PROJECT CHINA STONE

Aquatic Ecology 10

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10 AQUATIC ECOLOGY

10.1 INTRODUCTION

This section provides a summary of the aquatic ecology values present within the project site. A detailed aquatic ecology impact assessment was undertaken by Cumberland Ecology as part of the Environmental Impact Statement (EIS) and is presented in the *Aquatic Ecology and Stygofauna Report* (Appendix G). Potential impacts on stygofauna are discussed in Section 12 – Groundwater. This EIS section should be read in conjunction with Section 11 – Matters of National Environmental Significance, which addresses issues related to the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), as this section is restricted to assessing State aquatic ecology values.

10.2 OVERVIEW OF THE PROJECT SITE

The catchment setting for the project is described in detail in Section 13 – Surface Water. Drainage in the project site is generally towards the east from Darkies Range, which forms a catchment divide along the western boundary of the site. The project site is located in the headwaters of the Belyando River catchment and site drainages are highly ephemeral. There are no watercourses (under the definition of the *Water Act 2000* [Water Act]) on the project site. Site drainages are highly ephemeral drainage lines which flow only during, and shortly after, rainfall. These drainage lines contain a number of remnant pools that form after rainfall, and then dry out during the dry season. Areas of potential aquatic habitat are restricted to these drainage lines, along with two seasonal wetlands and two farm dams.

10.3 REGULATORY REQUIREMENTS

10.3.1 Nature Conservation Act

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

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

10.3.2 Water Act

The Water Act provides for the sustainable management of water resources. The Water Act governs the construction, control and management of works with respect to water conservation and protection, irrigation, drainage, water supply and flood control and prevention. The Water Act is administered by the Department of Natural Resources and Mines (DNRM). As detailed in Section 13 – Surface Water, DNRM has determined that the ephemeral drainage lines on the project site do not meet the definition of a watercourse under the Water Act. No approvals in relation to works within a watercourse are, therefore, required for the project.

10.3.3 Fisheries Act

The *Fisheries Act 1994* (Fisheries Act) provides for the use, conservation and enhancement of the community's fisheries resources and fish habitat by providing for, amongst other things, the protection of fish habitats. The Department of Agriculture and Fisheries (DAF) is the administering authority for the Fisheries Act.

Development permits under the *Sustainable Planning Act 2009* (SP Act) are required prior to constructing any waterway barrier works (i.e. structures such as culverts, road crossings, dams, etc.) that may inhibit fish passage. The DAF has prepared mapping which classifies all waterways in Queensland in relation to the level of risk that waterway barrier works could pose to fish movement and fish communities (DAF 2014). This mapping is used for projects that require approvals under the SP Act to assist proponents in determining the level of assessment that is required. The activities being assessed in this EIS are restricted to activities to be undertaken within the proposed mining lease boundaries, and these activities will be undertaken in accordance with the Environmental Authority (EA) that will be obtained for the project. The SP Act does not apply to activities undertaken within a mining lease, and there is consequently no need to obtain separate approvals for waterway barrier works. The DAF's waterway mapping is, therefore, not directly relevant to the project, given that approval under the SP Act is not required. Nevertheless, the DAF's waterway mapping is discussed in Section 10.6.2, and a copy of the DAF waterway map for the project site is provided.

The Fisheries Act also contains provisions for the declaration of fish habitat. No declared fish habitat has been recorded within the project site.

10.3.4 Government Mapping of Wetlands and Watercourses

The EHP has prepared a map of referable wetlands that includes:

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

Significant, residual impacts on WPAs are required to be offset in accordance with the Queensland Environmental Offsets Framework (Section 10.3.5). As detailed in Section 10.5.1, there is an HES wetland and associated WPA located within the project site.

10.3.5 Environmental Offsets Framework

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

Offsets are only required in the event of significant, residual impacts being predicted. The EHP published a guideline to further define a significant residual impact for individual MSES in December 2014. This guideline was used in the assessment of whether the project would have a significant residual impact on any MSES. The offset requirements for the project are discussed in Section 10.8.

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

10.4 METHODOLOGY

The methodology included a desktop study, comprising database analysis and literature review of environmental assessments prepared for the nearby Carmichael Coal Mine and Rail Project (CCM&RP), and field surveys and data analysis.

10.4.1 Desktop Study

Several aquatic surveys have been undertaken within and surrounding the project site in the past five years. The project site is adjacent to the recently approved CCM&RP. Flora and fauna surveys undertaken for the CCM&RP EIS were reviewed as part of the desktop assessment. However, these surveys were of limited relevance because a significant watercourse traverses the site for the CCM&RP. In contrast, the project site is located within the headwaters of the catchment and has no permanent watercourses. The desktop assessment also included relevant database searches.

10.4.2 Field Surveys

Overview

Aquatic field surveys were conducted by specialist ecologists from Cumberland Ecology over 29 days across the following two survey periods:

- 16 May until 25 May 2012; and
- 22 October until 9 November 2012.

Although all survey sites were inspected during both surveys, not all sites were sampled in the October/November 2012 survey due to a lack of water. Above average rainfall was experienced in 2012, especially prior to the May 2012 survey. Less rain was experienced prior to the October/November 2012 survey, and several sites that contained water during the May survey were found to be dry during the October/November survey.

A total of 22 sites were surveyed within three different aquatic habitats, comprising: ephemeral drainage lines, seasonal wetlands and artificial farm dams (Figure 10-1).

Aquatic Habitat Assessment

Aquatic habitat assessments were conducted at each of the 22 aquatic sampling locations in accordance with the AusRivAS Manual. The assessment considered the habitats within the survey site in terms of habitat diversity and extent, suitability for aquatic fauna groups, existing disturbances/modifications, riparian condition and flow characteristics.

In Situ Water Quality

A suite of water quality measurements (including alkalinity, electrical conductivity, dissolved oxygen, temperature, pH and turbidity) were recorded at each survey site using hand-held meters. Water quality data were analysed, tabulated and compared to the relevant guideline values, including the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC and ARMCANZ, 2000), in particular, *Volume 1, Water Quality Guidelines for Aquatic Ecosystems*.

Aquatic Flora Assessment

Aquatic flora species at each survey site were noted, and an estimate was made of their relative abundance. This assessment targeted aquatic macrophytes and water dependent flora species only. Details of the riparian vegetation community present at each survey site were recorded as part of the standard AusRivAS habitat assessment of each survey site. Further assessment of riparian vegetation was conducted for the terrestrial ecology assessment (refer to Section 9 – Terrestrial Ecology).

Aquatic Macroinvertebrates

Macroinvertebrate samples were collected from bed and/or edge habitat from each survey site where possible, in accordance with methods detailed in the AusRivAS Manual. A macroinvertebrate dip net (with 250 micron mesh) was used to collect samples. A maximum of 10 m of habitat was surveyed along a 100 m stretch at each location, where possible. The samples were live-sorted for a minimum of 30 minutes where forceps and pipettes were used to extract all macroinvertebrate species observed. Specimens were stored in a solution of 70% ethanol for transport to the laboratory for identification.

Aquatic Vertebrates (Fish and Turtles)

Fish were surveyed using a combination of seine netting and dip nets, depending on habitat type and water depth at the sample location. A seine net with 1 cm mesh was used at large pools, dams and the seasonal wetlands, while a smaller, hand-held dip net was used to survey the smaller remnant pools. All specimens caught were counted, identified, measured (to determine life history stage), photographed, and then returned to the same body of water from which they were sampled. Observations of each of the 22 survey sites were undertaken prior to fish surveys to determine turtle presence. The majority of the survey sites consisted of remnant pools in ephemeral drainage lines and were small in size and, therefore, if turtles were present they would have been readily recorded. No snorkelling surveys were undertaken in larger water bodies (i.e. the dams) due to the high degree of turbidity (i.e. low visibility) of the water.

10.5 RESULTS

10.5.1 Habitat Values

The drainage lines on the project site are shown on Figure 10-1. The drainage lines are highly ephemeral and dependent on seasonal rainfall. The only sources of water in the dry season are remnant pools in some ephemeral drainage lines, and farm dams that are deep enough to retain water. No artesian springs or bores are present in the project site.

The ephemeral drainage lines within the project site usually flow during rainfall events and dry out soon after rainfall ceases. Some remnant pools in the drainage lines may persist into the dry season. The majority of drainage lines were observed to have no distinct riparian zone and the majority were degraded due to stock access. Aquatic habitat such as in-stream vegetation, rocks and snags was variable between ephemeral drainage lines, with some completely devoid of aquatic habitat and instead characterised by bare banks, no woody debris and no macrophyte cover for shelter and spawning.

Two seasonal wetlands are present in the project site, referred to as the northern and southern seasonal wetlands (Figure 10-1). The seasonal wetlands contained water during the May 2012 survey but, as expected, were dry in the October/November 2012 survey. The northern seasonal wetland is approximately 127 ha in size and has been mapped as a HES Wetland by the EHP. The northern seasonal wetland has been created by rainfall accumulating during the wet season, however it has been enhanced by the construction of a nearby farm dam (Red Dog Dam [Figure 10-1]) that helps retain water in this area. The substrate is clay in this area, and due to the low permeability of this soil type, the water accumulates, forming a wetland. The northern seasonal wetland is not dependent on groundwater recharge due to its relatively high elevation and the deep groundwater table in this area. When the northern seasonal wetland contains water, it provides good habitat for macroinvertebrates such as leaf litter, woody debris, macrophytes and fringing vegetation such as reeds and rushes. The southern seasonal wetland is surrounded by typical tree species of low lying areas, such as River Red Gum (*Eucalyptus camaldulensis*). At times when it contains water, it contains aquatic habitat features such as emergent rushes, reeds and large woody debris.

Two farm dams are present within the project site, namely: Red Dog Dam, which has been developed by excavating a section of the northern seasonal wetland and the southern farm dam (Figure 10-1). During the May 2012 surveys, both dams were full and overflowing with water, while the water level dropped significantly in both dams during the October/November 2012 survey. Red Dog Dam was highly turbid and contained no fringing

vegetation or woody debris and habitat values were very low. The southern farm dam provided adequate habitat and fringing vegetation in May 2012, but by October 2012 the dam was surrounded by bare clay, and contained no fringing vegetation, aquatic macrophytes or woody debris. The southern farm dam was highly turbid during the October/November 2012 surveys and the margins of the dam were very boggy and pugged by stock hooves.

Water quality within the surveyed aquatic ecology habitats was generally in accordance with the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC and ARMCANZ, 2000). However where stock had access to the ephemeral drainage lines, seasonal wetlands and dams, the water was more turbid and had elevated levels of nitrogen and phosphorus.

10.5.2 Aquatic Flora and Fauna

No macrophytes were recorded at any of the ephemeral drainage line survey locations. Some limited macrophytes were observed in the seasonal wetlands (mostly present at the northern seasonal wetland).

Three species of fish were recorded from the project site, namely the Spangled Perch (*Leiopotherapon unicolor*), the Desert Rainbowfish (*Melanotaenia splendida*) and Agassiz's Glassfish (*Ambassis agassizii*). The three fish species recorded are all common and widespread species. The low diversity of fish species in the project area may be a result of a number of factors including hydrologic characteristics of the project site, and a relatively low diversity of aquatic habitats. No turtle species were recorded in the project site.

10.5.3 Threatened Species

No listed (NC Act or EPBC Act) 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 project site does not contain any declared fish habitat areas, aquatic reserves or habitat areas declared under state provisions.

10.6 IMPACT ASSESSMENT

10.6.1 Overview

The following project activities have the potential to give rise to impacts on aquatic ecology:

- Vegetation clearing and earthworks associated with open cut mining and the construction of mine infrastructure;
- Disturbance of aquatic habitat due to the impacts of mine subsidence;
- The potential to impact the water quality of ephemeral drainage lines and watercourses downstream of the project site due to the release of mine-affected water; and
- The potential for project activities to spread weeds and thereby impact vegetation.

No creek diversions are proposed as part of the project. There are also no proposed creek crossings as a result of the project.

These impacts are described in the remainder of this section and mitigation measures for these impacts are discussed in Section 10.7. This section also provides an overview of potential impacts on threatened species.

10.6.2 Clearing of Aquatic Habitat

The project will result in the clearing of aquatic habitat present in ephemeral drainage lines, the southern seasonal wetland and the southern farm dam for the construction of the open cut mining area and mine infrastructure area. The extent of aquatic habitat clearing in these areas is shown in Figure 10-2. Approximately 11,000 ha will be disturbed as a result of clearing associated with this construction. The open cut mining area and mine

infrastructure area have been designed to avoid disturbance to the upper reach of an ephemeral drainage line in the Tomahawk Creek catchment (shown as a “major waterway” on the DAF’s waterway map – Figure 10-3). This is the only “major waterway” under the DAF’s mapping system on the project site. However, it will be necessary to remove the southern farm dam and the southern seasonal wetland, as well as some ephemeral drainage lines, as a result of open cut mining and mine infrastructure development. The HES wetland in the northern section of the project site is well beyond the clearing footprint of the project and would not be disturbed by open cut mining or mine infrastructure development.

The construction of the open cut mining area and mine infrastructure area has the potential to impact on the aquatic environment through the creation of barriers to fish movement. In the context of aquatic habitat values within the project site and surrounds, the aquatic habitat to be removed within the open cut mining area and mine infrastructure area is considered to be low value fish habitat due to the ephemeral nature of the drainage lines and seasonal wetland. As shown on Figure 10-3, the majority of drainage lines that will be removed are classified as orange or green waterways under the DAF’s mapping system (i.e. waterway barrier works would pose a low or moderate risk to fish passage). As noted above, the project has been designed to avoid disturbance to the upper reach of an ephemeral drainage line in the Tomahawk Creek catchment (shown as a major waterway on the DAF’s waterway map – Figure 10-3). In addition, the project site is not located within an area of declared fish habitat under the Fisheries Act, and only common, widespread fish species were recorded from the field survey. Consequently, loss of aquatic habitat, and any associated impact on fish passage, due to the construction of the open cut mining area and mine infrastructure area is not considered to be significant.

The project has the potential to increase the amount of erosion and sedimentation of waterways occurring in the project site through the construction of the open cut mining and mine infrastructure areas. Erosion and sedimentation of waterways have the potential to increase turbidity, and sediment movement can also mobilise nutrients and pollutants to aquatic habitats. Although erosion and sedimentation can potentially give rise to significant impacts on aquatic ecosystems, the impacts on the ecological values of the project site are expected to be minor. This is because no significant, permanent streams occur that could be impacted by sedimentation, and the ephemeral drainage lines that are present are accustomed to heavy rainfall and associated erosion during the wet season. In addition, a range of mitigation measures will be established to avoid any potential impacts due to erosion and sedimentation. These measures will be described in detail in the Erosion and Sediment Control Plan (Section 10.7.3) that will be prepared for the project. It is concluded that, with the implementation of appropriate measures, it is unlikely that erosion or sedimentation will significantly affect the aquatic ecology of the project site.

Mitigation measures for these activities are provided in Section 10.7 and are designed to ensure that the construction work described above will not significantly impact aquatic environments.

10.6.3 Subsidence

An overview of subsidence is provided in Section 6 – Subsidence. The impacts of subsidence on ephemeral drainage lines, seasonal wetlands and farm dams are described in the *Aquatic Ecology and Stygofauna Report* (Appendix G), which draws on the findings of the *Subsidence Report* (Appendix A) and the *Open Cut Mine Drainage Report* (Appendix J). Key findings are outlined below.

Ephemeral Drainage Lines

Ephemeral drainage lines within the limit of measureable subsidence will be subject to subsidence (Figure 10-2). In some areas, this may lead to localised changes in bed gradients and flow velocities and erosion potential (refer to Section 13 – Surface Water for further detail). Monitoring of areas of subsided drainage lines will be undertaken to ensure that no long-term impacts arise, and to identify any necessary mitigation measures for the control of erosion.

Subsidence cracking may occur within the bed and banks of the ephemeral drainage lines located within the limit of measureable subsidence (Figure 10-2). The cracks are likely to be shallow and any cracks in the bed of drainage lines are likely to fill quickly with sediment following flow events. A rehabilitation program for subsidence cracking will be implemented for the project to ensure that all cracks are remediated and the program will include measures to limit impacts on vegetation and prevent erosion and sedimentation.

Overall, subsidence is not predicted to give rise to any long-term, significant impacts on ephemeral drainage lines or their ecological values. This conclusion is supported by monitoring work undertaken at other Queensland coal mines, where watercourses have been subsided a number of times, without any significant impact on channel stability. Nevertheless, the mitigation measures described in Section 10.7 will be adopted in relation to any subsidence of ephemeral drainage lines.

Subsidence Ponding

Subsidence troughs can result in localised alteration of surface drainage paths and create ponding areas. Subsidence ponding will be mitigated by the installation of minor remedial drainage earthworks to re-establish free drainage. With the installation of the minor remedial drainage earthworks and the re-instatement of free drainage, there will be no significant changes in the existing ponding regime within the project site due to subsidence.

Repair of subsidence cracks on the project site will be undertaken in accordance with the proponent's rehabilitation program for subsidence cracking, which has been designed to limit impacts on vegetation and prevent erosion and associated sedimentation. These measures are further described in the *Terrestrial Ecology Report* (Appendix F) and *Draft Subsidence Management Plan* (Appendix B).

Northern Seasonal Wetland

The northern seasonal wetland (mapped by the EHP as a HES wetland) is located above the Northern Underground mining area and is located within the limit of measureable subsidence (Figure 10-2). This wetland is not fed by groundwater and is a natural depression that collects surface water during the wet season. Groundwater drilling in the area of the wetland has determined that the water table in this area of Darkies Range is very deep, being some 100 m below the land surface. This means the wetland does not interact with the underlying groundwater systems, and the source of the water is direct rainfall and runoff from the local catchment. Changes to the groundwater regime induced by longwall mining will therefore not impact upon the wetland. In addition, the substrate is clay in this area, and due to the low permeability of this soil type, the water accumulates, forming a wetland. The water collected in this wetland during the wet season evaporates during the dry season.

As noted above, the wetland will be subject to subsidence and will potentially experience impacts due to surface cracking and changes in drainage. Subsidence cracks that form within the ponded area of the wetland are likely to be shallow, and will have no connection to underground workings. If cracks form at a time when the wetland contains water, the cracks would fill with water and the cracks would ultimately fill with the sediment contained in the water. Monitoring of cracks will be undertaken and individual cracks will be repaired as necessary. Cracks that form when the wetland is dry would be repaired in accordance with the subsidence crack rehabilitation program outlined in the Subsidence Management Plan for the project (Section 10.7.3).

Figure 10-4 shows the location of the northern seasonal wetland in relation to the project site. It shows the northern seasonal wetland is a depression where surface water ponds and does not overflow, given its small isolated catchment. Figure 10-5 shows the pre and post-mining topography in the vicinity of the wetland. As indicated in Figure 10-5, changes in surface topography due to subsidence will have the effect of increasing the surface area and storage capacity of the wetland pond. The ponding area before mining is approximately 127 ha and it will increase to approximately 199 ha as a result of subsidence. In order to ensure that the wetland pond continues to retain water following subsidence, a small bund will be constructed along the eastern margin of the northern seasonal wetland. The bund will be a small scale structure – approximately 1 m in height, 3 m wide along the crest, and 460 m long. The wetland pond catchment will also be potentially affected by subsidence and it is anticipated that the catchment will change in size from 2,711 ha pre-mining to 2,399 ha post-mining, resulting in a 12% reduction in the size of the catchment.

These changes to the pond storage and catchment area of the wetland will result in changes to the ponding characteristics of the seasonal wetland. For a particular rainfall event, the water level of the seasonal wetland will be reduced following subsidence, compared to the wetland pre-subsidence. This will also mean that the wetland will dry out more rapidly and more frequently.

The northern seasonal wetland is a HES wetland and consequently it will be necessary to provide offsets under the EO Regulation in the event of the project giving rise to significant, residual impacts on the wetland

(Section 10.8). The need for offsets will be determined prior to any subsidence of the wetland and based on detailed mine planning and subsidence predictions for the area. Figure 10-5 is based on the current mine layout, but detailed design supported by further exploration work is still to be undertaken. Even minor changes in the mine plan could significantly alter the predicted nature and extent of impacts on the wetland. It is therefore proposed to:

- Undertake detailed ground survey of the wetland prior to subsidence;
- Undertake a detailed review of potential impacts on the wetland, making use of subsidence predictions based on the detailed mine plan;
- Design any necessary drainage works, such as drains or levees, in order to reduce potential impacts on the wetland; and
- Determine offset requirements if significant, residual impacts on the wetland are predicted.

This work will be described in the Subsidence Management Plan (Section 10.7.3).

Red Dog Dam

Red Dog Dam, which is a farm dam located within the northern seasonal wetland, will be subsided (Figure 10-2). Red Dog Dam is a bunded dam within the HES wetland and because it is bunded, it is more likely to contain permanent water than the HES wetland. Therefore, potential impacts on Red Dog Dam are likely to be associated with maintaining the bund. The potential impact of subsidence on the dam will depend on the relative location of the dam embankment and pond area in relation to the surface subsidence profile. Potential effects may include cracking of the earth embankment and changes in the lateral extent and depth of the pond area. The *Subsidence Report* (Appendix A) has concluded that there will be no connection between the dam and the underground workings due to sub-surface cracking. Consequently, sub-surface cracking would not lead to the loss of any water from the dam.

Based on experiences at other longwall mines in Queensland and New South Wales, any subsidence effects on small earth dams can be easily remedied with minor civil earthworks and subsidence does not generally give rise to any lasting adverse impacts on the use and functioning of the dams, including any ecological values.

10.6.4 Release of Mine-Affected Water

As discussed in Section 13 – Surface Water, modelling of the proposed mine water management system indicates that there will be no uncontrolled discharges of mine-affected water. However, during extended wet periods, significant volumes of rainfall runoff will accumulate in the open cut pit. To ensure that the mine can continue to operate following extended rainfall periods, controlled discharge of mine-affected water will be required.

The water management system has, therefore, been designed to allow for the controlled release of stored water from the Mine Water Dam to the Belyando River via a tributary drainage pathway in the North Creek catchment. The tributary drainage pathway from the Mine Water Dam to the Belyando River is approximately 64 km in length and comprises ephemeral drainage lines and creek lines within the North Creek Catchment, upstream of the Belyando River. The land use surrounding the tributary drainage pathway is cattle grazing. The tributary drainage pathway is within a highly ephemeral system that only flows for relatively short periods following significant rainfall during the wet season.

An assessment on the potential impact to aquatic ecology along the tributary drainage pathway has been conducted. Aquatic ecology along the tributary drainage pathway is likely to be similar to the aquatic ecology found within the project site. The results of the aquatic ecology surveys conducted within the project site found that due to the highly ephemeral and degraded nature of drainage lines due to stock access, aquatic ecology values were very low. The majority of drainage lines were observed to have no distinct riparian zone and aquatic habitat, such as in-stream vegetation, rocks and snags, was variable between ephemeral drainage lines. Some drainage lines are completely devoid of aquatic habitat and are characterised by bare banks, no woody debris and no macrophyte cover for shelter and spawning. In addition, no threatened aquatic flora or fauna species were

recorded or predicted to occur within the project site. A search for wetlands listed as MSES under the EO Act was conducted along the proposed tributary drainage pathway and no WPAs or wetlands under the vegetation management wetlands map were recorded.

As discussed in Section 13 – Surface Water (Subsection 13.5.5), mine affected water released from the Mine Water Dam is estimated to have salinity levels that are well within the guidelines for stock watering but exceeding the aquatic ecosystem protection limits. However, controlled releases of mine-affected water are not expected to have a significant impact on aquatic ecology along the tributary drainage pathway due to the limited aquatic ecology values associated with the highly ephemeral drainage pathway. In addition, controlled releases would only be required following extreme wet periods when further dilution of released water would be likely to occur due to natural flows in the catchment. Further monitoring of the downstream receiving environment and assessment of EA discharge conditions will be conducted as part of the Receiving Environment Monitoring Program (REMP) required by the EA conditions. Further discussion of the REMP is included Section 10.7.3.

Controlled releases of mine-affected water will be conducted in accordance with the EHP Model Mining Conditions which are specifically designed to protect downstream water quality and associated environmental values, including aquatic ecology (refer Section 13 – Surface Water, subsection 13.5.5). The EHP model discharge conditions are outlined in Section 24 – Environmental Management (Attachment 24-4). The application of these conditions to controlled releases of mine-affected water will ensure that there are no significant impacts on the aquatic ecology of the Belyando River.

There are no release points for other mines within the North Creek catchment, therefore no cumulative impacts on the aquatic ecology in this catchment are predicted. Potential cumulative impacts due to mine-affected water discharges from other mines on the aquatic ecology of the Belyando River will be managed by the application of the model EA discharge conditions which are specifically designed to manage cumulative impacts by taking into account the assimilative capacity of the receiving water. Therefore, there are unlikely to be any significant changes to habitat values for fish and other aquatic biota within or downstream of the project site, due to controlled discharges of mine-affected water.

10.6.5 Spread of Weeds

During the construction and operations phases of the project, environmental management measures will be required to prevent the transportation of pest plants; prevent the introduction of additional pest species; and to manage and reduce the area of occupancy of pest plants on the site. A Feral Animal and Weed Management Plan will be developed and implemented for the site and has been described in Section 9 – Terrestrial Ecology and the *Terrestrial Ecology Report* (Appendix F).

10.6.6 Potential Impact to Threatened Species

No threatened aquatic species, habitats, populations or communities listed under the EPBC Act or NC Act have been recorded in the project site. No turtles were recorded during the field survey, and no threatened turtles are considered likely to occur as the project site is beyond the known distribution limit of any threatened turtle species. Similarly, no threatened fish species were recorded or considered likely to occur, and the fish species recorded are common, widespread species in these kinds of environments. Based on the data available from the project site, it is considered that the project would not adversely impact any populations of Commonwealth or State listed aquatic species.

10.7 IMPACT MITIGATION

10.7.1 Measures to Avoid Impacts

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 to an upper reach of an ephemeral drainage line in the Tomahawk Creek catchment (shown as a “major waterway” on the DAF’s waterway map) (Figure 10-3). This is the only ‘major waterway’ under the DAF’s mapping system within the project site.

The southern seasonal wetland is located within the mine infrastructure footprint, in close proximity to the open cut mining area. Avoidance of disturbance to the southern seasonal wetland is not possible without eliminating mine infrastructure from the project site and/or sterilising open cut mine reserves and hence making the project unviable.

The northern seasonal wetland is located above the Northern Underground mining area, within the limit of measureable subsidence (Figure 10-2). Avoidance of disturbance to the northern seasonal wetland is not possible without sterilising mine reserves. The management of potential impacts on the northern seasonal wetland is discussed in Section 10.6.3.

10.7.2 Minimising Aquatic Habitat Loss

A number of controls will be placed on construction activities to limit potential impacts on aquatic habitat. Clearing will be undertaken in accordance with a clearing procedure that restricts the area of remnant vegetation to be cleared to that required for the safe construction and operation of facilities. The clearing procedure is described in Section 9 – Terrestrial Ecology. Particular care will be taken in relation to any work in or adjacent to drainage lines, with mitigation measures including:

- Construction adjacent to drainage lines will only be undertaken when flows have ceased within the drainage lines.
- Any necessary sediment control works will be implemented, particularly if remnant pools are located adjacent to construction activities.
- Work will be undertaken in accordance with the requirements of an Erosion and Sediment Control Plan (Section 10.7.3).
- The proponent will consult with the DAF, as necessary, in relation to construction in drainage lines that could impact fish habitat or fish passage. Figure 10-3 shows the location of waterways, as mapped by the DAF.

The following available guidelines and codes will be reviewed, where relevant, as part of the detailed design of any works in waterways:

- *Guide for the Determination of Waterways using the Spatial Data Layer Queensland Waterways for Waterway Barrier Works* (DAFF 2013); and
- *Fisheries Guidelines for Fish Habitat Buffer Zones* (Bavins *et al*. 2000).

The remainder of the project site, beyond the clearing footprint of the project, will be managed to retain and enhance ecological values as far as possible. This will include managing grazing pressure and provision of additional fauna watering points. As detailed in Section 9 – Terrestrial Ecology, fauna watering points will mitigate for the loss of water sources (i.e. the southern seasonal wetland, southern farm dam and a number of remnant pools) and will comprise a combination of water troughs and areas of aquatic habitat. Although these watering points are primarily intended to mitigate for the loss of water for terrestrial species, a number of the watering points will be designed in a manner that will also provide aquatic habitat. Such watering points 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. The construction and management of these watering points will be in accordance with a Biodiversity Management Plan (Section 10.7.3).

10.7.3 Monitoring and Management Plans

Subsidence Management Plan

A Subsidence Management Plan will be a requirement of the project's EA to be developed over the life of the project. The Subsidence Management Plan will include:

- Methods for remediating subsidence cracking (including cracking in the beds and banks of ephemeral drainage lines and the northern seasonal wetland).
- Survey of the pre-subsidence and post-subsidence condition of ephemeral drainage lines, and prescriptions for management measures to prevent erosion due to localised changes in gradient within the bed and banks of ephemeral drainage lines within the limit of measurable subsidence.
- The installation of minor remedial drainage earthworks to prevent ponding of water in subsidence depressions.
- Management measures for the northern seasonal wetland. As noted in Section 10.6.3, this will include an accurate ground survey of the wetland; a detailed assessment of the potential impacts of subsidence on the wetland (based on the mine plan developed as part of detailed mine planning) and prescriptions for the installation of remedial works to limit any impacts on the wetland.
- Monitoring of Red Dog Dam to confirm any subsidence effects, and installation of remedial works to ensure the ongoing functioning of this dam.

Appendix B provides the draft Subsidence Management Plan for the project.

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, and the contamination of stormwater. The Erosion and Sediment Control Plan is discussed in Section 24 – Environmental Management.

Biodiversity Management Plan

Please refer to Section 9 – Terrestrial Ecology for information on the project's Biodiversity Management Plan.

Feral Animal and Weed Management Plan

Please refer to Section 9 – Terrestrial Ecology for information on the project's Feral Animal and Weed Management Plan.

Receiving Environment Monitoring Program

A Receiving Environment Monitoring Program (REMP) will be developed and implemented in accordance with conditions prescribed in the EA. The REMP will include periodic monitoring of the effects of mine water discharges on the downstream receiving environment including environmental values, such as aquatic ecology as well as surface water flow and quality.

10.8 OFFSETS

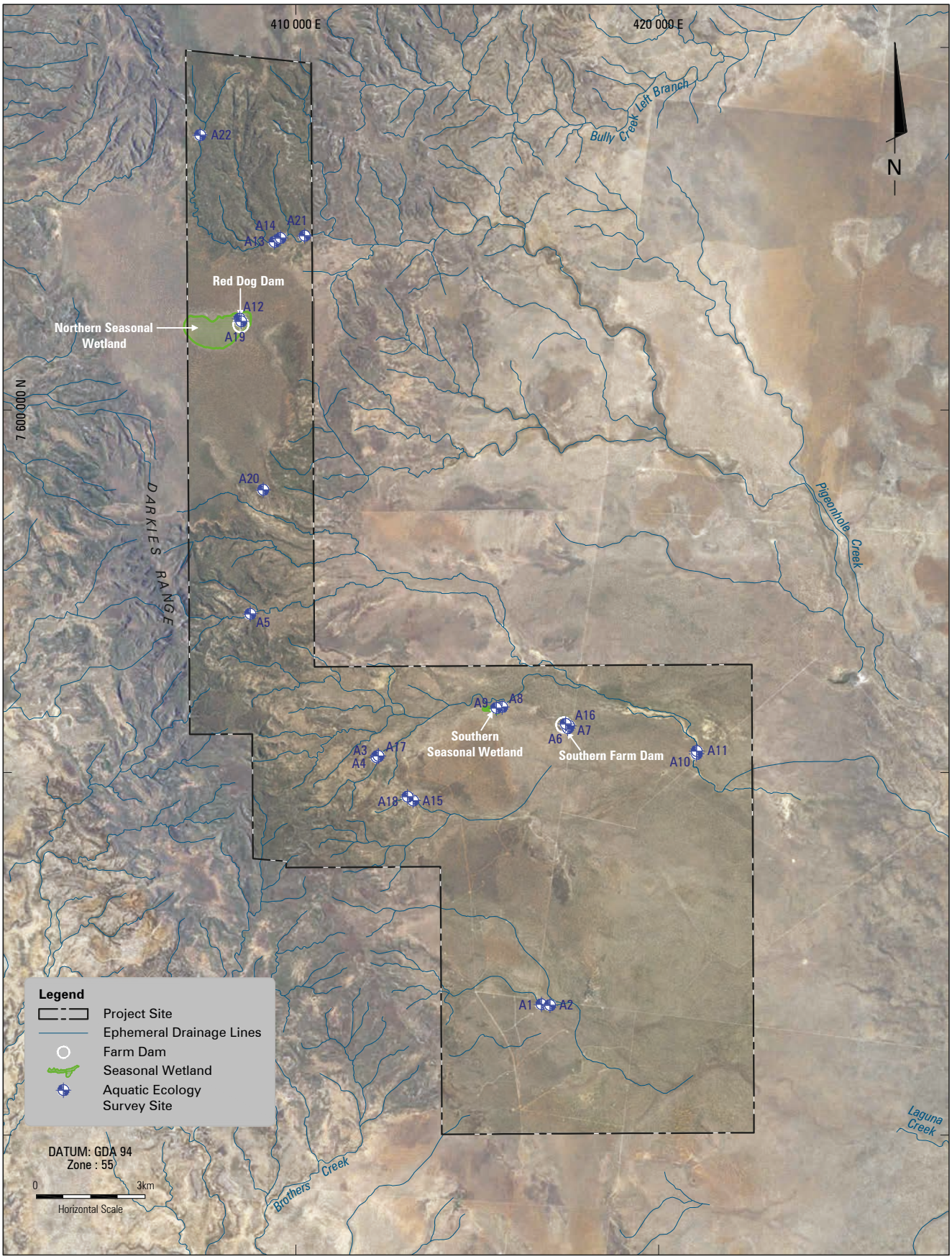
Offsets are required to compensate for any significant, residual impacts on MSES.

Subsidence impacts may cause a significant, residual impact on the northern seasonal wetland. The northern seasonal wetland is a HES wetland and, therefore, is considered to be a MSES. It will consequently be necessary to provide offsets under the EO Regulation in the event the project gives rise to significant, residual impacts on the

wetland. The need for offsets will be determined once detailed mine planning has been conducted for this area given that even minor changes in the mine plan could significantly alter the currently predicted nature and extent of any impacts on the wetland. There are no other aquatic values potentially impacted by the project that are considered to be MSES.

Biodiversity offsets are discussed further in Section 9 – Terrestrial Ecology.

FIGURES



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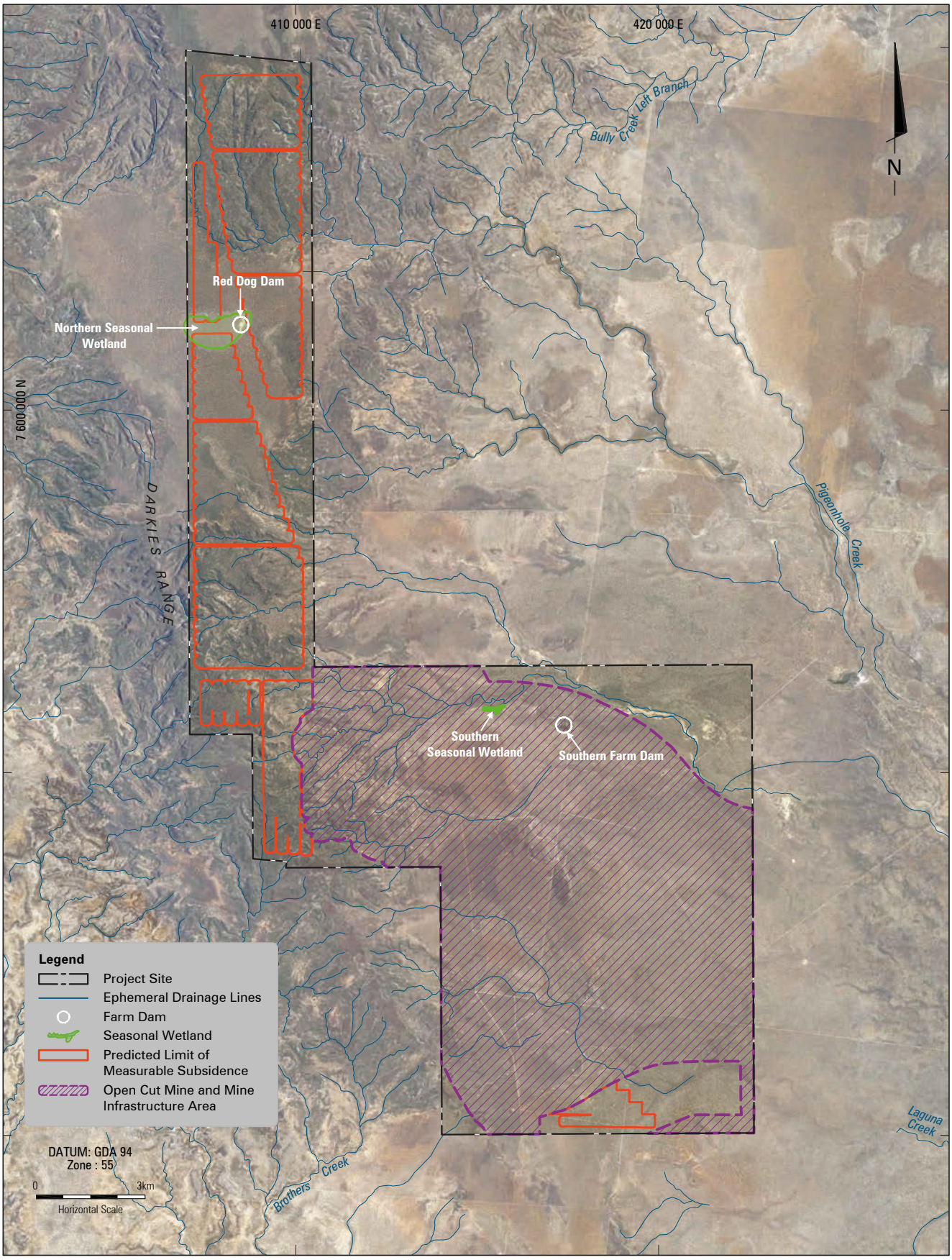
Aquatic Survey Sites within the Project Site

FIGURE 10-1



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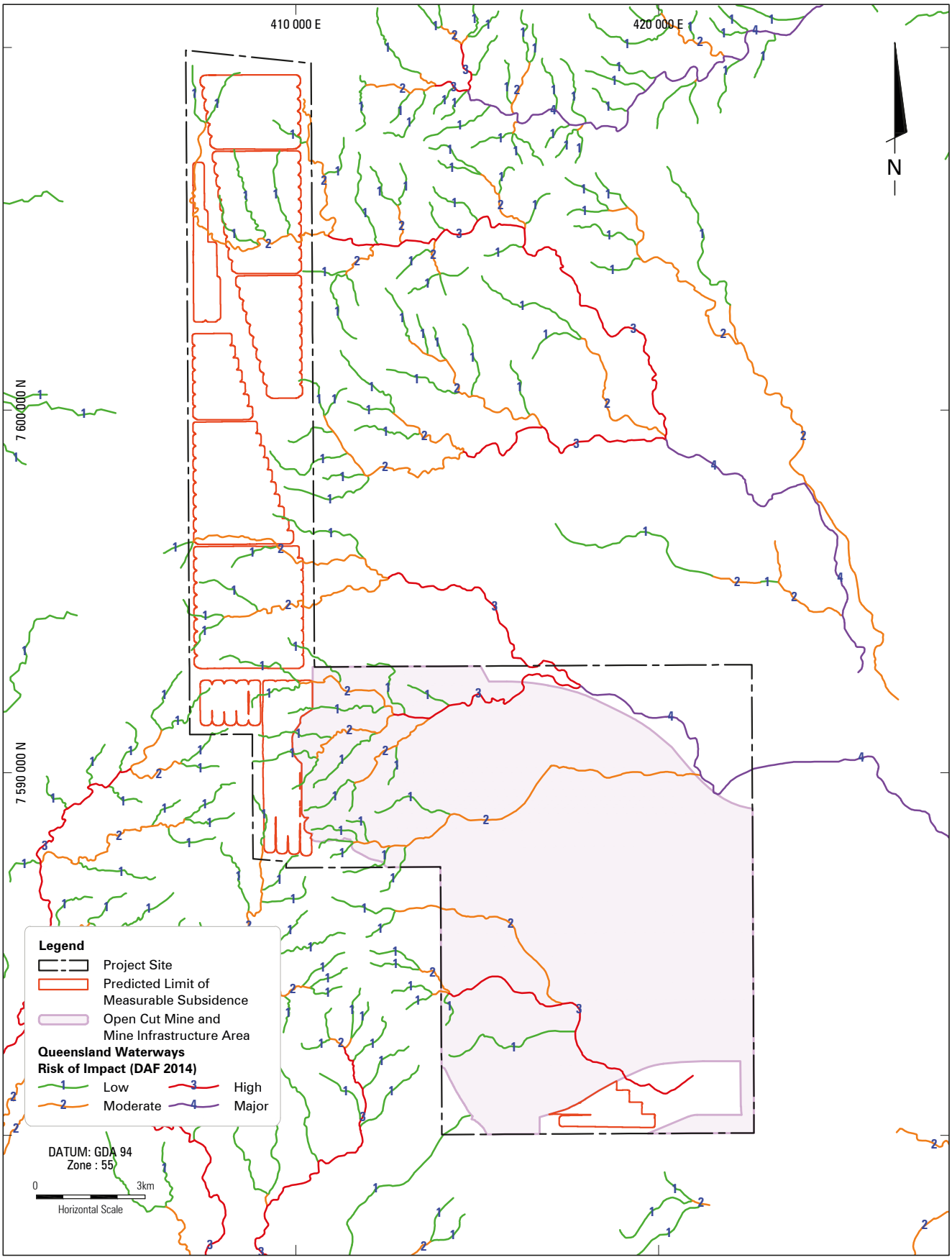
Aquatic Habitat within Disturbance Boundary and Predicted Limit of Measurable Subsidence

FIGURE 10-2



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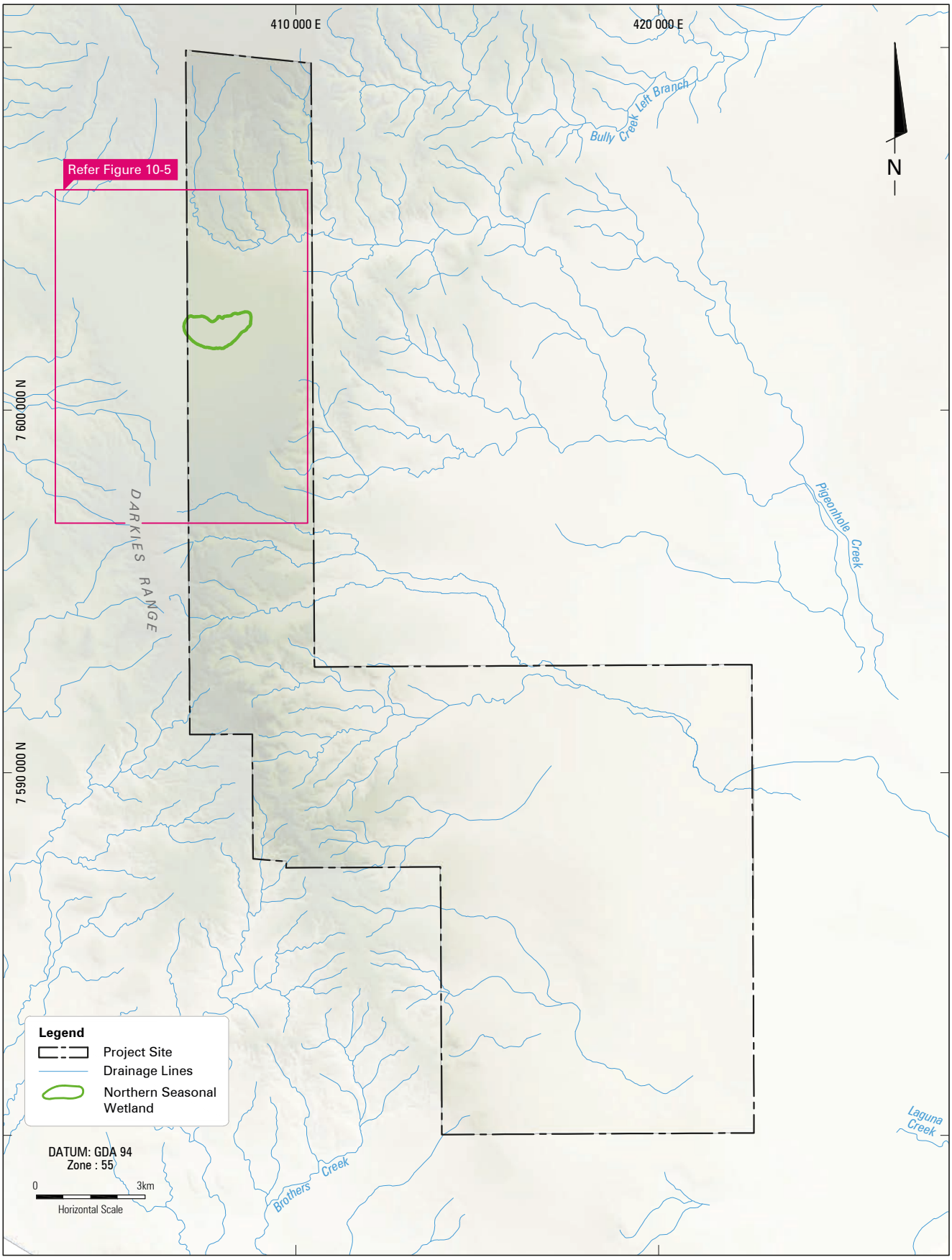
DAF Queensland Waterways for Waterway Barrier Works

FIGURE 10-3



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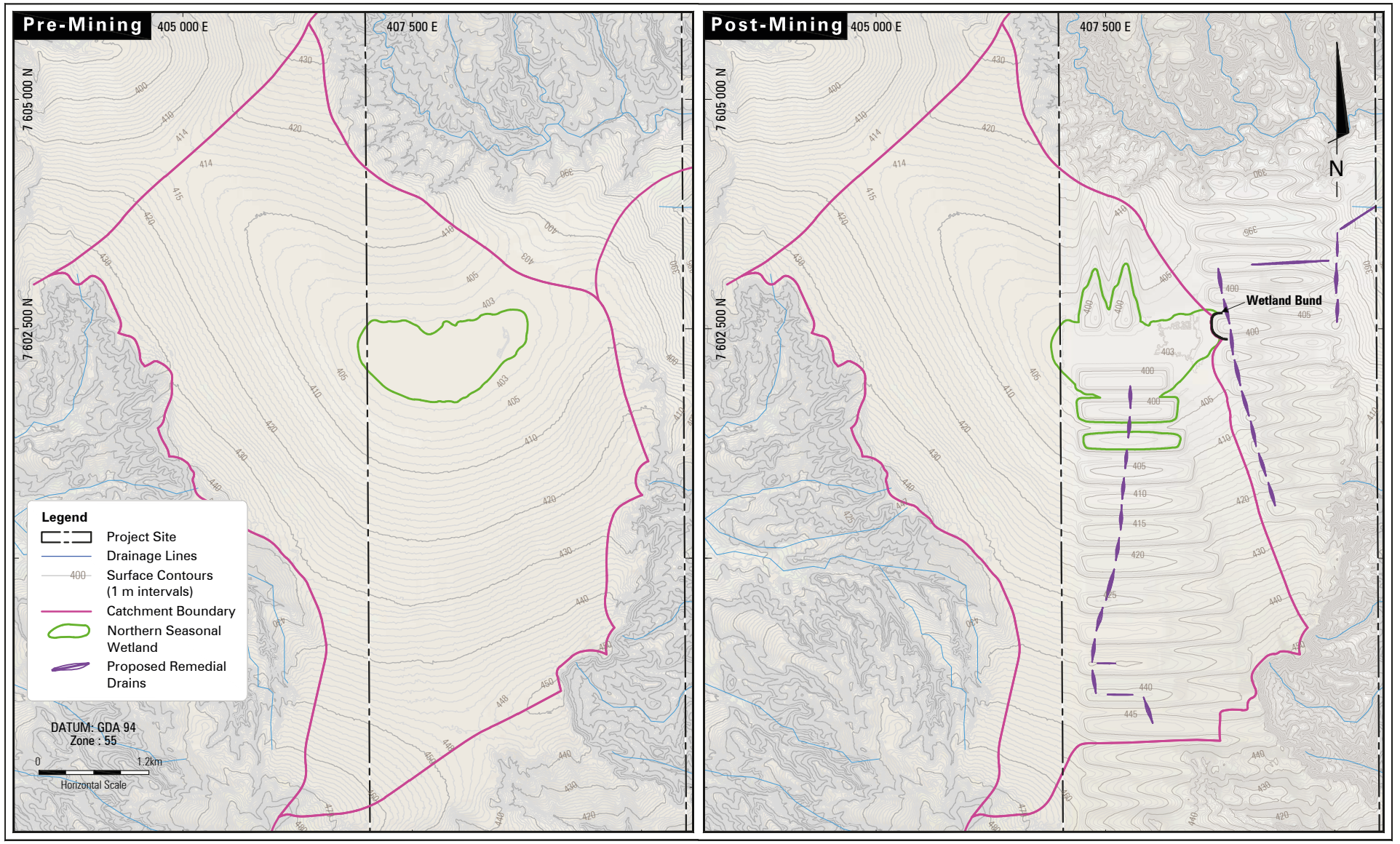
Northern Seasonal Wetland Location

FIGURE 10-4



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Northern Seasonal Wetland - Pre and Post-Mining

FIGURE 10-5