Restoration Plan to Support RIDA Application
Saraji East Project

Final V3
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GT Environmental Pty Ltd
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1 INTRODUCTION

GT Environmental Pty Ltd (GTE) was commissioned to assist AECOM Australia Pty Ltd (AECOM) in compiling a Restoration Plan (RP) to support a regional interests development approval (RIDA) application for the Saraji East Project (the Project).

The Regional Planning Interests Act 2014 (RPI Act) identifies and protects areas of regional interest from inappropriate resource or regulated activities. A Strategic Cropping Area (SCA) is an area of regional interest under the RPI Act and consists of the areas shown in the Strategic Cropping Land (SCL) trigger map as SCL (Department of Infrastructure, Local Government and Planning (DILGP), 2014).

A resource activity or regulated activity located within an SCA will be required to obtain a regional interests development approval (RIDA) under the RPI Act, unless exempt under sections 22, 23, 24 or 25 of the Act (DILGP, 2014).

A RIDA is being sought to undertake resource activities (the Project) that have potential to disturb Strategic Cropping Land (SCL). This RP is provided in support of a SCA RIDA to demonstrate how permanent impacts to SCL shall be avoided.

1.1 Scope of Works

This RP is to demonstrate that an electrical transmission line (ETL) infrastructure easement will be returned to pre-activity condition. The RP focuses on areas of the proposed disturbance which includes the ETL disturbance footprint (herein known as the Project site) falling within mapped SCL, as outlined within *Saraji East Strategic Cropping Land Assessment* (GT Environmental, 2020b [Appendix A]).

This RP will present:

- The land is able (without constraints) to be restored to its pre-activity condition following the undertaking of the proposed activity, and,
- The impacted SCL has been restored to its pre-activity condition, capacity and/or productivity following the cessation of that activity.

1.2 Project Description

BM Alliance Coal Operations Pty Ltd (BMA) proposes to develop the Project, a greenfield single-seam underground mine development on Mining Lease Area (MLA) 70383 commencing from within Mining Lease (ML) 1775. A new infrastructure transport and infrastructure corridor will be constructed on MLA 70383.

The Project proposal also comprises a Coal Handling Preparation Plant (CHPP), associated Mine Infrastructure Area (MIA) and a new rail spur and balloon loop; which are proposed to be located on the site of the existing adjacent Saraji Mine. The Project is expected to produce up to seven million tonnes per annum (Mtpa) of metallurgical product coal for the export market over a life of 25 to 30 years.

1.3 Project Location

The Project is located approximately 30 kilometres (km) north of Dysart and approximately 170 km southwest of Mackay in Queensland.

2 LEGISLATIVE CONTEXT

2.1 Overview

The RPI Act identifies and protects areas of Queensland that are of regional interest. The intent of the RPI Act is to manage the impact and support coexistence of resource activities and other regulated activities in areas of regional interest. The RPI Act is supported by the Regional Planning Interests Regulation 2014 (RPI Regulation).

The RPI Act and RPI Regulation seek to establish an appropriate balance between protecting priority land uses and delivering economic projects for Queensland regions.

The RPI Act protects:

- living areas in regional communities,
- high-quality agricultural areas from dislocation,
- Strategic Cropping Land, and,
- regionally important environmental areas.

Areas of Regional Interest are defined under the RPI Act as follows:

- a Priority Agricultural Area,
- a Priority Living Area,
- the Strategic Cropping Area, and,
- a Strategic Environmental Area.

The RPI Act restricts the carrying out of resource or regulated activities where the activity is not exempt from the provisions of the RPI Act, or a regional interests development approval (RIDA) has not been granted.

A resource activity (as applicable to the Project) is defined under the section 12 (2) of the RPI Act as follows:

- An activity for which a resource authority is required to lawfully carry out, and,
- For a provision of a resource authority or proposed resource authority – an authorised activity for the authority or proposed authority (if granted) under the relevant resource act.

2.2 Strategic Cropping Land Requirements

A resource activity or regulated activity located within an SCA will be required to obtain a RIDA under the RPI Act, unless exempt under sections 22, 23, 24 or 25 of the Act (DILGP, 2014). It is considered on this basis that the Project is not exempt from the requirement for a RIDA for SCL.

2.2.1 Strategic cropping areas

SCA covers the area mapped as SCL on the Department of Natural, Resources, Mines and Energy (DNRME) SCL trigger map and is updated by DNRME periodically to indicate 'potential Strategic Cropping Land.' There are three required outcomes for the SCA when applying for a RIDA:

- No impact on SCL in the SCA,
- No material impact on SCL on the property, and,
- No material impact on SCL in an area in the SCA.

A number of prescribed solutions are encouraged when assessing outcomes of RIDA applications in relation to SCL which include:

- Voluntary agreement with landowners,
- Locating the resource activity on land not used for SCL,
- Minimising the construction and operation footprint of a resource activity, and,
- No permanent impact on more than two (2) percent (%) of the SCL on the 'property'.

As defined under the RPI Regulation, a property in the SCL area is considered to be:

- A single lot, or,
- Otherwise – all the lots that are owned by the same entity or have one (1) or more common owners and:
    - are managed as a single agricultural enterprise, or,
    - form a single discrete area because 1 lot is adjacent, in whole or part, to another lot in that single discrete area (other than for any road or watercourse between any of the lots).

As defined under the RPI Regulation, a resource activity or regulated activity has a permanent impact on SCL if because of carrying out the activity, the land cannot be restored to its pre-activity condition.

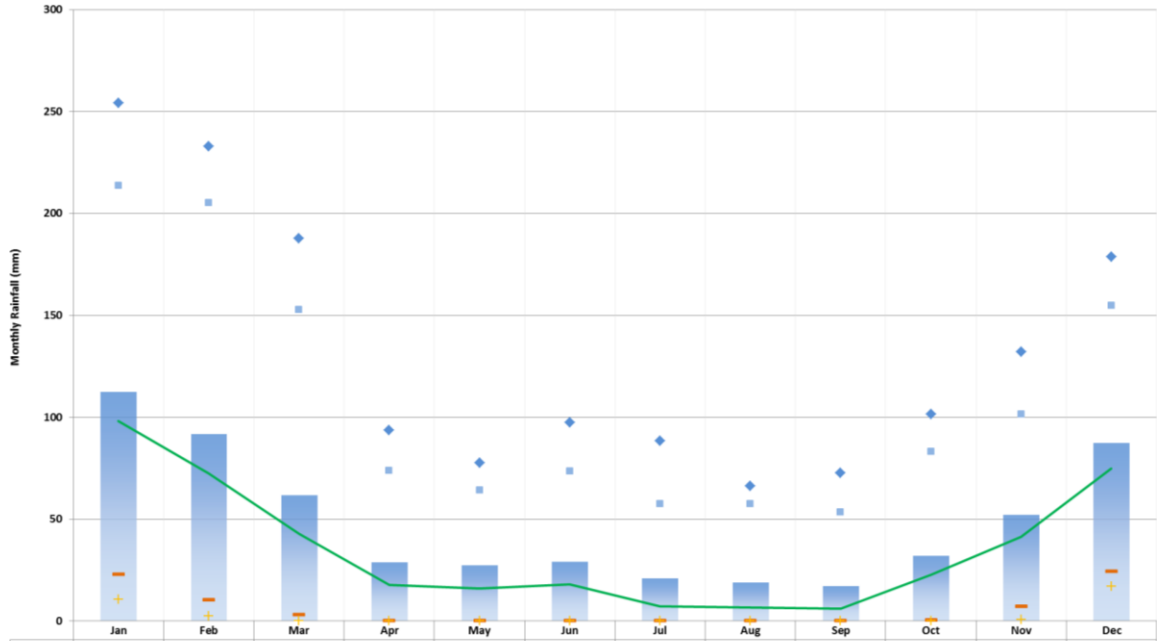
3 SITE ENVIRONMENT

3.1 Climate

Climate at the Project Site is classified as subtropical with a moderately dry winter (as per the Köppen Climate Classification). Historic climate data was sourced from the Bureau of Meteorology SILO Data Drill using 128 years of records (1889 to 2017). The data is produced by accessing grids of data derived from interpolating the bureau's records from individual weather recording stations.

Plate 1 shows mean monthly rainfall for the Project. It can be seen that annual rainfall at the Project site is highly variable and subject to prolonged periods of above and below average rainfall. The mean monthly rainfall shows a distinct seasonal distribution with monthly rainfall totals greatest in the wet season extending from December through March. The average monthly evaporation exceeds the average monthly rainfall throughout the year with a maximum of around 238 millimetres (mm) average monthly evaporation in December.

Plate 1 Monthly Rainfall (SILO Data Drill, 1889-2018)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	112.2	91.7	61.8	28.6	27.2	29.1	21.0	18.8	17.0	31.9	52.0	87.4
P95	254.1	232.8	187.8	93.6	77.6	97.3	88.5	66.2	72.7	101.6	132.1	178.8
P90	213.7	205.2	152.9	73.8	64.3	73.5	57.5	57.6	53.4	83.2	101.5	154.7
P50	98.1	72.6	42.8	17.6	16.1	18.1	7.3	6.8	6.0	22.8	41.2	74.9
P10	22.7	10.3	3.0	0.0	0.2	0.0	0.0	0.0	0.0	0.5	7.2	24.2
P5	10.5	2.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.6	17.1

3.2 Hydrology and Topography

Typical of the watercourses in the region, the watercourses in the Project site flow intermittently through the year in response to rainfall and runoff, with extended periods of no flow. Watercourses located nearby the project site include Philip Creek to the north and Downs creek to the south.

The topography is gently undulating with a surface height variance of approximately 15 metres (m) and two tributary channels transecting the Project site. The ecological values of the Project site are considered typical for the northern Bowen Basin with large areas of land historically cleared for grazing. Prior to land clearing for agricultural land uses, much of the area supported Brigalow and Belah vegetation on clay soils with tracts of Eucalypt woodlands on the alluvial and sand plains.

3.3 Geology and Geomorphology

The Project site is located on the western limb of the northern Bowen Basin with geology from the late Tertiary, Quaternary age in the north west to the Eocene, Oligocene age in the south east.

The shallower Tertiary sediments consist of clay, sandy clay, clayey sand and gravel, but have been noted as consisting predominantly of clay. The clay-bound nature of the Tertiary sediments ensures that permeable lenses of sands and gravels are complex in distribution and irregular. In-filled Quaternary alluvial channels associated with the present day creek courses are locally incised into the Tertiary Formation.

The south eastern portion of the Project site includes sedimentary rocks of the Duaringa formation consisting of mudstone, sandstone, conglomerate, siltstone, oil shale, lignite and basalt.

Two single tributaries transect through the Project site. A tributary the northern area of the Project site flowing north east to a confluence prior to Philip creek. A first order tributary flows to the east through the southern portion of the Project site towards the Isaac River.

3.4 Soil Mapping Units

Soil Mapping Units (SMUs) were identified for the Project site in Baseline Land Resources and Soil Suitability Assessment (GTE, 2020a). SCL Map unit naming outlined below was applied to isolated areas of each SMU within SCL Assessment (GTE, 2020b [Appendix A]). The following SMUs have been identified to include trigger mapped SCL and are detailed below.

- SMU A2g / Polygon 7
    - Crusting Grey vertosol (minor sub-dominant black vertosol), SMU variant consists of crusting grey clay with sub dominant black clays soils on gently undulating alluvial plains with mixed shrubbery and woodlands.
- SMU A4 / Polygon 2
    - Black dermosol, duplex dark grey sands with sandy loam subsoils near drainage lines.
- SMU A4c / Polygon 4
    - Black dermosol, SMU variant consists of dark grey, greyish brown sandy loams to sandy clay loams near drainage lines.

- SMU A5 / Polygon 11
    - Grey dermosol, consists of dark grey clay loams to grey brown clays in forested drainage line areas.
- SMU B1 / Polygons 3, 9, 12, 13 and 15
    - Black vertosol, deep, well-structured medium clays on gently undulating plains with Brigalow, Belah softwood scrub.
- SMU B2bl / Polygon 6
    - Black dermosol, consists of dark sandy clay with coarser structured clay subsoils on gently undulating plains.
- SMU B2g / Polygon 5
    - Black chromosol, consists of a grey and black duplex sandy loam to clay soils on gently undulating plains with mixed eucalyptus species.
- SMU B2s / Polygons 1 and 8
    - Black chromosol, SMU variant consists of dark greyish brown weak to moderately structured clay soils on cleared gently undulating plains.
- SMU B3bl / Polygon 16
    - Black vertosol, consists of black clay soils with gilgai microrelief on gently undulating plains of mixed regrowth.
- SMU B5 / Polygon 10
    - Black dermosol, consists of deep sandy clay loams with clay subsoils on gently undulating plains of tall woodlands.
- SMU E1r / Polygon 14
    - Red chromosol, consists of a texture contrast sandy loams over red clay subsoils on cleared gently undulating plains.
- SMU E2 / Polygon 17
    - Black vertosol, dark cracking clays on basalt with mixed Mountain Coolibah on undulating plains.

3.5 Strategic Cropping Land

SCL is identified to occur within the Project Site and immediate surrounds, with areas where intersect with mapped SCL limited to Lot 101 on SP310393 as detailed in Figure 1.

4 RESTORATION PLAN

4.1 Overview

A RP is required to demonstrate how permanent impacts to SCL as a result of a resource activity will be avoided. The RP is required to demonstrate the capacity for SCL disturbed by the resource activity to be returned to pre-activity status.

The following RP information requirements for demonstrating land will be restored to pre-mine condition is presented in RPI Act Statutory Guideline 09/14, (2019). These have been used to guide the contents of this RP and presented in relevant sections below, as summarised in Table 1.

Table 1 Restoration Plan Information Requirements and Report Section

RPI 09/14 (2019) Information Requirements	Section
Information on the nature of impact on the land and methods used to determine impact	4.2, 4.3.1
Characterisation of the pre-activity (current) condition of the land and soils	4.3.1, 4.3.2, 4.4
Evaluation of the nature and risk of any predicted impacts on the land	4.3.1, 4.3.2, 4.4
Evidence that scientifically proven and practical methods do exist for restoring the land	4.3.3 - 4.3.6
Detail on the application of the restoration methods including timeframes	4.3.3 - 4.3.6, 4.4.7, 4.4.8, Table 6
A monitoring program including benchmarking and progress milestones	4.4.7
A fully costed estimate of identified restoration works	4.4.2, Table 6
Restoration criteria against which successful restoration can be demonstrated	4.4.8

This RP should be considered a live and adaptive document. It will require adjustment based on circumstances changing based on the current design and plan in site construction activities, technology, knowledge and best practice.

4.2 Proposed Disturbance

No more than two 2% of SCL may be permanently impacted, as required under the RPI Act. The total area of the mapped SCL is calculated as the area of a SCL map unit that covers one or more lot and plans under the ownership of a single landholder. Permanent disturbance to that mapped SCL under the ownership of that single landholder cannot exceed 2% of that mapped area.

The area of impact is considered to be the area of that mapped SCL which will potentially be impacted by the activity, whether or not the land can be restored to its pre-activity condition after the activity ceases.

The proposed disturbance to SCL as a result of the Project is presented in Figure 1. Table 2 details areas of impacted SCL and associated Lot and Plans. The total proposed disturbance to the mapped SCL within Lot 101 on SP310393 is 21 hectares (ha).

Table 2 Areas of Impacted SCL

Lot and Plan	SCL Mapped (ha)	Impacted SCL (ha)	Impacted SCL (%)	Owner
101, SP310393	3,306	21	0.63%	BHP Coal Pty Ltd Umal Consolidated Pty Ltd BHP Queensland Coal Investments Pty Ltd Mitsubishi Development Pty Ltd QCT Investment Pty Ltd QCT Mining Pty Ltd QCT Resources Pty Ltd

As the proposed percentage of impacted SCL is below 2%, it is considered that the prescribed outcome that no permanent impact on more than 2% of the SCL on the property is able to be met. This is supported by the RP which demonstrates that the SCL can be returned to its pre-activity and pre-disturbance condition.

4.2.1 Proposed Disturbance Activity

The project site activity will include a co-aligned 66 kV powerline and connection extending off lease and connecting to the Dysart Substation.

The easement width for the ETL is 35m and accommodates for the powerline, structures, conductors and ground stays. This width includes the construction, maintenance activities and electrical clearance to objects located on the easement boundary.

Disturbance will primarily include the clearing or mulching of vegetation, installation of poles and access of vehicles.

Vegetation mulching or clearing will be minimal as the alignment is primarily through open pasture and adjacent to an existing ETL easement. Installation of the poles will include minimal disturbance to the area and will consist of excavation of top and subsoils at each pole location.

Benching is not anticipated to be required throughout the larger sections of level or near level graded areas; however, may be required at areas with major changes in grade, for example at waterway crossings and where such features cannot be spanned.

An access track will be established beside the centre line of poles for heavy machinery access during construction. These tracks will be maintained for the life of the proposed activity to be used for maintenance of the ETL and will not require any soils stripping to establish.

4.3 Activities to Restore SCL to Pre-Disturbance Condition

4.3.1 Land Suitability and SCL Assessment

GTE (2020a) conducted an assessment of soil and land suitability and SCL (as defined by SCL trigger mapping at the time of study).

In order to establish restoration criteria to return proposed disturbed SCL areas to pre-disturbance activities, comparison to land suitability criteria determined by GTE (2020b [Appendix A]) is recommended.

Land suitability has been previously assessed for the Project according to the Queensland Technical Guidelines for Mining (DME, 1995), the Guideline for Agricultural Land Evaluation in Queensland, second edition (Department of Science, Information Technology and Innovation (DSITI) and the Department of Natural Resources and Mines (DNRM), 2015) and Regional Land Suitability Frameworks for Queensland (DNRM, 2013) for the Inland Fitzroy and Southern Burdekin area.

These assessments account for climate, soils, geology, geomorphology, soil erosion, topography and past land uses and classifies overall class against the suitability subclasses (various cropping of the area), rainfed broadacre cropping and beef cattle grazing.

Both assessments use a land suitability class system of five classes, with land suitability decreasing progressively from class 1 to class 5. Table 3 provides an overview of the land suitability classification class system used.

Table 3 Land Suitability Classes (GALE, 2015)

Class	Suitability	Limitations	Description
1	Suitable	Negligible	Highly productive land requiring only simple management practices to maintain economic production.
2	Suitable	Minor	Land with limitations that either constrain production or require more than the simple management practices of class 1 land to maintain economic production.
3	Suitable	Moderate	Land with limitations that either further constrain production or require more than those management practices of class 2 land to maintain economic production.
4	Unsuitable	Severe	Currently unsuitable land. The limitations are so severe that the sustainable use of the land in the proposed manner is precluded. In some circumstances, the limitations may be surmountable with changes to knowledge, economics or technology.
5	Unsuitable	Extreme	Land with extreme limitations that preclude any possibility of successful sustained use of the land in the proposed manner.

The limitations were assessed for identified SMUs by GTE (2020a) in the affected SCL trigger map of the Project Site. The overall land suitability for a SMU was based on the most severe limitation relating to the nominated subclasses and beef cattle grazing.

Table 4 summarises the SMUs, limitations and land suitability for the nominated subclasses within the Project site.

Table 4 SMUs, Limitations and Land Suitability Assessments

SMU	Concept	Main Limitations and Value	Land Suitability for Rainfed Cropping	Land Suitability for Regional Frameworks, Overall Class
A2g	Crusting Grey Vertosol	Soil Water Availability (M3) Narrow Moisture Range (Pm5)	-	3
B1	Black vertosol	Water availability (m2), Nutrient deficiency (n2), Soil Physical Factors (p2)	2	-
B2bl	Black Dermosol	Erosion Hazard (Es32) Soil Water Availability (M4) Narrow Moisture Range (Pm5)	-	4
B2s	Black Chromosol	Soil Water Availability (M3)	-	3
B3bl	Black Vertosol	Erosion Hazard (Es33) Soil Water Availability (M3) Narrow Moisture Range (Pm7)	-	4
E1r	Red Chromosol	Soil Water Availability (M4)	-	4
E2	Black Vertosol	Soil Water Availability (M3)	-	3

4.3.2 Defining Restoration Criteria

Restoration criteria will be based on the pre-mine land suitability assessment classes outlined in Table 4. The assessment is presented in GTE, 2020a with physical and chemical characteristics of the SMUs.

Table 5 provides restoration criteria for relevant tenures, associated SMUs, SCL map units, land suitability and SCL trigger map and GTE assessment status within the Project disturbance area.

Table 5 Restoration Criteria for mapped SCL proposed to be disturbed

SMU	Lot and Plan	SCL Map Units	Land Suitability for Rainfed Cropping	Land Suitability for Regional Frameworks, Overall Class	DRNM SCL Trigger Map / GTE SCL
A2g	101, SP310393	7	-	3	Yes / Yes
B1	101, SP310393	13	2	-	Yes / Yes
B2bl	101, SP310393	6	-	4	Yes / Not SCL
B2s	101, SP310393	8	-	3	Yes / Yes
B3bl	101, SP310393	16	-	4	Yes / Yes
E1r	101, SP310393	14	-	4	Yes / Not SCL
E2	101, SP310393	17	-	3	Yes / Yes

Figure 1 presents these SMUs and SCL map units in the Project site as well as SMUs and SCL map units in the remaining Project site.

4.4 Restoration Methods

Trigger mapped SCL has been identified for the Project Site on the following tenure:

- Lot 101 on SP310393.

Associated SMUs and individual SCL map units are detailed in Table 4 and include restoration criteria (outlined as land suitability criteria for rainfed cropping and regional frameworks) that will be required to be met in order to establish pre-activity land uses. Pre-activity land suitability's to be achieved are:

- Rainfed Cropping Class 2 (SMU B1),

- Regional Frameworks Class 3 (SMU A2g, B2s and E2), and,
- Regional Frameworks Class 4 (SMU B2bl, B3bl and E1r).

Methodologies are listed below for restoration to pre-mine suitability and include mitigation measures and recommendations for the Project Site.

4.4.1 Previous Studies

A number of studies have been conducted to describe and assess the soils encountered in the Project Site and surrounding areas. These have been reviewed as a basis for developing the RP methodologies:

- BHP Billiton Mitsubishi Alliance (2012), Saraji East EIS Project, Chapter 4 Land Resources,
- BHP Billiton Mitsubishi Alliance (2012), Peak Downs High Wall Areas, Soil and Land Suitability Survey,
- CSIRO (1967), Land Systems of the Isaac-Comet Area,
- Emmerton, B (2005) Soil and Land Suitability Survey, in Potential Disturbance Areas in Advance of Mining, Saraji Mine 2004 Survey,
- GTE (2020), Baseline Land Resources and Soil Suitability Assessment,
- GTES (2012), Saraji East Coal Mine Project, Soils and Land Suitability,
- GTES (2007), Soil Evaluation on Proposed Easement for Power Line, Golden Mile Road to Saraji Mine,
- GTE (2020), Strategic Cropping Land Assessment,
- J.W.Burgess (2003), Land Resource Assessment of the Windeyers Hill Area, Isaac-Connors and Mackenzie River Catchments, Central Queensland, Volume 1 and 2, and,
- SKM/GTES (2013), Saraji Mine and Saraji East, Assessment of Strategic Cropping Land.

4.4.2 Restoration Plan Procedures, Schedule and Costs

The RP general procedures include all infrastructure and associated materials be removed. All materials will be removed including but not limited to cables, poles, concrete foundations and fill materials as well as signage and miscellaneous items associated with access roads. Once completed, inspected and recorded, the amelioration and revegetation of impacted areas such as access tracks may commence.

Removal of infrastructure and associated materials shall be completed in a time no longer than installation, pending the site conditions and weather. Restoration works will only be undertaken when soils are dry.

Schedule for restoration will be at the end of the life of the powerline. The following schedule presented in Table 6 outlines the restoration work, actions and approximate costs at current estimated rates where available. Additional subsections 4.4.3 to 4.4.8 outline further recommendations in detail.

Table 6 Restoration Milestones, Actions, Estimated Schedule and Cost Estimates

Restoration Work Milestones	Action to be undertaken	Estimated Time Frame (Months)	Estimated Cost ($)
Infrastructure removal	All services disconnected: • Disconnection point for safe removal of infrastructure	Three	35,000
	Infrastructure removed: • Removal of power lines on poles: o Steel o Wooden o Concrete • Removal of Switchyards • Removal of Substations • Removal of concrete pads: o <300mm thick o >300mm thick	Six	 30,204/km 19,199/km 33,618/km 600/m2 55/m2 15/m2 65/m2
	Visual survey and observation of removed infrastructure area by suitably qualified civil engineer	One	2,500
Landform re-profiling and development	Pole location pits backfilled and assessed	One	Not available [pending further/future review] (n/a)
	Topsoil removed prior to installation of infrastructure (i.e. poles) is returned		
Surface preparation	Visual survey and observation of final landform by suitably qualified geotechnical engineer	One	n/a
	Assessment completed of infrastructure corridor soil health and suitability by a suitably qualified person	One	n/a
Revegetation (pre-disturbance status)	Ripping of topsoil, grading and re-seed: • Track (no surface prep) • Track (gravel) • Track (crushed rock)	12	1,746/km 5,322/km 8,869/ha
	Areas requiring revegetation will need seeding of target vegetation species such as Lucerne - seeding rates may be assessed based on soil analysis, current climate and best practices of nearby land use		n/a
	Amelioration of access tracks and infrastructure soils based on visual, laboratory assessment, as determined necessary: • Fertilizer (to increase soil fertility) • Gypsum (to reduce dispersive attributes) • Lime (to increase pH)		 n/a n/a n/a
	Treatment of weeds and pest species as required		n/a
Revegetation / restoration criteria success	Survey by a suitability qualified person to include but not limited to: • Restoration vegetation with nearby established vegetation at selected reference sites, ecosystem and based on percent ground covered • Weed and pest species are equal to or below selected reference sites • No active erosion and drainage follows appropriate drainage paths	36	n/a
Ongoing monitoring	Suitably qualified person to conduct assessment of restoration plan area	Refer Table 8	n/a

4.4.3 General Recommendations during Project Site Activities

The following are recommended general management procedures for activities in the construction, ongoing project site activities and restoration in the project site:

- Limiting vehicle traffic to defined tracks only along the corridor,
- Limiting construction activity when soils are dry and weather forecasts indicate dry conditions, and,
- The selection of lighter equipment, vehicles and payloads where possible for transportation, construction and restoration of the project site.

4.4.4 Soil Surface Preparation

The following are recommended general management procedures for soil preparation in the disturbance and restoration to pre-disturbance condition:

- Supervisors and competent operators should be familiar with the restoration works area, existing soils mapping and recommended topsoil and subsoil depth (refer to Table 7 and Figure 1),
- Current weather forecast should be checked prior to preparing of soils to reduce exposure of bare sodic, erosive soils and sediment runoff,
- Removal of any foreign material bought in, not limited to gravels, road stabilizers, concrete footings, should be undertaken prior to soil replacement,
- Areas of land downgradient, low-lying areas or areas of observed runoff should have suitable erosion and sediment control measures in place prior to construction commencing, and,
- Topsoil suspected of being mixed with subsoils should be analysed and separated until results have been reviewed, appropriate amelioration methods recommended, and an area selected to re-distribute.

4.4.5 Revegetation

The following are recommended procedures for revegetation activities in the disturbance and restoration to pre-disturbance condition:

- Suitable machinery should be utilised in topsoil ripping activities. Ripping should be undertaken with care to minimise the mixing of subsoils,
- Soils are recommended to be ripped at the depths indicated in Table 7 below (GTE, 2020a) for topsoil. Subsoils may be required to ripped prior to placement of topsoil to reduce the impact of compaction during vehicle traffic,
- After the ripping of soils, additional seeding with native, pasture grasses and tree species will assist with encouraging vegetation regrowth,
- The selection of native, pasture grasses and tree species may include Lucerne, which has additional benefits such as loosening soil compaction due to its extensive root system,

- Sediment and erosion controls may be utilised within low lying areas to ensure that loss of soil resources are minimal, and product can be recovered,
- Amelioration of soils to be undertaken as required based on the soil assessment. The assessment will confirm soil conditions and any appropriate amelioration prior to vegetation establishment. The density of soils samples to be taken should cover at minimum, the identified SMUs that transect the project site as per Figure 1.

Table 7 Topsoil and Subsoil Depths and General Recommendations (GTE, 2020a)

SMU	Topsoil Depth (mbgl[1])	Subsoil Depth (mbgl)	General Recommendations
A2g	0.00-0.10	0.10-0.30	Topsoil is suitable for use on all rehabilitation areas. Subsoils may be marginal for use as supporting subsoils on level plains.
B1	0.00-0.50	0.50-0.90	Topsoil material is suitable for use on all rehabilitation areas and should ideally be placed to a depth of 20 cm or more. Subsoils may be used as either additional topsoil reserves or as supporting buried subsoils for topsoil placement.
B2bl	0.00-0.10	0.10-0.80	Topsoil is suitable for use on all rehabilitation areas. Suitable for support topsoil placement, slopes or level plains.
B2s	0.00-0.15	0.15-0.60	Topsoil is suitable for use on all rehabilitation areas. Suitable for support topsoil placement, slopes or level plains.
B3bl	0.00-0.10	0.10-1.00	Topsoil is suitable for use on level plains. Subsoils may be suitable for use as supporting subsoils on level plains.
E1r	Not suitable	0.15-1.00	Rehabilitation use for topsoils is not recommended. Preference would be to either use other topsoil resources. Subsoils may be suitable for use as supporting subsoils on level plains.
E2	0.00-0.40	0.00	Topsoils are high quality clay soils with a high moisture retention capacity, however, the establishment of permanent pasture cover on rehabilitation may take considerable time as problems occur with germination of fine seeded plants in the shrinking and swelling medium.

1. Metres below ground level (mbgl)

4.4.6 Recommended Soil Treatments and Amelioration

The restoration reuse of soil resources may be assisted with the following treatments and amelioration recommendations:

- If the establishment of vegetation is inadequate, the application of multi nutrient fertilizer such as Mono-ammonium phosphate (MAP) or Di-ammonium phosphate (DAP) may be suitable to boost nutrient levels,
- Gypsum ameliorants may be used to reduce any dispersive attributes for soils. The majority of soils currently disturbed in the project site present non-dispersive attributes. SMU B3bl may present some dispersive attributes, therefore the application of fine grade gypsum distributed using a broadcasting method over the site will minimise this,
- Reduce time bare soils is exposed by planting native grasses and encouraging organic matter horizon, preferably during dry season, and,
- Contour ripping of topsoils and subsoils where necessary during the rehabilitation process will reduce erosion and hard setting of surfaces prior to vegetation establishment. Table 7 outlines the topsoil and subsoil recommended ripping depths.

4.4.7 Monitoring Program

Table 8 details monitoring procedures recommended for project site restoration.

Table 8 Monitoring Program for Restoration Plan

Item	Action	Monitoring	Frequency
Approvals and clearances	Obtain the appropriate approvals and clearance documentation prior to commencing work	Check validity of approvals and clearance permits	Prior to clearance activities
Infrastructure removal	Ensure infrastructure has been fully removed	Survey and visual observation of removed infrastructure area by suitably qualified civil engineer	After clearance activities
Surface preparation	Ensure that final landform meets final design	Survey and visual observation of final landform by suitably qualified geotechnical engineer	After clearance activities
Soil resource status	Soil sampling and analysis to monitor soil fertility and quality	Samples should be collected to reassess key soil fertility indicators including but not limited to; pH, Electrical conductivity, Chloride, Cation exchange capacity, Nitrogen, Phosphorus and Total organic matter. Texture (particle size analysis) may also be included on the final analysis	Prior to restoration activities commencing
Soil resource condition	Prior to surface preparation and revegetation, soils is the appropriate moisture content	Visual inspection by operators and environmental officers	Prior to and during surface preparation and revegetation activities
Restoration Criteria Success	Monitor soil resources in the disturbance area have been restored	Visual inspection, photos and associated laboratory result review by environmental officers	Within six months initially and after three years of final restoration works

4.4.8 Restoration Criteria Success

The RP may be assessed against the pre-disturbance land suitability and limitations in which the SMUs presented prior to disturbance.

Restoration success may be assessed when the following has been demonstrated:

- Soil resources in the disturbance area have been restored including monitoring reports, photos and associated laboratory results within 6 months of final restoration works,
- Monitoring notes and photos of native vegetation establishment and pre-disturbance land use in the project site, within three years of final restoration works, and,
- Independent review and field inspection by a third-party consultant.

5 REFERENCES

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6 FIGURES

Figure 1 Project Disturbance, SCL and Soil Mapping Units

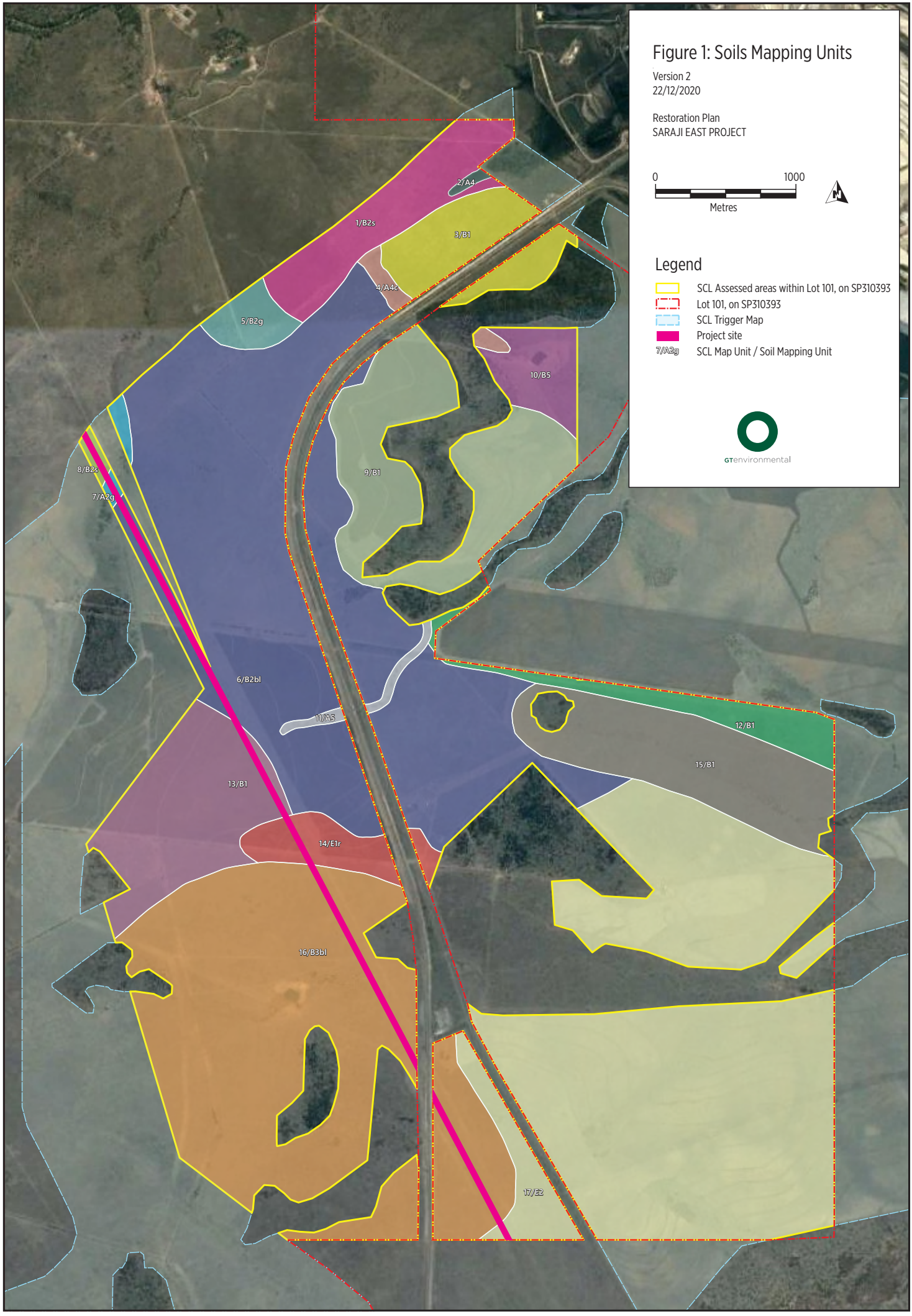
Figure 1: Soils Mapping Units
Version 2
22/12/2020
Restoration Plan
SARAJI EAST PROJECT
0
1000
Metres
Legend
SCL Assessed areas within Lot 101, on SP310393
Lot 101, on SP310393
SCL Trigger Map
Project site
7/A2g
SCL Map Unit / Soil Mapping Unit
GTenvironmental
1/B2s
2/A4
3/B1
4/A4c
5/B2g
8/B2s
7/A2g
10/B5
9/B1
6/B2bl
11/A5
12/B1
15/B1
13/B1
14/E1r
16/B3bl
17/E2

7 APPENDICES

Appendix A **GT Environmental (2020), Saraji East Coal Mine Project, Strategic Cropping Land Assessment**

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