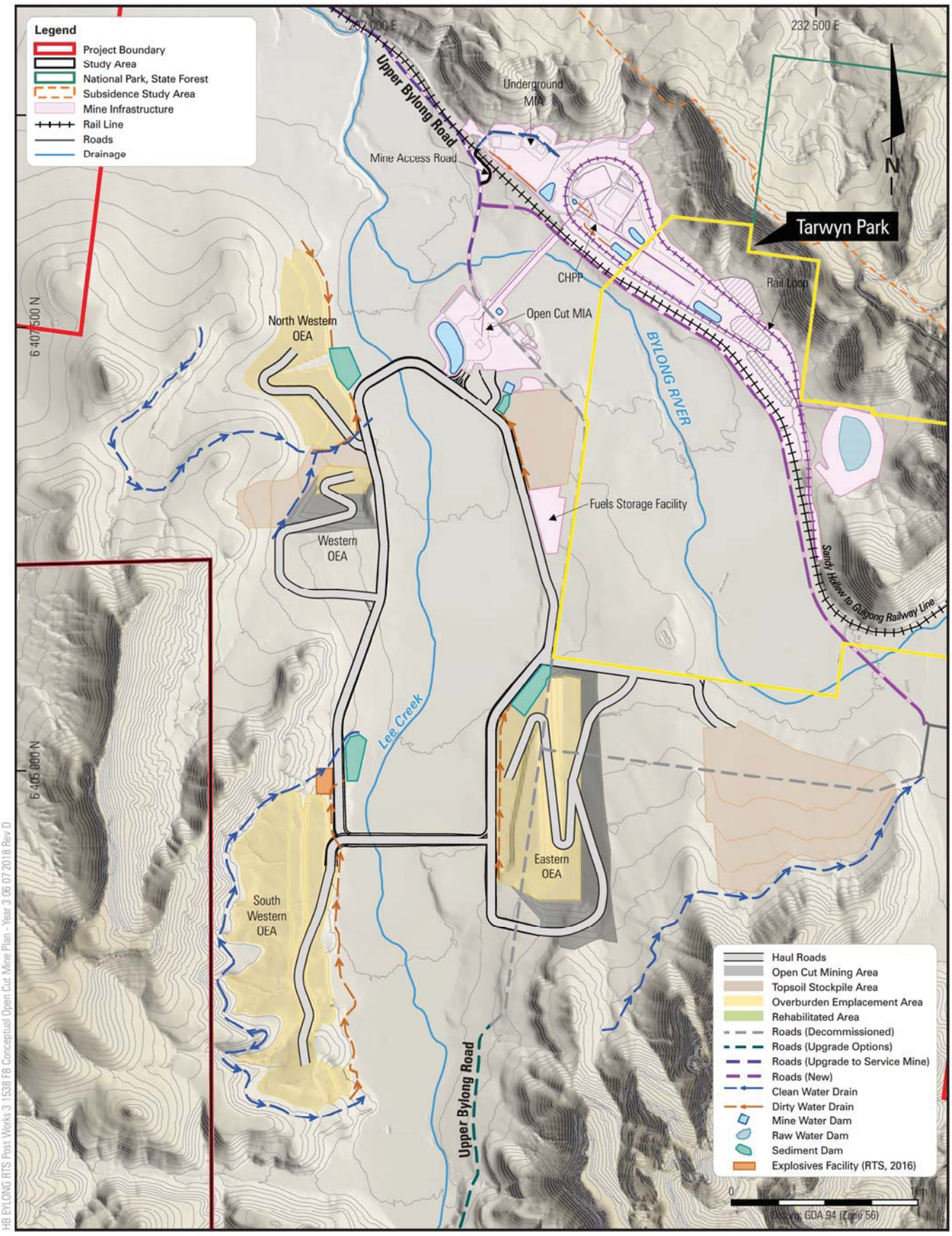
During the life of the mine, minor variations in rehabilitation schedules may occur. In the event of minor delays, the adjustment of sequencing will be incorporated into the internal production/rehabilitation schedule. However, if the variance continues for longer than approximately 12 months, this will be reported on and justified within the Annual Report, with concerted efforts to rectify any delay and bring the rehabilitation sequencing back to the schedule. In the event the delays to rehabilitation extend over the MOP period, a revised MOP scheduling may be required to be submitted for approval.

Plate 1: Pre Mining Landform – Looking South

Plate 2: Final Landform – Looking South

Plate 3: Pre Mining Landform – Looking North

Plate 4: Final Landform – Looking North



H8 BYLONG RTS Post Works 3 1538 F8 Conceptual Open Cut Mine Plan - Year 3 06 07 2018 Rev D

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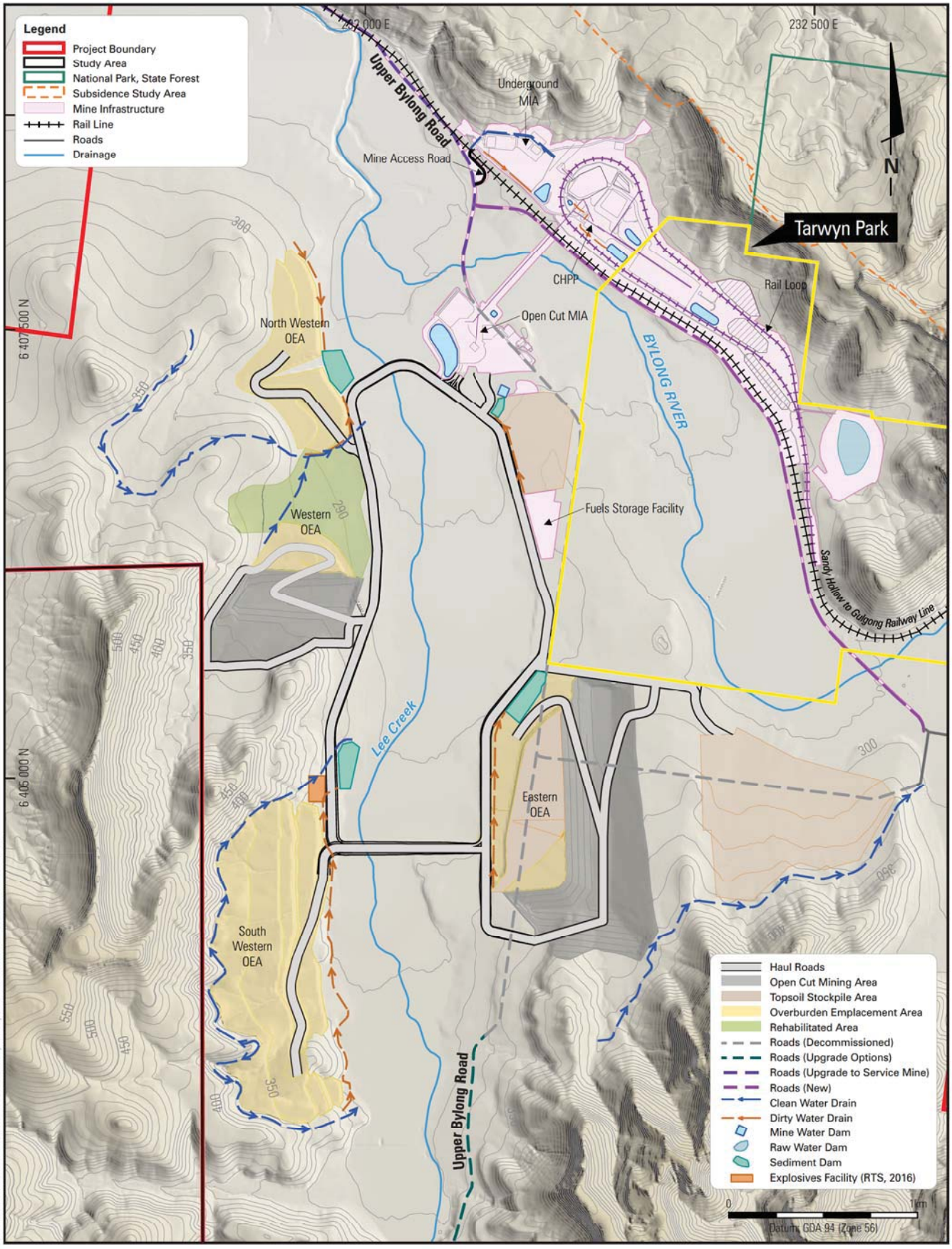
Conceptual Open Cut Mine Plan - Year 3

FIGURE 8



H8 BYLONG RTS Post Works 3 1538 F9 Conceptual Open Cut Mine Plan - Year 5 06 07 2018 Rev H

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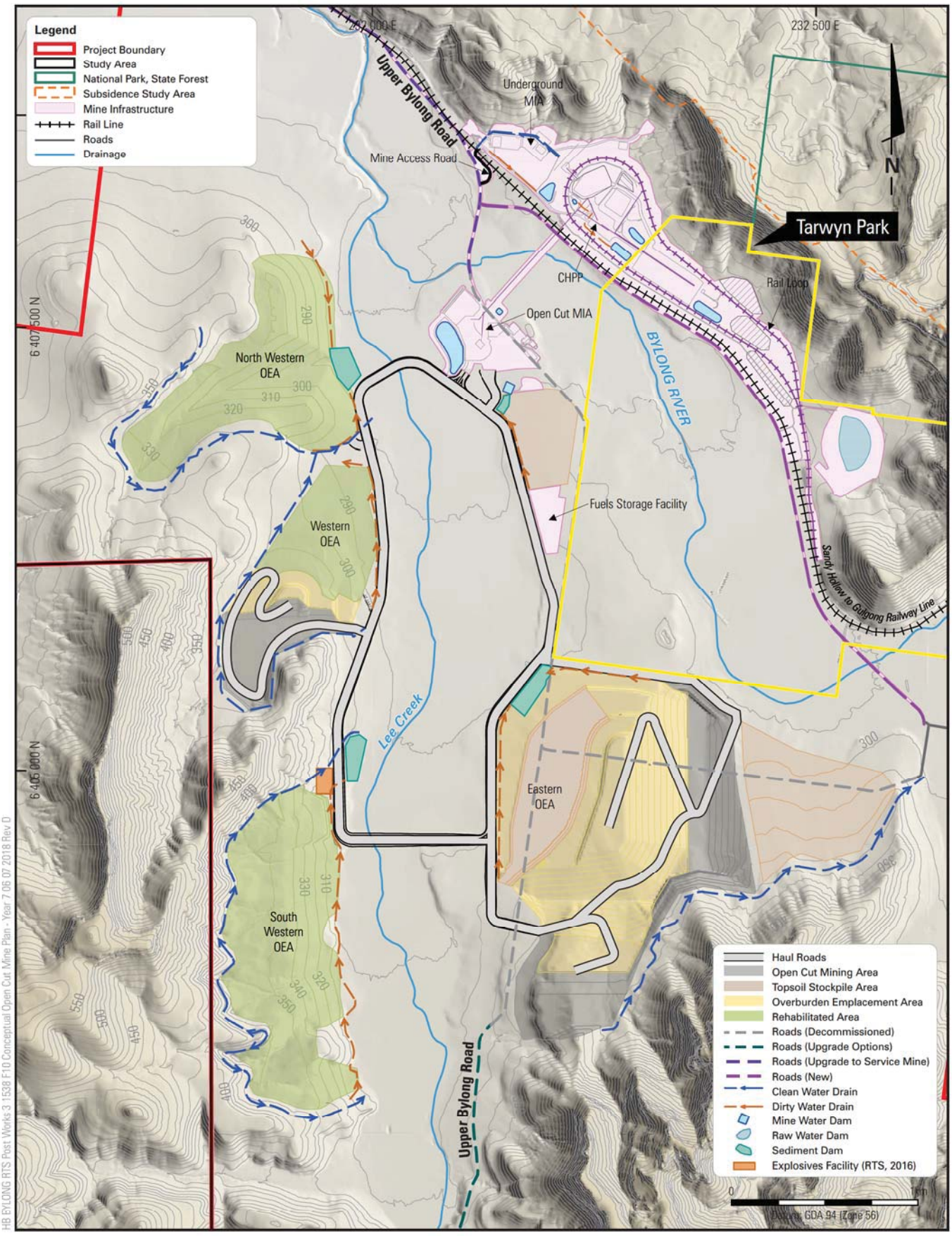
Conceptual Open Cut Mine Plan - Year 5

FIGURE 9



H8 BYLONG RTS Post Works 3 1538 F10 Conceptual Open Cut Mine Plan - Year 7 06 07 2018 Rev D

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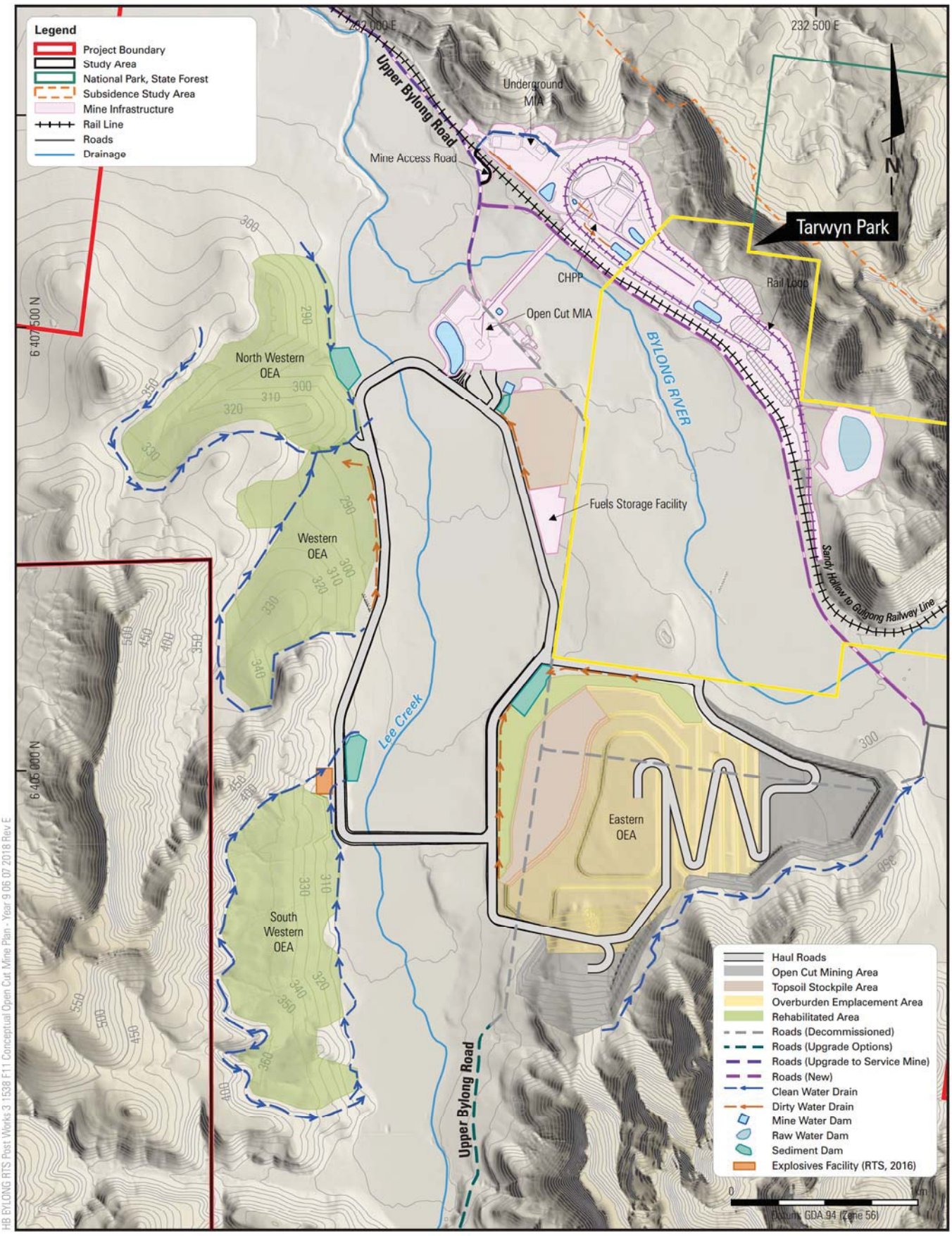
Conceptual Open Cut Mine Plan - Year 7

FIGURE 10



H8 BYLONG RTS Post Works 3 1538 F11 Conceptual Open Cut Mine Plan - Year 9 06 07 2018 Rev E

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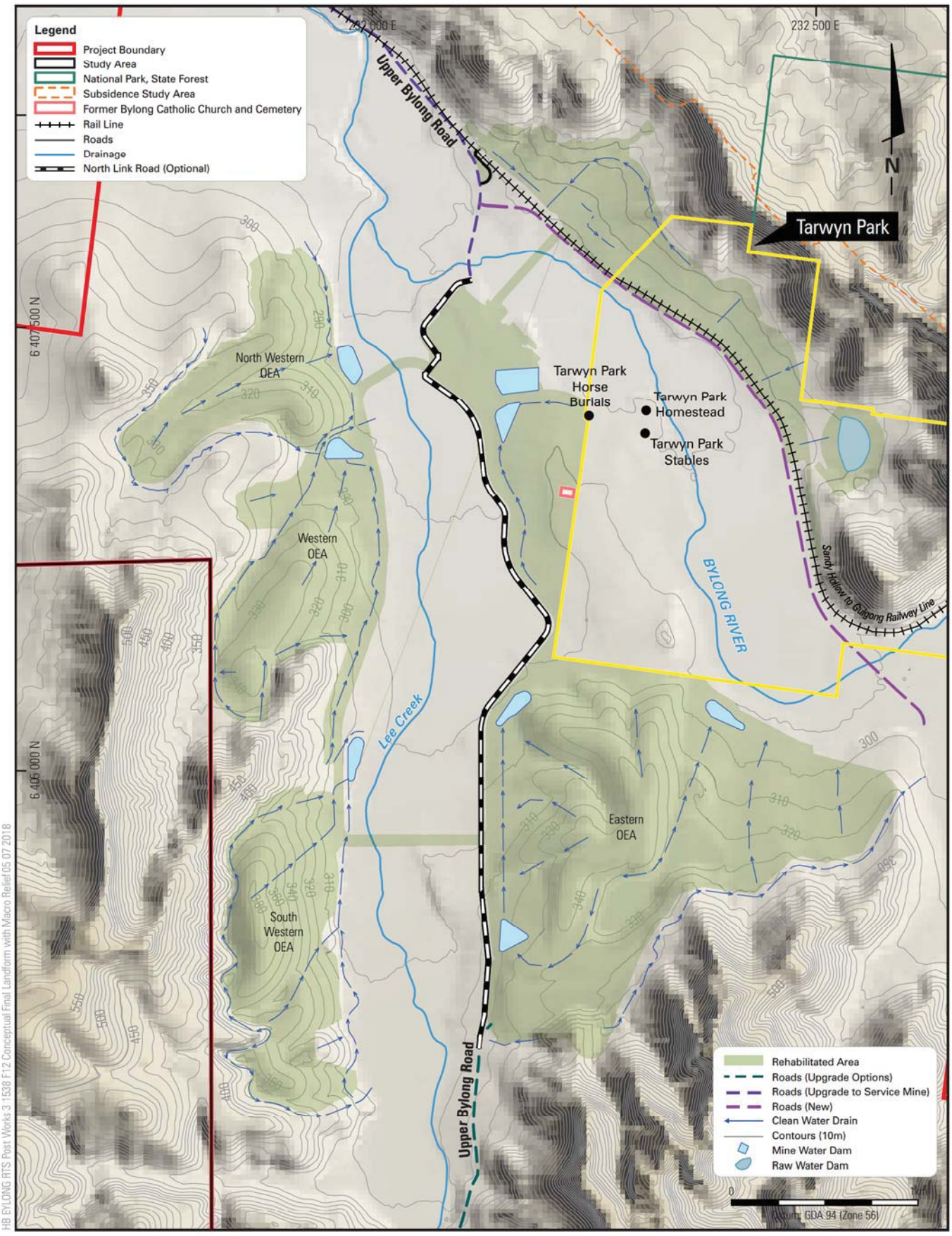
Conceptual Open Cut Mine Plan - Year 9

FIGURE 11



HB BYLONG RTS Post Works 3 1538 F12 Conceptual Final Landform with Macro Relief 05 07 2018

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Conceptual Final Landform (with Macro Relief)

FIGURE 12

7 Conclusion

This assessment was undertaken following a request by DPE for KEPCO to provide information in relation to the potential environmental impacts to BSAL, and LSC classes, an indication of the reinstatement of BSAL on rehabilitated land and a revised soils inventory, of contracting the open cut mining footprint of the Project to remain off the Tarwyn Park property as well as other requirements.

The key findings of the assessment were as follows:

- There would be a reduction of 22.7 ha (or 5.4%) of verified BSAL to be impacted by the Project with the Tarwyn Park property being excluded from the Project Disturbance Boundary.

- There is a reduction across all LSC classes from the Project Disturbance Boundary to the Revised Project Disturbance Boundary. The most significant was a 52.74 ha reduction of impacted LSC Class 4 land, a 27.64 ha and 26.85 ha reduction of LSC Class 5 and 6 respectively. Only minor reductions of impacted areas for LSC Class 3 (2.43 ha) and LSC Class 7 (2.78 ha).

- The soil balance was re-calculated in consideration of the Revised Project Disturbance Boundary and the inclusion of the infrastructure soil resources and rehabilitation requirements, within the OEA's and Open Cut Pits calculations. The results showed there is adequate soil resources to re-establish soil profiles to adequate depths and quality to meet the requirements of BSAL and LSC criteria.

- The proposed methodology for establishing landforms and soil profiles within rehabilitation areas, remains consistent with that shown in previous assessment documents. The continued building of examples of independently and scientifically assessed rehabilitation to quality agricultural land demonstrates the successful methodologies used on mine sites can be applied to the Bylong Project.

- There are two examples of final landforms which may be applied to the Revised Project Disturbance Boundary; firstly, the proposed landform for approval containing slopes and design principles which allow the maximum usable land for agriculture, and secondly an example of a landform which best blends into the surrounding landforms, however limits the use of agriculture due to steeper slopes in some areas. Therefore, the final approved MOP final landform is likely to be a compromise of an agricultural landform with limited macro-relief and one which incorporates macro relief as the dominant design principle.

The overall results of the assessment indicate the Revised Project Disturbance Boundary will reduce the impact on BSAL and all classes of LSC land. The soil resources available remain adequate to fulfil the rehabilitation requirements of the impacted BSAL and better quality LSC classes of land. The two examples provided of final landforms both contain adequate areas of suitable slopes for the re-instatement of impacted BSAL.

8 References

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