



PROJECT CHINA STONE

Terrestrial Ecology

9

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9 TERRESTRIAL ECOLOGY

9.1 INTRODUCTION

This section provides a summary of the terrestrial ecology values present within the project site. A detailed Terrestrial Ecology Impact Assessment was undertaken by Cumberland Ecology and is presented in the *Terrestrial Ecology Report* (Appendix F). A summary of the aquatic ecology values within the project site are presented in Section 10 – Aquatic Ecology and a summary of stygofauna values are detailed in Section 12 – Groundwater.

This Environmental Impact Statement (EIS) section should be read in conjunction with Section 11 – Matters of National Environmental Significance, which addresses issues related to the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This section is restricted to assessing State terrestrial ecology values.

9.2 OVERVIEW OF THE PROJECT SITE

The project site is remote and comprises approximately 20,000 ha of well vegetated land. The entire project site contains remnant vegetation comprising Eucalyptus and Acacia open woodland. The project site is currently used for cattle grazing.

The south-eastern part of the project site is characterised by flat to undulating plains with sandy loam soils that support large expanses of savannah woodlands. These plains graduate to elevated sandstone ranges to the north and west of the project site, which support low Eucalyptus woodlands and shrublands. Darkies Range, a densely vegetated ridgeline, runs north to south through the western portion of the site (Figure 9-1).

The project site is located in the headwaters of North and Tomahawk Creeks and drains eastwards from Darkies Range. Drainage lines within the project site are highly ephemeral. The site does not contain any watercourses as defined under the Queensland *Water Act 2000* (Water Act). The project site itself is relatively dry and surface water sources are ephemeral and limited to two seasonal wetlands and two artificial farm dams. These aquatic habitat features are discussed in Section 10 – Aquatic Ecology.

The proposed Carmichael Coal Mine site is located immediately adjacent and to the south of the project site (Figure 9-1).

9.3 OVERVIEW OF REGULATORY REQUIREMENTS

9.3.1 Vegetation Management Act

The *Vegetation Management Act 1999* (VM Act) is administered by the Department of Natural Resources and Mines (DNRM). The VM Act, in conjunction with the *Sustainable Planning Act 2009*, regulates the clearing of native vegetation in Queensland.

The VM Act does not apply to mining activities undertaken on mining leases (MLs), however, it is relevant to the terrestrial ecology assessment because it classifies remnant vegetation into Regional Ecosystems (REs) which form the basis of the assessment of vegetation communities. REs are defined by Sattler and Williams (1999) as vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil. Remnant vegetation is referred to under the VM Act as vegetation where the dominant canopy has >70% of the height and >50% of the cover, relative to the height and canopy cover of the pristine (undisturbed) vegetation community. The Queensland Government produces RE maps illustrating the distribution

of REs throughout Queensland. REs are assigned one of the following three conservation status categories (Sattler and Williams 1999): endangered; of concern; or least concern.

The Queensland Government also assigns a biodiversity status to each RE, in addition to the status under the VM Act. The biodiversity status has no formal regulatory meaning under the VM Act but is used for a variety of planning and management applications.

9.3.2 Nature Conservation Act

The *Nature Conservation Act 1992* (NC Act) is the principal legislation which establishes a framework for the identification, gazettal and management of protected areas (such as National Parks) and the protection of native flora and fauna (protected wildlife) listed under the *Nature Conservation (Wildlife) Regulation 2006* (NC Regulation). The NC Act is administered by the Department of Environment and Heritage Protection (EHP).

The NC Act also classifies native flora and fauna species into specific categories including extinct in the wild, endangered, vulnerable, near threatened and least concern in recognition of how threatened they are and what action needs to be taken to protect them.

The proponent will need to comply with the NC Act, particularly in regard to obtaining the following approvals for the project:

- Where the mining activities may cause disturbance to animal breeding places, the proponent must prepare a Species Management Program under section 332 of the Queensland *Nature Conservation (Wildlife Management) Regulation 2006* (NC WM Regulation) and obtain approval from the EHP;
- Any Spotter Catcher employed by the project must be in possession of a rehabilitation permit (spotter catcher endorsement) for managing fauna during clearing activities (section 207 of NC WM Regulation); and
- If it is necessary to remove animals posing a threat to human health or property, a damage mitigation permit under section 181 of the NC WM Regulation will be required.

The project site does not contain any endangered, vulnerable or near threatened (EVNT) plants that are protected under the NC Act. As such, it is not expected that a protected plant clearing permit would be required to be obtained. There are no protected areas that have been proclaimed under the NC Act or *Marine Parks Act 2004*, or are under consideration for proclamation, on the project site.

9.3.3 Land Protection (Pest and Stock Route Management) Act

The *Land Protection (Pest and Stock Route Management) Act 2002* (LP Act) provides a framework for the control of declared pests. Schedule 2 of the *Land Protection (Pest and Stock Route Management) Regulation 2003* lists three classes of declared pests (1, 2 and 3). The LP Act operates in conjunction with the *Plant Protection Act 1989*, which provides for the control and eradication of pest plants, invertebrate animals, fungi, viruses and diseases that are harmful to crop plants in Queensland. The LP Act is administered by the Department of Agriculture and Fisheries.

The LP Act requires landowners to take reasonable measures to keep their land free of declared plants and animals with different levels of control required for the three different classes of pest described under the LP Act. Weed control is discussed in Section 9.7.3.

9.3.4 Government Mapping

Map of Referrable Wetlands

EHP has prepared a map of referable wetlands that includes:

- Wetland Protection Areas (WPAs), which comprise:
 - Wetlands of High Ecological Significance located within Great Barrier Reef catchments (termed HES wetlands); and
 - Trigger areas that represent the area of hydrological influence of HES wetlands. Outside urban areas, the trigger area is 500 m from the edge of a HES wetland.
- Wetlands of General Ecological Significance (GES wetlands).

WPAs are considered to be Matters of State Environmental Significance (MSES) under the Queensland Environmental Offsets Framework (Section 9.3.5).

Vegetation Management Wetlands Map

The Queensland Government has produced a vegetation management wetlands map that shows wetlands, as defined under the VM Act. It is used primarily to regulate vegetation clearing in areas mapped as wetlands. Remnant vegetation that intersects an area shown as a wetland on the vegetation management wetlands map is considered to be an MSES.

Vegetation Management Watercourse Map

The Queensland Government has produced a vegetation management watercourse map that shows watercourses, as defined under the VM Act. It is used primarily to regulate vegetation clearing in proximity of watercourses. The map is produced based on desktop information and includes stream order mapping under the Strahler method (DNRM 2014). It should be noted that the definition of a watercourse under the VM Act is different to the definition under the Water Act. The project site contains no watercourses under the Water Act, but contains watercourses as per the vegetation management watercourses map. Remnant vegetation located within a defined distance of watercourses shown on the vegetation management watercourse map is considered to be an MSES.

Groundwater Dependent Ecosystem Mapping

The Commonwealth Bureau of Meteorology (BoM) has produced a Groundwater Dependent Ecosystem (GDE) Atlas, which provides ecological and hydrogeological information on known GDEs and ecosystems that could potentially use groundwater. The GDE Atlas collates information from a number of sources into a central database, including published research and interpreted remote sensing data. The GDE Atlas identifies areas that may warrant further investigation for the presence of GDEs, but does not provide a confirmed map of GDEs.

Queensland Wetland Data Springs Mapping

The Queensland Government has prepared maps of Queensland, which show the location of springs. These springs are dependent on the surface expression of groundwater and their locations are used to infer the location of potential GDEs.

Queensland Essential Habitat Mapping

Essential habitat is mapped by the EHP and is vegetation in which species that are endangered, vulnerable or near threatened have been known to occur. Areas of essential habitat are considered to be MSES.

9.3.5 Environmental Offsets Framework

The Queensland Government recently passed the *Environmental Offsets Act 2014* (EO Act) along with the *Environmental Offsets Regulation 2014* (EO Regulation). The *Queensland Environmental Offsets Policy* (QEOP) (EHP 2014) came into force on 1 July 2014 and was subsequently updated on 19 December 2014. The EO Act, EO Regulation and QEOP comprise the Queensland Environmental Offsets Framework. According to this framework, it is necessary to provide offsets for any significant, residual impacts on MSES. MSES are defined under Schedule 2 of the EO Regulation as:

- Regulated vegetation including:
 - Endangered or of concern REs;
 - REs that intersect wetlands shown on the vegetation management wetlands map;
 - Essential habitat as shown on the essential habitat map; and
 - REs that are within a defined distance from the banks of a watercourse as shown on the vegetation management watercourse map.
- Connectivity areas that contain remnant vegetation;
- Wetlands and watercourses including:
 - Wetlands in WPAs or HES wetlands; and
 - A wetland or watercourse in high ecological value waters.
- A designated precinct in a strategic environmental area;
- Protected wildlife habitats including:
 - High risk areas on the flora survey trigger maps that contain endangered or vulnerable plants;
 - Areas that contain endangered or vulnerable plants that are not shown as high risk areas on the flora survey trigger map;
 - Non-juvenile koala habitat trees in areas within the South East Queensland Koala Conservation State Planning Regulatory Provisions;
 - Habitat for an animal that is endangered or vulnerable or the following special least concern species: Koala, Short-beaked Echidna and Platypus.
- Protected areas (such as National Parks);
- Highly protected zones of State marine parks;
- Fish habitat areas;
- Waterways providing for fish passage;
- Marine plants; and
- Legally secured offset areas.

Offsets are only required in the event of significant, residual impacts being predicted. The EHP published a guideline to further define a significant residual impact for individual MSES in December 2014. This guideline was used in the assessment of whether the project would have a significant residual impact on any MSES. The offset requirements for the project are discussed in Section 9.8.

The QEOP has identified Strategic Offset Investment Corridors which are areas where land may be suitable for management activities that provide a benefit to environmental matters likely to be impacted by development. The Galilee Basin is the first Strategic Offset Investment Corridor to be mapped. The areas within the Galilee Basin that have been mapped are presented in the *Galilee Basin Offset Strategy* (EHP 2013).

9.4 METHODOLOGY

9.4.1 Desktop Assessment

Desktop terrestrial flora and fauna studies were undertaken prior to the field surveys. They were conducted to obtain background information on the potential presence and distribution of species and ecological communities (particularly threatened communities and species). The desktop studies also provided information on topography and potential habitat values. The desktop studies involved database searches, review of environmental assessments prepared for the nearby Carmichael Coal Mine and Rail Project (CCM&RP), interpretation of recent high resolution aerial photography and review of the published government mapping.

9.4.2 Field Surveys

Terrestrial flora and fauna field surveys were undertaken over 36 days across three survey periods: between 16 May and 25 May 2012, between 22 October and 9 November 2012, and between 14 October and 20 October 2013. Above average rainfall was experienced in 2012, especially prior to the May 2012 survey.

The information from the desktop studies was used to refine the field survey methodology in order to target a wide range of vegetation communities and terrestrial flora and fauna species, including listed species and communities. Once the field surveys were complete, the likelihood of VM Act, NC Act and EPBC Act listed communities and species being present on the site was assessed. The assessment was based on consideration of whether each vegetation community/species was detected during field surveys, the availability and condition of potential habitat within the project site, and the species' habitat requirements and ecology. The following four categories were used to classify the likelihood a species being present: present; high; moderate; or low.

The presence and extent of any pest plant and animal species (as listed under the LP Act) were also recorded.

9.4.3 Terrestrial Flora

Colour aerial imagery of the project site, together with published RE mapping was reviewed. Extensive traverses of the project site were then undertaken to confirm vegetation mapping and to record flora species.

The secondary and quaternary survey methodology of the Queensland Herbarium (Neldner *et al.* 2012) was used for recording an appropriate level of data to determine whether the vegetation satisfied remnant vegetation criteria, and to which RE it could be most accurately assigned. Flora sampling was undertaken at 77 secondary quadrats, and the validation and mapping of remnant vegetation was undertaken at a total of 676 quaternary sites, conducted from the ground (either from a vehicle or on foot) and also from the air using a helicopter. Multiple sites were conducted within each RE type.

In addition, random meander searches were conducted in the vicinity of each of the secondary quadrat sites and at other flora search areas, which were sites of botanical interest. The terrestrial flora survey locations are shown on Figure 9-2.

9.4.4 Terrestrial Fauna

Terrestrial fauna surveys were undertaken in accordance with the *Terrestrial Vertebrate Fauna Survey Assessment Guidelines for Queensland* (Eyre 2012) at 15 generic fauna sites (each site being 100 x 100 m).

A large variety of faunal survey methods were used at each generic fauna survey site, as well as at a number of additional sites. Faunal survey methods included the use of systematic trap sites, infrared camera traps, hair tubes, spotlighting, callback and active searching, supplementary survey sites (including at remnant pools), Anabat survey sites and observation (e.g. bird surveys, reptile and amphibian surveys and opportunistic observations). The survey comprised 2,040 trap nights, 116 infrared camera trap nights (including 40 trap nights at waterholes), 480 hair tube trap nights, 15 person hours of spotlighting, 15 person hours of call playback, 37 person hours of bird surveys, 44 person hours of active searches for amphibians and reptiles and 68 nights of ultrasonic bat recording.

The terrestrial fauna survey locations are shown on Figure 9-3.

9.4.5 Habitat Mapping

For the purposes of impact assessment, habitat modelling and mapping was undertaken for threatened species that are known, or assessed as having a high or moderate potential to occur in the project site. Habitat mapping involved the identification and consideration of species-specific habitat criteria to create a model that enabled mapping of high and low value habitat for threatened fauna species. This included consideration of the existing quality of habitat. The habitat mapping methodology for each species is described in detail in the *Terrestrial Ecology Report* (Appendix F).

9.5 RESULTS

9.5.1 Broad Vegetation and Habitat Values

The vegetation and biodiversity patterns in the project site are strongly influenced by the different landforms that are present. The project site contains three broad habitat types, namely:

- Sandplains and savannah woodlands;
- Elevated sandstone ranges, plateau margins, talus slopes and ironstone jump-ups; and
- Riparian environments.

These are shown on Figure 9-4 and discussed in more detail in the following section.

There is very limited surface water in the project site and no shallow groundwater. The availability of water is a limiting factor for a number of fauna species.

The south-eastern part of the project site is characterised by sandplains and savannah woodlands (Figure 9-4). These areas contain a diversity of grasses for granivorous species and taller Eucalyptus trees for larger animals. The seasonal wetland and artificial farm dam in the central part of the project site provide an important water source for granivorous species and for predatory species dependent on amphibians.

The elevated sandstone ranges, plateau margins, talus slopes and ironstone jump-ups occur in the western portion of the project site (Figure 9-4). These areas support very little vegetation as much of the soil profile has been eroded. The vegetation that does occur is similar to that in the low woodlands. The upland areas provide high quality habitat for nectarivorous birds due to abundant flowering shrubs such as *Grevillea* spp. The rocky outcrops, rock slabs and crevices also provide habitat for reptiles and microbats. There are a number of small remnant pools in the ephemeral drainage lines that can persist into the dry season (although, being dependent on surface water, the pools will dry out during the extended dry season). These small remnant pools, when present, are considered to provide important refuge habitat. The seasonal wetland and farm dam in the north of the project

site also provide a water source for birds, although the seasonal wetland generally only contains water in the wet season. Tree hollows are scarce in the uplands, and this is likely to limit the value of habitats in this area for arboreal mammals such as gliders and possums. A range of native grasses are present in the understorey which would provide an important food source for granivorous birds.

Riparian environments within the project site comprise vegetation along ephemeral drainage lines (riparian vegetation) and are characterised by a mosaic of tall woodland types (Figure 9-4). The *Groundwater Report* (Appendix I) has confirmed that there is no groundwater associated with these environments. The riparian vegetation associated with riparian environments form important habitats as they provide forage and shelter habitat in proximity to a water source, which is important for a range of species, especially birds that require this combination in order to breed successfully. The remnant pools that form in the ephemeral drainage lines are an important resource for fauna in the project site, in particular for birds such as finches that need to drink daily.

9.5.2 Vegetation Communities

Vegetation across the entire project site comprises remnant vegetation (Figure 9-5), with communities dominated by open Eucalyptus, *Corymbia* spp. and Acacia woodlands. A full list of remnant vegetation within the project site is contained in the *Terrestrial Ecology Report* (Appendix F).

One community listed as of concern under the VM Act is present within the project site, namely RE 10.10.3 *Eucalyptus drepanophylla* open-woodland on sandstone ranges. RE 10.10.3 occurs as a minor component of a number of mixed vegetation communities. A total of approximately 271 ha of RE 10.10.3 occurs within the project site.

No plant communities of cultural, commercial or recreational significance have been recorded on the project site.

The groundtruthed RE mapping was compared to the existing Queensland Government RE mapping. Although the mapping was not identical, the differences do not give rise to any implications for impact assessment. This is because the REs affected by the discrepancy in the mapping are all classified as least concern under the VM Act and have similar habitat values.

9.5.3 Flora Species

Overview

A total of 311 flora species were recorded within the project site during the three field surveys. This included 302 (97%) native species and nine (3%) exotic species representing 62 families and 172 genera. The dominant family groups include Poaceae, Fabaceae, Myrtaceae and Mimosaceae.

No plant species of commercial or recreational significance have been recorded on the project site.

The species richness of field validated vegetation communities was found to be lower than benchmark condition in most cases. This was probably a function of the moderately to markedly degraded nature of the groundcover layer in most communities. As such, the relative abundance of native grass and herbaceous species within these areas was markedly reduced.

Threatened Species

Desktop searches indicated that eight flora species listed as endangered or vulnerable under the NC Act potentially occur within the project site. The likelihood of these species being present was assessed in the *Terrestrial Ecology Report* (Appendix F) based on the known habitat preferences of these species, the availability and condition of habitats within the project site and results of the field survey. The assessment concluded that all eight flora species have a low likelihood of occurring within the project site.

Exotic Species

One of the nine exotic species recorded from the project site is a declared weed species listed under the LP Act, namely, *Parthenium hysterophorus*, which is listed as a Class 2 Declared Weed. No Class 1 or Class 3 Declared Weeds under the LP Act were recorded. The *Terrestrial Ecology Report* (Appendix F) contains a full list of the exotic species that were recorded during the field survey.

9.5.4 Fauna Species

Overview

A total of 190 fauna species (including 182 native species and eight introduced species) were recorded within the project site comprising eight amphibians (including seven native and one introduced species), 22 reptiles, 128 birds and 32 mammals (including 25 native species and seven introduced species).

Overall, the majority of the fauna recorded within the project site was listed as least concern under the NC Act and was typical of that occurring in the surrounding area. No poorly known fauna species were recorded within the project site. The fauna assemblage recorded within the project site is typical of the Desert Uplands Bioregion and the project site is not considered to be of particular importance for values such as high biodiversity, important feeding areas, high endemism, unusual fauna assemblages, or unique habitat types or assemblages. The project site does not represent a distributional limit for any fauna species.

Threatened and Special Least Concern Species

Desktop searches indicated that 10 fauna species listed under the NC Act potentially occur within the project site. The likelihood of these species being present was assessed in the *Terrestrial Ecology Report* (Appendix F) based on the known habitat preferences of these species, the availability and condition of habitats within the project site and results of the field surveys. The assessment concluded:

- The Squatter Pigeon (southern subspecies) (*Geophaps scripta scripta*) (vulnerable), Black-throated Finch (white-rumped subspecies) (*Poephila cincta cincta*) (endangered), Koala (*Phascolarctos cinereus*) (special least concern) and Short-beaked Echidna (*Tachyglossus aculeatus*) (special least concern) were confirmed to be present in the project site during field surveys;
- The Australian Painted Snipe (*Rostratula australis*) (vulnerable) was considered to have a moderate potential of occurring within the project site; and
- The remaining five species (of the 10 potentially present) have a low potential of occurring within the project site due to a lack of suitable habitat.

The Squatter Pigeon (southern subspecies) was recorded at several locations in the project site (Figure 9-6). It was commonly observed along tracks and many records were adjacent to the artificial farm dams or ephemeral drainage lines (Figure 9-6). High value habitat for this species is present in the northern portion of the project site and along remnant pools in the southern portion of the project site. A full description of suitable habitat for this species within the project site and maps showing high value habitat are provided in the *Terrestrial Ecology Report* (Appendix F).

The Black-throated Finch (white-rumped subspecies) was recorded from eight locations in the southern portion of the project site (Figure 9-6). This species was also recorded in the project site during field surveys undertaken as part of the EIS process for the CCM&RP. High value habitat for this species is present in the parts of the project site that contain remnant pools. A full description of suitable habitat for this species within the project site and maps showing high value habitat are provided in the *Terrestrial Ecology Report* (Appendix F).

One individual Koala was recorded within the project site during the first survey period in Red Gum (eucalypt) forest (Figure 9-6). High value habitat for this species is present along ephemeral drainage lines in the project site where primary food trees (i.e. River Red Gum [*Eucalyptus camaldensis*] and Forest Red Gum [*E. tereticornis*]) occur. A full description of suitable habitat for this species within the project site and maps showing high value habitat are provided in the *Terrestrial Ecology Report* (Appendix F).

The Short-beaked Echidna was recorded opportunistically in one location within Eucalyptus-dominated woodland in the southern portion of the project site during the October 2013 survey (Figure 9-6). High value habitat for this species is present in the southern portion of the project site where lower-lying flat grassy woodland areas occur and in the northern-central upland areas of the project site where similar habitats are present. A full description of suitable habitat for this species within the project site and maps showing high value habitat are provided in the *Terrestrial Ecology Report* (Appendix F).

In addition, the Common Death Adder (*Acanthophis antarcticus*), which is listed as Near Threatened under the NC Act, was recorded within the project site.

Feral and Declared Animals

Four Class 2 Declared Animals under the LP Act were recorded from the project site, including the Dingo (*Canis familiaris*), Feral Cat (*Felix cattus*), Feral Pig (*Sus scrofa*), and European Rabbit (*Oryctolagus cuniculus*). No Class 1 or Class 3 Declared Animals listed under the LP Act have been recorded in the project site. The *Terrestrial Ecology Report* (Appendix F) contains a full list of the feral animals that were recorded during the field survey.

9.5.5 Groundwater Dependent Ecosystems

The *Australian Groundwater Dependent Ecosystem Toolbox* (GDE Toolbox), prepared by the National Water Commission (2011), defines GDEs as

“Ecosystems that require access to groundwater to meet all or some of their water requirements so as to maintain the communities of plants and animals, ecological processes they support, and ecosystem services they provide”.

The potential for GDEs to be present within the project site was reviewed, with the review consisting of:

- A search of the Queensland Springs Database;
- A search of the BoM’s GDE Atlas; and
- Groundwater field investigations, as described in the *Groundwater Report* (Appendix I).

A search of the Queensland Springs Database indicated that no spring wetlands are located within the project site. The nearest springs are approximately 22 km south of the southern boundary of the project site (Figure 9-1). BoM’s GDE mapping shows that there are several potential GDEs in the project site.

Section 12 – Groundwater provides an overview of the regional hydrogeology and water-bearing strata within the project site. As indicated in Section 12 – Groundwater, there is no shallow groundwater within the project site. In the elevated Darkies Range ridgeline, groundwater is typically more than 100 m below ground level. In low lying areas, east of Darkies Range, the groundwater table is at least 25 m below ground level and disconnected from surface water features. Given this lack of shallow groundwater, BoM’s GDE mapping of the project site does not appear to be consistent with the hydrogeological setting of the project site. In addition, the vegetation survey did not identify any areas of vegetation that would appear to be dependent on groundwater. Consequently, it is concluded that there are no GDEs within the project site.

9.6 IMPACT ASSESSMENT

9.6.1 Overview

Project activities that have the potential to impact terrestrial flora and fauna species include:

- Vegetation clearing for the open cut mine and construction of mine infrastructure (Section 9.6.2).
- Subsidence resulting from underground mining, and the disturbance of vegetation as a result of:

- The subsidence crack rehabilitation program (Section 9.6.3); and
- Clearing associated with minor remedial drainage earthworks due to subsidence (Section 9.6.4).
- Indirect impacts such as the effects of noise and vibration, vehicle strikes, lighting, dust, erosion and the introduction of invasive species (Section 9.6.5).

These impacts are described in the remainder of this section and mitigation measures for these impacts are provided in Section 9.7. The impacts described are considered to be known and predictable. Impacts that are considered to be irreversible are proposed to be offset and are discussed in Section 9.8.

9.6.2 Direct Vegetation Clearing

Overview

Figure 9-7 shows the clearing footprint for the proposed open cut mine and mine infrastructure area. A number of options for the location of the open cut mine and mine infrastructure were considered, but it was not possible to design a layout that avoided significant vegetation clearing because of the numerous technical and environmental constraints on the project design. Further detail on the consideration of project layout alternatives is provided in Section 9.7.1.

A total of 10,998 ha of remnant vegetation will be progressively removed over the mine life to allow for open cut mining and the construction of mine infrastructure. Vegetation to be cleared comprises mostly least concern REs (10,974 ha) with 24 ha of of concern RE 10.10.3 proposed to be removed. Impacts on the of concern RE are described in Section 9.6.6.

Vegetation clearing will be undertaken in accordance with the controls described in Section 9.7.3 to ensure that the clearing is undertaken in a manner that limits the disturbance to the minimum area possible.

Vegetation clearing is a long-term residual impact and offsets are proposed for the related significant impacts on biodiversity. However, progressive rehabilitation of the overburden emplacement areas will occur over the life of the open cut mine. At the cessation of all mining activities, rehabilitation of the open cut and underground mining areas, and the TSF will be completed. Mine infrastructure areas will also be decommissioned and rehabilitated. Rehabilitation activities are described in Section 8 – Rehabilitation and include planting of native trees and shrubs in disturbed areas to establish a self-sustaining native bushland. As revegetation establishes, rehabilitated areas will create suitable habitat for an increasing number of fauna species. At the time open cut mining activities cease, some of the overburden emplacement areas are expected to have been rehabilitated for more than 20 years and will likely be substantially revegetated. Progressive rehabilitation will assist to reduce the longevity of direct vegetation clearing impacts.

General Impacts of Vegetation Clearing on Fauna Species

Loss of Habitat Features

The largest direct impact of vegetation clearing would be the removal of habitat for a wide range of fauna species (Figure 9-7). Vegetation is in relatively good condition across the project site and provides habitat for a range of fauna, including some species that are listed under the NC Act. Within these vegetation communities, a range of habitat features provide foraging, shelter and breeding opportunities for fauna. Important fauna habitat features that may be removed by the project are:

- Dense understorey vegetation;
- Fallen logs, debris and leaf litter;
- Rocky outcrops;
- Hollow-bearing living trees and stags;
- Nectar-producing trees and shrubs;

- Food trees, shrubs and grasses for a range of species;
- Ecotonal (edge) communities;
- Ephemeral drainage lines; and
- Aquatic habitat provided by the southern seasonal wetland and southern farm dam.

Habitat Fragmentation

One of the impacts of the project on flora and fauna would be habitat fragmentation. Fragmentation is the process where habitats that were once continuous become divided into separate fragments isolated from each other by non-forest land. As shown on Figure 9-8, the project site is located within a large area of contiguous remnant vegetation. Areas of remnant vegetation extend significant distances to the north, south and west of the project site, and there is remnant vegetation some distance to the east. Clearing associated with open cut mining and the development of mine infrastructure could, therefore, be anticipated to potentially impact habitat connectivity. However, as the clearing of vegetation is only in the southern portion of the project site, full east to west connectivity will remain in the northern portion of the project site (Figure 9-8). In addition, areas beyond the clearing footprint are proposed to be managed to retain and enhance biodiversity values (Section 9.7). Progressive rehabilitation of areas disturbed by open cut mining will also be undertaken, which will serve to reduce the severity of the potential impact on habitat connectivity.

The potential impact on habitat connectivity has also been considered in relation to the cumulative impacts from the project and the CCM&RP, located adjacent to the project site. Figure 9-8 shows the proposed location of clearing associated with open cut mining and mine infrastructure development for the project and the CCM&RP. Key factors to be considered in assessing this impact are that the open cut mining/mine infrastructure footprints for these two projects are approximately 10 km apart, leaving a large corridor of remnant vegetation between the cleared areas. This will allow for continued movement and dispersal opportunities.

It is considered unlikely that the project will have a significant, residual impact on connectivity in the locality due to the high amount of remnant vegetation available in the landscape around the project site, and the fact that there will be staged rehabilitation of the mined area. In accordance with the EHP's 2014 *Significant Residual Impacts Guideline*, EHP's Landscape Fragmentation and Connectivity (LFC) Tool was used to assist in identifying and quantifying any significant impact as a result of the project on connectivity. EHP's LFC Tool determined that the project would not result in a significant residual impact on local or regional connectivity and, therefore, offsets for connectivity are not required for the project.

9.6.3 Subsidence Crack Rehabilitation

As described in Section 6 – Subsidence, subsidence may give rise to localised surface cracking due to tensile strain on the ground surface. Cracking occurs most commonly within a limited zone of residual tensile strain around the perimeter of each underlying longwall panel. The exact location of individual cracks can only be confirmed through monitoring, although the majority of the subsided surface area (within the Limit of Measurable Subsidence) will be unaffected by cracking. Figure 9-9 shows the remnant vegetation present within the Limit of Measurable Subsidence for the project. Residual tension cracks occur within a few weeks of an area being mined.

Subsidence cracking itself will not necessarily impact on vegetation communities. However, the rehabilitation of cracks needs to be carefully managed to avoid impacts on vegetation. The proposed rehabilitation program for subsidence cracking is described in detail in Section 8 – Rehabilitation. It involves monitoring areas potentially subject to subsidence cracking and repairing any individual cracks that develop. This targeted method of subsidence crack rehabilitation has been proposed in order to minimise disturbance of vegetation.

Section 8 – Rehabilitation describes the subsidence crack rehabilitation program and explains that monitoring will be undertaken to ensure that any disturbed vegetation regenerates. A Feral Animal and Weed Management Plan will be implemented for the project and will include areas that have been disturbed as part of the subsidence crack rehabilitation program.

The total area of vegetation to be disturbed by crack rehabilitation has been estimated to be approximately 50 ha over the life of the project. This disturbance will occur progressively over the life of the longwall mine (estimated as 47 years), with progressive rehabilitation occurring to ensure that there is no significant, residual impact. Revegetation of progressively rehabilitated areas is expected to become established within five years of rehabilitation.

The predicted disturbance to threatened vegetation communities and threatened fauna habitat as a result of the subsidence crack rehabilitation program is described in detail in the *Terrestrial Ecology Report* (Appendix F) and is summarised in Sections 9.6.6 and 9.6.8.

9.6.4 Drainage Changes Due to Subsidence

Subsidence troughs can alter surface drainage paths and lead to the ponding of water in localised shallow surface depressions. Subsidence ponding will be mitigated by the installation of minor remedial drainage earthworks to re-establish free drainage (Figure 9-9) (Section 13 – Surface Water provides further detail). With the installation of minor remedial drainage earthworks, and the re-instatement of free drainage, there will be no significant residual ponding caused by mine subsidence and consequently no impact on vegetation due to the ponding of water. The key potential impact on vegetation due to changes in drainage, therefore, relates to the clearing of vegetation for the construction of minor remedial drainage earthworks. However, the total area to be cleared is estimated to be only 12 ha, with the clearing occurring over a 47 year period. Revegetation of progressively rehabilitated areas is expected to become established within five years of rehabilitation.

The predicted disturbance to threatened vegetation communities and threatened fauna habitat due to the construction of drains is described in detail in the *Terrestrial Ecology Report* (Appendix F) and is summarised in Sections 9.6.6 and 9.6.8.

One seasonal wetland and farm dam, located in the north of the project site, may be impacted as a result of subsidence. These areas will be specifically managed as part of the subsidence management process to ensure that the installation of minor remedial drainage earthworks does not lead to hydrological changes that would impact on the ecological functioning of these areas. Potential impacts on the seasonal wetland and farm dam due to subsidence are described further in Section 10 – Aquatic Ecology and the *Aquatic Ecology and Stygofauna Report* (Appendix G).

9.6.5 Indirect Impacts

Indirect impacts will potentially occur over the 50 year mine life and are discussed in the following sections.

Noise, Vibration and Lighting

Noise, vibration and lighting emissions are not expected to give rise to significant impacts on fauna and any impact would be limited to the immediate vicinity of the infrastructure. This issue is discussed further in the *Terrestrial Ecology Report* (Appendix F).

Vehicle Strike

The project will result in the construction of additional roads and tracks which means an increased length of road for animals to cross and navigate, as well as a significant increase in the number of vehicles operating in the project site. These changes will increase the likelihood of vehicle strikes on native fauna, with an associated increase in mortality. However, although some mortality of animals as a result of vehicle strike is likely, it is not expected to be significant. Speed limits along internal roads, appropriate signage and careful driving policies will increase the awareness of drivers and decrease the risk of vehicles striking fauna. The risk of vehicle strike will diminish following rehabilitation of the mined area and cessation of mining. This issue is discussed further in the *Terrestrial Ecology Report* (Appendix F).

Dust

Dust pollution can lead to a decrease in habitat quality which has the potential to extend the area of impact beyond the area directly disturbed by the mine. Predicted dust emissions from the project are described in Section 15 – Air Quality. In the context of the scale of the project, dust is not considered likely to cause a significant impact on the ecological values of the project site. This issue is discussed further in the *Terrestrial Ecology Report* (Appendix F).

Erosion and Sedimentation

The project has the potential to increase the amount of erosion occurring in the project site through the clearing of vegetation and construction of roads, tracks, and infrastructure. Erosion and sediment controls will be established to minimise the amount of erosion and consequent impacts of the project. These controls will be described in an Erosion and Sediment Control Plan. With the implementation of appropriate measures, it is unlikely that erosion will significantly affect the ecology of the project site. This issue is discussed further in the *Terrestrial Ecology Report* (Appendix F).

Feral Animals and Weeds

Alterations to habitat conditions often favour introduced and/or hardy native plant and animal species that can proliferate in disturbed conditions. A Feral Animal and Weed Management Plan (Section 9.7) will be prepared to mitigate the potential impacts of weeds and feral animals. It will include measures to prevent the introduction of domestic animals to the area. This will include provision for the implementation of appropriate control measures including monitoring and population reduction. With the implementation of these measures, it is unlikely that feral animals or weeds will have a large impact on the ecology of the project site. This issue is discussed further in the *Terrestrial Ecology Report* (Appendix F).

9.6.6 Impacts on Threatened Vegetation Communities

Threatened Vegetation Communities

The majority of vegetation to be cleared as a result of the project is listed as least concern under the VM Act (Figure 9-9). However, one RE that is listed as of concern under the VM Act, and therefore defined as MSES under the EO Regulation, would be removed by the project, namely RE 10.10.3: *Eucalyptus drepanophylla* open woodland on sandstone ranges. Potential impacts to RE 10.10.3 as a result of the project are outlined in Table 9-1.

Table 9-1 Proposed Clearing of Threatened REs

RE	VM ACT STATUS	AREA IN THE PROJECT SITE (ha)	AREA CLEARED – MINING AND INFRASTRUCTURE (ha)	AREA CLEARED - REMEDIAL DRAINS (ha)	AREA DISTURBED BY SUBSIDENCE CRACK REHABILITATION (ha)
10.10.3	Of Concern	270	24	0	2

A total of 270 ha of RE 10.10.3 occurs in the project site, and 24 ha occurs in the clearing footprint and will be removed by the project (i.e. approximately 9% of the total RE in the project site would be removed) (Table 9-1). In addition, approximately 2 ha would be disturbed due to subsidence crack rehabilitation. This vegetation would be progressively rehabilitated, ensuring that there is no residual impact due to subsidence crack rehabilitation. The area to be cleared is a very small proportion of this vegetation within the project site, and the vast majority of the vegetation would be retained. In accordance with the EHP's (2014) *Significant Residual Impacts Guideline*, the project may have a significant, residual impact on RE 10.10.3. This is discussed further in Section 9.8.

Vegetation Communities along Watercourses

The EHP's Vegetation Management Watercourse Map has been overlaid on the RE mapping to determine the areas of riparian vegetation that are classified as MSES. Vegetation located within 25 m of a stream order 1 and 2, 50 m of a stream order 3 and 4 or 100 m of a stream order 5 or greater, is classified as a MSES. The REs and

areas that are classified as a MSES in accordance with the QEOP are outlined in the *Terrestrial Ecology Report* (Appendix F). A total of 359 ha of very sparse to sparse vegetation is proposed to be cleared for open cut mining and the construction of mine infrastructure.

The loss of riparian vegetation will impact on native species through the removal of habitat. Due to the presence of water (even seasonally), riparian vegetation is often denser and has a greater species richness than adjacent areas. Accordingly, riparian vegetation provides higher quality habitat for fauna. This habitat may provide refuge in times of drought, and shelter for fauna utilising watercourses to drink.

Offsets are required for any significant, residual impacts on the REs along watercourses classified as MSES. In accordance with the EHP's (2014) *Significant Residual Impacts Guideline*, offsets are required if more than 2 ha sparse vegetation is cleared (Table 1 of EHP 2014). All of the vegetation within the project site has been classified as either sparse or very sparse. Approximately 14 ha of sparse and 345 ha of very sparse vegetation will be cleared for the project. In accordance with the QEOP, the removal of this vegetation for the project will have a significant residual impact and will require offsets under the EO Regulation. Offsets required for the project are described in more detail in Section 9.8.

9.6.7 Impacts on Threatened Flora Species

As discussed in Section 9.5.4, no threatened flora species listed under the NC Act were recorded or are considered likely to occur within the project site. Therefore, no threatened flora species listed under the NC Act will be impacted as a result of the project.

9.6.8 Impacts on Threatened Fauna Species

The fauna species listed under the NC Act that were either recorded on the project site or assessed as having a high or moderate likelihood of occurrence are listed in Section 9.5.5. Impacts on these species are outlined in Table 9-2. Maps showing project disturbance relative to high value habitat for each species are provided in Figures 9-10 to 9-14.

Table 9-2 Proposed Clearing of High Value Habitat for Threatened/Special Least Concern Fauna Species

FAUNA SPECIES	NC ACT STATUS	AREA IN THE PROJECT SITE (ha)	AREA CLEARED – MINING AND INFRASTRUCTURE (ha)	AREA CLEARED - REMEDIAL DRAINS (ha)	AREA DISTURBED BY SUBSIDENCE CRACK REHABILITATION (ha)	AREA UNDISTURBED IN THE PROJECT SITE (%)
Squatter Pigeon (southern subspecies)	V	3,440	1,436	3	8	58
Black-throated Finch (white-rumped subspecies)	E	7,066	4,434	9	10	37
Australian Painted Snipe	V	135	12	3	0.03	89
Koala	SLC	6,878	3,246	0.4	21	52
Short-beaked Echidna	SLC	16,226	10,880	12	24	33

Threatened and/or special least concern species status under the NC Act (current at 28 October 2014).

V = Vulnerable; E = Endangered; SLC = Special Least Concern

Impacts on the species listed in Table 9-2 are as follows:

- Approximately 1,436 ha of high value habitat for the Squatter Pigeon (southern subspecies) would be cleared for open cut mining and the construction of mine infrastructure and 3 ha of high value habitat would be cleared for the construction of remedial drains (Figure 9-10). In addition, approximately 8 ha would be disturbed due to subsidence crack rehabilitation. This vegetation would be progressively rehabilitated, ensuring that there is no residual impact due to subsidence crack rehabilitation. The Squatter Pigeon (southern subspecies) is also listed under the EPBC Act and an assessment of significance has been conducted for this species according to the EPBC Act *Significant Impact Guidelines* (DotE 2013) for vulnerable species (refer to Section 11 – Matters of National Environmental Significance). This assessment indicates that the project has the potential to give rise to a significant impact on the Squatter Pigeon (southern subspecies). This is primarily due to the clearance of large areas of high value habitat for this species. It will, therefore, be necessary to provide offsets for this impact.
- Approximately 4,434 ha of high value habitat for the Black-throated Finch (white-rumped subspecies) would be cleared for open cut mining and the construction of mine infrastructure and 9 ha of high value habitat would be cleared for the construction of remedial drains (Figure 9-11). In addition, approximately 10 ha would be disturbed due to subsidence crack rehabilitation. This vegetation would be progressively rehabilitated, ensuring that there is no residual impact due to subsidence crack rehabilitation. The Black-throated Finch (white-rumped subspecies) is also listed under the EPBC Act and an assessment of significance has been conducted for this species according to the EPBC Act *Significant Impact Guidelines* (DotE 2013) for endangered species (refer to Section 11 – Matters of National Environmental Significance). This assessment indicates that the project has the potential to give rise to a significant impact on the Black-throated Finch (white-rumped subspecies). This is primarily due to the clearance of large areas of high value habitat for this species. It will, therefore, be necessary to provide offsets for this impact.

- Approximately 12 ha of high value habitat for the Australian Painted Snipe would be cleared for open cut mining and the construction of mine infrastructure and 3 ha of high value habitat would be cleared for the construction of remedial drains (Figure 9-12). In addition, approximately 0.03 ha would be disturbed due to subsidence crack rehabilitation. This vegetation would be progressively rehabilitated, ensuring that there is no residual impact due to subsidence crack rehabilitation. The Australian Painted Snipe is also listed under the EPBC Act and an assessment of significance has been conducted for this species according to the EPBC Act *Significant Impact Guidelines* (DotE 2013) (refer to Section 11 – Matters of National Environmental Significance). This assessment indicates that due to the small area of impact, the seasonal nature of the wetlands present in the project site and the large areas of suitable habitat that will remain nearby, no significant impact is likely to occur to the Australian Painted Snipe as a result of the project.
- Approximately 3,246 ha of high value habitat for the Koala would be cleared for open cut mining and the construction of mine infrastructure and 0.4 ha of high value habitat would be cleared for the construction of remedial drains (Figure 9-13). In addition, approximately 21 ha would be disturbed due to subsidence crack rehabilitation. This vegetation would be progressively rehabilitated, ensuring that there is no residual impact due to subsidence crack rehabilitation. The Koala is also listed under the EPBC Act and an assessment of significance has been conducted for this species according to the EPBC Act *Significant Impact Guidelines* (DotE 2013) for vulnerable species (refer to Section 11 – Matters of National Environmental Significance). This assessment indicates that the project has the potential to give rise to a significant impact on the Koala. This is primarily due to the clearance of large areas of high value habitat for this species. It will, therefore, be necessary to provide offsets (under the EPBC Act – refer to Section 11 – Matters of National Environmental Significance) for this impact.
- Approximately 10,880 ha of high value habitat for the Short-beaked Echidna would be cleared for open cut mining and the construction of mine infrastructure and 12 ha of high value habitat would be cleared for the construction of remedial drains (Figure 9-14). In addition, approximately 24 ha would be disturbed due to subsidence crack rehabilitation. This vegetation would be progressively rehabilitated, ensuring that there is no residual impact due to subsidence crack rehabilitation. It has been assessed that the project is unlikely to have a significant residual impact on this species due to its broad habitat requirements and widespread areas of potential breeding and foraging habitat that will remain outside the project disturbance boundary. It is also likely that rehabilitation of the project site will restore some habitat of the species in the longer term.

9.7 IMPACT MITIGATION

9.7.1 Measures to Avoid Impacts

Alternative project layouts were considered during the project planning phase to seek to avoid and/or minimise clearing required for the project. However, the opportunities for alternative layouts are constrained by the location of the coal resources and the area available for the construction of infrastructure on the project site. The location of the open cut mine is determined by the shallower target coal seams. The location of the underground mining areas are determined by the location of the target coal seams, and are designed to maximise resource utilisation. The proponent does not own any land beyond the boundary of the proposed ML and therefore does not have an option to locate any of the mine site infrastructure beyond the ML. The eastern portion of the project site is the only suitable and sufficient area available for the construction of the mine infrastructure.

In order to enable management of drainage through the project site and to minimise the impact of the project on downstream drainage, the design of the mine infrastructure area includes drainage corridors at the northern and southern ends with capacity to convey drainage through the site. The northern corridor has been designed to avoid disturbance of a drainage line traversing the north-eastern corner of the site. The establishment of these drainage corridors also avoids disturbance of the remnant vegetation and high value fauna habitat in these areas, as shown in Figure 9-15.

The entire project site is well vegetated with remnant vegetation and hence there is no alternative project layout that would avoid clearing remnant vegetation. Table 9-2 shows a considerable percentage of high value habitat for

species listed under the NC Act that will remain undisturbed on the project site. However, high value habitat for these species is located within the proposed open cut mining and mine infrastructure areas. Avoidance of any additional areas of habitat for these species is not possible without sterilising open cut mine reserves and/or eliminating mine infrastructure from the project site and hence making the project unviable. Biodiversity offsets are proposed to offset these unavoidable impacts.

Vegetation and fauna habitat within the northern section of the project site will be largely unaffected by the project. Disturbance in this area will be limited to relatively minor impacts due to the rehabilitation of subsidence effects. Appropriate management and monitoring is proposed for these minor impacts.

9.7.2 Measures to Mitigate Impacts

The following impact mitigation measures will be implemented to mitigate the direct and indirect impacts of the construction and operation of the project.

Minimising Vegetation and Habitat Loss

In order to minimise clearing impacts and unnecessary disturbance to native vegetation, the following procedures will be implemented:

- The limits of clearing will be delineated prior to the commencement of any clearing and marked clearly on plans and on the ground;
- Vegetation beyond the identified clearing areas will not be disturbed; and
- Vegetation clearing will be undertaken sequentially and in accordance with the proponent's Permit to Disturb process. This will restrict the area of vegetation to be cleared to that required for the safe construction and operation of facilities.

Pre-clearing Surveys

Pre-clearing surveys will be undertaken ahead of clearing, to limit fauna injury and mortality and to identify habitat features to be relocated. Pre-clearing protocols will include:

- Preparation of an inventory of trees and hollows to be removed and relocated, prior to clearing;
- Checking hollow-bearing trees for the presence of bird nests and arboreal mammals, such as possums, gliders and bats, prior to felling;
- Animals found to be occupying trees and habitat will be safely removed before the clearing of trees and relocated into nearby woodlands;
- Salvaged tree hollows will be provided in nearby woodland to compensate for the hollows to be removed due to vegetation clearance; and
- Boulders and large logs will be placed in nearby areas of retained vegetation to allow their continued use as fauna habitat.

A Spotter Catcher, in possession of relevant permits under the NC Act, will be on hand to supervise clearing and to rescue any animals still remaining in the clearing area following the pre-clearing surveys. The Spotter Catcher will handle any animals injured during the process and will determine whether veterinary help is needed. If appropriate, animals will be taken to the nearest veterinary surgeon for treatment. However, if the injuries are too severe, the Spotter Catcher will humanely euthanize any injured animal according to the appropriate protocols.

Vegetation Conservation and Management

In order to maximise the conservation of biodiversity and to mitigate the impacts of the project, as much existing vegetation as possible will be retained in the project site. Areas of native vegetation in the project site, outside of the footprint of the open cut mining area and the mine infrastructure area, will be managed to conserve and enhance their conservation value. The following measures will be implemented to retain and enhance the habitat values of the project site:

- Measures to manage weeds and feral animals in accordance with a Feral Animal and Weed Management Plan;
- Inclusion of logs, dead trees, stumps and hollows in strategic locations to enhance fauna habitat;
- Management of grazing pressure in the project site;
- Implementation of a Fire Management Plan, designed to enhance biodiversity values (whilst also ensuring that risks to human safety and property due to bushfire are managed); and
- Provision of fauna watering points.

A key limiting factor for native species habitat in the project site is the lack of permanent water. This is especially true for some of the threatened seed eating bird species including the Black-throated Finch (white-rumped subspecies) and the Squatter Pigeon (southern subspecies) that must drink every day. During the wet season, water is usually abundant; however during the dry season, the ephemeral drainage lines dry out and few are deep enough to hold water throughout the dry season. High value habitat for the Black-throated Finch (white-rumped subspecies) and the Squatter Pigeon (southern subspecies) is delineated in relation to distance from a permanent water source. During the dry season, due to the lack of water in the landscape, areas of suitable habitat are reduced. One way to extend the areas of high value habitat for these species is to provide a network of water sources in areas that currently do not contain water in the dry season. These water sources will include cattle troughs, and areas of aquatic habitat created through excavating pools to provide a deeper reservoir of water. Such watering points will be fenced to prevent access by cattle. Areas of aquatic habitat will be designed to have:

- A deep section that provides a suitable reservoir of water that will persist into the dry season;
- A large, shallow area that is inundated during the wet season;
- Presence of a diversity of fringing vegetation such as sedges, rushes and reeds; and
- Canopy tree species nearby.

Creating watering points with these habitat features is considered to be achievable, given that these values are all present in the southern farm dam, an artificial structure.

Rehabilitation of Subsidence Cracking

Rehabilitation of subsidence cracking will be undertaken in accordance with the method described in Section 8 – Rehabilitation. This method has been designed to limit disturbance of vegetation and ensure that any areas disturbed as part of the subsidence crack rehabilitation program re-establish vegetation communities consistent with the pre-disturbance vegetation communities.

Effectiveness of Mitigation Measures

The proposed mitigation measures and rehabilitation methods are established measures that have been used successfully for many years at other operating coal mines in Central Queensland. Monitoring is proposed to confirm the effectiveness of the proposed mitigation measures on the site. Any areas identified to not be achieving their stated objectives would trigger corrective action and amendments of procedures, where relevant.

9.7.3 Management and Monitoring Plans

Biodiversity Management Plan

A Biodiversity Management Plan will be prepared for the project. It will include measures to conserve and enhance the conservation value of areas of native vegetation that will be retained in the project site (i.e. areas outside of the footprint of open cut mining and infrastructure). Measures that will be detailed in the plan include:

- Installation of logs, dead trees, stumps and hollows in strategic locations, in order to enhance habitat values;
- Management of grazing pressure in the project site;
- A Fire Management Plan; and
- Prescriptions for the installation of fauna watering points (as described in Section 9.7.2).

Measures to manage weeds and feral animals will be outlined in the Feral Animal and Weed Management Plan.

The Biodiversity Management Plan will also include prescriptions to monitor the ongoing status and health of flora and fauna that is to be retained in the project site, including through both vegetation monitoring and threatened species monitoring. This monitoring will provide data to determine the level of success of the mitigation measures. Key monitoring indicators and a framework for reporting on the results of the monitoring will be included in the Biodiversity Management Plan.

Vegetation Monitoring

The vegetation monitoring program would provide information to quantify any change in biodiversity over time within the project site. Key monitoring indicators for vegetation will include:

- Cover and structure of perennial terrestrial vegetation;
- Composition of perennial terrestrial vegetation; and
- Distribution and abundance of invasive weeds.

Appropriate data management procedures will be implemented to ensure that all data is collected using appropriate techniques and suitably analysed to allow meaningful spatial and temporal comparisons to be made.

Threatened Species Monitoring

Monitoring will also be undertaken on selected species of threatened flora and fauna, in order to confirm the effectiveness of proposed management measures in areas of vegetation that will be retained. Species that will be the subject of monitoring include the threatened fauna species that were recorded from the project site or assessed as having a high or moderate potential to be present. Key monitoring indicators for threatened species will include:

- Population abundance;
- Species distribution in the project site; and
- Population composition.

Threatened species monitoring will:

- Enable the identification of the impacts of the project on threatened species;
- Identify changes in population numbers over time;
- Determine the success of impact mitigation and conservation measures; and
- Highlight areas for improvement if these measures are found to be inadequate.

Threatened species monitoring will involve conducting targeted threatened species surveys biannually in areas of known habitat in order to record the abundance and distribution of selected species. The level of monitoring effort would be determined according to risk level and biology of the particular species in question (e.g. coordinating with breeding or movement times).

Feral Animal and Weed Management Plan

A Feral Animal and Weed Management Plan will be developed in accordance with the provisions of the LP Act and implemented for the project site in order to control feral animals and weeds that are known to occur, and to prevent the introduction and establishment of any new invasive exotic species. Detailed weed mapping within the project site will be undertaken during the development of the plan.

The plan will also include monitoring for the presence and abundance of exotic species recorded from the project site and those with potential to occur. The monitoring program will allow for early recognition of any weed or feral animal that may pose a threat to biodiversity, and will enable the timely implementation of control measures. Key indicators to be used for monitoring weeds and feral animals will include:

- Presence/absence of weeds and feral animals; and
- Distribution and abundance.

The weed monitoring program will be coordinated with the vegetation monitoring program.

The Feral Animal and Weed Management Plan will contain details of appropriate management measures that will be implemented if numbers are such that control is required of any feral animal or weed species. This will include information such as appropriate control strategies, timing, and specifications for follow up works.

Erosion and Sediment Control Plan

An Erosion and Sediment Control Plan will be prepared for the project and is discussed in Section 24 – Environmental Management. It will include mitigation measures that aim to minimise erosion and the release of sediment to receiving waters. These may include measures such as revegetating soil stockpiles, appropriate timing for soil disturbance activities, and the installation of erosion, drainage and sediment control measures.

Subsidence Management Plan

A draft Subsidence Management Plan is provided in Appendix B. It includes a description of management measures related to the repair of subsidence cracking, the subsidence of ephemeral drainage lines and the northern seasonal wetland, and the installation of minor remedial drainage earthworks. It also describes details of a vegetation monitoring program, which will be undertaken to confirm that subsidence does not give rise to impacts greater than those listed in the *Terrestrial Ecology Report* (Appendix F) and to identify additional mitigation measures in the event of unanticipated impacts.

Species Management Program

A Species Management Program is required to be developed and implemented for the project in accordance with the requirements of the NC Act. The Species Management Program will outline actions to be taken to minimise impacts on animal breeding places and will be submitted to the EHP for approval prior to the commencement of construction activities. The program will include prescriptions on the nature and duration of pre-clearing surveys as well as measures to be employed during any clearing activities (e.g. relocation of habitat features such as hollows and logs). The Species Management Program would also describe the role of a Spotter Catcher and the necessary permits for any relocation of fauna. Information contained in the Species Management Program will likely be derived from the Biodiversity Management Plan.

9.8 OFFSETS

Biodiversity offsets will be required for any significant, residual impacts on MSES. The following impacts have been determined to be significant, residual impacts requiring offsets:

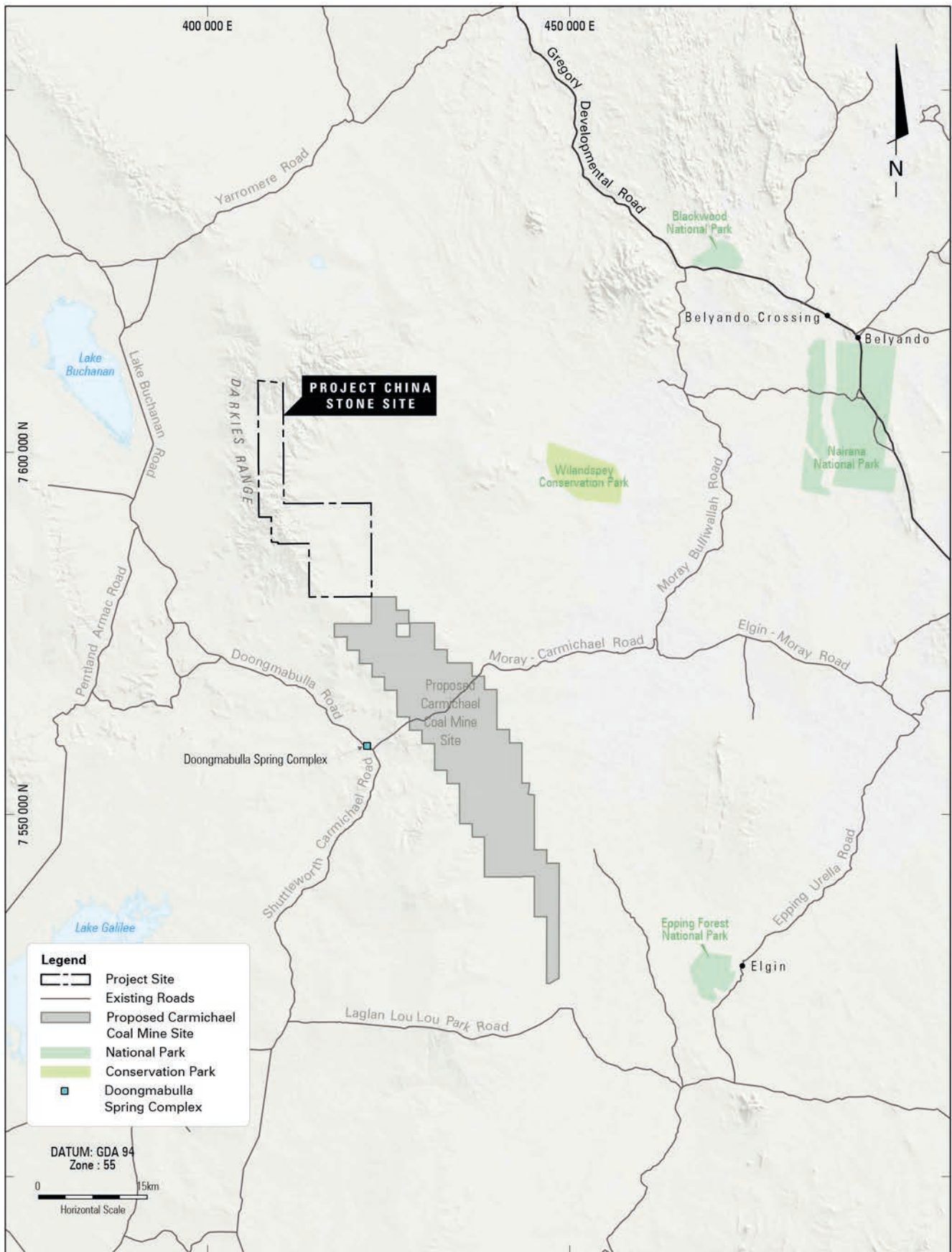
- Clearing of approximately 24 ha of RE 10.10.3 *Eucalyptus drepanophylla* open-woodland on sandstone ranges for the purposes of open cut mining and the construction of mine infrastructure.
- Clearing of approximately 359 ha of vegetation comprising 23 REs as per the vegetation management watercourse map for the purposes of open cut mining and the construction of mine infrastructure.
- Clearing approximately 1,436 ha of high value habitat for the Squatter Pigeon (southern subspecies) for the purposes of open cut mining and the construction of mine infrastructure. A further 3 ha of high value habitat may be cleared for the construction of minor remedial drainage earthworks in subsided areas (although it is noted that the exact location and design of drains is still to be confirmed).
- Clearing approximately 4,434 ha of high value habitat for the Black-throated Finch (white-rumped subspecies) for the purposes of open cut mining and the construction of mine infrastructure. A further 9 ha of high value habitat may be cleared for the construction of minor remedial drainage earthworks in subsided areas (although it is noted that the exact location and design of drains is still to be confirmed).
- Clearing approximately 3,246 ha of high value habitat for the Koala for the purposes of open cut mining and the construction of mine infrastructure. A further 0.4 ha of high value habitat may be cleared for the construction of minor remedial drainage earthworks in subsided areas (although it is noted that the exact location and design of drains is still to be confirmed).

The proponent has developed a Biodiversity Offset Strategy to provide these offsets. The Biodiversity Offset Strategy includes:

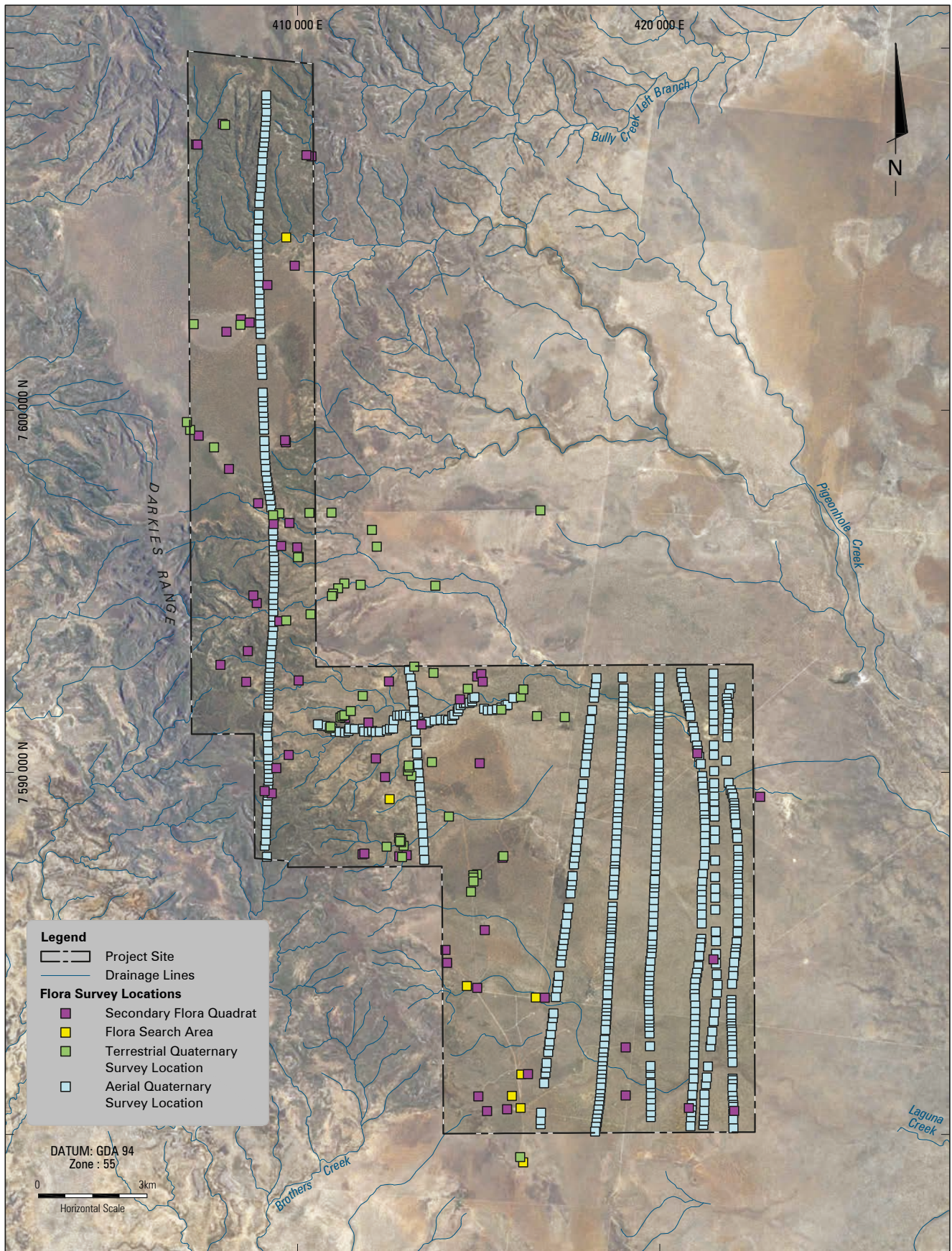
- The proposed offset area/s, including the location, property description, ecological values and proposed mechanism to secure the offset;
- The proposed management strategy for the offset area;
- Monitoring and reporting to be undertaken for the offset;
- A description of the objectives of the offset, particularly in relation to any relevant objectives and recovery actions for the species/community; and
- A description of the environmental gains to be achieved with the offset.

Further detail on offsets is provided in the *Biodiversity Offset Strategy* (Appendix H).

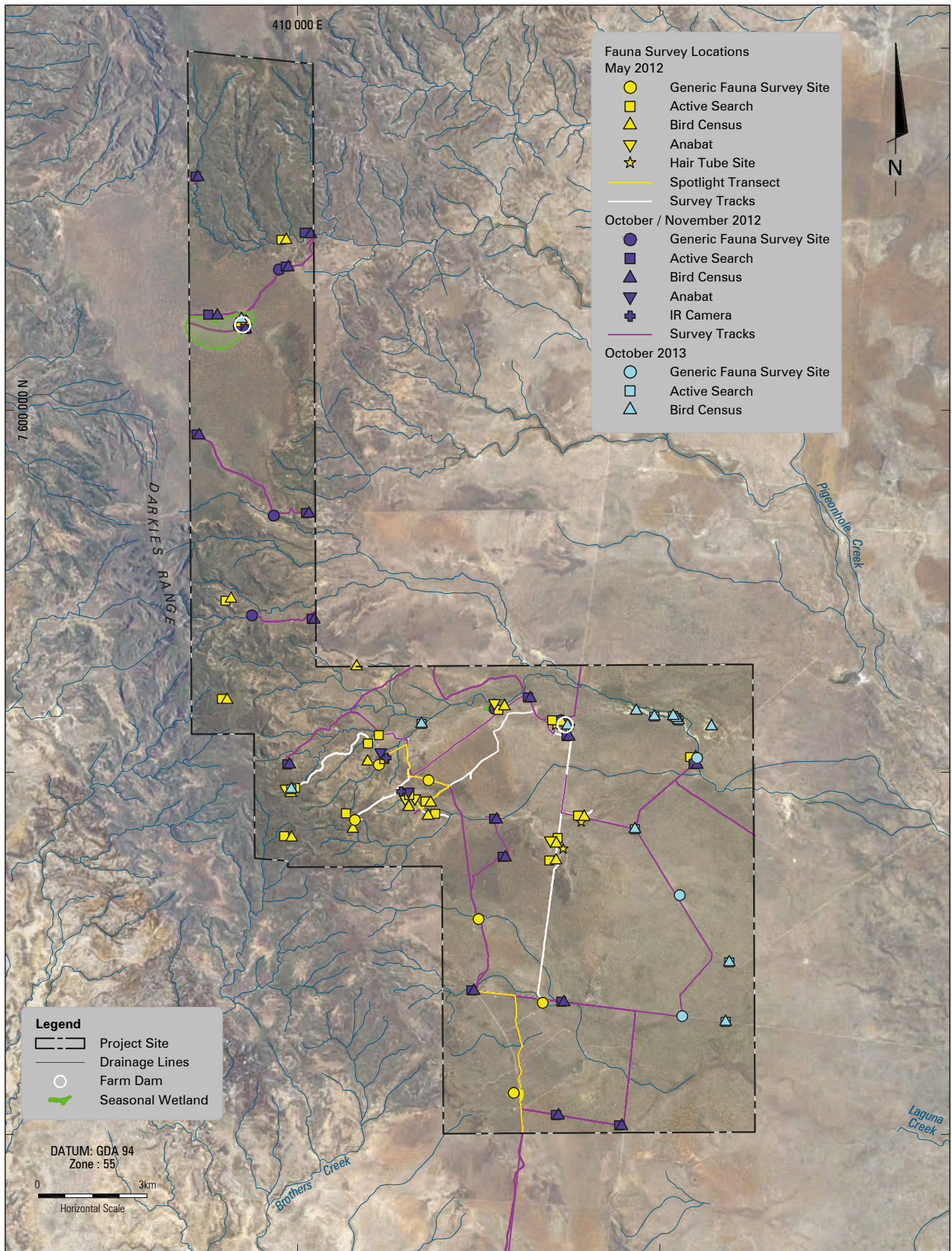
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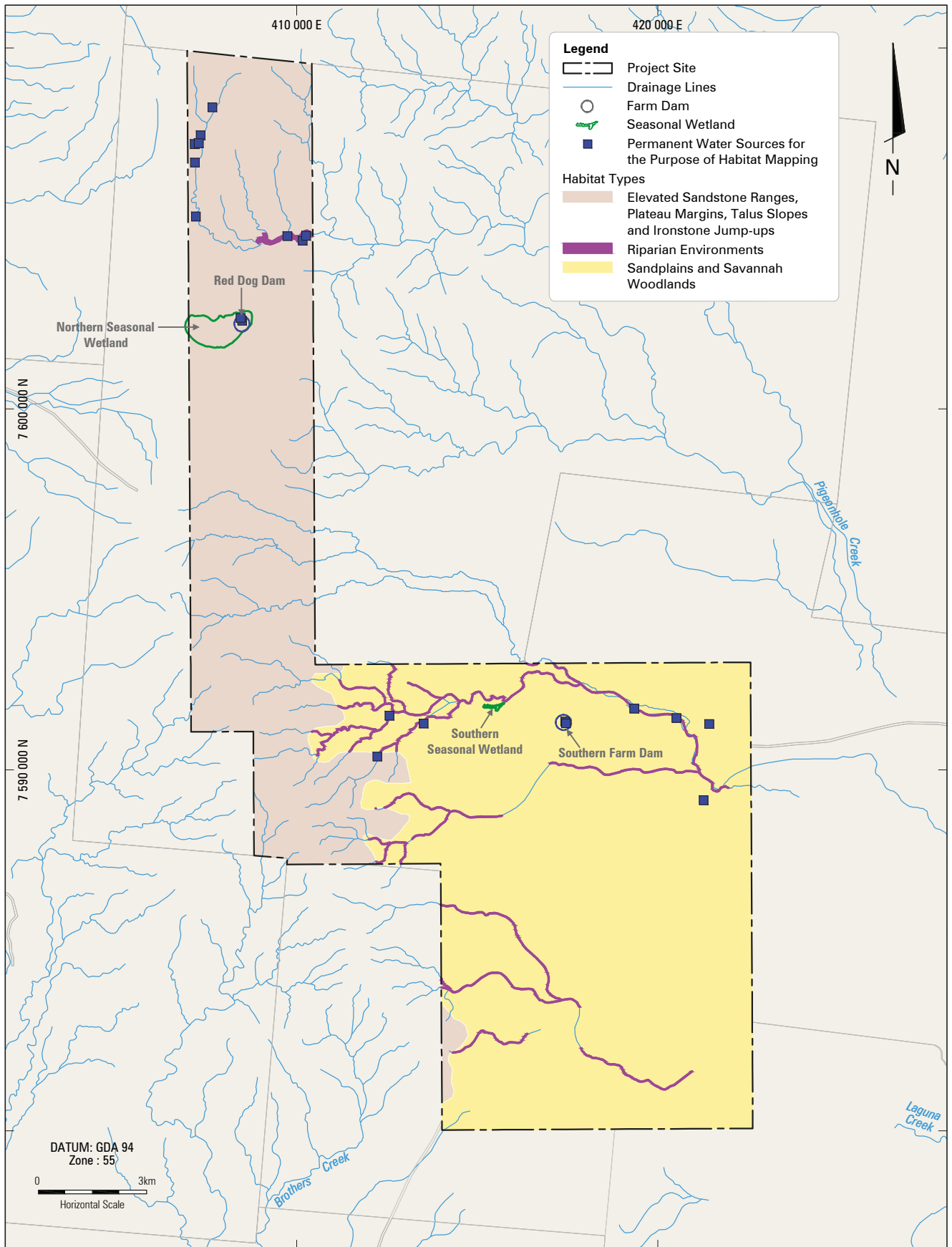
PROJECT CHINA STONE



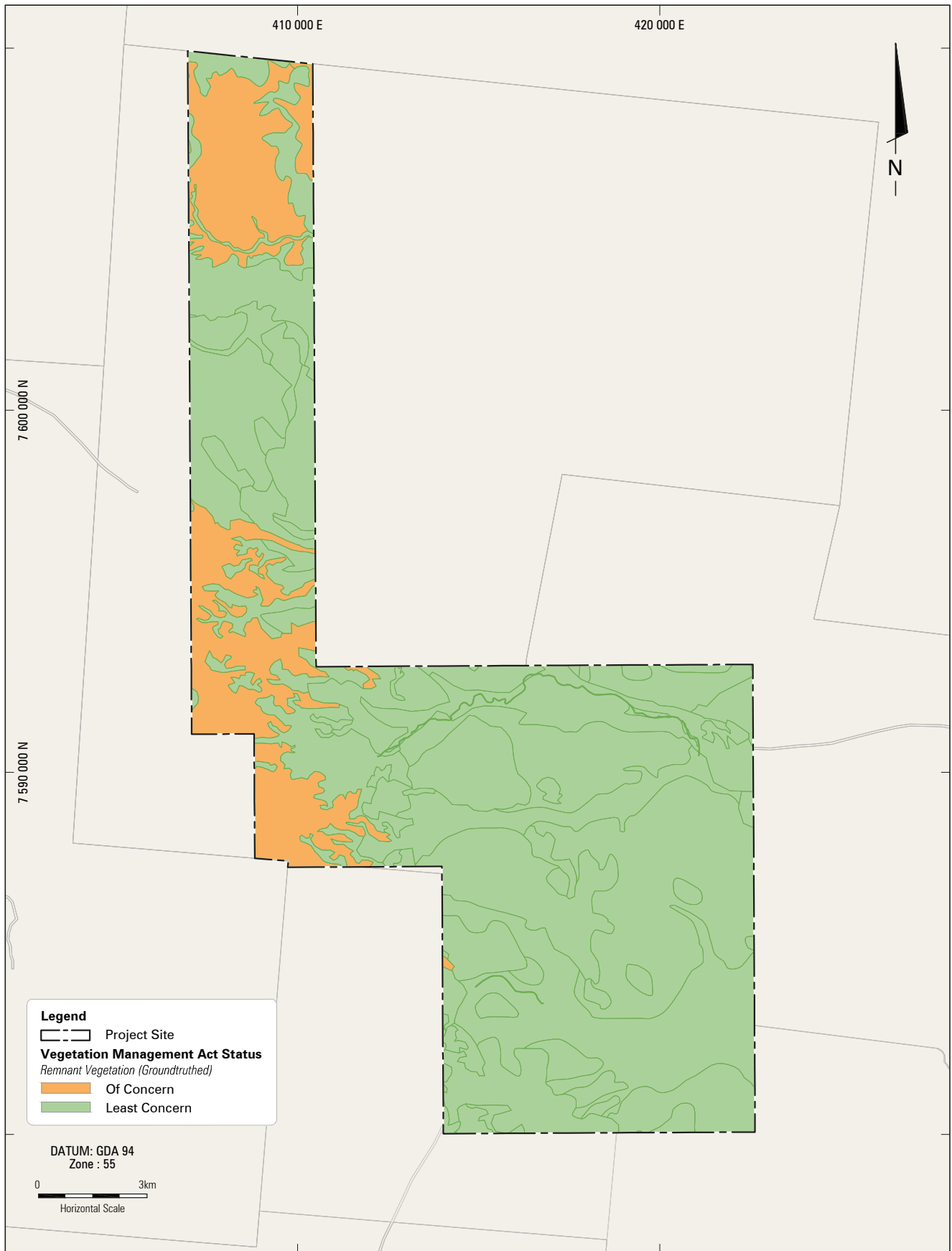
PROJECT CHINA STONE



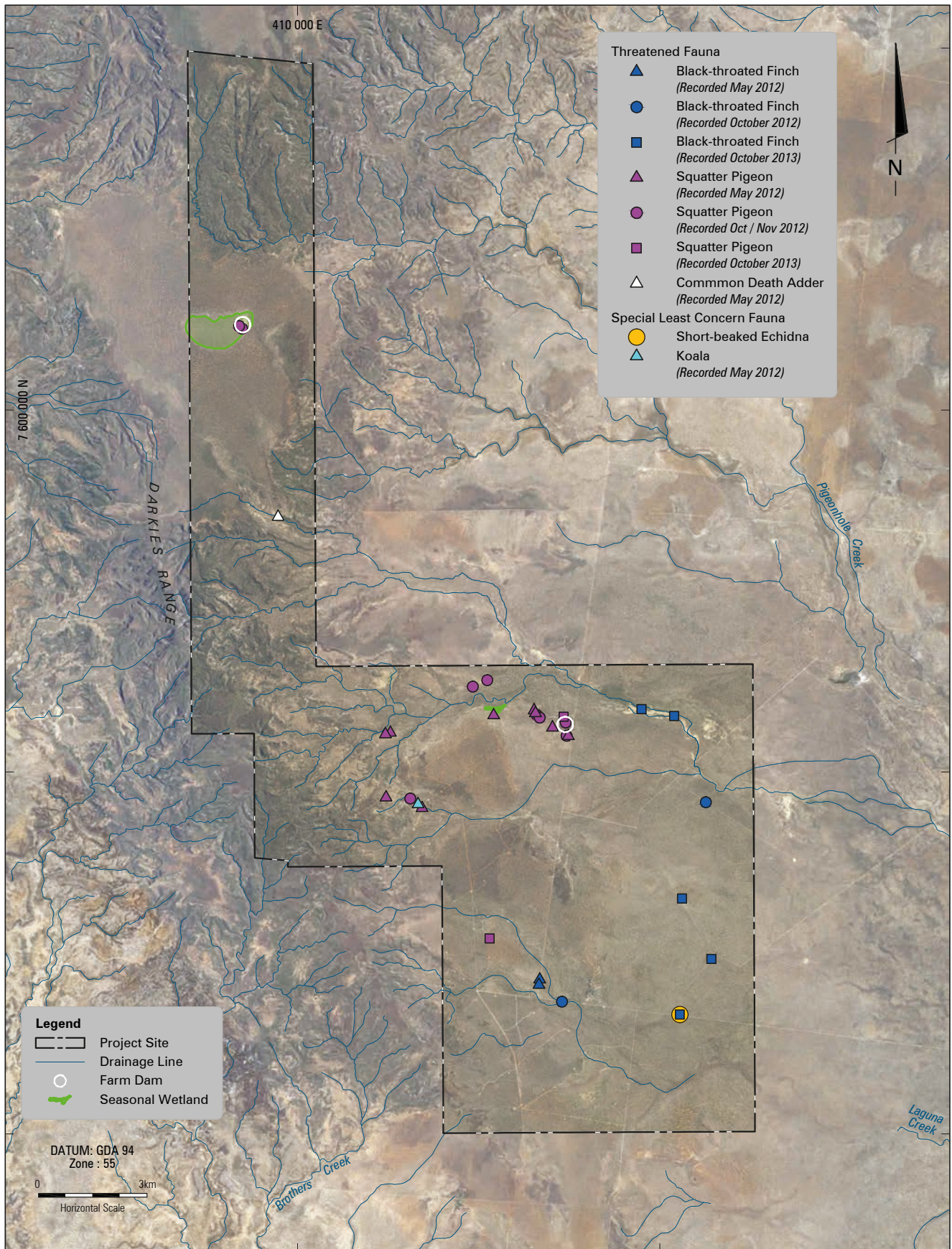
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PROJECT CHINA STONE



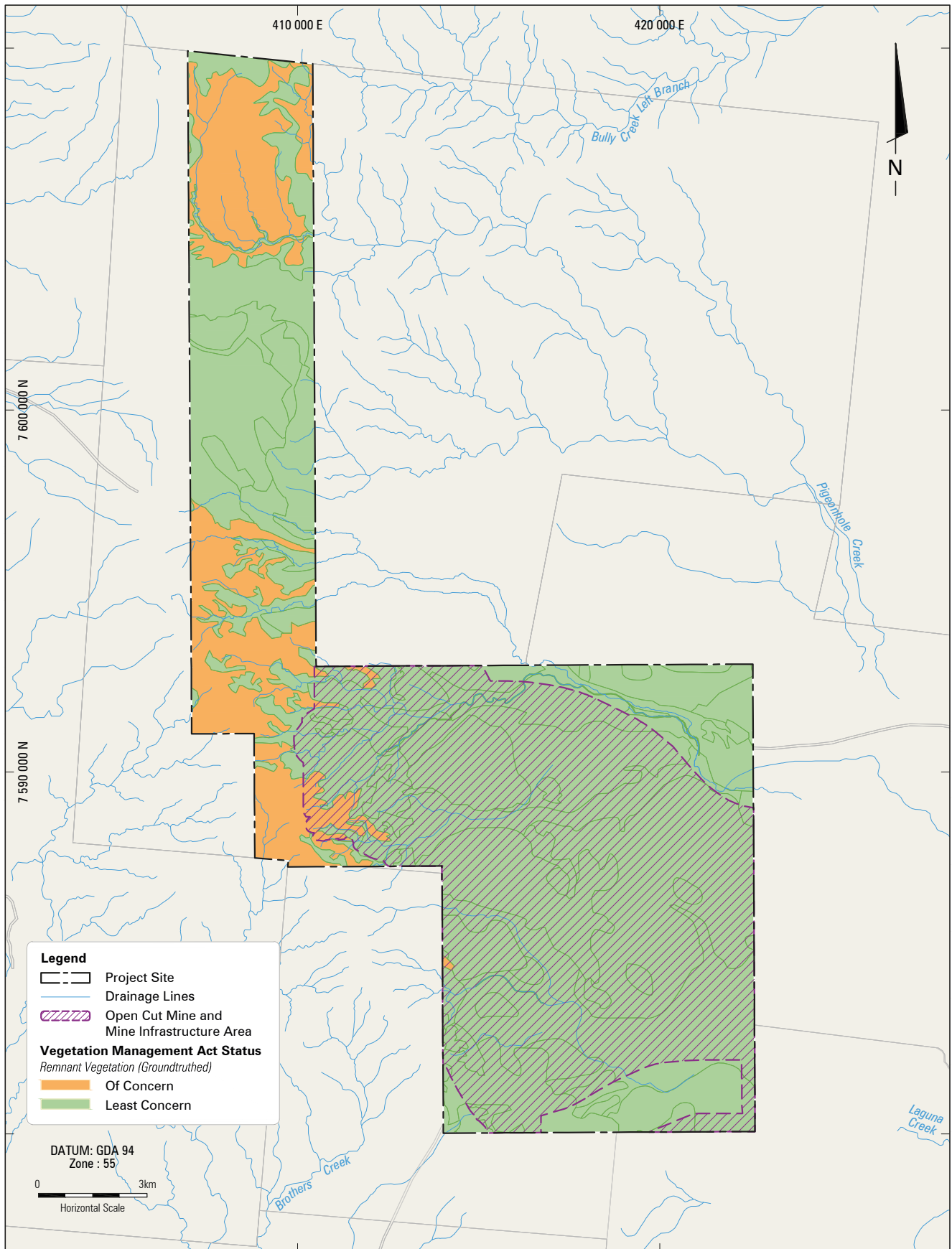
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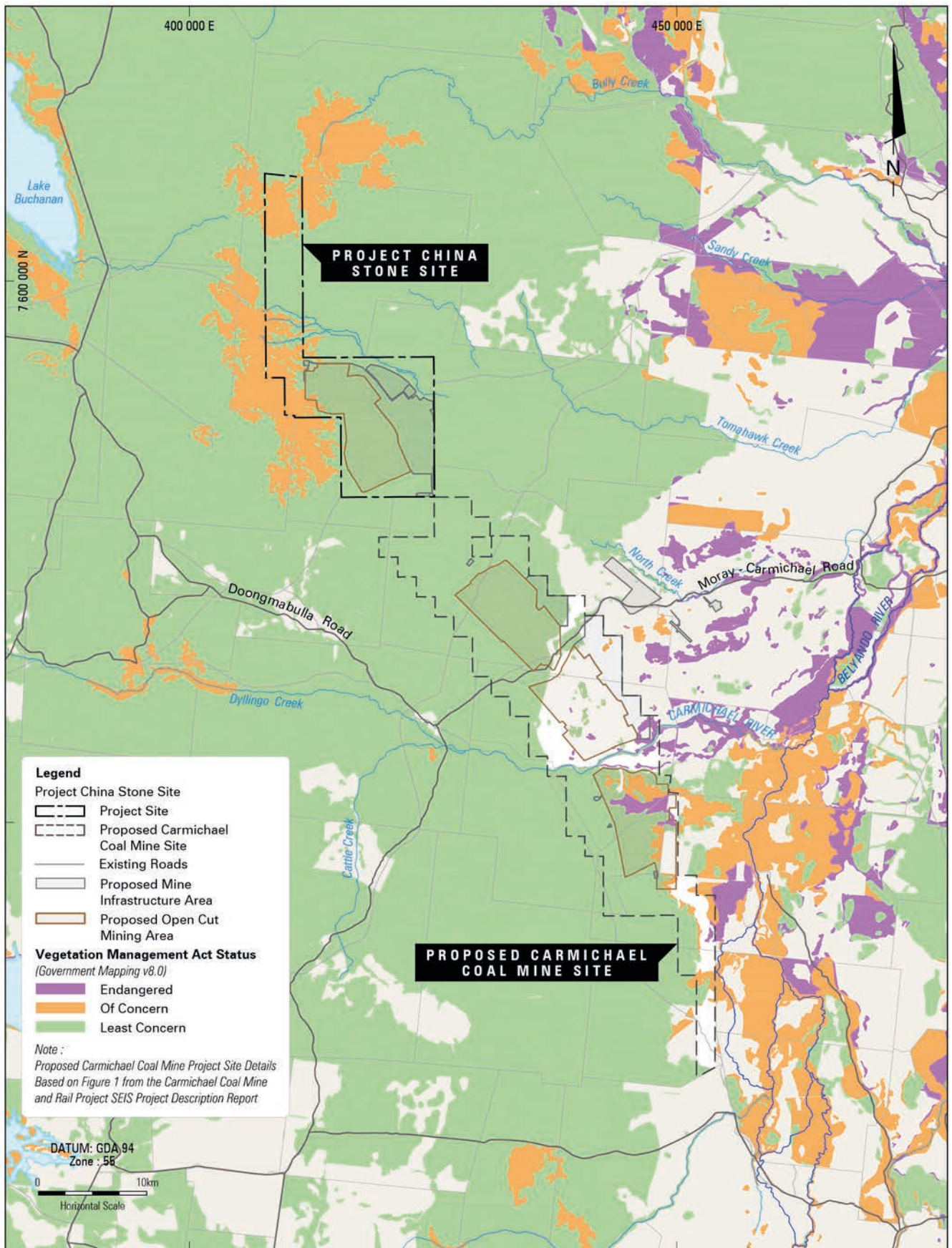
PROJECT CHINA STONE

Threatened and Special Least Concern
Fauna Species Records

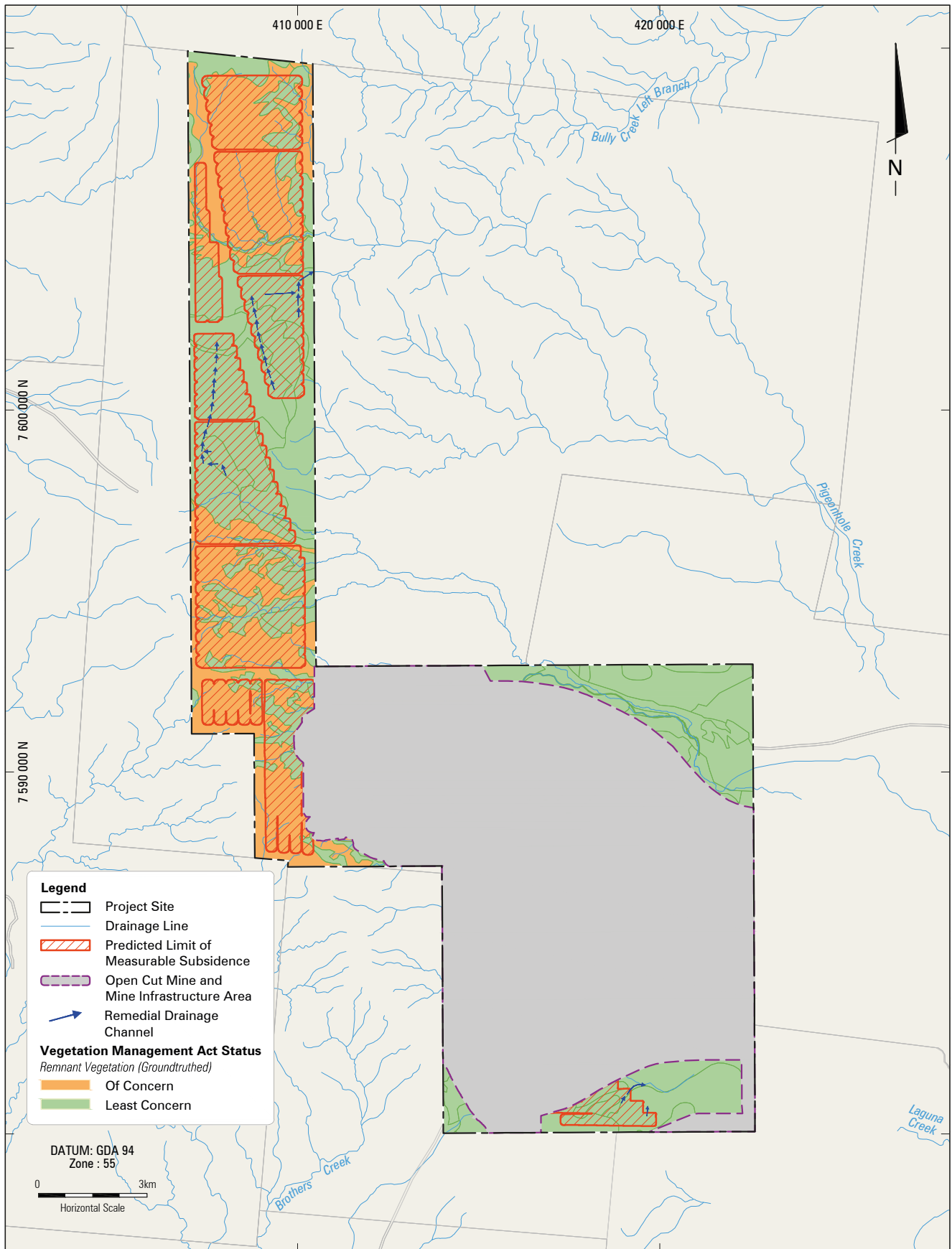
FIGURE 9-6



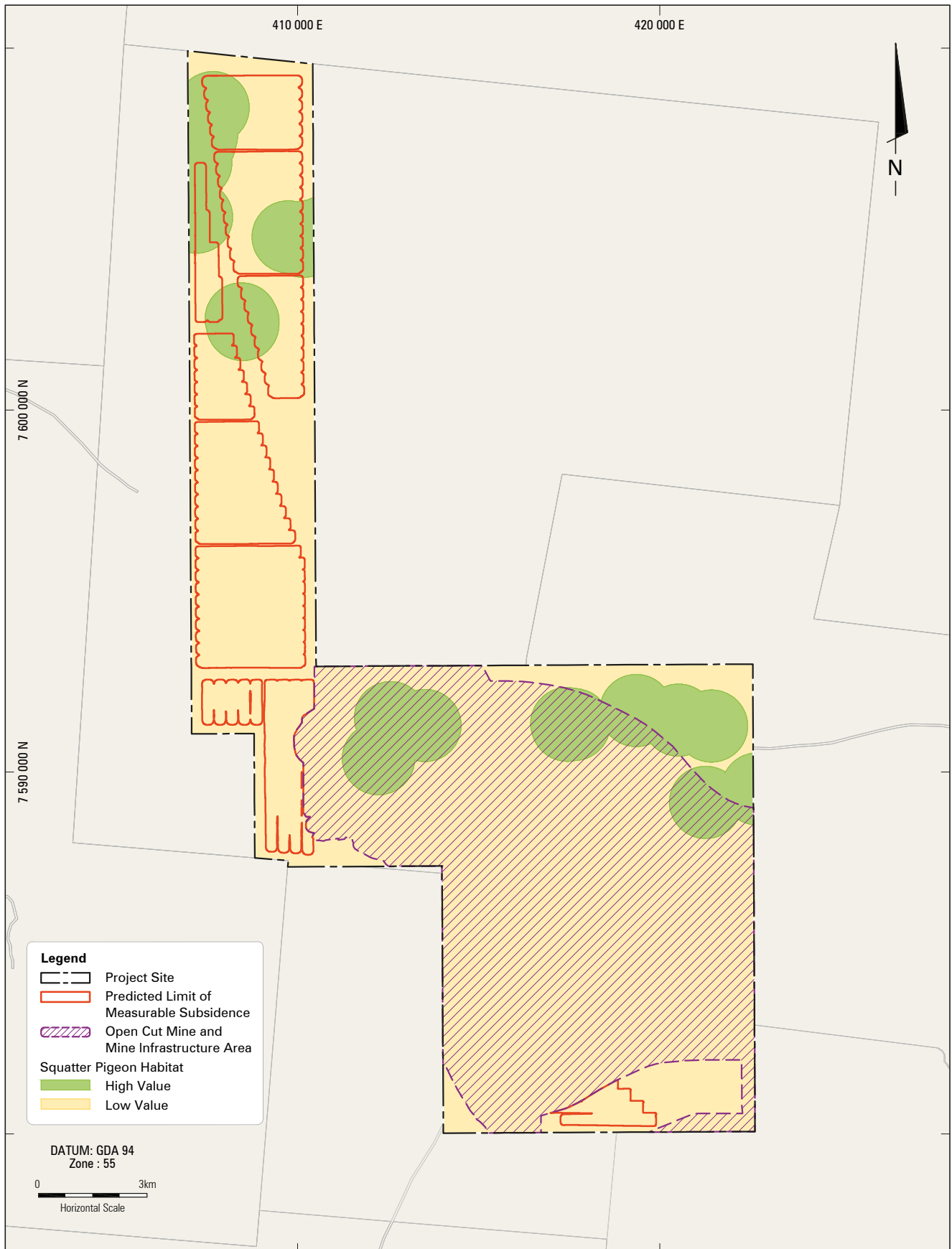
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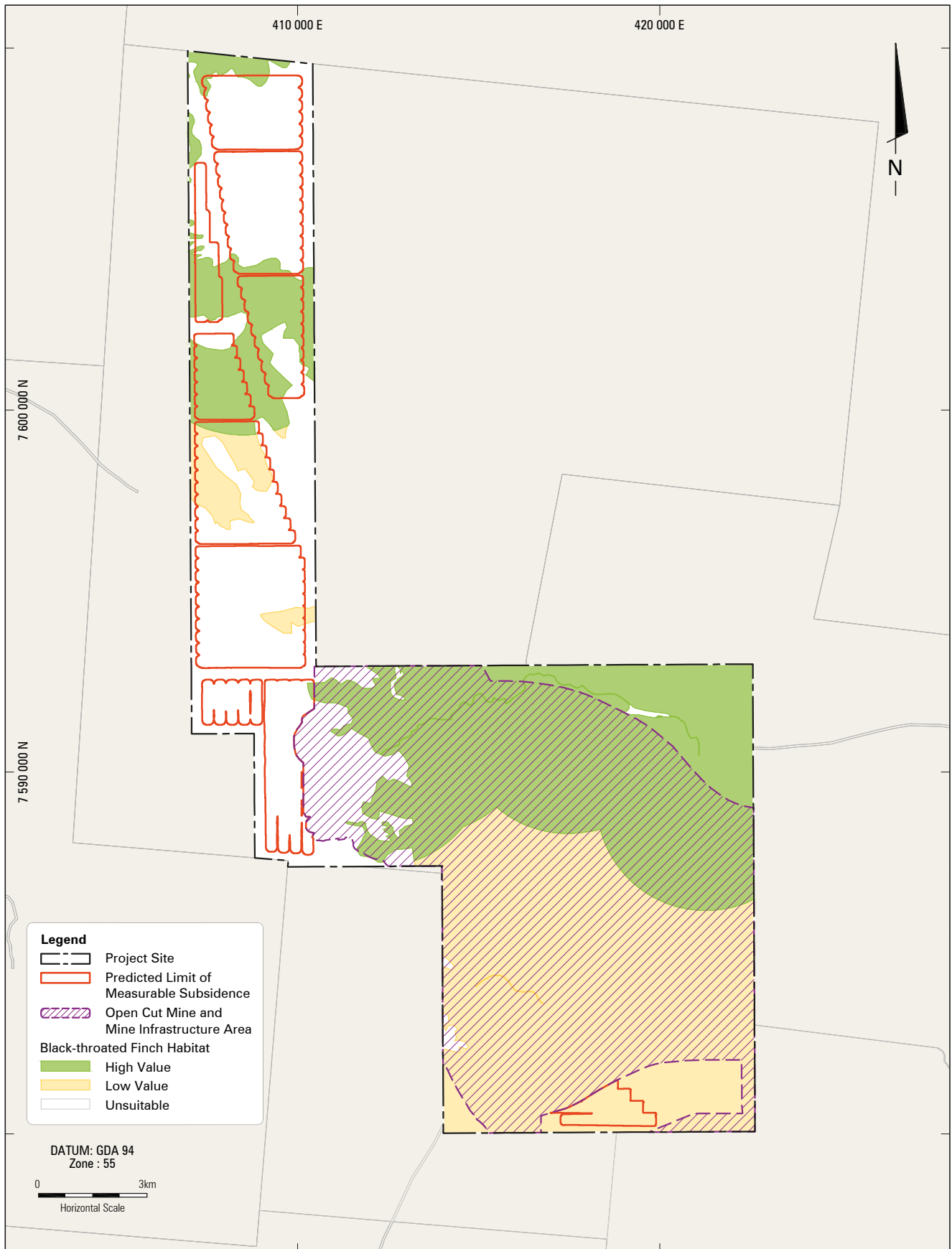
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PROJECT CHINA STONE



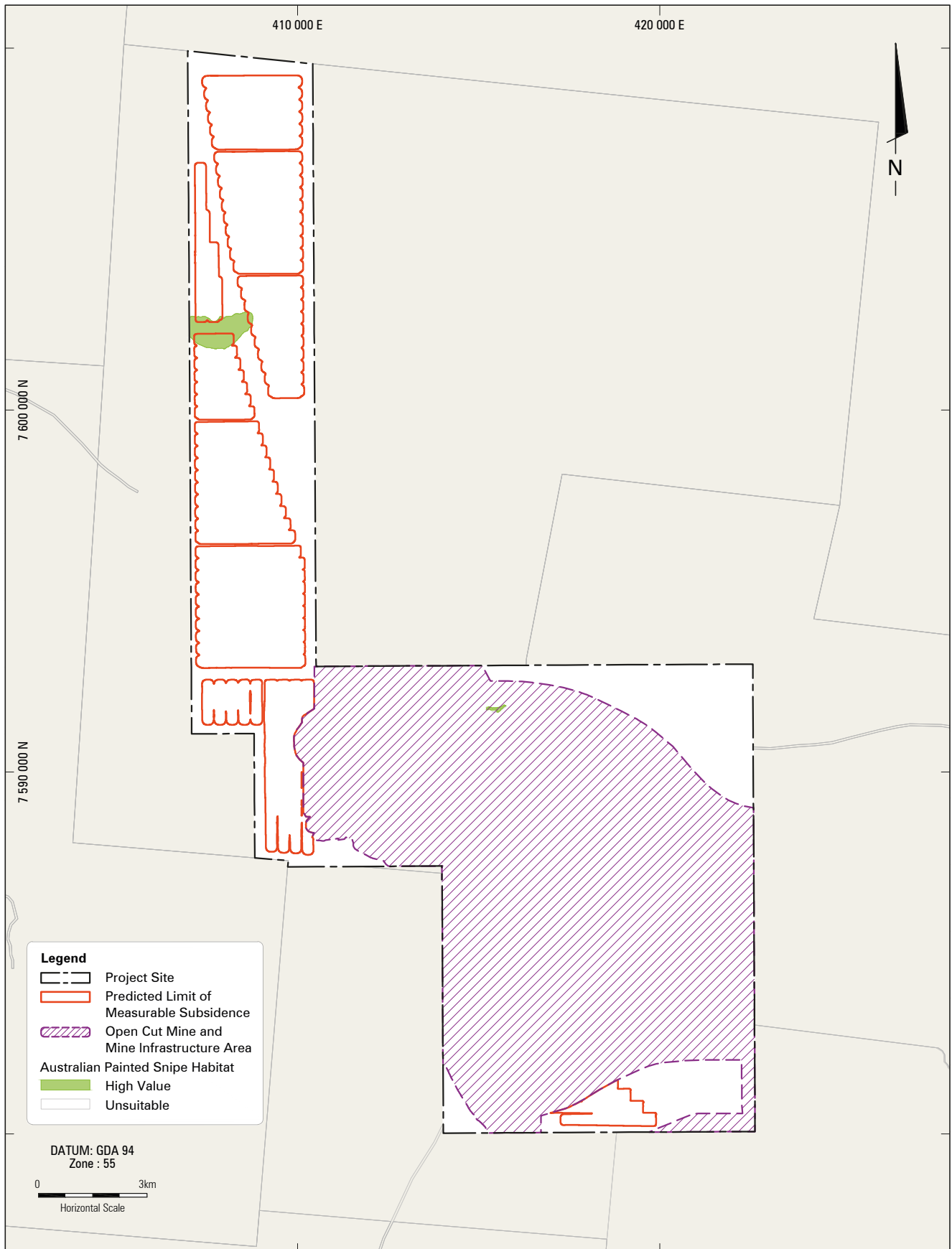
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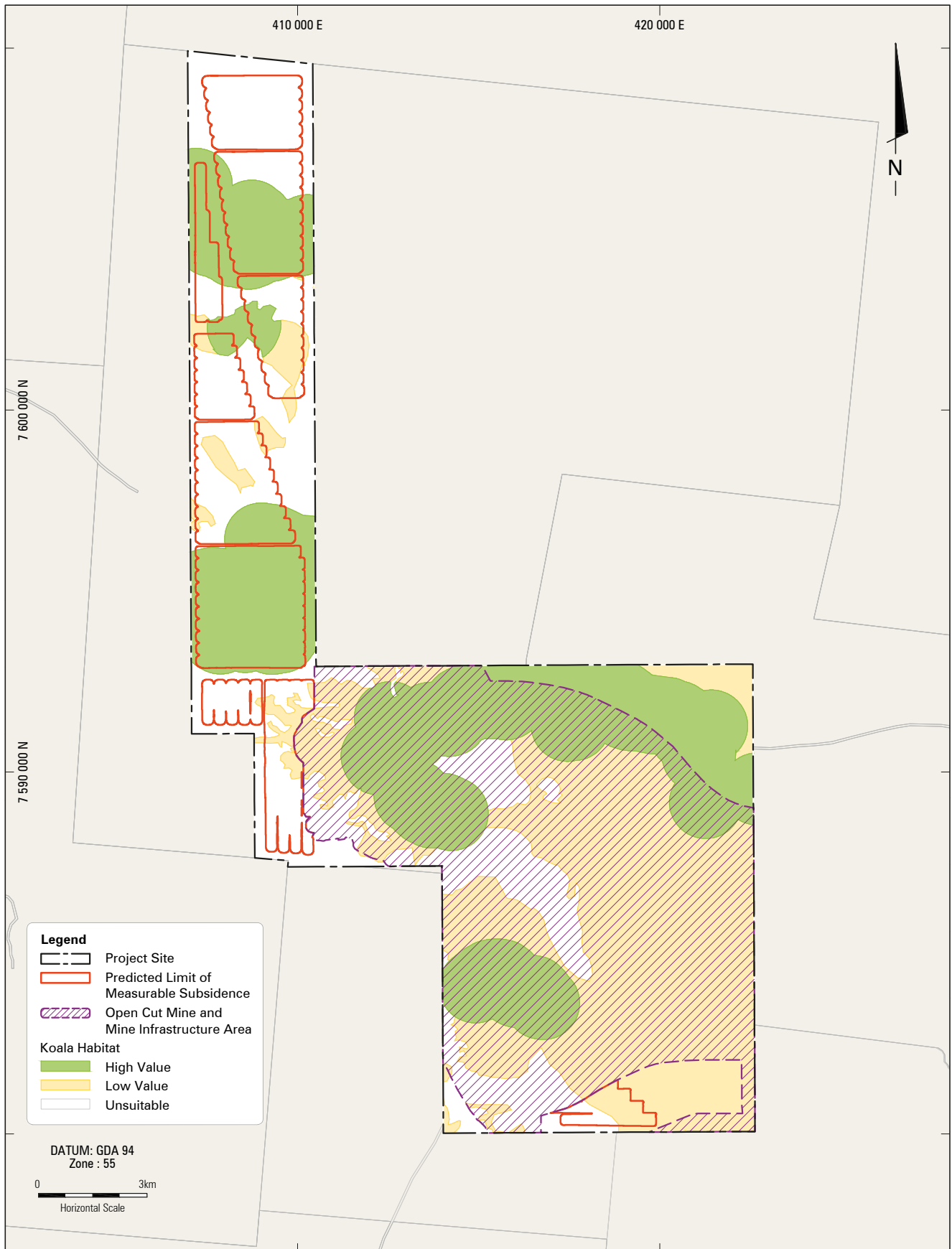
PROJECT CHINA STONE

Black-throated Finch Habitat

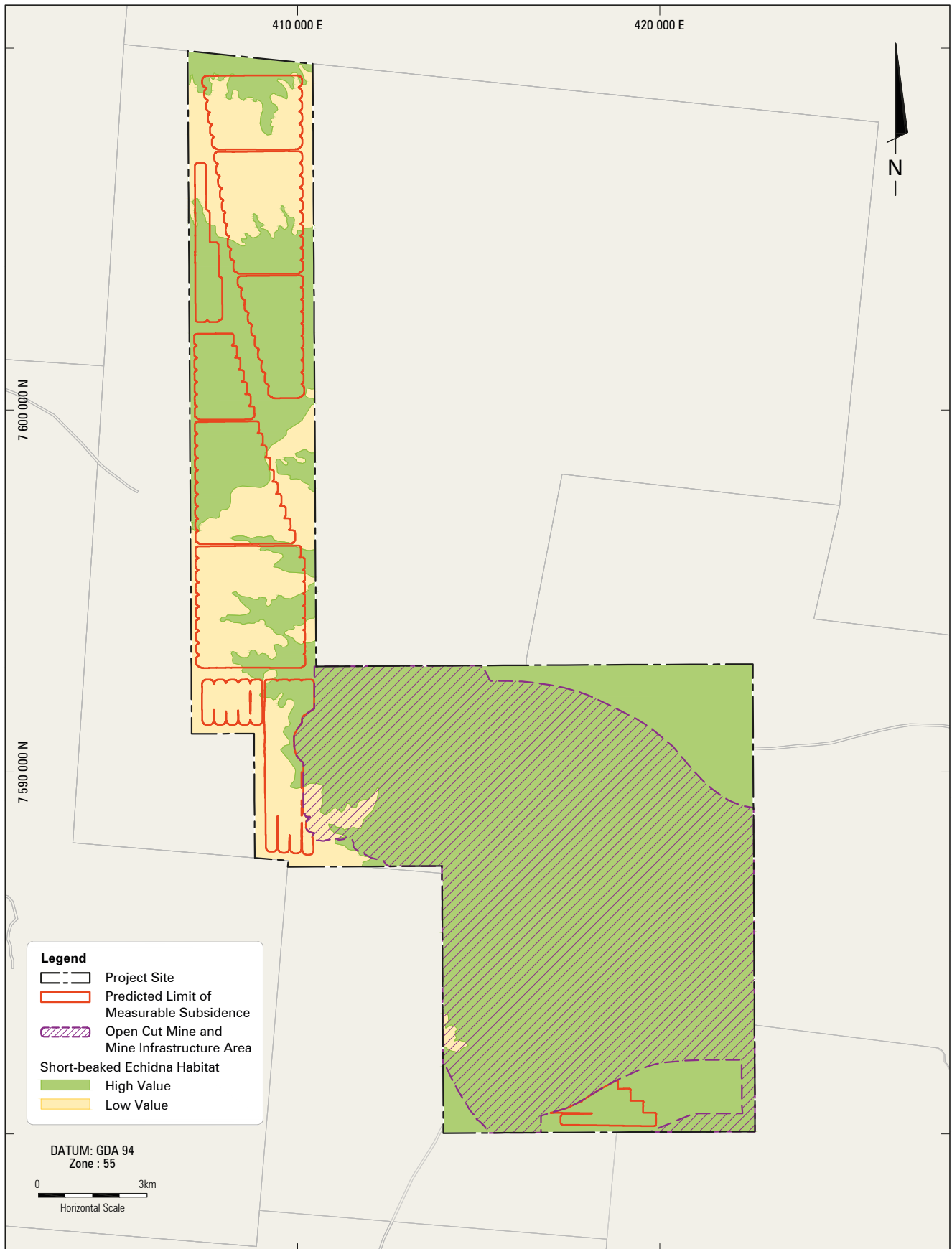
FIGURE 9-11



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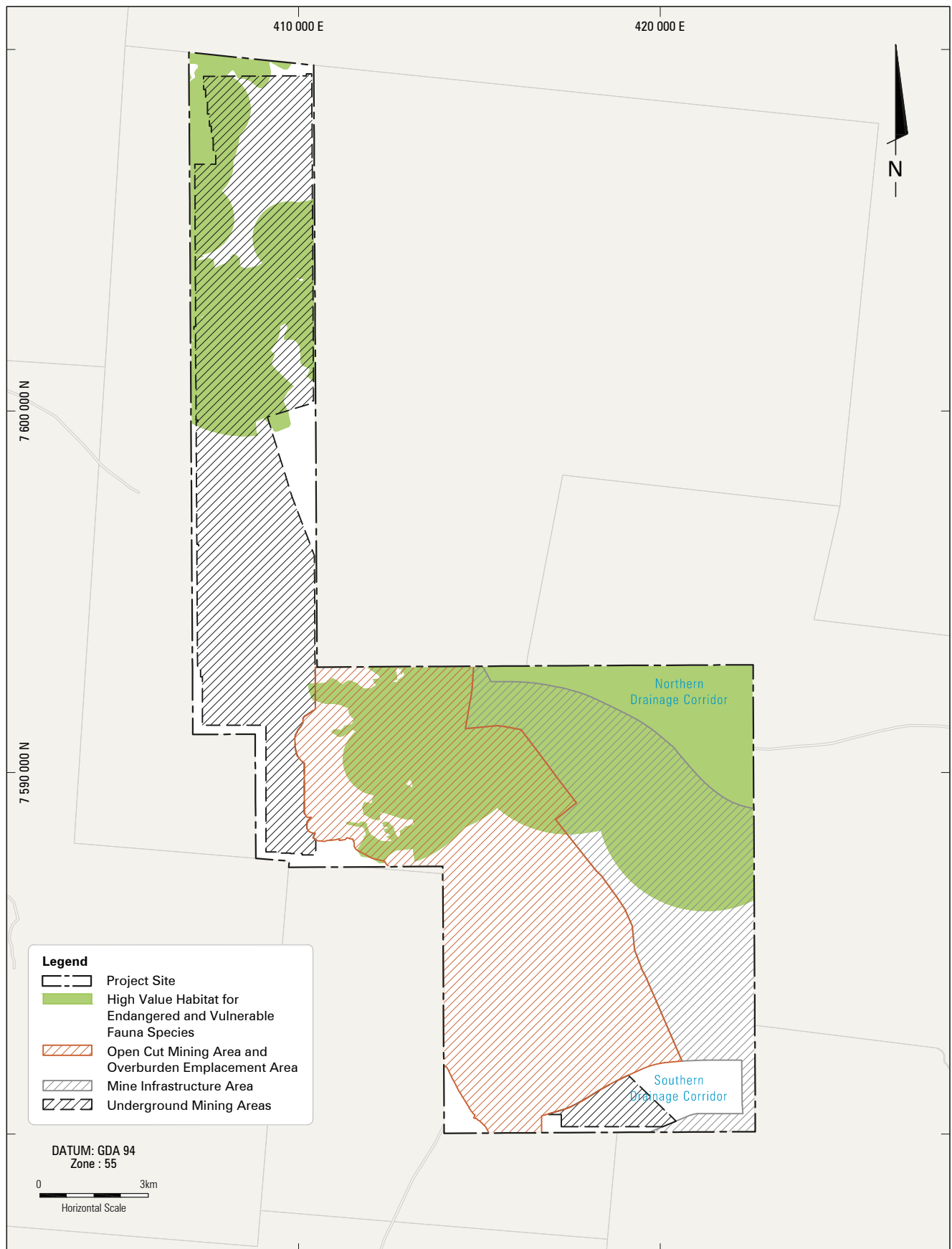


FIGURE 9-15