PROJECT CHINA STONE

Matters of National Environmental Significance 11

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11 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

11.1 INTRODUCTION

This section provides an overview of Matters of National Environmental Significance (MNES) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) to the extent that they are relevant to Project China Stone (the project). A number of technical areas, including terrestrial ecology, surface water and groundwater, are relevant to the assessment of potential impacts on MNES. This section makes reference to relevant technical reports, as well as to summaries of the reports provided elsewhere in Volume 1 of the Environmental Impact Statement (EIS).

11.2 PROJECT EPBC ACT STATUS

The EPBC Act is the Australian government's principal piece of environmental legislation, and is administered by the Commonwealth Department of the Environment (DotE). It is designed to protect national environmental assets, known as MNES, which include, amongst others, threatened species of flora and fauna, endangered ecological communities, migratory species and water resources.

Any action (which includes a development, project or activity) that is considered likely to have a significant impact on MNES is termed a Controlled Action and is subject to assessment under the EPBC Act. The project was declared a Controlled Action on 30 October 2014 and requires approval under the EPBC Act before it can proceed. The controlling provisions are:

- Listed threatened species and communities (sections 18 & 18A);
- Listed migratory species (sections 20 & 20A); and
- A water resource, in relation to coal seam gas development and large coal mining development (section 24D).

An accredited process will be used for the assessment of the project's impacts on MNES and the EIS Terms of Reference (TOR) includes requirements in relation to the assessment of potential impacts on MNES. These requirements are addressed in this section, or in the other sections of the EIS specifically referred to in this section. Sections 11.3 to 11.9 discuss listed threatened species and communities, and migratory species and Section 11.10 discusses water resources.

11.3 THREATENED SPECIES AND COMMUNITIES AND MIGRATORY SPECIES

11.3.1 Introduction

Section 12 of the EIS TOR indicates that the MNES section of the EIS (i.e. this section) should provide cross references to the relevant sections of the EIS that address the requirements under Division 5.2 of the *Environment Protection and Biodiversity Conservation Regulations 2000*. Attachment 11-1 of this section comprises a table which outlines the requirements of Division 5.2 and provides cross references to relevant EIS sections.

This section provides a summary of the ecology values present within the project site, as relevant to MNES. A detailed terrestrial ecology impact assessment and aquatic ecology and stygofauna impact assessment were undertaken by Cumberland Ecology and are presented in the *Terrestrial Ecology Report* (Appendix F) and *Aquatic Ecology and Stygofauna Report* (Appendix G).

No EPBC Act listed aquatic flora and fauna species were found utilising the project site and, based on a review of habitat requirements and known species distribution, none are expected to occur. No listed aquatic communities were identified within the project site. The section is therefore restricted to assessing terrestrial ecology issues. Aquatic ecology is discussed in Section 10 – Aquatic Ecology.

11.3.2 Overview of Regulatory Requirements

Section 11.2 provides an overview of the EPBC Act, and the status of the project in relation to the Act. Additional regulatory requirements relevant to threatened and migratory species are described below.

International Treaty Obligations

Australia is signatory to several agreements relating to migratory birds. These include the following:

- Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals Appendices I and II);
- China–Australia Migratory Bird Agreement (CAMBA);
- Japan–Australia Migratory Bird Agreement (JAMBA); and
- Republic of Korea–Australia Migratory Bird Agreement (ROKAMBA).

The Bonn Convention appendices identify migratory taxa at and below the species level, as well as some whole families. These species lists have been used to inform the migratory species listed under the EPBC Act.

The CAMBA, JAMBA and ROKAMBA agreements list terrestrial, water and shorebird species which migrate between Australia and China, Japan and Republic of Korea, respectively. In both cases the majority of listed species are shorebirds.

Migratory birds listed under CAMBA, JAMBA and ROKAMBA are protected in Australia through being listed as MNES (Migratory Controlling Provision) under the EPBC Act (Section 11.2).

Commonwealth Offsets Policy

Environmental offsets are actions taken to counterbalance residual, significant impacts on matters of environmental significance (e.g. Matters of National or State Significance). Offsets are used as a last resort in instances where an action will give rise to residual impacts, even after the application of management measures.

The *EPBC Act Environmental Offsets Policy* came into force in October 2012 (Commonwealth Department of Sustainability, Environment, Water, Population and Communities [SEWPaC] [now DotE] 2012) and provides guidance on the role of offsets in environmental impact assessments and how the DotE considers the suitability of a proposed offset package.

According to the policy, an offsets package is a “suite of actions that a proponent undertakes in order to compensate for the residual significant impact of a project” (SEWPaC 2012). It can comprise a combination of direct offsets and other compensatory measures.

Direct offsets are those actions that provide a measurable conservation gain for an impacted protected matter. Direct offsets are an essential component of a suitable offsets package. A minimum of 90% of the offset requirements for any given impact must be met through direct offsets. Other compensatory measures are those actions that do not directly offset the impacts on the protected matter, but are anticipated to lead to benefits for the impacted protected matter, for example funding for research or educational programs (SEWPaC 2012).

11.4 OVERVIEW OF 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 that support low Eucalyptus woodlands and shrublands. Darkies Range, a densely vegetated ridgeline, runs north to south through the western portion of the site (Figure 11-1).

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.* 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 11-1).

11.5 METHODOLOGY

11.5.1 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.

11.5.2 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 levels were 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 occurrence of EPBC Act listed communities and species 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 of a species being present: Present; High; Moderate; or Low. Assessments of Significance were undertaken for any EPBC Act species or communities recorded or assessed as having a high or moderate potential to occur within the project site by addressing the requirements of the *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (DotE, 2013).

Vegetation communities listed under the EPBC Act are commonly defined by reference to the Queensland remnant vegetation classification system which is defined under the Queensland *Vegetation Management Act 1999* (VM Act). The VM Act categorises remnant vegetation into regional ecosystems (REs). This assessment has assessed the presence/absence of EPBC Act listed communities through identifying the REs present within the project site.

11.5.3 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 11-2.

Targeted searches were also undertaken for flora species listed under the EPBC Act.

11.5.4 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 field survey methodology is consistent with the EPBC Act survey guidelines for threatened frogs, reptiles, birds, mammals and bats (DEWHA, 2010a, 2010b; SEWPAC, 2011a, 2011b).

Targeted searches were also undertaken for fauna species listed under the EPBC Act.

The terrestrial fauna survey locations are shown on Figure 11-3.

11.5.5 Habitat Mapping

For the purposes of impact assessment, habitat modelling and mapping was undertaken for EPBC Act listed 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 EPBC Act listed species is described in detail in the *Terrestrial Ecology Report* (Appendix F).

11.6 RESULTS

11.6.1 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 11-4.

As noted in the remainder of this 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 11-4). 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 (Figure 11-4) 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 11-4). These areas support very little vegetation as much of the soil profile has eroded away. 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 11-4). 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, in particular 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.

11.6.2 Vegetation Communities

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

The project site does not contain any EPBC Act listed vegetation communities and the project will consequently not have any impact on EPBC Act listed communities.

11.6.3 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.

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 four flora species listed as endangered or vulnerable under the EPBC 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 four flora species have a low likelihood of occurring within the project site.

Exotic Species

Nine exotic species were recorded from the project site. The *Terrestrial Ecology Report* (Appendix F) contains a full list of the exotic species that were recorded during the field survey.

11.6.4 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).

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.

Threatened Species

Desktop searches indicated that nine threatened fauna species listed under the EPBC 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) and Koala (*Phascolarctos cinereus*) (vulnerable) were confirmed to be present in the project site during field surveys;
- The Australian Painted Snipe (*Rostratula australis*) (endangered) was considered to have a moderate potential of occurring within the project site; and
- The remaining five species (of the nine 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 11-5). It was commonly observed along the tracks and many records were adjacent to the artificial farm dams or ephemeral drainage lines. 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 (Figure 11-8). A full description of suitable habitat for this species within the project site is 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 11-5). 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 (Figure 11-9). A full description of suitable habitat for this species within the project site is provided in the *Terrestrial Ecology Report* (Appendix F).

No Australian Painted Snipes were recorded during any of the surveys undertaken within the project site or within the Carmichael Coal Mine site. High value habitat for this species is present within the project site and comprises the two seasonal wetlands (Figure 11-10). A full description of suitable habitat for this species within the project site is 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 forest (Figure 11-5). 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 camalduensis*] and Forest Red Gum [*E. teretecornis*]) occur (Figure 11-11). A full description of suitable habitat for this species within the project site is provided in the *Terrestrial Ecology Report* (Appendix F).

Migratory Species

Desktop searches indicated that 14 fauna species listed as migratory under the EPBC Act potentially occur within the project site. One of these species, the Australian Painted Snipe, is also listed as threatened under the EPBC Act and is considered above. 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 Eastern Great Egret (*Ardea modesta*), Rainbow Bee-eater (*Merops ornatus*) and Satin Flycatcher (*Myiagra cyanoleuca*) were confirmed to be present in the project site during field surveys;
- The Fork-tailed Swift (*Apus pacificus*) and Cattle Egret (*Ardea ibis*) were considered to have a high potential of occurring within the project site;
- Latham's Snipe (*Gallinago hardwickii*) and the Australian Painted Snipe (described above) were considered to have a moderate potential of occurring within the project site; and
- The remaining seven species (of the 14 potentially present) have a low potential of occurring within the project site due to a lack of suitable habitat.

A single Eastern Great Egret was observed feeding on the shallow margins of the southern seasonal wetland (Figure 11-5). Limited areas of habitat (135 ha) are present in the project site for this wetland-dependent species. A full description of suitable habitat for this species within the project site is provided in the *Terrestrial Ecology Report* (Appendix F).

The Rainbow Bee-eater was recorded from nine locations in woodland habitat adjacent to ephemeral drainage lines in the south of the project site (Figure 11-5). These records were of single individuals foraging in trees and shrubs. Due to this species general habitat requirements (i.e. this species can inhabit a broad range of different habitat types), the majority of the project site is likely to provide potential breeding and foraging habitat for this species. A full description of suitable habitat for this species within the project site is provided in the *Terrestrial Ecology Report* (Appendix F).

The Satin Flycatcher was recorded from a single location adjacent to an ephemeral drainage line located in the north-east of the southern section of the project site (Figure 11-5). This area contains woodland habitat, and the individual recorded was foraging in trees near a remnant pool in the ephemeral drainage line. The project site is unlikely to provide breeding habitat for the Satin Flycatcher, but it has potential to use parts of the project site as a foraging resource during migration.

Feral Animals

Eight feral animals were recorded from the project site. The *Terrestrial Ecology Report* (Appendix F) contains a full list of the feral animals that were recorded during the field survey.

11.6.5 Groundwater Dependent Ecosystems

The *Australian Groundwater Dependent Ecosystem Toolbox* (GDE Toolbox), prepared by the National Water Commission (2011), defines groundwater dependent ecosystems (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".

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. 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.

The nearest GDE to the project site is the Doongmabulla Spring Complex (Figure 11-1), a cluster of 11 springs, located within a 4 km radius of each other, along the Carmichael River. The Doongmabulla Spring Complex is located 20 km south of the southern boundary of the project site. The Doongmabulla Spring Complex supports vegetation that forms part of the "community of native species dependent on natural discharge of groundwater from the Great Artesian Basin Threatened Ecological Community". This community is listed as endangered under the EPBC Act. The Doongmabulla Spring Complex and the associated vegetation community will not be affected by the project and further detail is provided in Section 12 – Groundwater.

11.7 IMPACT ASSESSMENT

11.7.1 Overview

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

- Vegetation clearing for the open cut mine and construction of the mine infrastructure (Section 11.7.2).
- Subsidence resulting from underground mining, and the disturbance of vegetation as a result of:
  - The subsidence crack rehabilitation program (Section 11.7.3); and
  - Clearing associated with minor remedial drainage earthworks due to subsidence (Section 11.7.4).
- Indirect impacts such as the effects of noise and vibration, vehicle strikes, lighting, dust, erosion and the introduction of invasive species (Section 11.7.5).

These impacts are described in the remainder of this section and mitigation measures for these impacts are provided in Section 11.8. The impacts described are considered to be known and predictable. Impacts that are considered to be irreversible are proposed to be offset, as discussed in Section 11.9.

11.7.2 Direct Vegetation Clearing

Overview

Figure 11-6 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 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 11.8.1.

A total of 10,998 ha of remnant vegetation will be removed to allow for open cut mining and the construction of mine infrastructure.

Vegetation clearing will be undertaken in accordance with the controls described in Section 11.8.2 to ensure that the clearing is undertaken in a manner that limits the disturbance to the minimum area possible.

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 11-6). 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 EPBC 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 11-7, 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 11-7). In addition, areas beyond the clearing footprint are proposed to be managed to retain and enhance biodiversity values (Section 11.8). 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 11-7 shows the proposed location of clearing associated with open cut mining and infrastructure development for the project and the CCM&RP. Key factors to be considered in assessing this impact are that the open cut mining/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.

11.7.3 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 11-7 shows 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 residual, significant impact.

The predicted disturbance to habitat for threatened and migratory fauna species due to the subsidence crack rehabilitation program is summarised in Sections 11.7.8 and 11.7.9.

11.7.4 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 11-6) (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 residual, significant ponding caused by mine subsidence and consequently no impact on vegetation or fauna due to 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.

The predicted disturbance to habitat for threatened and migratory fauna species due to the construction of drains is summarised in Sections 11.7.8 and 11.7.9.

One seasonal wetland and a 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 adversely 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).

11.7.5 Indirect Impacts

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 11.8.2) will be prepared to mitigate the potential impacts of weeds and feral animals. 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).

11.7.6 Impacts on Threatened Vegetation Communities

As discussed in Section 11.6.2, no vegetation communities listed under the EPBC Act were recorded or are considered likely to occur within the project site. Therefore, no vegetation communities listed under the EPBC Act will be impacted as a result of the project.

11.7.7 Impacts on Threatened Flora Species

As discussed in Section 11.6.3, no threatened flora species listed under the EPBC Act were recorded or are considered likely to occur within the project site. Therefore, no threatened flora species listed under the EPBC Act will be impacted as a result of the project.

11.7.8 Impacts on Threatened Fauna Species

The threatened fauna species listed under the EPBC Act that were either recorded on the project site or assessed as having a high or moderate likelihood of occurrence are described in Section 11.6.4. Impacts on these species are outlined in Table 11-1. Maps showing project disturbance relative to high value habitat for these species are provided in Figures 11-8 to 11-11.

Table 11-1 Proposed Disturbance of High Value Habitat for Threatened Fauna Species

FAUNA SPECIES	EPBC ACT STATUS	AREA IN THE PROJECT SITE (ha)	AREA CLEARED – MINING AND INFRASTRUCTURE (ha)	AREA CLEARED – MINOR REMEDIAL DRAINAGE EARTHWORKS (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	E	135	12	3	0.03	89
Koala	V	6,878	3,246	0.4	21	52

Threatened fauna species status under the EPBC Act (current at 28 October 2014).

V = Vulnerable; E = Endangered

Impacts on the species listed in Table 11-1 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 minor remedial drainage earthworks (Figure 11-8). 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. An assessment of significance has been conducted for this species according to the EPBC Act *Significant Impact Guidelines* (DotE 2013) for vulnerable species. 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 minor remedial drainage earthworks (Figure 11-9). 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. An assessment of significance has been conducted for this species according to the EPBC Act *Significant Impact Guidelines* (DotE 2013) for endangered species. 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 minor remedial drainage earthworks (Figure 11-10). 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. An assessment of significance has been conducted for this species according to the EPBC Act *Significant Impact Guidelines* (DotE 2013) for endangered species. 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 minor remedial drainage earthworks (Figure 11-11). 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. An assessment of significance has been conducted for this species according to the EPBC Act *Significant Impact Guidelines* (DotE 2013) for vulnerable species. 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 for this impact.

11.7.9 Impacts on Migratory Fauna Species

The migratory species listed under the EPBC Act that were either recorded on the project site or assessed as having a high or moderate likelihood of occurrence are described in Section 11.6.4. The Australian Painted Snipe is listed as a migratory and threatened under the EPBC Act and the impacts on this species are discussed in Section 11.7.8.

Impacts on the remaining migratory species listed in Section 11.6.4 are as follows:

- Approximately 12 ha of habitat or potential habitat for the Eastern Great Egret and Latham's Snipe would be cleared for open cut mining and the construction of mine infrastructure and 3 ha of habitat or potential habitat would be cleared for the construction of minor remedial drainage earthworks. The subsidence crack rehabilitation program will also give rise to disturbance of habitat for these species. This vegetation would be progressively rehabilitated, ensuring that there is no residual impact due to subsidence crack rehabilitation. An assessment of significance has been conducted for these species according to the EPBC Act *Significant Impact Guidelines* (DotE 2013) for migratory species. This assessment indicates that the project will not have a significant impact on the Eastern Great Egret or Latham's Snipe as the project site is not considered to comprise important habitat for these species, there is no evidence to suggest that the project site supports an ecologically significant proportion of the population of these species and only a small area of habitat is proposed to be cleared.
- Approximately 10,998 ha of habitat or potential habitat for the Rainbow Bee-eater, Satin Flycatcher, Fork-tailed Swift and Cattle Egret would be cleared for open cut mining and the construction of mine infrastructure. 12 ha of habitat or potential habitat would be cleared for the construction of minor remedial drainage earthworks. The subsidence crack rehabilitation program will also give rise to disturbance of habitat for these species. This vegetation would be progressively rehabilitated, ensuring that there is no residual impact due to subsidence crack rehabilitation. An assessment of significance has been conducted for these species according to the EPBC Act *Significant Impact Guidelines* (DotE 2013) for migratory species. This assessment indicates that the project will not have a significant impact on the Rainbow Bee-eater, Satin Flycatcher, Fork-tailed Swift and Cattle Egret as the project site is not considered to support an ecologically significant proportion of the population of these species.

11.8 MITIGATION MEASURES

11.8.1 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 11-12.

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 11-1 shows the percentage of high value habitat for species listed under the EPBC 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.

11.8.2 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 will be on hand during clearing to rescue any animals still remaining in the clearing area following the pre-clearance 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 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 the requirements of 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 migratory species and 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. Where monitoring indicates mitigation objectives are note being achieved, corrective action and amendment of procedures would be triggered, where relevant.

11.8.3 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 the open cut mining area and mine infrastructure area). 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 11.8.1).

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 both vegetation monitoring and threatened species monitoring. This monitoring will provide feedback 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. The plan will describe the alignment of the management measures with relevant recovery plans.

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 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. The management measures described in the plan will align with the relevant threat abatement plans. This will 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. 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 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).

Species Management Program

A Species Management Program is required to be developed and implemented for the project. The Species Management Program will outline actions to be taken to minimise impacts on animal breeding places and will be submitted to the Queensland government for approval prior to the commencement of construction activities. The program will include prescriptions on the nature and duration of pre-clearance 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.

11.9 OFFSETS

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

- 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).

11.10 WATER RESOURCES

The EPBC Act referral for the project provided an assessment of the project's potential for significant impacts on water resources against the EPBC Act *Significant impact guidelines 1.3: Coal seam gas and large coal mining developments—impacts on water resources* (DotE, 2013). The DotE declared the project a controlled action, with one of the controlling provisions for the project being:

> *"A water resource, in relation to coal seam gas development and large coal mining development".*

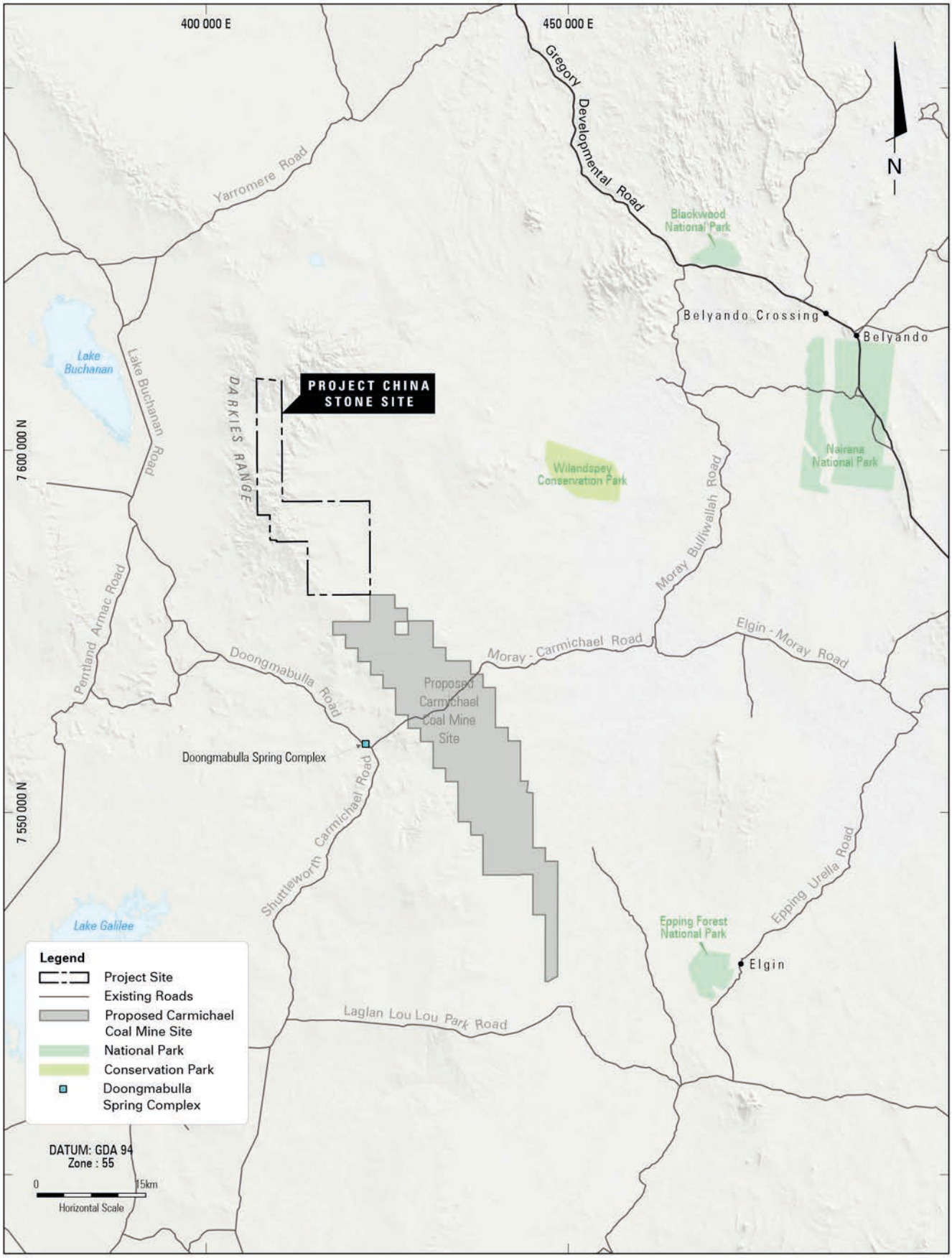
There are several technical studies relevant to the assessment of this controlling provision.

Table 11-2 lists the technical assessments relevant to this controlling provision, as well as the sections of the EIS that summarise these assessments. Section 12 of the EIS TOR requires that the MNES Section address the *Information Guidelines for Independent Expert Scientific Committee advice on coal seam gas and large coal mining development proposals*. In particular, it requires that a cross reference table is provided to identify where each component of the *Information Guidelines for Independent Expert Scientific Committee advice on coal seam gas and large coal mining development proposals* has been addressed. This cross reference table is provided as Attachment 11-2.

Table 11-2 EIS Studies Relevant to Water Resources Controlling Provision

TECHNICAL AREA	EIS REFERENCE	DESCRIPTION
Groundwater	Section 12 – Groundwater	This section provides an assessment of the impacts of the project on groundwater resources. It includes a description of the groundwater setting and an assessment of groundwater impacts.
	Groundwater Report (Appendix I)	This report provides a full assessment of groundwater issues, including a description of the groundwater setting, groundwater monitoring program, predicted impacts, mitigation measures and proposed monitoring program.
Surface Water	Section 13 – Surface Water	This section provides an assessment of the impacts of the project on surface water resources. It includes a description of the surface water setting, proposed mine water management strategies and mine water management system and an assessment of surface water impacts.
	Open Cut Mine Drainage Report (Appendix J)	This report provides a detailed assessment of the proposed open cut mine drainage arrangement and associated surface water impacts.
	Water Management System Modelling Report (Appendix K)	This report provides modelling of the performance of the proposed mine water management system.

FIGURES



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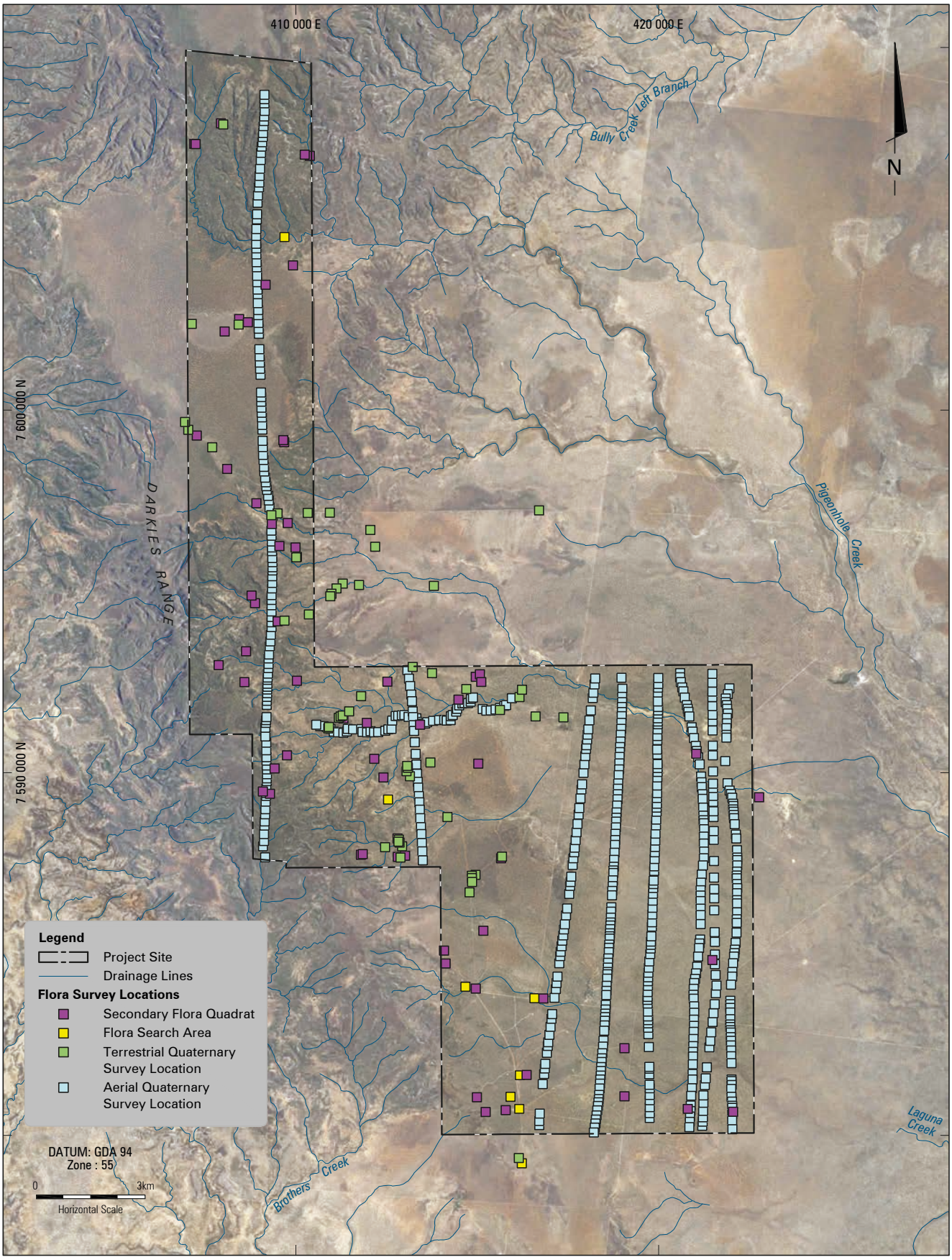
Regional Project Setting

FIGURE 11-1



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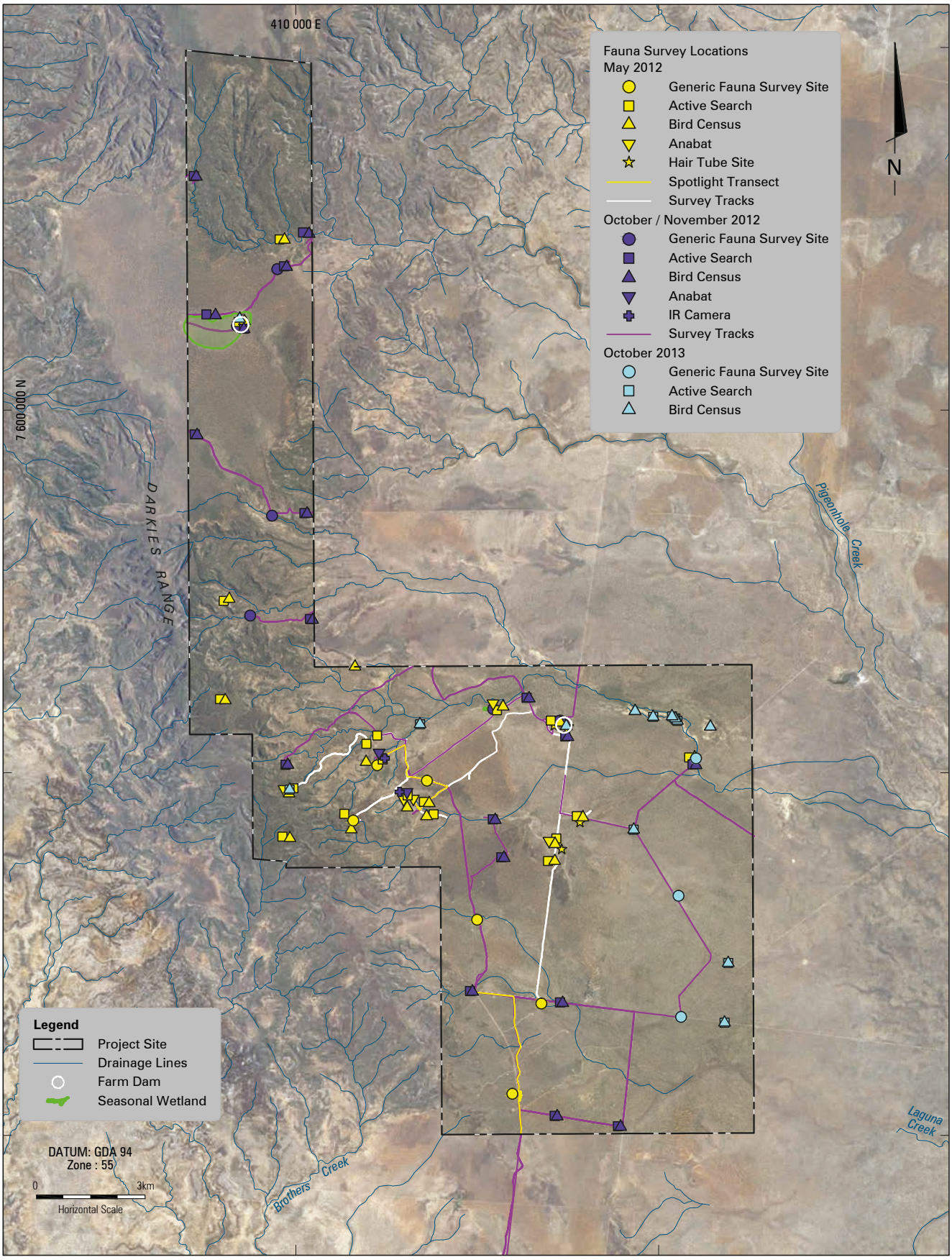
Flora Survey Sites

FIGURE 11-2



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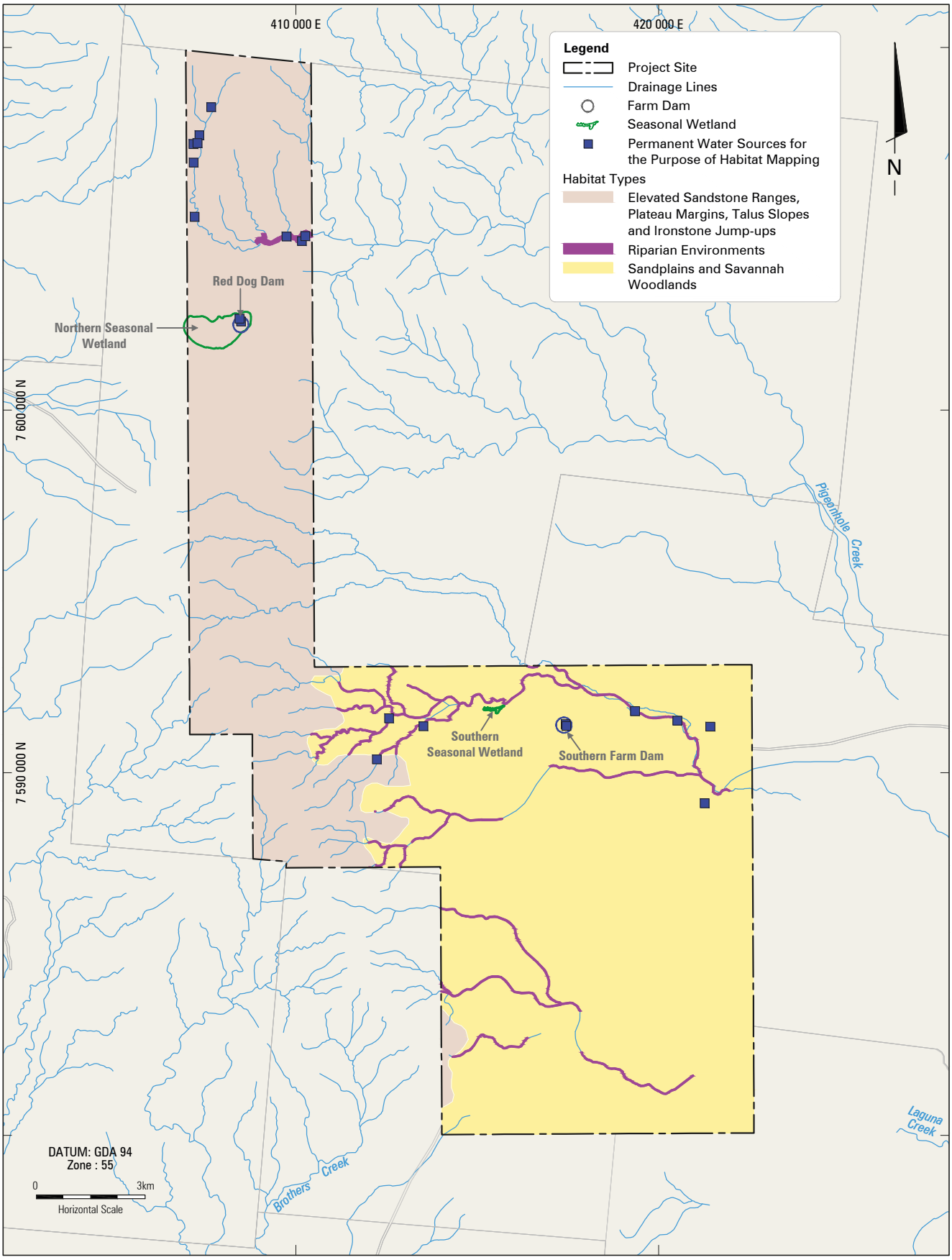
Fauna Survey Sites

FIGURE 11-3



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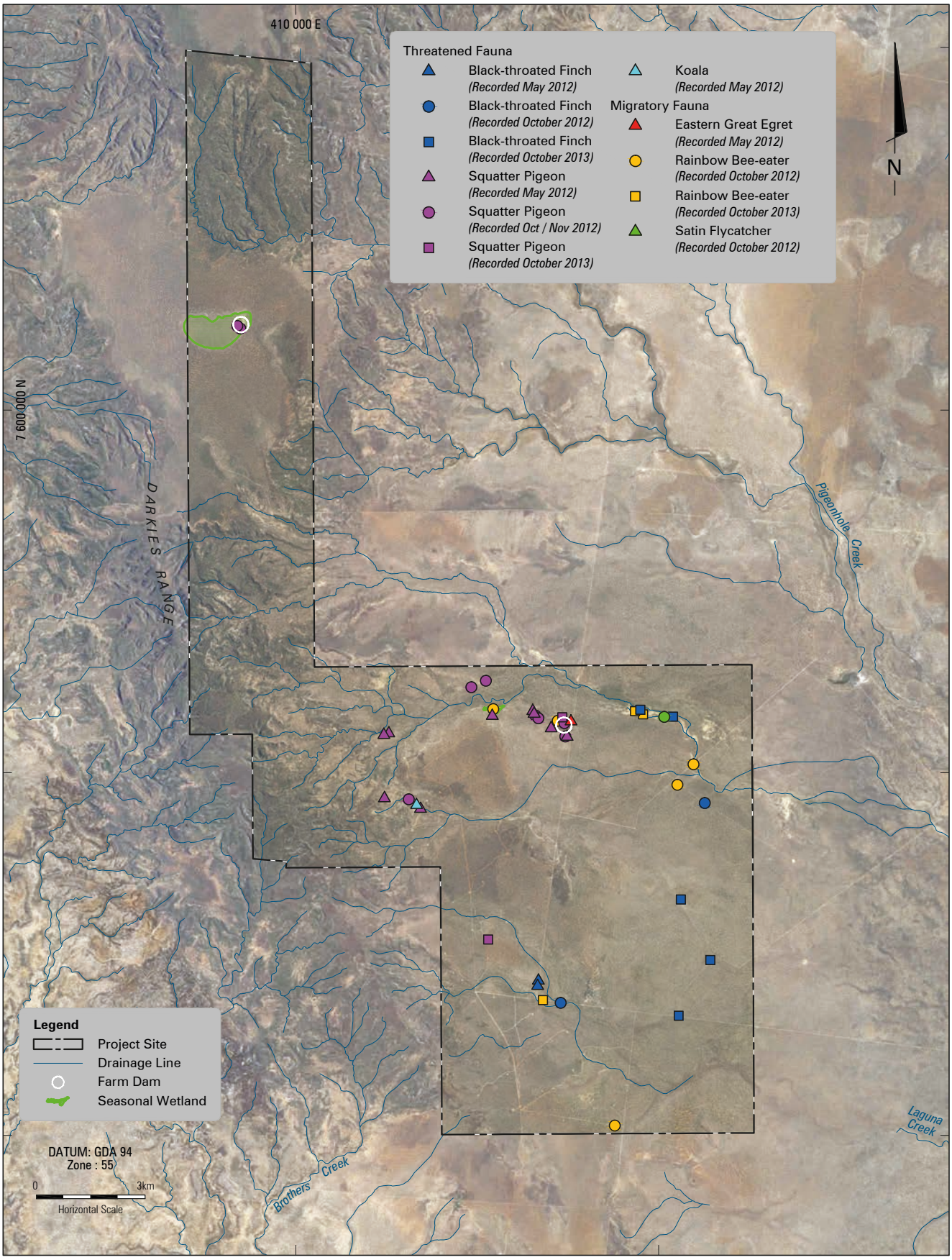
Habitat Types

FIGURE 11-4



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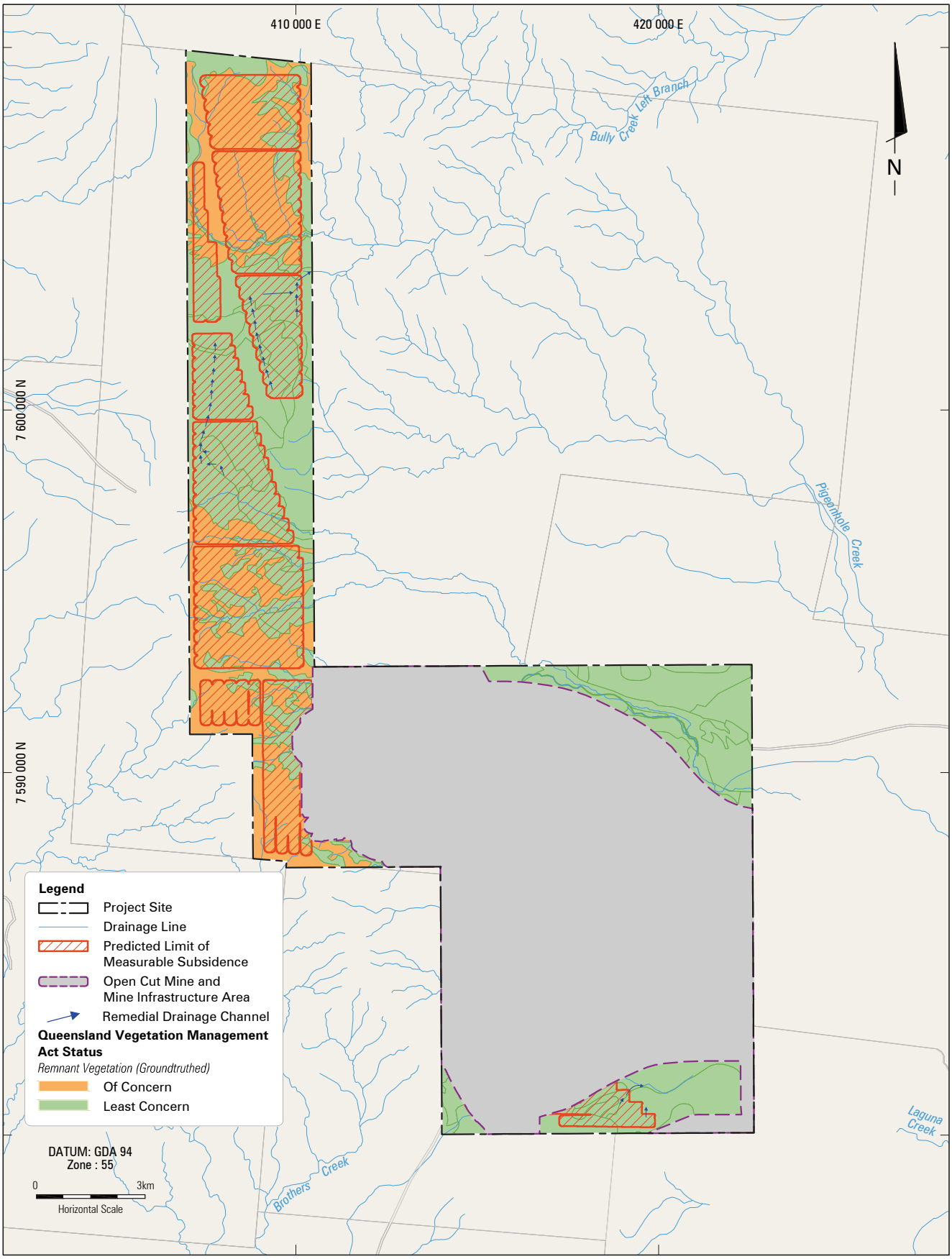
Threatened and Migratory Fauna Species Records within the Project Site

FIGURE 11-5



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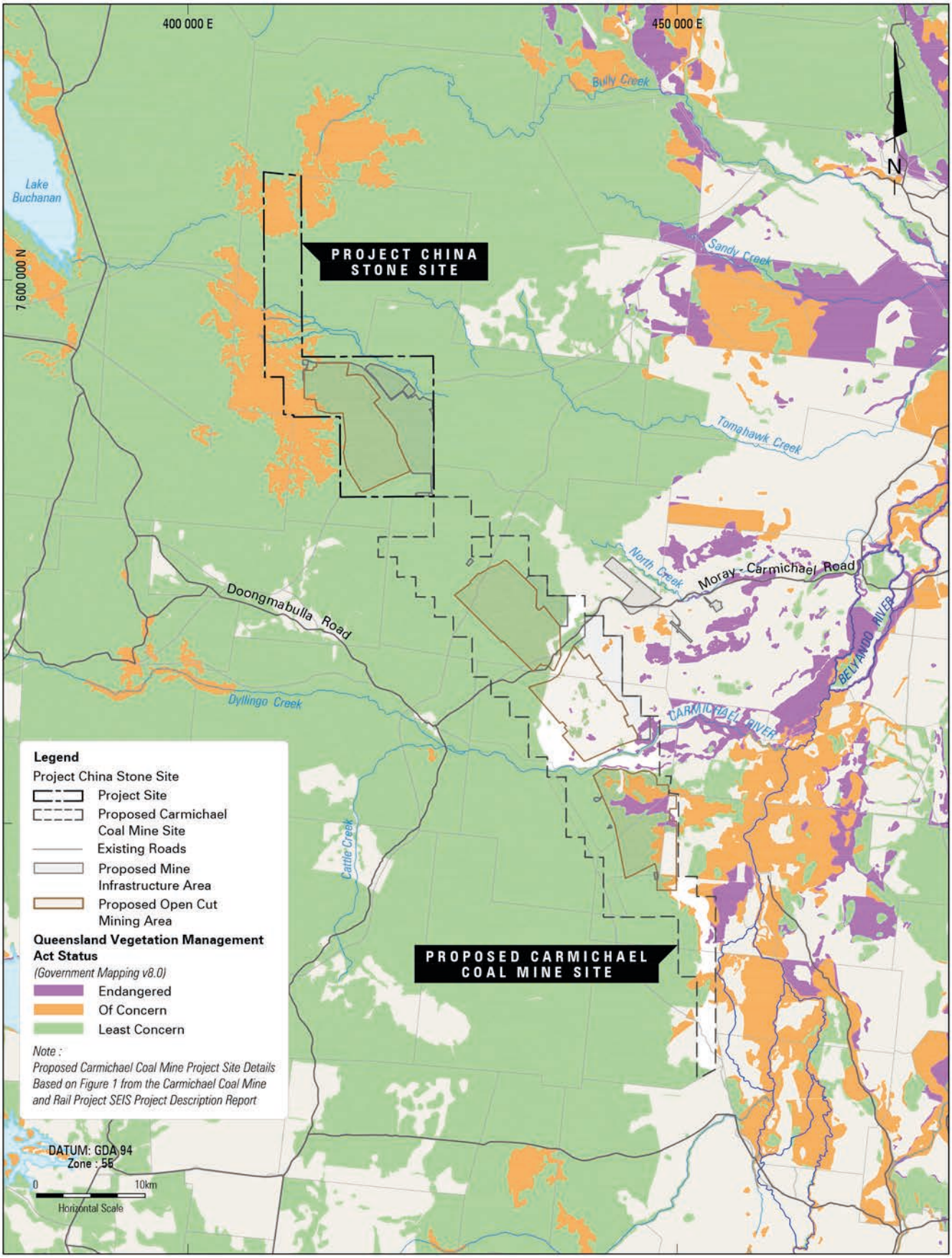
Project Disturbance Footprint

FIGURE 11-6



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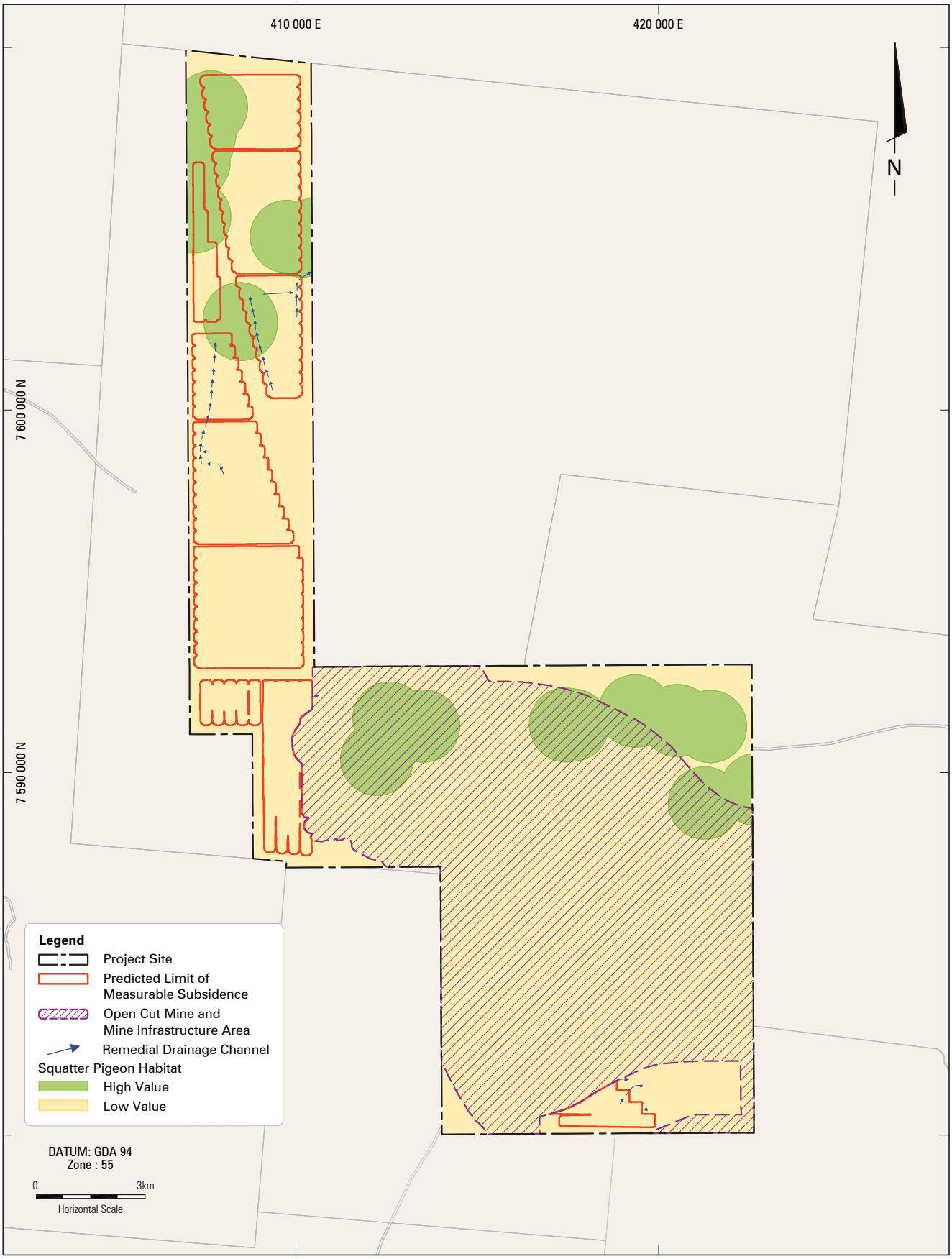
Regional Vegetation Connectivity

FIGURE 11-7



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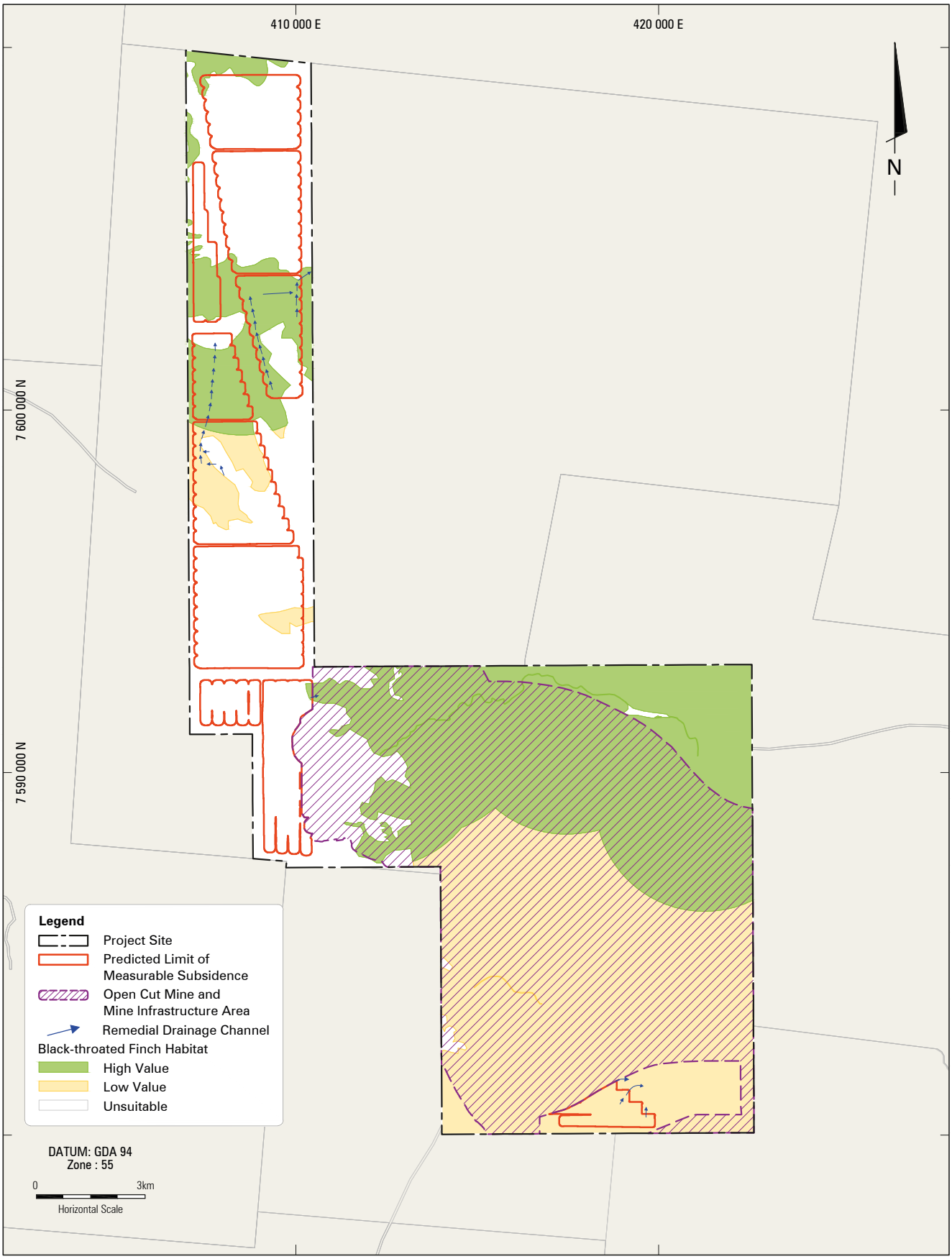
Squatter Pigeon Habitat

FIGURE 11-8



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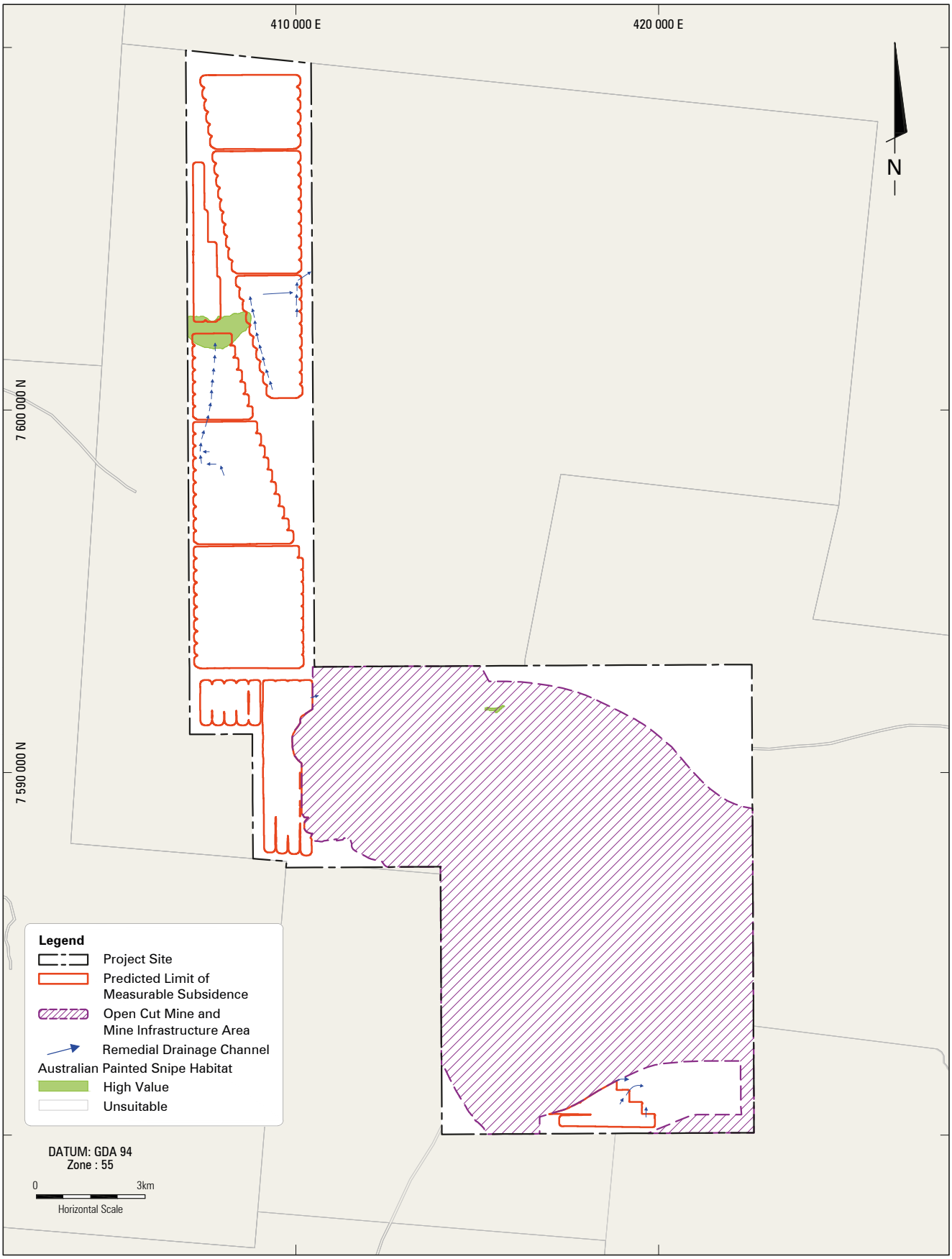
Black-throated Finch Habitat

FIGURE 11-9



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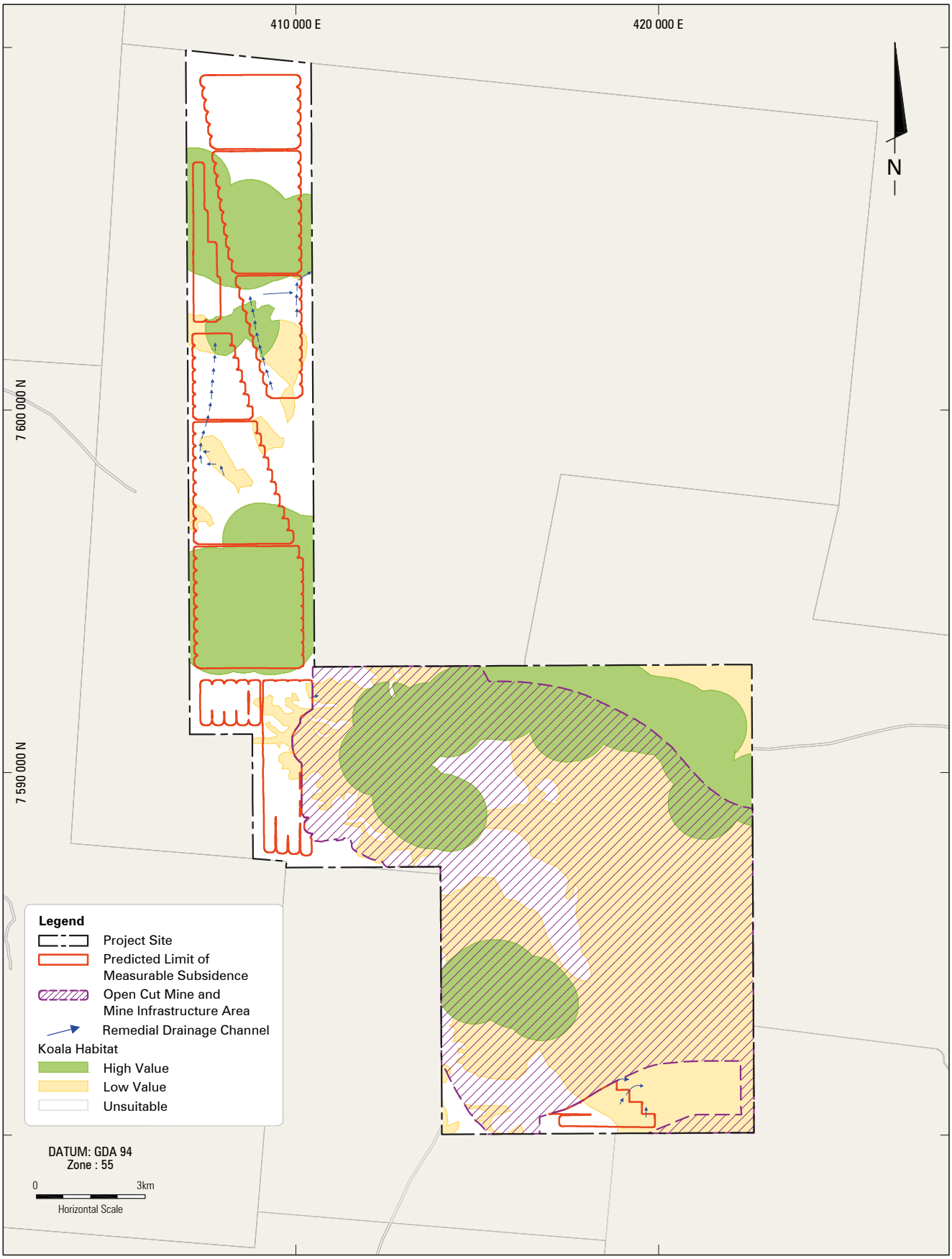
Australian Painted Snipe Potential Habitat

FIGURE 11-10



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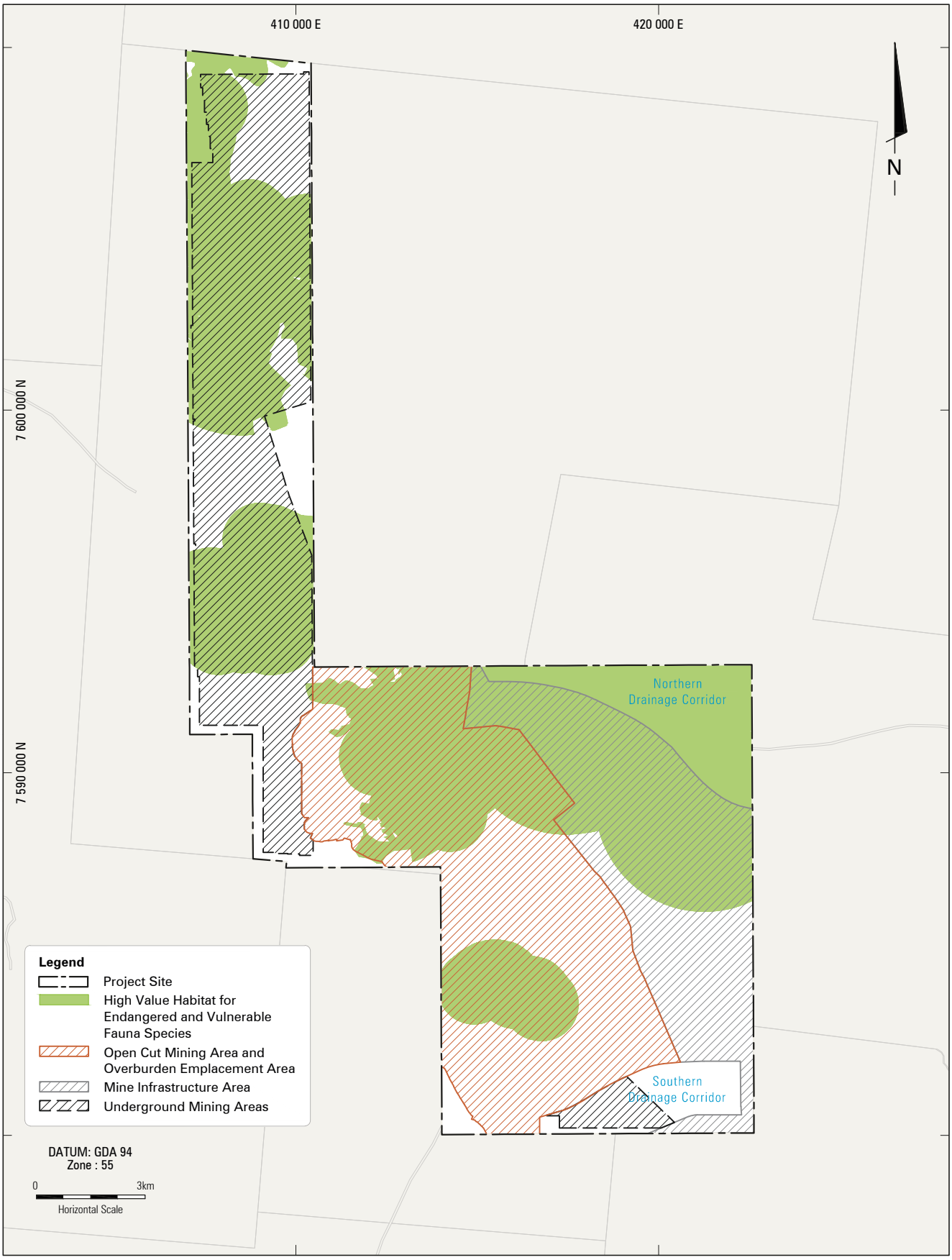
Koala Habitat

FIGURE 11-11



PROJECT CHINA STONE

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Habitat Disturbance

FIGURE 11-12

ATTACHMENTS

ATTACHMENT 11-1

Environment Protection and Biodiversity Conservation Regulations 2000

Table 1 Environment Protection and Biodiversity Conservation Regulations 2000

REQUIREMENT	EIS SECTION
Schedule 4—Matters to be addressed by draft public environment report and environmental impact statement (regulation 5.04)	
1 General information 1.01 The background of the action including: (a) the title of the action;	Section 1 – Introduction (Subsections 1.1 and 1.2)
(b) the full name and postal address of the designated proponent;	Section 1 – Introduction (Subsection 1.4)
(c) a clear outline of the objective of the action;	Section 1 – Introduction (Subsection 1.5.2)
(d) the location of the action;	Section 4 – Project Description (Subsection 4.3.1)
(e) the background to the development of the action;	Section 4 – Project Description (Subsection 4.5.2)
(f) how the action relates to any other actions (of which the proponent should reasonably be aware) that have been, or are being, taken or that have been approved in the region affected by the action;	Section 4 – Project Description (Subsections 4.3 and 4.4) Section 5 – Land Use (Subsection 5.3.1)
(g) the current status of the action;	Section 1 – Introduction (Subsection 1.6) Section 4 – Project Description (Subsection 4.14)
(h) the consequences of not proceeding with the action.	Section 4 – Project Description (Subsection 4.16.3)
2 Description 2.01 A description of the action, including: (a) all the components of the action;	Section 4 – Project Description
(b) the precise location of any works to be undertaken, structures to be built or elements of the action that may have relevant impacts;	Section 4 – Project Description (Subsections 4.6, 4.8, 4.9, 4.10, 4.11 and 4.12 and Figures 4-23 to 4-26)
(c) how the works are to be undertaken and design parameters for those aspects of the structures or elements of the action that may have relevant impacts;	Section 4 – Project Description (Subsections 4.6, 4.8, 4.9, 4.10, 4.11 and 4.12 and Figures 4-23 to 4-26)
(d) relevant impacts of the action; (e) proposed safeguards and mitigation measures to deal with relevant impacts of the action; (f) any other requirements for approval or conditions that apply, or that the proponent reasonably believes are likely to apply, to the proposed action;	These requirements underpin the EIS. They have provided the framework upon which each of the relevant sections and technical appendices of this EIS are based. As a result, these generic requirements have been addressed in all relevant sections of the EIS. MNES is discussed in Section 11 – Matters of National Environmental Significance.

REQUIREMENT	EIS SECTION
(g) to the extent reasonably practicable, any feasible alternatives to the action, including: (i) if relevant, the alternative of taking no action; (ii) a comparative description of the impacts of each alternative on the matters protected by the controlling provisions for the action; (iii) sufficient detail to make clear why any alternative is preferred to another;	Section 4 – Project Description (Subsection 4.16)
(h) any consultation about the action, including:	Section 3 – Consultation
(i) any consultation that has already taken place;	Section 3 – Consultation (Subsections 3.3 to 3.7)
(ii) proposed consultation about relevant impacts of the action;	Section 3 – Consultation (Subsection 3.8)
(iii) if there has been consultation about the proposed action—any documented response to, or result of, the consultation;	Section 3 – Consultation (Subsection 3.7)
(i) identification of affected parties, including a statement mentioning any communities that may be affected and describing their views.	Section 3 – Consultation (Subsection 3.4)
3 Relevant impacts 3.01 Information given under paragraph 2.01(d) must include: (a) a description of the relevant impacts of the action; (b) a detailed assessment of the nature and extent of the likely short term and long term relevant impacts;	These requirements underpin the EIS. They have provided the framework upon which each of the relevant sections and technical appendices of this EIS are based. As a result, these generic requirements have been addressed in all relevant sections of the EIS. MNES is discussed in Section 11 – Matters of National Environmental Significance.
(c) a statement whether any relevant impacts are likely to be unknown, unpredictable or irreversible;	Section 11 – Matters of National Environmental Significance (Subsection 11.7)
(d) analysis of the significance of the relevant impacts;	Section 11 – Matters of National Environmental Significance (Subsection 11.7) Appendix F (Subsections 3.4 and 5 and Appendix L)
(e) any technical data and other information used or needed to make a detailed assessment of the relevant impacts	Appendix F – *Terrestrial Ecology Report* Appendix I – *Groundwater Report* Appendix J – *Open Cut Mine Drainage Report*
4 Proposed safeguards and mitigation measures 4.01 Information given under paragraph 2.01(e) must include: (a) a description, and an assessment of the expected or predicted effectiveness of, the mitigation measures;	Section 11 – Matters of National Environmental Significance (Subsection 11.8)
(b) any statutory or policy basis for the mitigation measures;	Section 11 – Matters of National Environmental Significance (Subsections 11.2 and 11.8)
(c) the cost of the mitigation measures;	To be confirmed in detailed design.

REQUIREMENT	EIS SECTION
(d) an outline of an environmental management plan that sets out the framework for continuing management, mitigation and monitoring programs for the relevant impacts of the action, including any provisions for independent environmental auditing;	Section 11 – Matters of National Environmental Significance Section 24 – Environmental Management
(e) the name of the agency responsible for endorsing or approving each mitigation measure or monitoring program;	The Department of Environment and Heritage Protection.
(f) a consolidated list of mitigation measures proposed to be undertaken to prevent, minimise or compensate for the relevant impacts of the action, including mitigation measures proposed to be taken by State governments, local governments or the proponent.	Section 11 – Matters of National Environmental Significance (Subsection 11.8)
5 Other approvals and conditions 5.01 Information given under paragraph 2.01(f) must include: (a) details of any local or State government planning scheme, or plan or policy under any local or State government planning system that deals with the proposed action, including:	Section 2 - Regulatory Framework (Attachment 2-1, Table 2)
(i) what environmental assessment of the proposed action has been, or is being, carried out under the scheme, plan or policy;	Section 2 - Regulatory Framework (Attachment 2-1, Table 2)
(ii) how the scheme provides for the prevention, minimisation and management of any relevant impacts;	Section 2 - Regulatory Framework (Attachment 2-1, Table 2)
(b) a description of any approval that has been obtained from a State, Territory or Commonwealth agency or authority (other than an approval under the Act), including any conditions that apply to the action;	Section 11 – Matters of National Environmental Significance (Subsection 11.2)
(c) a statement identifying any additional approval that is required;	Section 2 - Regulatory Framework (Subsections 2.2 and 2.3)
(d) a description of the monitoring, enforcement and review procedures that apply, or are proposed to apply, to the action.	Section 11 – Matters of National Environmental Significance (Subsection 11.2)
6 Environmental record of person proposing to take the action 6.01 Details of any proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against	Section 24 – Environmental Management (Subsection 24.3.1)
(a) the person proposing to take the action; and	Section 24 - Environmental Management (Subsection 24.3.1)
(b) for an action for which a person has applied for a permit, the person making the application.	Not applicable.

REQUIREMENT	EIS SECTION
6.02 If the person proposing to take the action is a corporation—details of the corporation's environmental policy and planning framework.	Section 24 - Environmental Management (Attachment 24-1 and Subsection 24.3)
7 Information sources 7.01 For information given in a draft public environment report or environmental impact statement, the draft must state: (a) the source of the information; and (b) how recent the information is; and (c) how the reliability of the information was tested; and (d) what uncertainties (if any) are in the information.	These requirements underpin the EIS. They have provided the framework upon which each of the relevant sections and technical appendices of this EIS are based. As a result, these generic requirements have been addressed in all relevant sections of the EIS. MNES is discussed in Section 11 – Matters of National Environmental Significance Section 11 – Matters of National Environmental Significance (Subsections 11.5 to 11.7), Appendix F – *Terrestrial Ecology Report* (Subsections 3 to 5), Appendix G – *Aquatic Ecology and Stygofauna Report* (Subsections 3 to 5), Appendix H – *Biodiversity Offset Strategy* (Subsection 3).

ATTACHMENT 11-2

Information Guidelines for Independent Expert Scientific Committee Advice on Coal Seam Gas and Large Coal Mining Development Proposals

Table 1 Information Guidelines for Independent Expert Scientific Committee Advice on Coal Seam Gas and Large Coal Mining Development Proposals

REQUIREMENT	EIS SECTION
1. A description of the proposal	
(a) An overall description of the proposal that clearly describes its location, purpose, character, duration, scale and the means by which it is likely to have a significant impact on water resources.	Section 4 – Project Description
(b) A description of the statutory context, including information on the proposal's status within the regulatory assessment process and on any water management policies or regulations applicable to the proposal.	Section 2 – Regulatory Framework
2. Contextual information	
Background data and conceptual modelling is needed to provide a description of baseline water resources and the water related assets supported by those resources.	Section 12 – Groundwater (Subsection 12.3) and Appendix I – *Groundwater Report* (Subsections 6 and 7) describe the existing groundwater regime Section 13 – Surface Water (Subsection 13.2) and Appendix J – *Open Cut Mine Drainage Report* (Subsection 2) describe the catchment and drainage setting
Background data This information should include but is not limited to: (a) A description of the water resources of the site and region, incorporating raw data such as records of seasonal and historic annual variations in rainfall, evaporation, groundwater and surface water quality and quantity, including hydrographs and well logs. Data should include dates and locations of measurements, flow conditions and elevations of the reference points from which water levels were measured. Maps of all relevant surface water and groundwater resources should be provided.	Section 10 – Aquatic Ecology (Subsection 10.5) Section 12 – Groundwater (Subsection 12.3) and Appendix I – *Groundwater Report* (Subsections 6 and 7) describe the existing groundwater regime Section 13 – Surface Water (Subsection 13.2) and Appendix J – *Open Cut Mine Drainage Report* (Subsection 2) describe the catchment and drainage setting Section 14 – Climate, Section 13 – Surface Water (Subsection 13.5), Appendix J – *Open Cut Mine Drainage Report* (Subsection 5), and Appendix I – *Groundwater Report* (Subsection 3.4) describe climate data relating to water resources Appendix I – *Groundwater Report* (Subsection 6 and Appendix A) provides raw groundwater data including hydrographs and well logs Appendix J – *Open Cut Mine Drainage Report* (Subsections 5 and 6) describe existing flow conditions Supporting figures are provided throughout these sections where necessary

REQUIREMENT	EIS SECTION
(b) Descriptions and mapping of geology at an appropriate level of spatial and vertical resolution (i.e. at both site and regional scale) including: definition of the geological sequence in the area, with names and descriptions of the formations with accompanying surface geology and cross sections; and definitions of any geological structures (e.g. faults) in the area and descriptions of the influence of the structures on groundwater, in particular, groundwater flow, discharge or recharge.	Section 4 – Project Description (Subsection 4.5) and Appendix I – *Groundwater Report* (Subsection 4) describe the geological setting Figures 4-9 to 4-11 and Figures 12-2 to 12-5 show the mapped geology at local and regional scales Section 12 – Groundwater (Subsections 12.3 and 12.4 and Appendix I – *Groundwater Report* (Subsections 7 and 8.3 and Appendix B) describe the influence of structures on groundwater
(c) Descriptions of hydraulic characteristics (e.g. hydraulic conductivity and storage characteristics) for each hydrogeological unit.	Section 12 – Groundwater (Subsection 12.3) Appendix I – *Groundwater Report* (Subsections 6 and 7 and Appendices A and B)
(d) Presentation of data to demonstrate the varying depths to the hydrogeological units and associated standing water levels or potentiometric heads, including values, contour maps and hydrochemical characteristics.	Section 12 – Groundwater (Subsection 12.3) Appendix I – *Groundwater Report* (Subsections 6 and 7 and Appendices A and B)
(e) Definition of the likely recharge sources for each hydrogeological unit, details of discharge from the hydrogeological units, direction of groundwater flow and discharge pathways for all hydrogeological units likely to be impacted by the proposed development.	Section 12 – Groundwater (Subsection 12.3) Appendix I – *Groundwater Report* (Subsections 6 and 7)
(f) Description of the hydrological regime, including drainage patterns, watercourse hydrographs and spatial and temporal and seasonal trends in streamflow and/or standing water levels, water quality data (such as turbidity, acidity, salinity, relevant organic chemicals, metals and metalloids, radionuclides and other potentially harmful chemicals), and geomorphology for all watercourses across the site.	The Department of Natural Resources and Mines have conducted a watercourse determination, under the *Water Act 2000* ,which confirmed there are no watercourses within the project site Section 13 – Surface Water (Subsection 13.2.4) presents relevant surface water quality data Section 13 – Surface Water (Subsection 13.2) and Appendix J – *Open Cut Mine Drainage Report* (Subsection 2) describe the drainage patterns
(g) Description of the existing flood regime, including flood volume, depth, duration, extent and velocity for a range of annual exceedance probabilities, including flood hydrographs and maps identifying peak flood extent, depth and velocity.	Section 13 – Surface Water Appendix J – *Open Cut Mine Drainage Report* (Subsections 5 and 6)
(h) Assessments of the frequency, volume and direction of interactions between water sources, including surface water/ groundwater connectivity, inter-aquifer connectivity and connectivity with sea water.	Section 12 – Groundwater (Subsections 12.3, 12.4.5 and 12.4.6) describe groundwater-surface water interactions Section 13 – Surface Water (Subsection 13.2) describes project connectivity with the sea

REQUIREMENT	EIS SECTION
(i) Identification of water related assets of the site and region, including habitat, fauna and flora surveys as they relate to dependence on surface water and groundwater resources, including the location of springs and other groundwater dependent ecosystems (GDEs), identification of the hydrogeological unit on which the GDEs are dependent and an estimation of the ecological water requirements of identified GDEs. GDEs should be identified in accordance with the methodology outlined by Eamus et al. (2006)	Water related assets are identified in the following: Section 12 – Groundwater (Subsections 12.3 and 12.4), Section 13 – Surface Water (Subsection 13.2) and Appendix I – *Groundwater Report* (Subsections 2, 3 and 7) Stygofauna is addressed in Appendix G – *Aquatic Ecology and Stygofauna Report* (Subsections 4.8 and 5.6) GDEs are addressed in Appendix G – *Aquatic Ecology and Stygofauna Report* (Subsection 4.4) Dams and wetlands are addressed in Section 10 – Aquatic Ecology (Subsections 10.5.1, 10.6.3 and 10.7) and Appendix G – *Aquatic Ecology and Stygofauna Report* (Subsection 5)
(j) Relevant information generated by a bioregional assessment. Where a bioregional assessment has not been initiated and/or completed, best available information should be used in describing the existing location and condition of water related assets at the regional scale.	No bioregional assessments have been completed for the project site Section 13 – Surface Water (Subsection 13.2) and Appendix J – *Open Cut Mine Drainage Report* (Subsection 2) describe the regional catchment and drainage setting Regional inputs to the groundwater assessment are described in Section 12 – Groundwater (Subsection 12.2) and Appendix I – *Groundwater Report* (Subsections 2.2, 4 and 5 and Appendix A)
Conceptual modelling A conceptual model(s) is the most appropriate basis for assessing potential changes in water resources and water related assets. In some cases, it may be necessary to develop conceptual models for different components of the designated region.	Noted
In general terms, a conceptual model is a pictorial hydrological, hydrogeological and ecological representation of the site showing the stores, flows and uses of water, including use of water by ecosystems. A conceptual model provides the basis for developing water and salt balances and a numerical model. The model should show the geological formations, water resources and water related assets likely to be impacted by the proposal.	The local and regional conceptual groundwater regime is described and illustrated in Section 12 – Groundwater (Subsection 12.3 and Figure 12-4) and Appendix I – *Groundwater Report* (Subsection 7 and Figure 25) The conceptual hydrology of the project site and surrounding catchment is described in Section 13 – Surface Water (Subsection 13.2)

REQUIREMENT	EIS SECTION
The level of detail within the conceptual model should be based on the impact assessment objectives, data availability and knowledge of the water resources and flow processes within a designated region. These resources and processes should be identified in the conceptual model, and include those related to surface water, groundwater and the atmosphere.	The impact assessment objectives relating to each water resource and water related asset are described in the relevant sections of the EIS The conceptual understanding of the local and regional hydrology and hydrogeology has been informed by detailed information gathering, field investigations and modelling and is suitably detailed to support the assessments undertaken for the EIS Impact assessments are provided in Section 9 – Terrestrial Ecology (Subsection 9.6), Section 10 – Aquatic Ecology (Subsection 10.6), Section 12 – Groundwater (Subsection 12.3) and Section 13 – Surface Water (Subsection 13.6).
An example of a regional conceptual model, showing aquifers and aquitards, and how groundwater systems interact with possible CSG extraction, is provided in Figure 1 on the next page, in relation to the Surat Cumulative Management Area in Queensland. Such a conceptual model would be improved by showing the known, or estimated, hydrological/hydrogeological fluxes in the system.	Noted
3. Data analysis and modelling, including water and salt balances	
Data analysis and modelling The data analysis and modelling will build on the background data and conceptual modelling to enable an analysis of potential impacts on water resources and water related impacts from the development proposal. The information provided should include but not be limited to:	Noted
(a) Surface water and groundwater assessments and modelling, including detailed hydrology and water quality assessments.	Section 12 – Groundwater Section 13 – Surface Water Appendix I – *Groundwater Report* Appendix J – *Open Cut Mine Drainage Report* Appendix K – *Water Management System Modelling Report*
(b) Groundwater models that are calibrated to baseline conditions and enable a probabilistic evaluation of potential future scenarios. The groundwater modelling, and associated reporting, should:	Section 12 – Groundwater (Subsection 12.4.2) Appendix I – *Groundwater Report* (Subsection 8.3 and Appendix B)
(i) outline the model conceptualisation of the hydrogeological system or systems, including key assumptions and model limitations;	Section 12 – Groundwater (Subsection 12.4.2) Appendix I – *Groundwater Report* (Subsection 8.3 and Appendix B)

REQUIREMENT		EIS SECTION
(ii)	represent each hydrogeological unit, their thickness, storage and flow characteristics of each unit, linkages between units, if any, and the existing recharge/discharge pathways of the units and the changes that are predicted to occur upon commencement, throughout, and after completion of the development activities;	Section 12 – Groundwater (Subsection 12.4.2) Appendix I – *Groundwater Report* (Subsection 8.3 and Appendix B)
(iii)	capture solute transport modelling, if required;	Not required
(iv)	incorporate the various stages of the proposed development and provide predictions of water level and/or pressure declines in each hydrogeological unit for the life of the project and beyond, including pre and post development water level or potentiometric surface contour maps for each hydrogeological unit;	Mine scheduling is discussed in Appendix I – *Groundwater Report* (Subsection 8.3 and Appendix B) Model predictions are presented in Appendix I – *Groundwater Report* (Subsection 8.4 and Figures 27 to 48) The water level and/or pressure declines during mining operations are discussed in Appendix I – Groundwater (Section 8.5 and Figures 27 to 33).The water level and/or pressure declines post mining are discussed in Appendix I – Groundwater (Section 8.5 and Figures 35 to 41).
(v)	provide information on the time for maximum drawdown and post development drawdown equilibrium to be reached;	The operational and post mining drawdown predictions are presented in Section 12 – Groundwater (Subsection 12.4.2) and Appendix I – *Groundwater Report* (Subsection 8.4 and Figures 27 to 48)
(vi)	identify the volumes predicted to be dewatered on an annual basis with an indication of the proportion supplied from each hydrogeological unit;	Groundwater inflows to the open cut mine and underground mines are presented in Section 12 – Groundwater (Subsection 12.4.2) and Appendix I – *Groundwater Report* (Subsection 8.4 and Figures 33, 40 and 41)
(vii)	provide information on potential water level recovery rates and timeframes in each hydrogeological unit for the life of the project and beyond;	Groundwater recovery is described in Section 12 – Groundwater (Subsection 12.4.2) and Appendix I – *Groundwater Report* (Subsection 8.4)
(viii)	consider a variety of boundary conditions across the model domain, including constant head or general head boundaries, river cells and drains, to enable a comparison of groundwater model outputs to seasonal field observations;	The model boundary conditions are described in Section 12 – Groundwater (Subsection 12.4.2) and Appendix I – *Groundwater Report* (Subsection 8.3 and Appendix B)
(ix)	include a sensitivity analysis of boundary conditions and justification for the conditions applied in the final groundwater model;	The model boundary conditions are described in Section 12 – Groundwater (Subsection 12.4.2) and Appendix I – *Groundwater Report* (Subsection 8.3 and Appendix B) The sensitivity analysis undertaken for the groundwater modelling is described in Section 12 – Groundwater (Subsection 12.4.2) and Appendix I – *Groundwater Report* (Subsection 8.3 and Appendix B)

REQUIREMENT		EIS SECTION
(x)	be undertaken in accordance with the Australian Groundwater Modelling Guidelines , including being peer reviewed; and	The groundwater model was undertaken in accordance with the Australian Groundwater Modelling Guidelines as discussed in Appendix I – *Groundwater Report* (Subsection 8.3 and Appendix B)
(xi)	include recommendations and a program for review and update of the models as more data and information becomes available.	A groundwater monitoring program will be conducted over the 50 year life of the mine to confirm the actual extent of groundwater impacts and validate the conservative predictions. The groundwater monitoring program is described in Section 12 – Groundwater (Subsection 12.5) and Appendix I – *Groundwater Report* (Subsection 9)
(c) An assessment of the quality of, and risks and uncertainty inherent in, the data used in the background data and modelling, particularly with respect to predicted potential scenarios.		Section 12 – Groundwater (Subsection 12.2) and Appendix I – *Groundwater Report* (Subsections 1, 5 and 6 and Appendix A) detail the extensive body of data incorporated into the groundwater model developed for the project It should be noted that the data collected from monitoring bores and vibrating wire piezometers installed at the adjacent proposed Carmichael Coal Project site was included as a starting point for the project groundwater model. This dataset was then compounded with additional data from field investigations undertaken at the project site, its locality and the surrounding region. The proponent has therefore utilised an extensive and robust body of data for use in the groundwater model calibration and predictions The proponent has further mitigated residual uncertainty by adopting highly conservative modelling assumptions for key model parameters and design features, including hydraulics and subsidence cracking behaviour. Section 12 – Groundwater (Subsection 12.4.2) and Appendix I – *Groundwater Report* (Subsection 8.3 and Appendix B) explain that inherent conservatism of these assumptions. These assumptions more than adequately account for any residual uncertainty associated with data used to develop key model parameters and design features, and therefore provide a conservative basis for assessing potential worst case groundwater impacts Despite these conservative assumptions, the groundwater modelling demonstrated that there is low potential for significant impacts to water related assets, including springs of the Great Artesian Basin. The predictions reflect the fact that the key local aquifer (the Clematis Sandstone) is largely dry and unsaturated within the vicinity of the project site The sensitivity of the model predictions to the input

REQUIREMENT	EIS SECTION
	parameters was tested and analysed. The sensitivity analysis included testing the effects of changes in hydraulic conductivity, specific yield and storage, rainfall recharge and the properties of the geological fault on the predicted results. The results of the sensitivity analysis are presented in Appendix I – *Groundwater Report* (Appendix B) Crucially, the model parameters and design features were adjusted to encompass the range of likely uncertainty in the baseline data underpinning the modelling predictions (i.e. extreme values and characteristics). It should be noted that the magnitude of these adjustments were so extreme as to reduce the ability of the model to match measured water levels and degrade the calibration statistics of the model Based upon this approach, further analysis of uncertainty, for example using probabilistic model inputs, would be unlikely to materially change the outcomes of the assessment A probabilistic assessment of project impacts is only considered warranted when a) the predictions subject to significant uncertainty; and/or b) the potential impacts are significant As discussed above, the EIS groundwater assessment includes a 'traditional' sensitivity analysis that clearly demonstrates that predicted impacts are not subject to significant uncertainty. Furthermore, previous experience indicates that impacts predicted by probabilistic uncertainty are typically within the ranges provided by traditional sensitivity analysis, which is therefore sufficient The significance of the project impacts are discussed above and are limited by an elevated project setting where the key aquifers are largely dry and unsaturated, remoteness from springs of the Great Artesian Basin and watercourses, and groundwater use by private landholders is sparse. The EIS groundwater assessment concludes there are no potential significant adverse impacts due to these factors and probabilistic uncertainty analysis is not needed to provide confidence in this conclusion
Water and salt balances Site specific water and salt balances, complemented by an understanding of the inputs, outputs and exchanges of water in a region, should be available for both pre and post development scenarios. Where appropriate, these should then be verified and updated using the results of numerical modelling.	Section 13 – Surface Water (Subsection 13.5) Appendix K – *Water Management System Modelling* Report

REQUIREMENT	EIS SECTION
Information should be provided about the set of water and salt stores and the movement of water and salt between those stores, taking into account seasonal and long term climate variation. An assessment is required of the changes to any store or flow of water, including changes to the concentration and mass of salt loads, and the changes to the properties of those stores arising from the development proposal.	Section 13 – Surface Water (Subsection 13.5) Appendix K – *Water Management System Modelling* Report
Figure 2 provides an illustrative example of the elements that form the basis for a site specific water balance for CSG and large coal mining development proposals. The letters on the diagram correspond to the specific flows and changes that need to be identified. These flows and changes include:	Noted
A Hydrogeological unit storage properties and groundwater flows and pressures resulting from the depressurisation and/or dewatering of target coal measures.	The model parameters (including hydrogeological properties) are presented in Appendix I – *Groundwater Report* (Appendix B) Depressurisation effects of mining including changes to groundwater levels and groundwater inflows are presented in Section 12 – Groundwater (Subsection 12.4.2) and Appendix I – *Groundwater Report* (Subsection 8.4)
B Water infiltration from surface stores.	Nil infiltration loss from water storages dams have been adopted for the assessment of water movement, in accordance with Queensland guidelines for the assessment of water management system performance This approach represents a worst-case (or maximum containment scenario) in terms of mine water management Section 13 – Surface Water (Subsection 13.3) describe the infiltration of water in the open cut and underground mines
C An estimation of flow/exchange of water between overlying and/or underlying hydrogeological units and the target coal measure for all major units over the project area.	The flow and exchange of water between surface water and each groundwater unit is captured within the groundwater model presented in Appendix I – *Groundwater Report* (Appendix B)
D Waste-water from the proposal, including brine treatment processes, disposal methods, volumes and timing.	Section 4 – Project Description (Subsection 4.8.5) Section 13 – Surface Water (Subsections 13.3 and 13.5) Section 24 – Environmental Management (Attachment 24-2) Appendix K – *Water Management System Modelling Report*
E All volumes and quality of water intended for injection.	Not applicable – the project does not involve the injection of water into the coal seams.

REQUIREMENT	EIS SECTION
F Volumes and quality of water used during mining or CSG activities, including within the mine itself (for example, coal washing, dust suppression) and for other associated activities (for example, cooling or other industrial processes).	The volume and quality of water supplies and demands are described in Section 13 – Surface Water (Subsections 13.3 and 13.5) and Appendix K – *Water Management System Modelling Report*
G Volumes, quality and sources of water that is not available from within the extraction and treatment loops that must be imported from elsewhere. This water may be from surface, underground or from another activity external to the system boundary.	The external water supply requirement is discussed in Section 13 – Surface Water (Subsection 13.5) and Appendix K – *Water Management System Modelling Report* (Subsection 5.3) Sources of external water supply are presented in Section 4 – Project Description and Section 13 – Surface Water (Subsection 13.5.5)
H All existing interactions and flows that are part of the background (baseline) water flows of any given system. For example: recharge and discharge for each hydrogeological unit and seepage/recharge for each surface water store; rainfall interception and evaporation; and where there is a shallow subsurface transition zone (hyporheic) of interchange between surface water and groundwater where water may recharge the underlying hydrogeological units, or may be discharged to the surface water system.	Baseline groundwater conditions are described in Section 12 – Groundwater (Subsection 12.3) Groundwater – surface water interactions are described in Section 12 – Groundwater (Subsection 12.4) Groundwater recharge and discharge are discussed in detail in Appendix I – *Groundwater Report* (Subsections 6 and 7 and Appendix B)
I Estimates of water use in transpiration by vegetation, and the predicted changes to vegetation water use as a result of the proposal.	Evapotranspiration rates are assessed in Appendix K – *Water Management System Modelling Report* in relation to water management
4. Assessment of impacts on water resources and water related assets	
The assessment of impacts should identify the potential impacts to water resources and water related assets from the proposal. The assessment should include but not be limited to:	Noted
(a) an assessment of how the development proposal will change the water and salt balances;	Section 13 – Surface Water (Subsections 13.5.5 and 13.6) Section 24 – Environmental Management (Attachment 24-2) Appendix K – *Water Management System Modelling Report*
(b) predictions of subsidence and effects from dewatering and depressurisation (including lateral effects) on surface topography, water related assets, groundwater and movement of water across the landscape and possible fracturing of and other damage to confining layers;	Subsidence predictions are presented in Section 6 – Subsidence and Appendix A – *Subsidence Report* Groundwater depressurisation and dewatering are discussed in Section 12 – Groundwater (Subsection 12.4.2) and Appendix I – *Groundwater Report* (Subsection 8.4 and Appendix B)
(c) the hydrogeological units that will be directly impacted by mining or CSG operations, including the units that will be exposed/partially removed by open cut mining and/or underground mining;	Section 12 – Groundwater (Subsection 12.4) Appendix I – *Groundwater Report* (Subsection 8)

REQUIREMENT	EIS SECTION
(d) any hydrogeological units that will be dewatered or indirectly impacted by dewatering in connected units;	Section 12 – Groundwater (Subsection 12.4) Appendix I – *Groundwater Report* (Subsection 8)
(e) the extent of impact on hydrological interactions between water resources, including surface water/groundwater connectivity, inter-aquifer connectivity and connectivity with sea water;	Section 12 – Groundwater (Subsection 12.4) Appendix I – *Groundwater Report* (Subsection 8)
(f) predictions of the extent of the cone of depression and consequential impacts on water resources;	Section 12 – Groundwater (Subsection 12.4) Appendix I – *Groundwater Report* (Subsection 8)
(g) impacts associated with surface water diversions;	No diversions are proposed as part of the project Surface water drainage impacts are addressed in Section 13 – Surface Water (Subsection 13.6) and Appendix J – *Open Cut Mine Drainage Report*
(h) an assessment of direct and indirect impacts on water related assets, including ecological assets such as flora and fauna dependent on surface water and groundwater, springs and other GDEs (e.g. riparian vegetation, base flows in streams);	Groundwater impacts on water related assets are addressed in Section 12 – Groundwater (Subsection 12.4) and Appendix I – *Groundwater Report* (Subsection 8) Surface water impacts on water related assets are addressed in Section 13 – Surface Water (Subsection 13.6) Impacts on ecological water related assets are addressed in Section 10 – Aquatic Ecology (Subsections 10.6 to 10.8)
(i) impacts on hydraulic properties of hydrogeological units, including potential changes in storage, potential for physical transmission of water within and between units, effects of depressurisation due to gas extraction and estimates of likelihood of leakage of contaminants from coal beds through hydrogeological units;	The effects on mining on the hydraulic properties of hydrogeological units are addressed in Section 12 – Groundwater (Subsection 12.4.2) and Appendix I – *Groundwater Report* (Subsection 8.2 and Appendix B) The project does not involve gas extraction and no coal seam gas projects are currently proposed in the vicinity of the project site The potential project impacts on groundwater quality are addressed in Section 12 – Groundwater (Subsection 12.4.8) and Appendix I – *Groundwater Report* (Subsection 8.7)
(j) estimates of the quality and quantity of operational discharges of water (particularly saline water), including potential emergency discharges due to unusual events, and the likely impacts on water related assets;	Section 13 – Surface Water (Subsection 13.5.5) Appendix K – *Water Management System Modelling Report* (Subsection 5.2)
(k) indication of the vulnerability to contamination (for example, from salt production and salinity) and the likely impacts of contamination on the identified water related assets;	Section 10 – Aquatic Ecology (Subsection 10.6) Section 12 – Groundwater (Subsection 12.4) Section 13 – Surface Water (Subsection 13.6) Appendix I – *Groundwater Report* (Subsection 8)

REQUIREMENT	EIS SECTION
(l) identification and consideration of landscape modifications, for example, voids, onsite earthworks, roadway and pipeline networks through effects on surface water flow, erosion and habitat fragmentation of water dependent species and communities;	Surface water drainage is addressed in Section 13 – Surface Water (Subsections 13.4 and 13.6) and Appendix J – *Open Cut Mine Drainage Report* Erosion and sediment management is addressed in Section 13 – Surface Water (Subsections 13.3.4 and 13.6) The final void is addressed in Section 13 – Surface Water (Subsection 13.6.6), Appendix I – *Groundwater Report* (Subsection 8.4) and Appendix K – *Water Management System Modelling Report* (Subsection 7) Ecology impacts are addressed in Section 9 – Terrestrial Ecology (Subsection 9.6) and Section 10 – Aquatic Ecology (Subsection 10.6)
(m) an assessment of the long term impacts to water resources posed by various options for the final landform design, including complete or partial backfilling of mining voids;	The final void is addressed in Section 13 – Surface Water (Subsection 13.6.6), Appendix I – *Groundwater Report* (Subsection 8.4) and Appendix K – *Water Management System Modelling Report* (Subsection 7)
(n) the cumulative impact of the proposal when all developments (past, present and/or reasonably foreseeable) are considered in combination (see section titled Assessment of cumulative impacts in these Information Guidelines);	The potential cumulative impacts of the project are addressed in Section 23 – Cumulative Impacts The potential cumulative impacts relating to groundwater and surface water are addressed in Section 12 – Groundwater (Subsection 12.4.11) and Section 13 – Surface Water (Subsections 13.5 and 13.6), respectively
(o) the measures taken to avoid and minimise impacts to water resources and water related assets; and	Groundwater management and monitoring measures are discussed in Section 12 – Groundwater (Subsection 12.5) Water management strategies and design measures have been developed for the project. These measures are proposed to avoid and minimise impacts to surface water and water related assets. The surface water management strategies are described in Section 13 – Surface Water (Subsection 13.3) and the associated design measures are discussed in Section 13 – Surface Water (Subsections 13.4 and 13.5) Section 10 – Aquatic Ecology (Subsections 10.7 and 10.8)

REQUIREMENT	EIS SECTION
(p) proposed mitigation actions for each identified impact.	Water management strategies and design measures have been developed for the project. These measures are proposed to avoid and minimise impacts to surface water and water related assets. The surface water management strategies are described in Section 13 – Surface Water (Subsection 13.3) and the associated design measures are discussed in Section 13 – Surface Water (Subsections 13.4 and 13.5) Residual impacts and mitigation measures are described in Section 13 – Surface Water (Subsection 13.6) Section 10 – Aquatic Ecology (Subsections 10.7 and 10.8)
Assessment of cumulative impacts	
An assessment of cumulative impacts should be undertaken to assess the risks and impacts posed by a single new CSG or large coal mining development proposal. The assessment of cumulative impacts needs to consider all relevant past, present and reasonably foreseeable actions, including development proposals, programs and policies, that are likely to impact on water resources and cover geographic and temporal boundaries large enough to include all potential significant impacts on water resources.	Section 12 – Groundwater (Subsection 12.4.11) Section 13 – Surface Water (Subsection 13.6) Section 23 – Cumulative Impacts (Subsections 23.5, 23.6 and 23.7) Appendix F – *Terrestrial Ecology* (Subsection 5.8) Appendix G – *Aquatic Ecology and Stygofauna Report* Appendix I – *Groundwater Report* (Subsection 8.6)
In addition to the proponent's assessment of cumulative impacts, additional advice may be provided by relevant Australian government regulators. Regulators are well placed to combine knowledge about total past, present and future developments, in conjunction with the outcomes of regional assessments and information on regional water management policies and regulations, to evaluate the scale of impact within a broader context.	Noted
A quantitative assessment of cumulative impacts is preferred, however a qualitative or semi-quantitative approach may be required, particularly for ecological risk assessments, if data is lacking. Assessments may also require consideration of interactive or synergistic impacts, as well as a more simple summation of individual proposals or impacts.	Section 12 – Groundwater (Subsection 12.4.11) Section 13 – Surface Water (Subsection 13.6) Section 23 – Cumulative Impacts (Subsections 23.5, 23.6 and 23.7) Appendix I – *Groundwater Report* (Subsection 8.6) Appendix F – *Terrestrial Ecology Report* (Subsection 5.8) Appendix G – *Aquatic Ecology and Stygofauna Report*

REQUIREMENT	EIS SECTION
Information should include but is not limited to: (a) catchment and regional scale information (Geographic Information System (GIS) based water related assets, geophysical, hydrological, and ecological information, and past, present and reasonably foreseeable coal mining and CSG developments, including exploration);	Section 10 – Aquatic Ecology (Subsection 10.5) The groundwater setting is described in Section 12 – Groundwater (Subsection 12.3) and Appendix I – *Groundwater Report* (Subsections 3 and 7 and Appendix A) The surface water setting is described in Section 13 – Surface Water (Subsection 13.2) Surrounding coal mining and CSG projects are described in Section 5 – Land Use
(b) total existing and planned water entitlements, and the actual take of water for consumptive, industrial and agricultural purposes (past, present and/or reasonably foreseeable) from all surface and groundwater resources within a geographic and temporal boundary large enough to include all potential significant impacts on water resources;	Section 12 – Groundwater (Subsection 12.6) and Appendix I – *Groundwater Report* (Subsection 2) describe the regulation of available groundwater resources Section 12 – Groundwater (Subsection 12.3) and Appendix I – *Groundwater Report* (Subsections 2, 6 and 7) describe the groundwater use relevant to the project Section 13 – Surface Water (Subsection 12.2) describes the downstream surface water uses
(c) existing water quality guidelines and targets (i.e. salinity), environmental flow objectives and requirements for the surface catchment and groundwater basin within which the development proposal is based;	The existing groundwater values and quality are discussed in Section 12 – Groundwater (Subsection 12.3) and Appendix I – *Groundwater Report* (Subsections 2 and 7 and Appendix A3) The existing environmental values and guidelines relating to surface water are discussed in Section 13 – Surface Water (Subsections 13.2.3 and 13.2.4)
(d) the proportional increase in water resource use and impacts as a consequence of the development proposal; and	Impacts on groundwater resources are discussed in Section 12 – Groundwater (Subsection 12.4) and Appendix I – *Groundwater Report* (Subsection 8.5) Project water supply requirements are addressed in Section 13 – Surface Water (Subsection 13.5) Changes in catchment yield are addressed in Section 13 – Surface Water (Subsection 13.6.2)
(e) an assessment of the overall level of risk to water related assets that combines probability of occurrence with severity of impact of multiple actions.	The risks to water resources and related assets are addressed throughout the EIS and specifically in Section 12 – Groundwater (Subsection 12.4), Section 13 – Surface Water (Subsections 13.5 and 13.6) and Section 10 – Aquatic Ecology (Subsection 10.6)
A list of elements the IESC considers when reviewing cumulative impact assessments is provided at Appendix 2.	Noted. These elements are addressed as shown in the above cross-references to IESC Requirement 5 – Assessment of Cumulative Impacts

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There is a need to further develop groundwater and surface water models to enable the prediction of cumulative impacts. This could involve the collation of geological and operational data from CSG and large coal mining companies in relation to current and future production, timing and volumes. Data from other water users and other mining and CSG activities would also be needed to assess water related cumulative impacts, which could be made available from regulators or through completed bioregional assessments.	The proponent has undertaken a comprehensive assessment of cumulative impacts based upon the best available data. The procurement of additional data from other CSG or mining companies is beyond the means of the proponent and is an action that would more reasonably rest with government agencies No completed bioregional assessments are currently available for the project site. The proponent will participate in any relevant bioregional assessments, where necessary
Bioregional assessments will collate contextual information within a set of geographically defined areas (or 'bioregions') and provide an analysis of the potential cumulative impacts of CSG and coal mining developments on water resources.	Noted
5. Assessment of risk	
An explicit risk based appraisal of the impacts of CSG and large coal mining development proposals on water resources and water related assets underpins sound decision making.	Section 12 – Groundwater (Subsection 12.4) Section 13 – Surface Water (Subsection 13.6)
The IESC will review and evaluate the proponent's assessment of risk, in conjunction with any information provided by relevant Australian government regulators in their requests for IESC advice.	Noted
Available bioregional assessments will assist in the risk analyses within bioregions to help identify risks, possible consequences and likelihood of impacts to water related assets from CSG and large coal mining development proposals. Where a development proposal occurs within an area subject to a bioregional assessment, the IESC will consider this analysis in its review of the proponent's risk assessment.	Noted No completed bioregional assessments are currently available for the project site
Peak bodies, such as the Queensland Resources Council, have developed risk assessment frameworks for mining impacts. These could be used ahead of the release of the Bioregional Assessments or in areas where Bioregional Assessments are not being conducted.	Noted

REQUIREMENT	EIS SECTION
Where a proposal referred to the IESC could have a significant impact on water resources and water related assets, the proponent will need to determine the scope of potential impacts and the risks associated with their likelihood and magnitude. The risk assessment should address the impact of the single development proposal, as well as the cumulative impact of all past, present and reasonably foreseeable actions that are likely to impact on water resources. The advice the IESC provides, and any actions it recommends to mitigate risks, will be informed by the severity of the risk.	Section 12 – Groundwater (Subsection 12.4) Section 13 – Surface Water (Subsection 13.6) Appendix G – *Aquatic Ecology and Stygofauna Report* Appendix I – *Groundwater Report* (Subsection 8) Appendix J – *Open Cut Mine Drainage Report* (Subsections 5 and 9) Appendix K – *Water Management System Modelling Report*
If the risk is considered sufficiently high, according to the likelihood that it will occur and the consequence if it does, then the IESC will also consider whether the proponent has demonstrated that the risk can be mitigated.	Section 12 – Groundwater (Subsection 12.4) Section 13 – Surface Water (Subsection 13.6)
An assessment of risk should be provided that addresses the following elements: (a) identification of regional water related assets in the area of the proposal that might be vulnerable as a result of the development proposal; (b) identification of potential impacts on those assets from activities associated with the proposal; (c) an assessment of the likelihood and consequence of identified impacts occurring; (d) an assessment of the magnitude or severity of impact in the event that the impact was to occur; (e) an assessment of the overall level of risk to water related assets that combine likelihood of occurrence with consequence or severity of impact; and (f) an assessment of residual risk following the application of proposed mitigation measures.	The potential impacts and risks to water resources and water related assets related to the project are discussed in Section 12 – Groundwater (Subsection 12.4) Section 13 – Surface Water (Subsection 13.6) Section 24 – Environmental Management (Subsections 24.4.2 and 24.4.3) Appendix G – *Aquatic Ecology and Stygofauna Report* Appendix I – *Groundwater Report* (Subsection 8) Appendix J – *Open Cut Mine Drainage Report* (Subsections 5 and 9)
6. Ongoing management and monitoring	
Plans for ongoing management and monitoring are expected where impacts are likely as a result of the development proposal. Plans should focus, in particular, on a robust monitoring program to inform management and mitigation of impacts to water resources and water related assets identified in the assessment of the proposals. The monitoring program should include groundwater, surface water and associated ecological attributes and be capable of tracking changes from pre-development conditions. This requires a comprehensive baseline monitoring dataset prior to commencement of the development.	Baseline monitoring datasets are provided in Section 12 (Subsection 12.3), Section 13 (Subsection 13.2), and Appendix I – *Groundwater Report* (Subsections 6 and 7) Monitoring programs are discussed in Section 12 – Groundwater (Subsection 12.5), Section 13 – Surface Water, (Subsections 13.2.4 and 13.5.6), Section 24 – Environmental Management (Subsections 24.4.2 and 24.4.3), Appendix I – *Groundwater Report* (Subsection 9), Appendix K – *Water Management System Modelling Report* (Subsection 6)

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The rationale and design for monitoring programs should be provided. These should include the hypotheses to be tested by the monitoring programs, the temporal and spatial frequency of monitoring, the potential indicators to be monitored and the analytical methods to be used. The monitoring programs should identify the triggers and threshold and the proposed management actions if those levels are reached or exceeded.	Baseline monitoring datasets are provided in Section 12 (Subsection 12.3), Section 13 (Subsection 13.2), and Appendix I – *Groundwater Report* (Subsections 6 and 7) Monitoring programs are discussed in Section 12 – Groundwater (Subsection 12.5), Section 13 – Surface Water, (Subsections 13.2.4 and 13.5.6), Section 24 – Environmental Management (Subsections 24.4.2 and 24.4.3), Appendix I – *Groundwater Report* (Subsection 9), Appendix K – *Water Management System Modelling Report* (Subsection 6)
Water quality monitoring should comply with relevant National Water Quality Management Strategy (NWQMS) guidelines.	Noted
There should be a commitment to regular reporting of findings from monitoring programs, including raw data, analysis of data, and the results and conclusions. There should also be regular reviews and revisions of the monitoring program. The monitoring program should be robust and provide for an adaptive management approach to manage changes in the predicted impacts to water resources and water related assets.	Baseline monitoring datasets are provided in Section 12 (Subsection 12.3), Section 13 (Subsection 13.2), and Appendix I – *Groundwater Report* (Subsections 6 and 7) Monitoring programs are discussed in Section 12 – Groundwater (Subsection 12.5), Section 13 – Surface Water, (Subsections 13.2.4 and 13.5.6), Section 24 – Environmental Management (Subsections 24.4.2 and 24.4.3), Appendix I – *Groundwater Report* (Subsection 9), Appendix K – *Water Management System Modelling Report* (Subsection 6)
Elements of a robust monitoring program include: (a) clearly defined monitoring objectives and performance indicators;	Section 24 – Environmental Management (Subsections 24.4.6 and 24.4.7)
(b) a description of local and regional water regime/s and detailed historical baseline data against which monitoring results can be assessed;	Baseline monitoring datasets are provided in Section 12 (Subsection 12.3), Section 13 (Subsection 13.2), and Appendix I – *Groundwater Report* (Subsections 6 and 7)
(c) maps and coordinates of monitoring locations;	Section 12 – Groundwater (Table 12-1, Subsection 12-5 and Figure 12-1) Section 13 – Surface Water (Table 13-1, Subsection 13.2 and Figures 13-1 and 13-2)
(d) the number and spatial distribution of monitoring sites and monitoring frequency. The program should also be able to capture seasonal and inter-annual variability and enable valid statistical analysis of results; and	Baseline monitoring datasets are provided in Section 12 (Subsection 12.3), Section 13 (Subsection 13.2), and Appendix I – *Groundwater Report* (Subsections 6 and 7) Monitoring programs are discussed in Section 12 – Groundwater (Subsection 12.5), Section 13 – Surface Water, (Subsections 13.2.4 and 13.5.6), Section 24 – Environmental Management (Subsections 24.4.2 and 24.4.3), Appendix I – *Groundwater Report* (Subsection 9), Appendix K – *Water Management System Modelling Report* (Subsection 6)

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(e) a monitoring network extending beyond the predicted impact areas to identify and delineate the location and extent of impacts.	Baseline monitoring datasets are provided in Section 12 (Subsection 12.3), Section 13 (Subsection 13.2), and Appendix I – *Groundwater Report* (Subsections 6 and 7) Monitoring programs are discussed in Section 12 – Groundwater (Subsection 12.5), Section 13 – Surface Water, (Subsections 13.2.4 and 13.5.6), Section 24 – Environmental Management (Subsections 24.4.2 and 24.4.3), Appendix I – *Groundwater Report* (Subsection 9), Appendix K – *Water Management System Modelling Report* (Subsection 6)
Further guidance on groundwater, surface water and ecological monitoring programs is provided below.	Noted
a. Groundwater monitoring A groundwater monitoring network should be established as early as possible to collect sufficient physical aquifer parameters and hydrogeochemical data to establish pre-development conditions, including daily and seasonal fluctuations in groundwater levels. Long term groundwater monitoring should include a comprehensive assessment of all relevant chemical parameters to inform changes in groundwater quality and deter potential contamination events.	Baseline monitoring datasets are provided in Section 12 (Subsection 12.3), Section 13 (Subsection 13.2), and Appendix I – *Groundwater Report* (Subsections 6 and 7) Monitoring programs are discussed in Section 12 – Groundwater (Subsection 12.5), Section 13 – Surface Water, (Subsections 13.2.4 and 13.5.6), Section 24 – Environmental Management (Subsections 24.4.2 and 24.4.3), Appendix I – *Groundwater Report* (Subsection 9), Appendix K – *Water Management System Modelling Report* (Subsection 6)
The groundwater monitoring program should utilise dedicated groundwater monitoring wells and target specific aquifers for monitoring and management.	Baseline monitoring datasets are provided in Section 12 (Subsection 12.3), Section 13 (Subsection 13.2), and Appendix I – *Groundwater Report* (Subsections 6 and 7) Monitoring programs are discussed in Section 12 – Groundwater (Subsection 12.5), Section 13 – Surface Water, (Subsections 13.2.4 and 13.5.6), Section 24 – Environmental Management (Subsections 24.4.2 and 24.4.3), Appendix I – *Groundwater Report* (Subsection 9), Appendix K – *Water Management System Modelling Report* (Subsection 6)
A robust groundwater monitoring program will provide an understanding of the groundwater regime, inform recharge and discharge processes and identify changes over time in the groundwater system. These aspects will be important in informing appropriate management responses to mitigate impacts to groundwater resources.	Noted

REQUIREMENT	EIS SECTION
b. Surface water monitoring A surface water monitoring program should be established to collect sufficient data to detect and identify the cause of any changes from established baseline conditions, as well as assess the effectiveness of mitigation and management measures.	Baseline monitoring datasets are provided in Section 12 (Subsection 12.3), Section 13 (Subsection 13.2), and Appendix I – *Groundwater Report* (Subsections 6 and 7) Monitoring programs are discussed in Section 12 – Groundwater (Subsection 12.5), Section 13 – Surface Water, (Subsections 13.2.4 and 13.5.6), Section 24 – Environmental Management (Subsections 24.4.2 and 24.4.3), Appendix I – *Groundwater Report* (Subsection 9), Appendix K – *Water Management System Modelling Report* (Subsection 6)
The surface water monitoring program should identify dedicated sites to monitor hydrology, water quality and channel geomorphology throughout the life of the development proposal. Monitoring sites should be representative of the diversity of potentially affected water related assets and the nature and scale of potential impacts. The rationale for selected monitoring variables, duration, frequency and methods should be provided. Use of satellite or aerial imagery may be required to identify and monitor large-scale impacts.	Baseline monitoring datasets are provided in Section 12 (Subsection 12.3), Section 13 (Subsection 13.2), and Appendix I – *Groundwater Report* (Subsections 6 and 7) Monitoring programs are discussed in Section 12 – Groundwater (Subsection 12.5), Section 13 – Surface Water, (Subsections 13.2.4 and 13.5.6), Section 24 – Environmental Management (Subsections 24.4.2 and 24.4.3), Appendix I – *Groundwater Report* (Subsection 9), Appendix K – *Water Management System Modelling Report* (Subsection 6)
c. Ecological monitoring Ecological monitoring should be undertaken to evaluate the effectiveness of impact prevention or mitigation strategies, measure trends in ecological responses and detect whether ecological responses are within identified thresholds of acceptable change.	Section 9 – Terrestrial Ecology (Subsections 9.4.2 and 9.7.2) Section 10 – Aquatic Ecology (Subsection 10.7.3)
Ecological monitoring should comply with relevant state or national monitoring guidelines.	Section 9 – Terrestrial Ecology (Subsections 9.4.2 and 9.7.2) Section 10 – Aquatic Ecology (Subsection 10.7.3)