
Subject	Addendum to EPBC Act Self-Assessment	Project Name	Kooragang Island Waste Emplacement Facility Eastern Ponds Closure Works
Attention	Mike Bardsley	Project No.	IS330300
From	Thomas Muddle & Chris Thomson		
Date	20 October 2020		
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1. Introduction

Hunter and Central Coast Development Authority (HCCDC) commissioned Jacobs Group (Australia) Pty Ltd (Jacobs) to undertake a self-assessment of the Kooragang Island Waste Emplacement Facility (KIWEF) Eastern Ponds Closure Works (the proposed action) in accordance with the Department of the Environment, Water, Heritage and the Arts (2013) Significant Impact Guidelines 1.1 - Matters of National Environmental Significance (the guidelines). The guidelines outline a 'self-assessment' process, including detailed criteria, to assist persons in deciding whether or not they should submit a referral to the Australian Government Department of the Environment (the Department) for a decision by the Australian Government Environment Minister (the minister) on whether assessment and approval is required under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). Under the EPBC Act an action will require approval from the minister if the action has, will have, or is likely to have, a significant impact on a matter of national environmental significance.

The findings of the self-assessment are documented in a report titled "Kooragang Island Waste Emplacement Facility- Eastern Ponds Closure Works: EPBC Act Self-Assessment dated 4 September 2020 (Jacobs, 2020) and attached as Appendix A.

1.1 Addendum Purpose

The purpose of this addendum is to reconsider the findings of the self-assessment (Jacobs, 2020) in the context of a subsequent mortality event affecting a small number of the Commonwealth listed Green and Gold Bell Frog (GGBF). In doing so, revisions have been made to the Flora and Fauna management plan and rehabilitation management plan attached as Appendix B and C. Appendix B and C supersede Appendix C and D of the original self-assessment and these have been removed from Appendix A to avoid confusion.

2. Background

2.1 Existing environment

The Eastern Ponds are a series of partially filled waste emplacement cells. These cells historically comprised open water and over time have undergone a successive change to a more vegetated structure influenced by a change in surface hydrology, and specifically the gradual reduction of surface

water. HCCDC are required under the NSW Protection of the Environment Operations Act 1997 (EP&A Act) to close the waste emplacement cells through the installation of a landfill cap. Following capping the site is intended to be rehabilitated.

The proposed action area includes the four partially filled waste emplacement cells referred to as the Eastern Ponds, and comprising a total area of approximately 4 hectares, in addition to an isolated parcel of land immediately adjacent (around 1.5 hectares), to the west of the ponds that is proposed as a stockpile area for any material used during remediation.

The inspection of the Eastern Ponds confirmed there are no threatened ecological communities listed under the EPBC Act located within the proposed action area. This assessment identified three threatened fauna species that have been previously recorded within the locality and that are likely to occur within the Eastern Ponds area. These are:

- Green and Golden Bell Frog (*Litoria aurea*).
- Australasian Bittern (*Botaurus poiciloptilus*).
- Black Bittern (*Ixobrychus flavicollis*).

2.2 Impacts previously assessed

The Proposal would remove around 1.5 hectares of native regrowth vegetation comprising predominantly rushes, *Phragmites australis* and *Typha orientalis* (0.8 ha) and regrowth Swamp Oak (0.7 ha). All areas of native vegetation occur within the lower parts of the cells. The remaining areas of disturbance associated with the cell walls, access roads and stockpile area, comprise only exotic and non-indigenous plant species that are not characteristic of native plant communities.

An assessment of significance was provided in Appendix B of the self-assessment. The conclusion of these assessments indicated that the proposed activity was not likely to have a significant impact on populations of the three assessed threatened fauna species. This was determined in the context of the size and low to marginal condition of the habitats present, and the range of better-quality habitats available across the broader, KIWEF, Kooragang Island and Hunter Wetlands National Park. The proposed action was found to temporarily remove an area of marginal foraging habitat for GGBF at the Eastern Ponds occupied by a small proportion of the Kooragang Island population. The removal of this habitat was not expected to have a long-term impact on the size of the Kooragang Island population. The Eastern Ponds and receiving water bodies do not represent key breeding areas for the GGBF, and any temporary hydrology changes were not expected to have a long-term negative impact on the GGBF population.

2.3 Identification of additional risk

Following the completion of the self-assessment and during the overwintering period, prior to the majority of GGBF movements; HCCDC installed fauna exclusion fencing around the proposed action works area. The exclusion fencing is a required mitigation measure to prevent Green and Gold Bell Frog (GGBF) (listed as vulnerable under the EPBC Act and a key species under the nearby Ramsar wetlands, making them a matter of National environmental significance) from entering the works area where they would be at risk of direct impact. The fencing, along with pre-clearance surveys and relocation of GGBF from within the fence, form a key measure to protect GGBF from direct mortality and has been implemented successfully on all prior stages of KIWEF closure. During past stages of KIWEF closure HCCDC identified that the suppression of vegetation regrowth along the outside of the exclusion fence was important to prevent GGBF from using vegetation to access the works area. In response, the proposed action methodology included a vegetation suppression area.

Following fencing establishment and a warm, low humidity weather event, HCCDC observed GGBF sheltering along the outside the fence with some dead and sick individuals also present. This unexpected event has triggered an investigation and adaptive management response from HCCDC in response. While a definitive cause of the event has not been established, representatives of the University of Newcastle (UoN) have identified that it may be a result of one or all of the following contributing factors:

- Unusually hot and low humidity on day of incident
- Exposure to hot or dry weather in the vegetation exclusion zone
- Fine crushed rock used to suppress vegetation causing a smothering effect on GGBF skin
- Heat held by dark coloured rock
- Comorbidity vulnerabilities arising from Chytrid Fungus
- A lack of water or moisture around the fence perimeter.

Based on the condition of the GGBF and post mortem observations the UoN advised that the exposure to the Fine Crushed Rock was likely the major contributor to this incident and steps should be taken to prevent fine dust making contact with GGBF.

HCCDC requested Jacobs revisit assessment of significance for GGBF in light of these previously unidentified and unexpected risks.

2.4 Updated mitigation measures

The following responses were initiated immediately following the identification of the event and now form mitigation measures and part of the proposed action:

- Installation of micro habitats at 10m spacing around external perimeter of the exclusion fence
- Regular perimeter fence checks and relocations
- Several dousing events of fine rock with water and top up of refuge habitats on an as needed basis
- Placement of felled vegetation within and surrounding the micro habitats to act as shade and cover
- Coverage of dark fine crushed rock with light and heat reflective geofabric
- Placement of mulch over geofabric
- Installation of watering irrigation system to keep zone cool and moist on hot days.

These mitigation measures have been incorporated into the environmental management documentation and contractual obligations for the proposed action.

3. Revised Assessment of Significance - Green and Golden Bell Frog (*Litoria aurea*) (Vulnerable)

A revised test of significance has been conducted for GGBF as the only EPBC Act listed species having a moderate or high potential to occur in the study area based on the presence of habitat (see Appendix A of self-assessment) potentially impacted by the identified additional risks.

As per the Self-Assessment, this revised Significance assessment has been completed in accordance with the EPBC Act Policy Statement 1.1 Significant Impact Guidelines (Department of Environment, 2013). Whether or not an action is likely to have a significant impact depends upon the sensitivity,

value, and quality of the environment that is affected, and upon the intensity, duration, magnitude and geographic extent of the impacts (Department of Environment, 2013). Importantly, for a 'significant impact' to be 'likely', it is not necessary for a significant impact to have a greater than 50 per cent chance of happening; it is sufficient if a significant impact on the environment is a real or not remote chance or possibility (Department of Environment, 2013). This advice has been considered while undertaking the assessment.

1) Lead to a long-term decrease in the size of an important population

The Green and Golden Bell Frog population within Kooragang Island can be considered an important population and one of the Key Populations in the Lower Hunter, for which there is a draft Management Plan (OEH 2007). The University of Newcastle (UoN 2019a) has conducted regular monitoring of the Green and Golden Bell Frog (GGBF) population over the KIWEF since 2011. This work involves repeated visual encounter surveys during the breeding season targeting a range of artificially created ponds which has included the Eastern Ponds (K108 wetland located in SE cell of the Eastern Ponds). From these surveys the UoN (2019a) has reported regular encounters of frogs in K108 (Eastern Ponds) from surveys conducted between 2011-16 leading to assessment in 2014 that this pond comprises a healthy population (Clulow 2014). Since 2013-14 however, the overall pattern of GGBF in the Eastern Ponds has been one of decline (UoN 2019a), a phenomenon that is consistent with the reported gradual reduction in the area of open water available to frogs over this same period. Indeed both 2016-17 and 2017-18 were dry years and no GGBF were recorded in the Eastern Ponds at this time (UoN 2019). Very low numbers were reported in the following wetter season of 2019-20 however these numbers remain low compared to the ponds in the remainder of the KIWEF (McHenry 2020).

The most recent surveys in 2019-20 describe the pattern of a gradual retreat of open water within Eastern Ponds and identify that as a consequence the habitat in the Eastern Pond is being infrequently occupied by GGBF, with no evidence of breeding taking place within them in recent years. This is consistent with data from the University's annual monitoring program which shows that for the last five consecutive years (2015-20) the Eastern Ponds have provided terrestrial and ephemeral aquatic habitat that is only occasionally occupied by GGBF (McHenry, 2020). These data suggest the ponds do continue to provide foraging habitat for a small proportion of the GGBF population, although the ponds are not important breeding sites. Indeed, McHenry (2020) describes the Eastern Ponds as ephemeral and semi-permanent wetlands, considered to have limited 'refuge' habitat value for GGBF due to the lack of open water.

The Proposal will therefore temporarily remove an area of marginal foraging habitat at the Eastern Ponds occupied by a small proportion of the Kooragang Island population. However, the removal of this habitat is not expected to have a long-term impact on the size of the Kooragang Island population.

2) Reduce the area of occupancy of an important population

The proposed activity at the Eastern Ponds will remove an area of around 2 hectares of identified marginal foraging habitat used by this population, and so will reduce the area of occupancy of an important population.

The most recent surveys in 2019-20 have described the habitat in the Eastern Pond as being infrequently occupied by GGBF and there is no evidence of breeding taking place within them. This is consistent with data from the University's annual monitoring program over the broader KWIEF which shows that for the last five consecutive years (2015-20) the Eastern Ponds have provided terrestrial and ephemeral aquatic habitat that is only occasionally occupied by GGBF (McHenry, 2020). Therefore, the area of habitat to be removed is not considered breeding habitat or high quality refuge and foraging habitat.

3) Fragment an existing important population into two or more populations

The work proposed at the Eastern Ponds is not expected to fragment the Kooragang Island GGBF population. Monitoring of this population has shown the GGBF is effective at movements and dispersal across spatially separated ponds (UoN 2019). The Eastern Ponds do not provide an important linkage to other areas of habitat for the species. The majority of the works will be in disturbed areas dominated by exotic species, with very limited surface water present and railway lines and associated embankments that limit dispersal. Wetlands areas and open lands to the south and west of the ponds that are known to be used by this species and provide potential movement opportunities, will not be impacted and no fragmentation of the population is anticipated.

4) Adversely affect habitat critical to the survival of a species

Habitat critical to the survival of a species refers to areas that are necessary:

- For activities such as foraging, breeding, roosting, or dispersal
- For the long-term maintenance of the species
- To maintain genetic diversity and long-term evolutionary development, or
- For the reintroduction of populations or recovery of the species.

The habitat within the Eastern Ponds is not considered critical habitat for the species. The most recent surveys in 2019-20 have described the habitat in the Eastern Pond as being infrequently occupied by GGBF and there is no evidence of breeding taking place within them. This is consistent with data from the University's annual monitoring program which shows that for the last five consecutive years (2015-20) the Eastern Ponds have provided terrestrial and ephemeral aquatic habitat that is only occasionally occupied by GGBF (McHenry, 2020).

The University of Newcastle has conducted regular monitoring of the Green and Golden Bell Frog (GGBF) population over the KIWEF since 2011, which has included the Eastern Ponds. It is evident from this work, that critical habitat is present and dispersed throughout the KIWEF and broader Kooragang Island and Ash Island. This includes breeding ponds, as well as foraging areas and open areas between ponds that are used for dispersal.

5) Disrupt the breeding cycle of an important population

The most recent surveys in 2019-20 have described the habitat in the Eastern Pond as being infrequently occupied by GGBF and there is no evidence of breeding taking place within them. This is due to the lack of open water in the Eastern Ponds. The UoN (2019) identifies that ephemeral and semi-permanent ponds such as these are preferred as breeding sites on Kooragang Island, however the key indicator has been that 'all wetlands in which breeding has been detected have areas of open water' (UoN 2019) a condition which is absent at the Eastern Ponds. On this basis, the Eastern Ponds are not considered important breeding habitat for the GGBF population and the removal of this habitat will not disrupt the breeding cycle of the population.

6) Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The proposed closure works will temporarily remove an area of marginal foraging habitat (2.0 ha) for the GGBF population by removal of vegetation and draining any residual surface water. Mitigation will be applied to prevent frogs entering the site area during the closure works (i.e. frog fencing with adjacent vegetation suppression zone), and this activity may temporarily impact habitat availability, and the movements and survival of low numbers of frogs in the vicinity of the eastern ponds. The most

recent surveys in 2019-20 have described the habitat in the Eastern Pond as being infrequently occupied by GGBF and there is no evidence of breeding taking place within them, and therefore any impact from the closure activity is unlikely to lead to a significant decline in the population.

After the works are complete the area will be capped, revegetated and new ponds established, therefore the loss of available habitat and interruption to movements of frogs is considered temporary. This area impacted represents a small proportion of the total potential foraging habitat available to the species in the KIWEF and it is likely that the temporary loss of a small proportion of foraging habitat and any interruption or impact on frogs from proposed mitigation will not result in an overall significant decline to the Kooragang Island GGBF population.

7) Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

Weeds are prevalent at the Eastern Ponds and dominant within areas of terrestrial habitat, including noxious weeds. The works provide an opportunity to reduce the prevalence of noxious weeds within the capping area, upon revegetation. Appropriate controls will be implemented to vehicles and equipment to avoid the introduction of any other invasive species to the site. The wetland areas should be considered restricted areas for personnel and no material should be exchanged between other wetland areas which may transport Eastern Gambusia, an invasive species which predates tadpoles.

8) Introduce disease that may cause the species to decline, or

The Project is not expected to introduce any diseases that may cause the species to decline. Chytrid fungus has been linked to declines in the GGBF, however the pathogen is considered widespread on Kooragang island (DECC 2007) and therefore it is unlikely that the proposed works will cause any further spread.

Nevertheless hygiene procedures will be implemented for personnel and equipment in order to prevent any spread of the disease. The proposed works are considered unlikely to change the hydrological conditions and water quality parameters to a level that would constitute an impact on the GGBF population through spread of Chytrid fungus.

9) Interfere substantially with the recovery of the species.

The decline of this species can be attributed to a number of likely factors including Chytrid fungus, predation of tadpoles by the Eastern Gambusia and habitat loss. The proposed works will not impact on an identified area of important habitat and breeding habitat will remain unaffected by this Proposal. It is anticipated that the Proposal will not affect the recovery of the species and the carrying capacity of the habitat within the area will remain largely unchanged. Appropriate mitigation measures and hygiene controls will prevent other factors such as Chytrid fungus and Gambusia becoming prevalent in the species habitat. The proposed works are considered a low risk to the species recovery.

3.1 GGBF Assessment of Significance Conclusion

The proposed closure of the Eastern Ponds avoids impacts to important breeding and refuge habitat for the Kooragang Island important population of Green and Golden Bell Frog. Based on the results of long-term monitoring of the population by University of Newcastle (UoN 2019a) it is evident that potential impacts will be limited to the temporary removal of an area of marginal foraging habitat only. The site is considered to be of low value as refuge habitat and breeding has not been recorded here since around 2014-15 as a result of changes in the quality of the habitat.

4. Conclusion

HCCDC is working to complete its requirement to close the former landfill areas referred to as the KIWEF Eastern Ponds. The Action would complement the previous rehabilitation of adjacent land and result in improved habitat and connectivity outcomes for MNES species. The Action would establish a rehabilitation area that provides a semi-permanent waterbody.

While there would be some environmental impacts as a consequence of the proposed Action such as short term biodiversity and traffic impacts and minor long term changes to hydrology, they have been avoided or minimised wherever possible through design and site-specific safeguards. The beneficial effects of the Proposed Action in providing the final rehabilitation of the KIWEF site, fostering biodiversity connectivity and improved contamination management is considered to outweigh the temporary adverse construction impacts and risks.

The findings of the Self-Assessment are reconfirmed that the proposed action is not likely to have a significant impact on matters of national environmental significance or the environment of Commonwealth land within the meaning of the *Environment Protection and Biodiversity Conservation Act 1999*. A referral to the Australian Department of Agriculture, Water and the Environment is not required.

Appendix A: Kooragang Island Waste Emplacement Facility- Eastern Ponds Closure Works Self-Assessment (Jacobs, 2020)



**Kooragang Island Waste Emplacement Facility - Eastern Ponds
Closure Works**

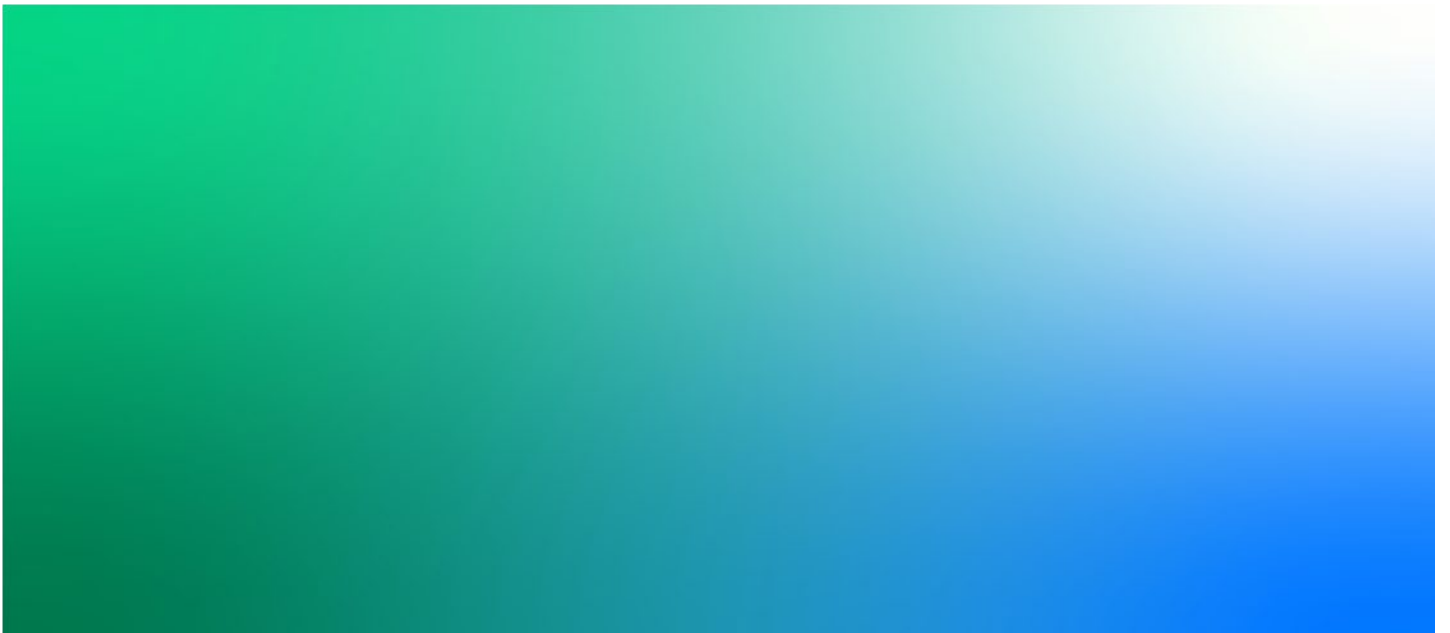
EPBC Act Self-assessment

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1. Introduction

Hunter and Central Coast Development Authority (HCCDC) propose to undertake the closure and rehabilitation of the Eastern Ponds (K24, K26, K31 and K32) area of the Kooragang Island Waste Emplacement Facility (KIWEF), near Newcastle NSW (Refer to , including the installation of drainage and sediment controls, capping and re-contouring of waste emplacement areas and rehabilitation including the creation of a lined artificial water body designed to support a permanent water body and landscaped to provide habitat for Green and Golden Bell Frog (GGBF) (the action). The action forms the final stage of the closure of KIWEF (collectively referred to throughout as the Closure Works)

The basic principles of the Closure Works are to reduce surface water infiltration into the groundwater by the following means:

- Re-grading of the site to a minimum 1% grade to prevent ponding of surface waters
- Drainage improvements
- Provision of a capping layer to achieve a minimum thickness of 0.5 m, minimum grade of 1% and permeability of 1×10^{-7}
- Rehabilitation using existing and imported topsoil; and alternative low in added nutrients and Chytrid free imported growth medium.

The intended outcome of the Closure Works is a site supporting similar levels of vegetation and providing similar surface water flows to surrounding ponds and habitat areas with a reduced contaminant load migrating from the fill material to the surrounding environment.

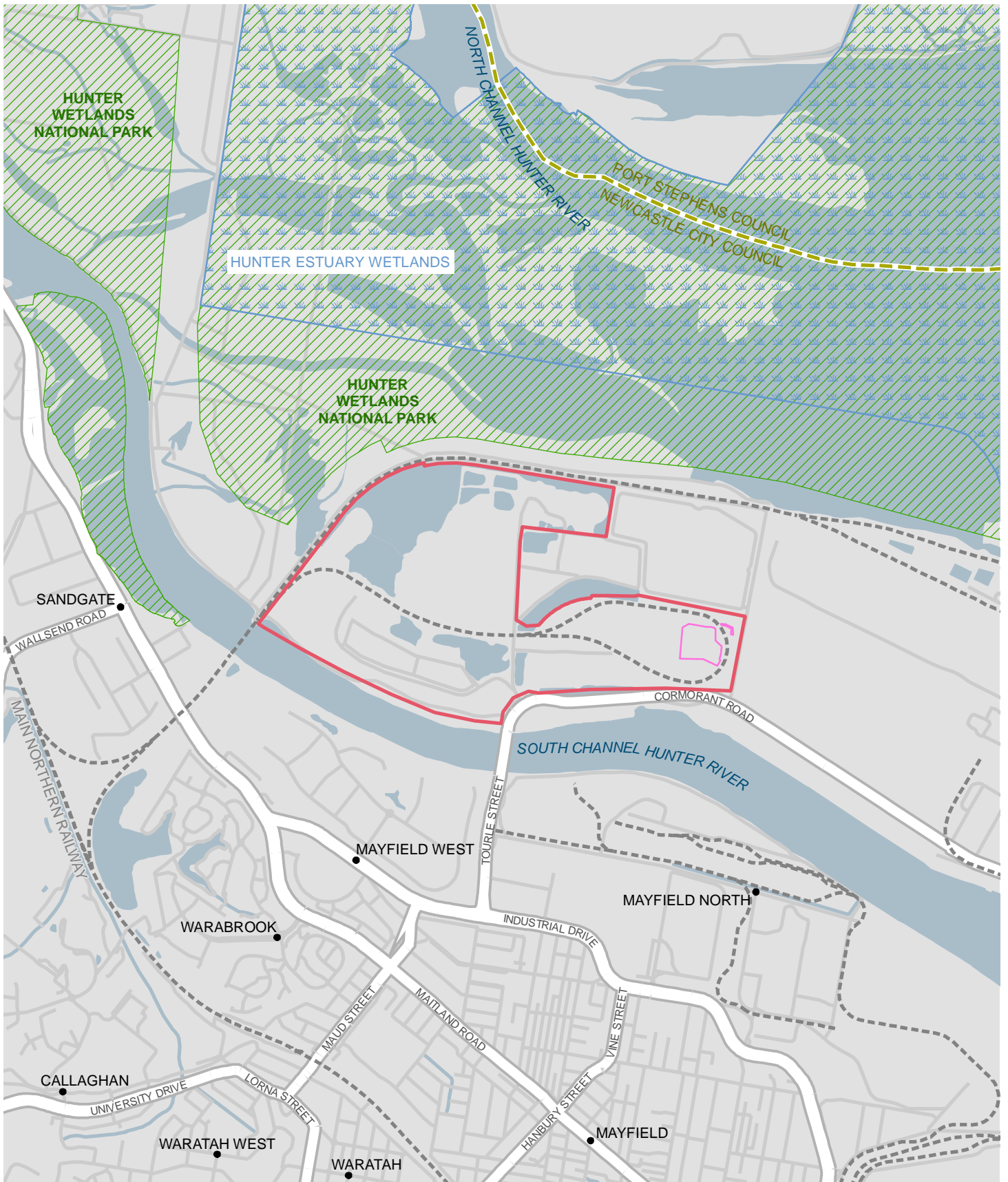
1.1 Site History

The site is a former landfill and continues to be regulated under the NSW Protection of the Environment Operations Act 1997. KIWEF ceased operation in 1999 and until this time was used by BHP as a landfill for disposal of waste from the Mayfield steelworks and associated operations. KIWEF was subject to Environmental Protection License (EPL) 6437 for the scheduled action of "Waste disposal by application to land" first issued in 1999 and subsequently transferred to Regional Land Management Corporation Pty Ltd in May 2003 and then the Hunter Development Corporation (Now Hunter and Central Coast Development Corporation (HCCDC)) in January 2008.

HCCDC surrendered EPL 6437 on 8 December 2010 and the EPA issued conditional Surrender Notice 1111840 and subsequent variation notices being issued on 2 May 2013 (notice number 1510956) and 17 April 2014 (notice number 1520063) collectively referred to as the Surrender Notice for the remainder of this report. Surrender conditions relate primarily to the closure process and describe the capping that is required across much of the area through reference to the GHD (2009) Revised Final Landform and Capping Strategy (the Capping Strategy).

The KIWEF Capping Strategy (GHD 2009) identified and described the proposed stages of capping works to be progressively completed. Due to the development of portions of the KIWEF footprint by external stakeholders, the stages of capping works were revised within a Variation of the Conditions of Surrender (Notice 1510956, issued on 2 May 2013). The current Stages of works and their status are:

- Area 1 – K2 and K10 North closure works completed in May 2015
- Area 2 – North of Rail Line (K3 and K5) closure works completed in July 2020
- Area 3 – K10 South closure works completed February 2017



- Legend**
- Locality
 - Railway
 - ▭ Surrender Notice boundary
 - ▭ Eastern Pond Closure Works
 - ▭ Local Government boundary
 - ▭ Ramsar Wetland
 - ▭ NPWS Reserve
 - ▭ Waterbody



Data sources
 Ramboll 2018
 © Department Finance, Services
 and Innovation Aug 2020
 NSW DPIE 2020
 GDA 1994 MGA Zone 56

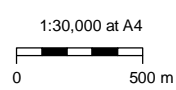


Figure 1-1 Location

The Capping Strategy was supported by a Flora and Fauna Assessment (GHD, 2010) with the aim of best managing the threat of significant environmental harm from the contaminants within the KIWEF whilst minimising risk to threatened fauna habitat. The EPA has provided an endorsement for the Revised Final Landform and Capping Strategy (GHD, 2009) as the best balance to achieve positive environmental outcomes for the site. The approach to closure is to implement minimal change in all site processes namely hydrology, vegetation and surface soils while further isolating potential contaminants. This is achieved by installing a low permeability capping layer to reduce infiltration and reduce the risk of contaminant migration.

The Eastern Ponds is the last area of KIWEF to be closed having been identified as potentially supporting a viable breeding population of Green and Gold Bell Frog (GGBF) listed as vulnerable under the EPBC Act and a key species under the nearby Ramsar wetlands, making them a matter of National environmental significance. The Surrender notice and capping strategy recognised this importance through the Eastern Ponds Action Plan (Golder, 2011a) which deferred closure while undertaking further investigations of the viability of the breeding population and significance of contamination. Recently the University of Newcastle researchers have determined that the Eastern Ponds no longer contain important breeding habitat having essentially dried out since the construction of the NCIG Rail Loop which encloses the site. This, combined with the success of earlier stages of KIWEF closure in protecting and providing breeding habitat for GGBF has triggered planning for closure of the eastern ponds.

The potential impacts to MNES for review have been identified as follows:

- Short term construction impacts related to clearing of existing vegetation dominated by weeds and non-native species with potential for direct impacts to GGBF
- Short term construction impacts associated with sedimentation able to be managed through the implementation of erosion and sediment control controls.

Unlike prior stages of closure, the action is unlikely to alter hydrology (including salinity levels identified as important in protecting GGBF from Chytrid fungus) in surrounding water bodies as the site is currently a zero-surface water discharge area and would continue to be so except in extreme or prolonged wet weather events.

The proposed action does not include the development and use of the site for any purpose including waste disposal. As such the self-assessment addresses the temporary construction impacts and ongoing potential changes to the environment associated with the construction of a low permeability capping layer above contaminated areas, with no ongoing loss of habitat considered likely.

1.2 Need for the Proposed Action

The KIWEF Eastern Ponds comprise four partially filled waste emplacement cells (cells K26/K32 and K24/K31) in the south-east corner of the site within the Newcastle Coal Infrastructure Group (NCIG) 'rail loop', with a total area of approximately 4 Ha.

Prior to construction of the NCIG rail loop (between 2008 and 2010), three of the four cells within Eastern Ponds contained aquatic habitat that supported a local population of Green and Golden Bell Frog (GGBF; *Litoria aurea*). Investigations undertaken by NCIG during the planning for the rail loop observed several locations within the Eastern Ponds with quantities of coal tar and oil staining contamination.

When the KIWEF Environmental Protection License was surrendered in 2010, the EPA required the development of the Eastern Ponds Action Plan (EPAP, Golders 2011) to provide a framework that determines when intervention within the Eastern Ponds is triggered. Section 6.1 of the EPAP excludes intervention in the Eastern Ponds, unless either of the following occurs:

- The GGBF population is deemed not viable, as determined via an appropriate monitoring programme; or
- The migration of groundwater presents a significant risk of harm to offsite environments such as the Hunter River.

Recent monitoring data from the University of Newcastle amphibian researchers at the KIWEF Eastern Ponds, has confirmed that the 2019/2020 season was the 5th consecutive year of GGBF occasional occupation within the Eastern Ponds. In accordance with the requirement of the KIWEF Surrender Notice and Eastern Ponds Action Plan the closure of the Eastern Ponds is now required to comply with the conditions of Surrender agreed between HCCDC and EPA, to be undertaken as Environmental Protection Works.

At completion of the Proposed Action, the Eastern Ponds Closure Works will achieve the primary objectives of the works, that may be stated as follows:

- Containing highly contaminated waste placed by BHP (1970-99) and reducing risk to the surrounding environment
- Conducting works in a manner that supports ongoing habitation of *Litoria Aurea*, an Endangered Species, present at KIWEF.

To meet our objectives, HCCDC must:

- Cap the site to a technical specification detailed in a GHD Capping Strategy (2010) - this establishes the performance criteria for capping surface grades, extent, thickness, permeability and serviceability
- Retention of *Litoria Aurea* habitat - to restore habitat on the remediated landscape to an extent, quality and function consistent with baseline levels (recorded at the time of the Surrender Notice and Action Plan).

2. Detailed description of proposed action

The Action is to undertake the closure of the K24, K26, K31 and K32 (Referred to throughout as the Eastern Ponds) of KIWEF in accordance with the Surrender Notice and Capping Strategy (GHD, 2009). The closure works are a part of the State Government's Closure Works required under approval of surrender of licence number 6437 (notice number 1111840).

Condition 4a of the surrender notice requires that the closure works be undertaken in accordance with:

- 'Hunter Development Corporation – Report on KIWEF – Revised Final Landform and Capping Strategy - August 2009 - Revision 2', prepared by GHD (the Capping Strategy)
- 'Green and Golden Bell Frog Management Plan – Kooragang Island Waste Emplacement Facility Closure Works' dated 19 April 2011 and prepared by Golder Associate
- 'K26/32 and K24/31 Ponds Action Plan – Kooragang Island Waste Emplacement Facility' dated 31 May 2011 and prepared by Golder Associates
- 'Materials Management Plan - Kooragang Island Waste Emplacement Facility' dated November 2012 prepared by RCA Australia.

The capping methodology is dictated by Condition 4h which requires validation that closure has been implemented in accordance with Chapter 7 of the GHD (2009) Revised Final Landform and Capping strategy and other relevant conditions of the Surrender Notice and in doing so specifies the mitigation measures within the documentation and management reports listed above.

Chapter 7 of GHD (2009) requires that the construction of the capping strategy will involve the following tasks:

- Establishment of erosion and sedimentation controls and construction of sedimentation basins as required
- Remove any vegetation and strip the top 100 mm of soil. Stockpile for re-use if deemed suitable
- Construct trunk drainage where required
- General earthworks (cut/fill) activities to establish the regraded surface with a final minimum 1% grade. If the stripped 100mm of soil is suitable for re-use, stockpile for use in revegetation, or screen and incorporate as fill for grading. Cut from within this area, if deemed suitable, may be used as fill and capped. Additional fill shall be sourced from an approved offsite source. Earthworks shall be compacted in accordance with the Technical Specification. Topsoil and re-vegetate the disturbed area if no further capping material is required.
- Place 0.5m capping material over the regraded surface at a final minimum 1% grade. Compact the capping material to achieve a maximum permeability of 1×10^{-7} m/s. Construction of the capping layer "should ensure that the final surface provides a barrier to the migration of water into the waste (or fill), controls emissions to water and atmosphere, promotes sound land management and conservation, and prevents hazards and protects amenity" (EPA, 1998)
- Topsoil 100mm thick using stockpiled surface soils or imported topsoil and revegetate the disturbed area
- Any cut material which is considered geotechnically unsuitable to use as fill shall be relocated to the proposed unsuitable material containment area
- Any cut material which is significantly contaminated (as defined by the materials management plan) shall be either disposed of off-site or relocated to a nominated containment cell area as directed by the principal.

Departures from the above standard approach to capping were described by the Capping Strategy and excluded the Eastern Ponds until further GGBF and water quality monitoring were completed in accordance with Golder (2011a) Eastern Pond Action Plan (EPAP). In addition to identifying closure triggers that have now been met, Golder (2011a) provided a review of closure options and confirmed that only regrading and capping remained feasible and viable. A further departure from the standard approach for the Eastern Ponds is the need to

minimise ground interaction and as such the stripping of topsoil for re-use is not proposed and an alternate source of revegetation growth medium would be required.

2.1 Design

The following sections provide a description of the design criteria, major design features and engineering constraints of the Action as illustrated in Figure 2.1. These features have been based on the concept design and would be subject to refinement during detailed design. **Engineering constraints**

The main issues and constraints considered by the Action included:

- **Water balance:** The Eastern Ponds currently comprise a zero surface water discharge catchment as they are formed from unfilled landfill cells surrounded by closed cells and NCIG Rail Infrastructure and reduced permeability following completion of the capping requires that surface water be managed
- **Soils:** The likely presence of contamination within the surface layers requiring minimal ground disturbance while avoiding settlement issues from vegetation and other unfavourable ground conditions and achieving adequate cover and compaction
- **Action staging:** Minimising project construction duration to limit construction impacts while facilitating impact avoidance for GGBF and ability to schedule works to minimise impacts on the GGBF life cycle
- **Access:** The site requires access through NCIG controlled area while Windmill Road is a left in left out configuration to Cormorant Road and the surrounding road network requiring a long round trip for return to material sources in KIWEF
- **Existing Infrastructure:** The Eastern Ponds are surrounded by completed KIWEF closure works to the west and south, NCIG Rail loop immediately to the East and NCIG access road to the north requiring careful consideration of potential impacts to existing infrastructure.

The concept design has considered these key engineering constraints and would be refined to minimise environmental impacts considered in this assessment.

2.2 Construction activities

For the purpose of this assessment, an indicative construction plan has been considered based on understanding of prior stages of the Closure Works. Detailed construction plans, and methods would be confirmed following completion of the detailed design and engagement of the contractor. The detailed construction plans would adopt mitigation measures as nominated in this assessment. The actual construction method may vary from the description in this chapter due to factors such as identification of on-site conditions during pre-construction activities, ongoing design refinement and consultation with property owners.



Legend

- | | | |
|------------------------------------|-------------------------------|------------------|
| Delineation rail corridor boundary | Staging/parking area | Stormwater drain |
| Surrender Notice boundary | Pavement works | Railway |
| Existing material stockpiles | Temporary stockpile | |
| Area 1 | NPWS Reserve | |
| Area 2 | Pump system | |
| Area 3 | East Pond pipe option A | |
| Proposed exclusion fence | East Pond pipe option B | |
| Area 2 closure works | Haul road | |
| Eastern Pond Closure Works | Existing grass drainage swale | |



Data sources

Ramboll 2018
 © Department Finance, Services and Innovation Aug 2020
 Aerometrex 2020

GDA 1994 MGA Zone 56

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Figure 3-1 Action layout

2.2.1 Work methodology

Construction activities would be guided by a Construction Environmental Management Plan (CEMP) to ensure construction work is carried out to HCCDC specifications within the specified work area. Detailed work methodologies would be identified by the construction contractor and would be refined to respond to engineering and environmental constraints relevant to the Action area. Before the start of each stage, the following general activities would be carried out:

- Implementation of environmental controls including:
 - Establishment and use of Chytrid Hygiene procedures such that the Chytrid fungus is not brought to site or transferred between areas of the site
 - Appropriate levels of GGBF pre-clearance/disturbance surveys and relocation to ensure to the extent possible that direct disturbance areas are free of GGBF on commencement of works in each area
 - Establishment of GGBF exclusion fencing in advance of works such that GGBF can move out of the site post dormancy, but the risk of GGBF re-entering surveyed areas is prevented
 - Establishment of clear boundaries of works areas such that unnecessary disturbance is avoided, particularly adjacent to existing ponds
 - Establishment of appropriate erosions and sediment controls to prevent sedimentation and pollution of waters providing GGBF habitat
 - Implementation of GGBF risk consideration to all decision making such that unintended consequences to GGBF can be avoided. This includes in considering suitability of imported materials from a Chytrid risk and nutrient perspective and use of chemicals including flocculants, herbicides and pesticides
- Establishment of lunch room and toilet facilities within previously completed area of K10 North and continued use of site office at KIWEF Area 2
- Establishment of a temporary stockpile area on previously completed capping works in Area K10 North adjacent to the Eastern Ponds
- Removal of vegetation within Eastern Ponds in a manner that protects GGBF to the extent possible. Removed vegetation will be relocated to an area outside the immediate works area to allow GGBF hiding within the vegetation to escape and the vegetation to compost and stabilise
- Engagement with topsoil layer to the minimum extent required as it is unlikely to constitute suitable growth medium under the Materials Management Plan
- Creation of a hydraulically contained system draining to a permanent lined sediment basin vegetated for stabilisation and to form GGBF preferred habitat
- Management of excess stormwater during construction using pumps to previously capped areas for filtration in established vegetation, evaporation and management through existing sediment basins; or via reinjection/infiltration into existing permeable structures onsite
- Regrading of existing slag walls within and around the Eastern Ponds to address stability issues
- Importation of capping and revegetation medium from offsite and stockpiles of surplus material from earlier stages of KIWEF closure (assessed separately) due to unsuitability of material within the Eastern Ponds for temporary storage in stockpile area prior to use in closure works
- Placement of fill material necessary to form capping base that facilitates drainage to the permanent sediment basin
- Establishment of trunk drainage, lined where necessary, to direct run-off to the sediment basin
- Placement and compaction of capping layer
- Placement and revegetation of growth medium and rehabilitation using species preferred by GGBF

- Establishment of a passive overflow pipeline from a highwater discharge point directing water to the northern end of Windmill Road Open Channel to allow post construction discharge under extreme and prolonged wet weather conditions or, if the passive systems is determined to be unfeasible, the installation of a remote solar powered pump system to discharge high waters from the sediment basin into the drainage channels on K10 north with ultimately discharging to Long Pond
- Demobilisation of construction compound
- Removal of construction environmental controls once site has stabilised.

2.2.2 Construction hours and duration

The works would be generally undertaken during standard construction hours, being:

- Monday – Friday: 7am – 6pm
- Saturday: 7am – 1pm
- Sunday and public holidays: No work.

Deliveries of fill/capping materials may extend beyond the standard construction hours to enable the project to capitalise on availability of materials from 24hr operations such as the current Sydney Tunnelling Operations. Any works outside the standard construction hours will be restricted to delivery of materials only and discontinued in the event of GGBF breeding or migration events.

The staging of construction would be sequenced so construction can be completed within the minimum possible timeframe. The duration of works is likely to be six months followed by a three-month care and maintenance period. Works are scheduled to occur in 2020 and be completed in the first half of 2021.

3. Description of the existing environment

The site history is summarised as follows based on GHD (2009):

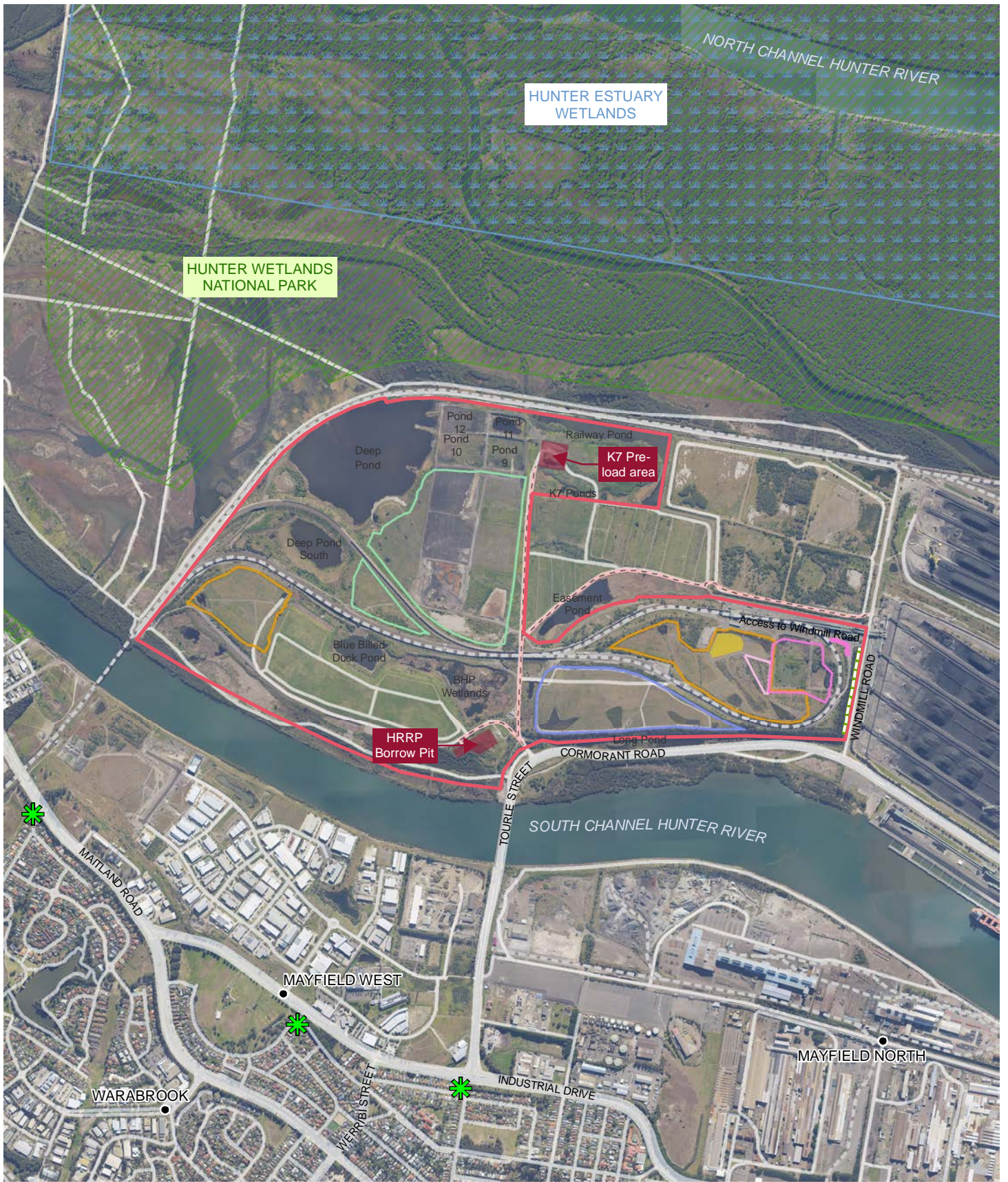
- Prior to European settlement in 1850, Kooragang Island was a mosaic of deltaic islands and tidal channels
- Kooragang Island was subsequently settled for agriculture, including livestock grazing and the cultivation of crops
- The most significant human activity on Kooragang Island has been the reclamation of extensive areas of estuarine wetlands through the placement of culverts on creeks and land filling such that the morphology, hydrology and vegetation has been profoundly altered
- In 1951 dredged material from Newcastle Harbour was used to initiate the filling of the tidal channels between the islands of the Hunter River
- Clearing for agriculture removed the majority of the swamp forest and rainforest vegetation on the island by 1954
- Filling of land with industrial by-products resulted in substantial changes to the south-east corner of Kooragang Island by 1966
- The KIWEF parcel of land was transferred to BHP in 1979 however, the site had been used for the landfilling operations since 1972
- The Eastern Ponds were constructed using blast furnace rock slag before being partially filled with industrial wastes associated with steel making. The site stopped receiving waste prior to 2002 when the land was transferred to the NSW Government.
- In 2010, NCIG completed construction of the embankment of the NCIG Rail Loop. The construction works included the filling and compaction of approximately 65% of ponds K32 and K26 (the north eastern and south eastern cells), which may have contributed to some of the changes observed in hydrology, surface water and vegetation since completion.

As a result of this history, the site is highly disturbed. Currently the Eastern Ponds consist of a steep, slag wall sided depression in the landscape. The Eastern Ponds are surrounded by the NCIG Rail Loop and dump station infrastructure to the north and east and previously completed K10 North capping to the South and West. The Eastern Ponds have a protruding slag wall running north-south through its middle and each side of this wall is vegetated largely with weeds and other vegetation as described below. The site context is illustrated in Figure 3.1.

3.1 Vegetation and fauna habitat

The Eastern Ponds are a series of partially filled waste emplacement cells in the southeast corner area of the KIWEF. These cells historically comprised extensive open water and over time have undergone a successive change to a more vegetated structure influenced by a change in surface hydrology, and specifically the gradual reduction of surface water. The overall pattern of open water reduction and vegetation succession is described by the University of Newcastle (2019) and has been summarised from this document for the purpose of providing historical context to the current environment. Following construction of the NCIG rail loop (2009-2010) these wetlands were either filled in or decreased significantly in hydroperiod.

Figure 3.2 and the accompanying text illustrates the change in structure from an aquatic habitat to a predominantly shallow and drier habitat. As the former shallow surface water has retreated this has favoured colonisation by the common reed (*Phragmites australis*) in low areas, with Swamp Oak (*Casuarina glauca*), Wattles (*Acacia* spp) and exotic vegetation colonising the slightly elevated batter slopes fringing the former ponded open water areas, that were installed as part of the NCIG rail loop construction.



- Legend**
- Sensitive receiver
 - Locality
 - Windmill Road Open Channel
 - Haul road
 - Railway
 - Surrender Notice boundary
 - Eastern Pond Closure Works
 - Staging/parking area
 - Area 1
 - Area 2
 - Area 3
 - Existing material stockpiles
 - Temporary stockpile
 - Ramsar Wetland
 - NPWS Reserve



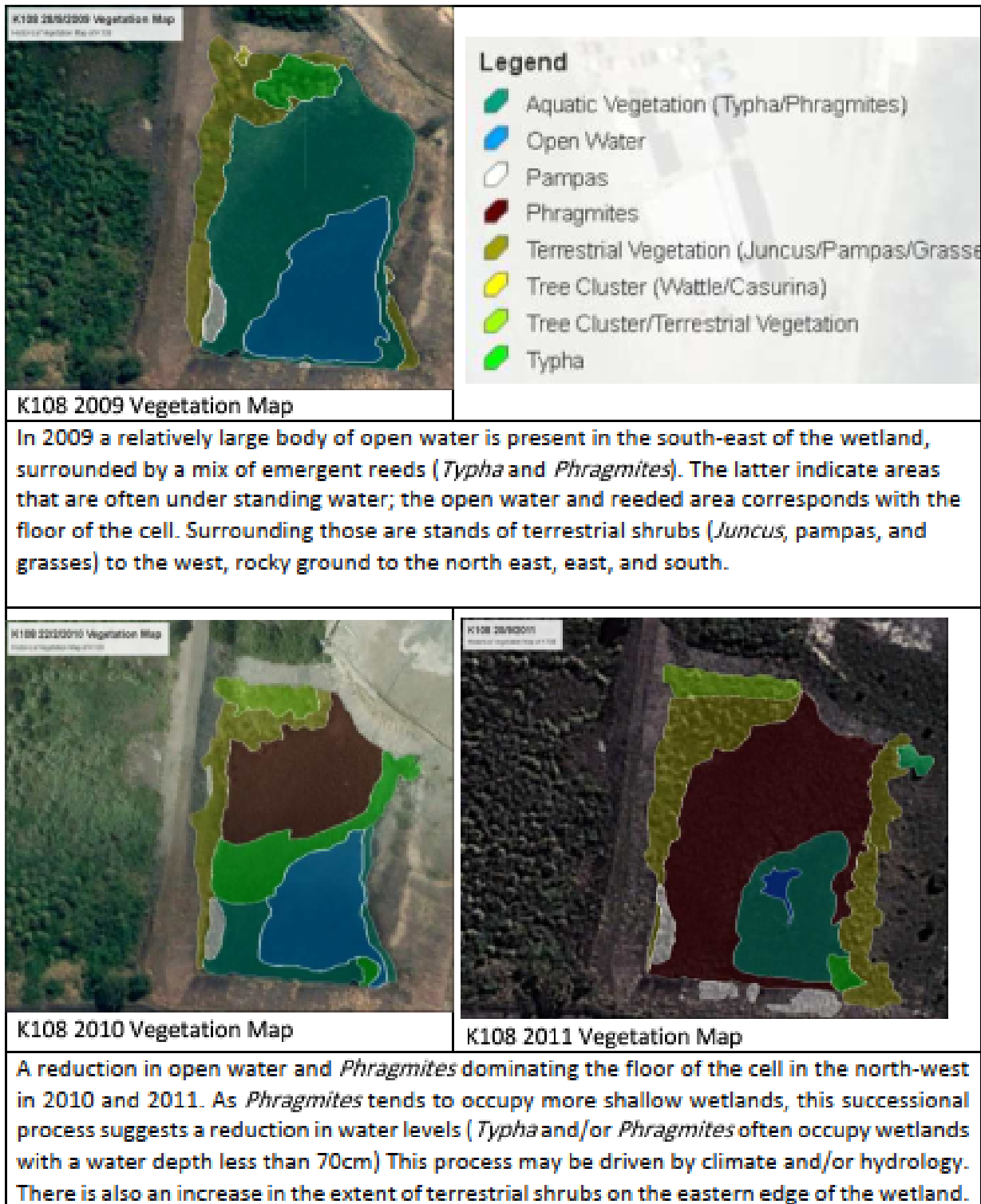
Data sources
 Jacobs 2020
 Ramboll 2018
 © Department Finance, Services and Innovation Aug 2020
 NSW DPIE 2020
 Aerometrex 2020

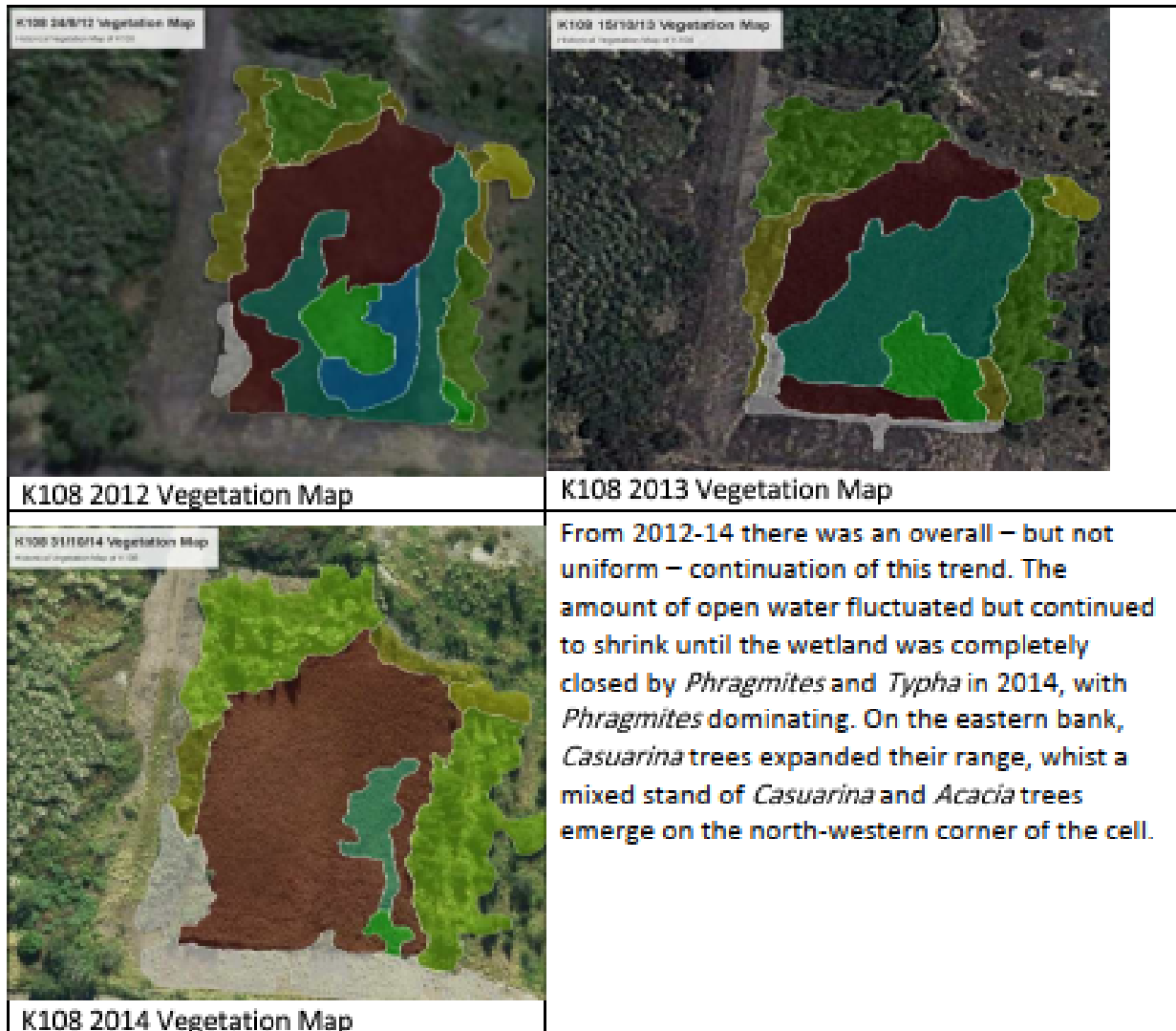
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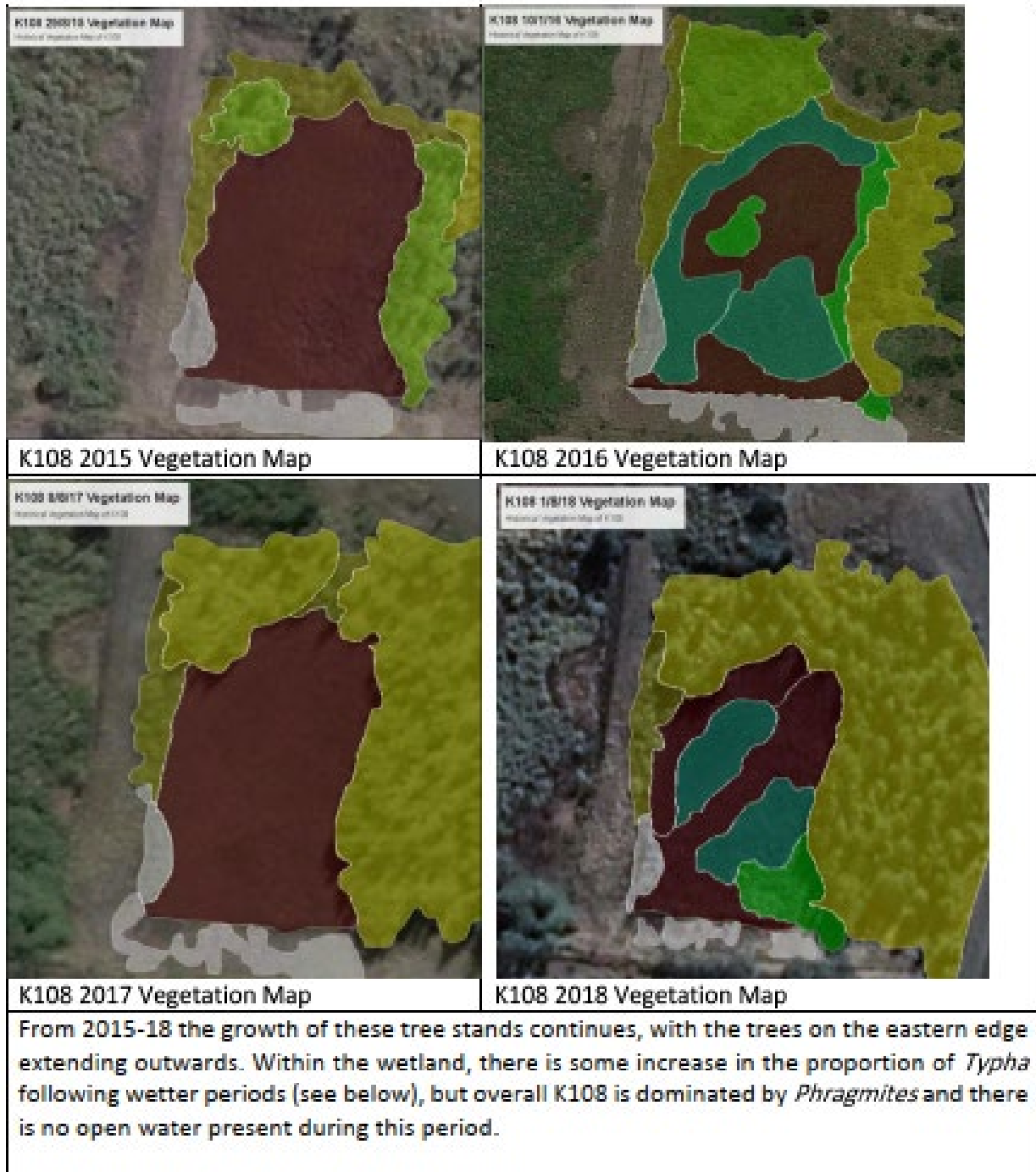


Figure 3-1 Context

Figure 3.2: Map series showing successional change in vegetation in the K108 pond 2009 to 2018 (source UoN 2019).







This pattern of change over time in K108 (the south eastern cell of the Eastern Ponds) has also been observed in the adjacent cell (K108B, the north western cell of the Eastern Ponds) and is illustrated in Figure 3-2. The large body of open water in the north was completely removed for construction of the rail loop between 2009 and 2010.

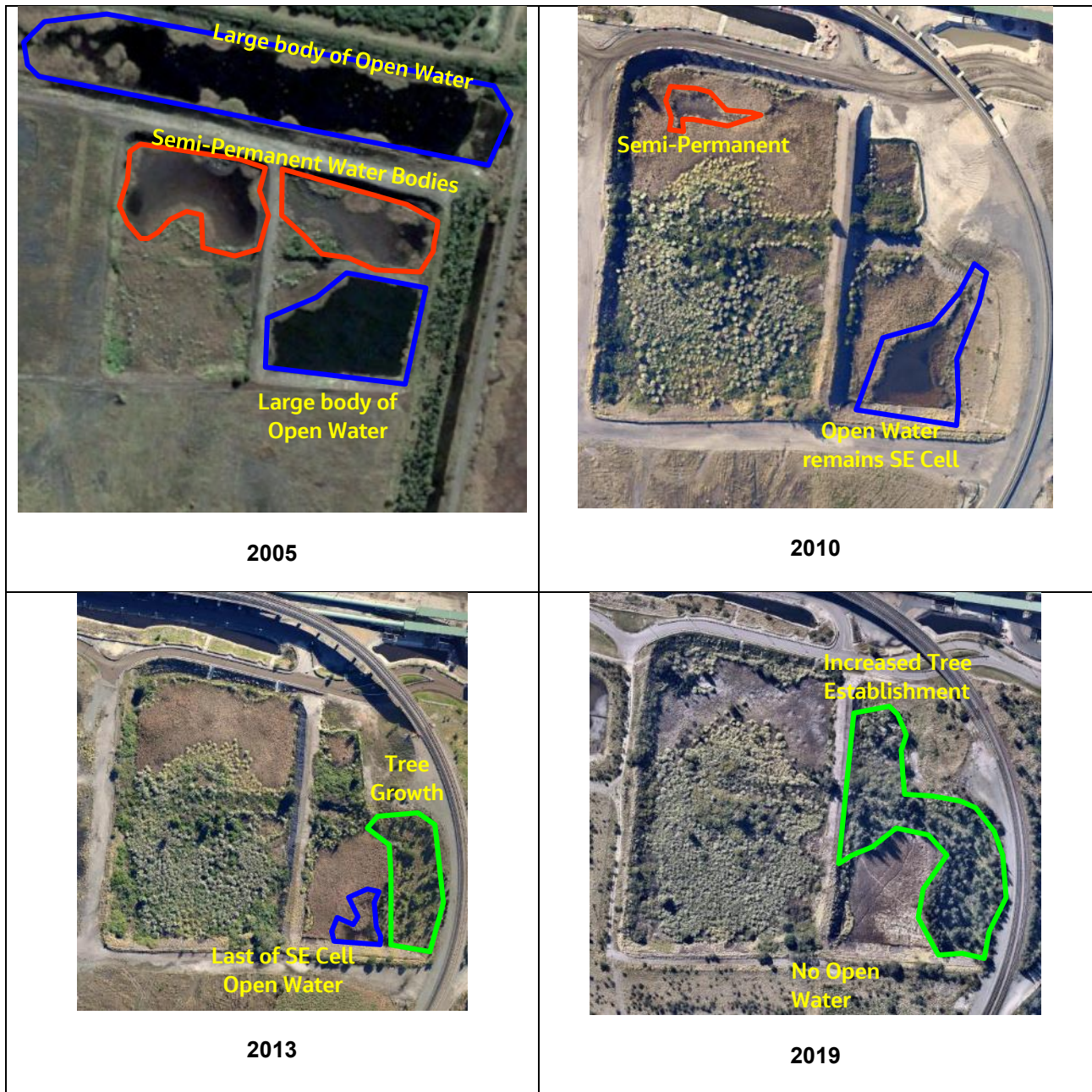


Figure 3-2. Map series showing successional change in vegetation over remaining eastern ponds.

An inspection of the vegetation in the eastern ponds was conducted on 5 June 2020 to validate the images provided in the UoN (2019). The inspection confirmed the successful change from an open water environment to a landscape now occupied by reeds (*Phragmites australis* and *Typha orientalis*) with very limited surface water within the cells. The presence of these native reeds, in addition to a low diversity of other semi aquatic plant species (*Hydrocotyle bonariensis* and the exotic *Juncus acutus*) indicates that shallow surface water periodically occurs within the Eastern Ponds, and is likely influenced by rainfall totals, with this condition likely to change rapidly in drier periods.

Slightly higher elevated portions of the cells floor, where surface water does not persist are dominated by a dense cover of exotic plant species, in particular *Cortaderia selloana* (Pampas Grass), as well non-indigenous Wattles (*Acacia* spp). The constructed walls of the cells and the dividing barrier between the cells are also occupied by a dense cover of exotic weeds as well as grasses, with the exception of a stand of *Casuarina glauca* (Swamp Oak) along the eastern and central parts of the K108 fringe and below the rail loop. A relatively small area of young regrowth Swamp Oak occurs in land fringing the cell floor on the eastern and northern section of

K108. This vegetation is in very low condition, with the mid and groundcover strata dominated by a suite of exotic plant species, including *Chrysanthemoides monilifera* (Bitou Bush), Pampas Grass, *Olea europaea subsp cuspidata* (African Olive), and *Ligustrum lucidum* (Large-leaved Privet), *Verbena bonariensis* (Purple Tops) and *Ambrosia artemisiifolia* (Ragweed). Due to its small patch size and dominance of weeds in the groundcover layer, the regrowth Swamp within the Eastern Ponds does not meet the criteria for the Swamp Oak Swamp Forest Threatened Ecological Community listed under the EPBC Act.

An open area of land to the immediate west of the Eastern Ponds has been selected as a potential site for storing fill material to be used in the closure activities. This site has been historically cleared of any native-vegetation and foreign fill material placed and compacted during closure. Currently, the site has a cover of exotic grasses and weeds.

A discussion on the value of the habitat for the Green and Golden Bell Frog is provided in Section 3.3. The value of the habitat for other threatened and migratory fauna species (MNES) is considered low. This assessment is based on the dominance of exotic vegetation and the lack of open water to provide foraging and breeding opportunities for amphibians and migratory birds.



Photo 1. Dense cover of exotic Pampas Grass dominating cell K108B



Photo 2. Phragmites australis (Common Reed) across cell K108, this species favours very shallow surface water and a wetting / drying regime. Linear patch of regrowth Casuarina glauca along perimeter



Photo 3. Cell embankments covered with exotic Fountain Grass



Photo 4 Proposed soil stockpile site to be used during closure, showing cover of exotic grasses and weeds.

3.2 Existing hydrology

The low-lying nature of the Eastern Ponds means there is no immediate surface water drainage. The lowest points are in the north-west and south-east cells, and these locations exhibit wetland vegetation (predominantly *Phragmites australis* and *Typha orientalis*) which are consistent with periodic inundation and ponded water. Low-lying areas are filled with rainfall and runoff from the adjoining slag walls and access tracks.

Because their elevation is below that of surrounding infrastructure and landforms, the eastern ponds are a zero surface water discharge area. While historically holding water for extended periods, over recent years the ponds have dried out, with waters infiltrating into groundwater or evaporating.

3.3 Green and Golden Bell Frog population monitoring – Eastern Ponds

A primary component of the KIWEF Eastern Ponds Action Plan (Golder 2011, EPAP) is due consideration for GGBF and their habitat. Trigger values are identified with a focus on monitoring the viability of the habitat to be impacted for the GGBF breeding population.

In response to the action plan, the University of Newcastle has conducted regular monitoring of the GGBF population over the KIWEF since 2011. This work involves repeated visual encounter surveys during the breeding season targeting a range of artificially created ponds across the KIWEF site including the Eastern Ponds. The K108 wetland (SE cell of the Eastern Ponds) has been surveyed for GGBF two to three times per summer season since 2011-12 (UoN 2019).

The results of the monitoring program are used to inform the triggers for management intervention prescribed in Golder 2011a. These include:

- Water quality: if concentrations of contaminants in surface water in the Ponds demonstrate an increasing trend and malformed individuals of GGBF and/or dead individuals are identified at the Ponds
- Habitat: significant die-off (that is, greater than 60% as determined by visual assessment) of emergent vegetation in the Ponds during the breeding season is observed
- Population: the population of breeding individuals in the Ponds (as determined by numbers of calling males) drops by more than 50% over one sampling period, and this occurs during favourable climatic conditions that are conducive to GGBF.

The University of Newcastle has reported regular encounters of frogs in K108 from surveys conducted between 2011-16 leading to assessment in 2014 that this pond comprises a healthy population (Clulow 2014). Since 2013-14 however, the overall pattern of GGBF in the Eastern Ponds has been one of decline (UoN 2019), a phenomenon that is consistent with the reported gradual reduction in the area of open water available to frogs over this same period. Indeed both 2016-17 and 2017-18 were dry years and no GGBF were recorded in the Eastern Ponds at this time (UoN 2019). Very low numbers were reported in the following wetter season of 2019-20 however these number remain low compared to the ponds in the remainder of the KIWE (McHenry 2020).

The most recent surveys in 2019-20 have described the habitat in the Eastern Pond as being infrequently occupied by GGBF and there is no evidence of breeding taking place within them. This is consistent with data from the University's annual monitoring program which shows that for the last five consecutive years (2015-20) the Eastern Ponds have provided terrestrial and ephemeral aquatic habitat that is only occasionally occupied by GGBF (McHenry, 2020).

McHenry (2020) describes the Eastern Ponds as ephemeral and semi-permanent wetlands, considered to have limited 'refuge' habitat value for GGBF due to the lack of open water. While the UoN (2019) describes that ephemeral and semi-permanent ponds such as these are preferred as breeding sites elsewhere on Kooragang Island, however the key indicator has been that 'all wetlands in which breeding has been detected have areas of open water' (UoN 2019) a condition which is absent at the Eastern Ponds.

The results of the monitoring at the Eastern Ponds and indeed the greater KIWEF area has indicated that the population of breeding individuals in the Eastern Ponds has indeed declined by > 50% over recent sampling events, and that this has occurred during a period that breeding activity has been high in other ponds in the KIWEF. Further to this, a decline in the area of open water and a transition to a more terrestrial environment has been noted and is the major factor leading to the lower value of the habitat for GGBF and absence of breeding.

These data are consistent with the habitat and population triggers prescribed in the KIWEF EPAP and support closure of the eastern ponds at this time.

4. Identification of Matters of National Environmental Significance

Actions that are likely to have a significant impact on Matters of National Environmental Significance (MNES) are subject to an assessment and approval process under the provisions of the EPBC Act. MNES are to be considered in the environmental assessment process and include:

- Wetlands of International Importance
- Listed Ecological Communities
- Listed Threatened Flora and Fauna
- Migratory Species listed under international agreements (e.g. JAMBA and CAMBA)

The presence of the listed vulnerable species, Green and Golden Bell Frog (*Litoria aurea*) has been confirmed and reported at the eastern ponds (University of Newcastle 2019) and constitutes part of the larger population extending across Kooragang Island.

The potential presence of other MNES in the study area has been determined from review of the protected matters search tool (PMST). Using the PMST, a search area of 10 km was placed around the eastern ponds. The resulting EPBC Act protected matters report identified:

- 1 wetland of international importance
- 4 listed threatened ecological communities (TECs)
- 78 listed threatened species, and
- 75 listed migratory species

4.1 Wetlands of International Significance

The PMST has identified the Hunter estuary wetlands occurs within the locality, this is a Ramsar wetland of international importance and protected under the EPBC Act. The Kooragang component of the Hunter Estuary Wetlands (HEW) Ramsar site is located in the estuary of the Hunter River, to the north of the KIWEF and the proposed activity for closure of the Eastern Ponds will not directly or indirectly impact on the Hunter estuary wetlands. Further discussion on potential impacts is provided in Chapter 5.

The Department of Agriculture, Water and Environment (DAWE) have previously considered the GGBF species to form a key component of the HEW Ramsar site. A discussion of the impacts from the Closure Works on the GGBF species is also provided in Chapter 5.

4.2 Threatened Ecological Communities

The PMST identified four threatened ecological communities that are known from a 10 km radius of the site, these include:

- Central Hunter Valley eucalypt forest and woodland (Critically Endangered)
- Lowland Rainforest of Subtropical Australia (Critically Endangered)
- Subtropical and Temperate Coastal Saltmarsh (Vulnerable)
- Coastal Swamp oak (*Casuarina glauca*) Forest of the New South Wales and South East Queensland ecological community (Endangered)

An inspection of the vegetation in the eastern ponds was conducted on 5 June 2020 which confirmed a landscape largely occupied by exotic and non-indigenous native plant species, interspersed around areas of native reeds (*Phragmites australis* and *Typha orientalis*) in the lowest lying parts of the cells. The vegetation is not consistent with the listed threatened communities.

Coastal Swamp oak (*Casuarina glauca*) Forest

A stand of *Casuarina glauca* (Swamp Oak) regrowth (approximately 0.3 hectares) occupies the eastern and central parts of the K108 cell on slightly elevated lands above the cell floor and below the rail loop. Based on review of historic aerial photographs over the site, this vegetation appears to have colonised over the last 10-15 years coinciding with the reduction in open water within the cells. The vegetation is not in natural condition, with the mid and groundcover strata completely dominated by a suite of exotic plant species, particularly *Chrysanthemoides monilifera* (Bitou Bush), Pampas Grass, *Olea europaea subsp cuspidata* (African Olive), *Ligustrum lucidum* (Large-leaved Privet), *Verbena bonariensis* (Purple Tops) and *Ambrosia artemisiifolia* (Ragweed). No native groundcover species were noted. Planted and regrowth Swamp oak also occurs along the open drain along Windmill Road, a small area at the northern end may be impacted to facilitate an overflow discharge point. This vegetation also comprises exotic understorey.

With regard to status of the community, in accordance with the EPBC Act, for a patch of vegetation to qualify it needs to meet key diagnostic characteristics and condition thresholds. There are a number of factors that preclude this area of Swamp Oak forest from qualifying as a MNES, namely:

- The soils present are a results of landform modification (excavation and fill) and are not derived from natural unconsolidated sediments (alluvium)
- The patch size is below the minimum threshold (i.e. <0.5 ha) with a dominant exotic understorey (i.e. patch does not have a predominantly native understorey).

No further assessment is required.

4.3 Threatened and migratory species

The list of threatened species identified from the PMST are shown in Appendix A, with a description of the preferred habitat for each species, and the likelihood of the species occurring or utilising the habitat at the eastern ponds. Of the 78 species identified, several of these are marine seabirds or marine mammals that would not occur at the site and these are not assessed further.

The PMST identified 18 listed plant species that have been recorded in the locality or have a modelled distribution which may include the locality surrounding the study site. An assessment of the likelihood of each of these species is provided in Appendix A and concludes that none of the threatened plant species listed is expected to occur in the Eastern Ponds. This is supported by the results of the site inspection, in which no threatened species were observed, and the fact that the ponds are an artificially created landscape, dominated by exotic plant species, with limited areas of native regrowth.

The PMST identified 22 listed fauna species (threatened and migratory species) that have been recorded in the locality or have a modelled distribution which may include the locality surrounding the study site. An assessment of the likelihood of each of these species is provided in Appendix A. The Green and Golden Bell Frog, is know from the Eastern Ponds and a further two species are considered to have a moderate chance of occurrence, at least on occasion, as identified below:

- Green and Golden Bell Frog (*Litoria aurea*) (Vulnerable species EPBC Act)
- Australasian Bittern (*Botaurus poiciliptilus*) (Endangered species EPBC Act)
- Australian Painted Snipe (*Rostratula australis*) (Endangered and Migratory species EPBC Act).

Potential impacts on the three threatened fauna species are described in Section 5. An assessment of significance is provided in Appendix B, which addresses the Significant impact guidelines 1.1 under the EPBC Act (DoE 2013).

5. Impacts on Matters of Environmental Significance

The proposal's likely direct and indirect impacts on biodiversity are summarised in this chapter. HCCDC is working towards the completion of the closure of KIWEF Eastern Ponds. The proposal would commence in mid to late 2020 and the final stage is expected to be completed end of 2020 or early 2021. The key features of the proposed activity will include:

- Closure of the KIWEF site next to the NCIG rail loop at Kooragang including:
 - Stabilising the slope along the west and south of the Eastern Ponds
 - Removing weeds, and flora within the pond
 - Excavating the top layer of the site
 - Capping the area to achieve a minimum thickness of 0.5 m, minimum grade of 1% and permeability of 1×10^{-7} .
- Temporary diversion of the shared road access to the site
- Temporary ancillary facilities including site compounds and stockpile sites.

Although it is not in the commitments required from HCCDC, the closure works of the KIWEF site will create a permanent water body within Eastern Ponds as requested by the University of Newcastle including changing the water balance within the area and stabilising flora such as acacias around the pond for potential habitat for the Green and Golden Bell Frog among other estuary and migratory species.

A trickle flow pipe will be installed at a high-water mark within the eastern cell designed to drain any overflow only during prolonged extreme weather events. There are two options considered for position of the drain, both will require shallow excavation of a narrow trench, to be backfilled. Option A will drain via pipeline into the open drain along Windmill Road, and eventually into Long Pond, while Option B will discharge directly into Long Pond via an existing drain below the rail loop. Long Pond is located to the south of the Eastern Ponds along Cormorant Road. Any overflow discharges would occur during extreme weather events only, and this will be associated with a charged drainage system.

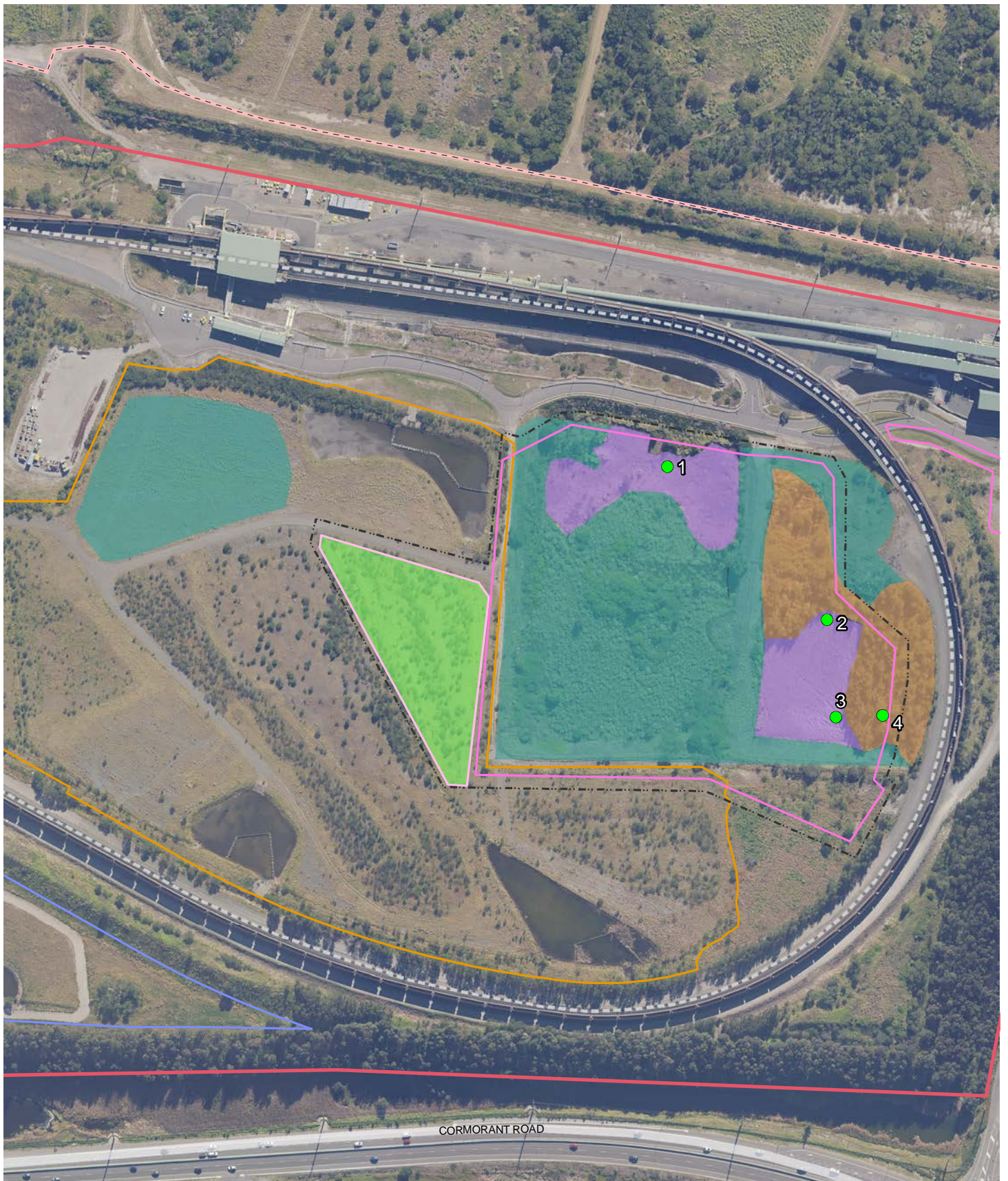
5.1 Key assumptions

Key assumptions of the works are that:

- All vegetation within the Eastern Ponds site boundary will be cleared which includes the stockpile site, and overflow pipeline to be trenched
- There will be no direct impacts during construction outside of the proposed works site boundary
- Overflow water from the Eastern Ponds would discharge to Long Pond to the south of the Eastern Ponds. This would occur only during prolonged extreme weather events when the drainage system is already charged.

5.2 Removal of native vegetation

The total area of the Eastern Ponds is around 4.3 hectares including the raised walls and the proposed activity would remove around 1.5 hectares of native regrowth vegetation comprising predominantly rushes, *Phragmites australis* and *Typha orientalis* (0.8 ha) and regrowth Swamp Oak (0.7 ha). All areas of native vegetation occur within the lower parts of the cells. The remaining areas of disturbance associated with the cell walls, access roads and stockpile area, comprise only exotic and non-indigenous plant species that are not characteristic of native plant communities (Refer to Figure 5.1). No nationally listed threatened ecological communities will be impacted.



Legend

- | | |
|----------------------------|--|
| Surrender Notice boundary | Vegetation plot location |
| Area 1 | PCT |
| Area 3 | Disturbed / non-native |
| Proposed exclusion fence | Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion (1071) |
| Eastern Pond Closure Works | Rehabilitation / Acacia |
| Staging/parking area | Swamp Oak coastal forest on coastal lowlands of the Central Coast and Lower North Coast (1729) |
| Haul road | |
| Railway | |



Data sources
 Jacobs 2020
 Ramboll 2018
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 Aerometrex 2020

GDA 1994 MGA Zone 56

1:3,000 at A4



Figure 5-1 Plant community types

5.3 Changes to hydrology

The area of rushland associated with a periodically flooded wetland provide marginal habitat for the Green and Golden Bell Frog as well as the Australian Bittern and Australia Painted Snipe. The area of rushland to be removed equates to around 0.8 hectares, although of this, the better quality habitat is located within cell K108 (around 0.4 ha).

The low elevation of the completed cap site means there will generally be no outflow of surface water from the Eastern Ponds. In addition to this, the presence of a low-permeability cap will result in reduced water loss through seepage and infiltration and therefore higher water levels in low-lying ponded areas than currently present. To avoid uncontrolled discharges from the ponds in large rainfall events, a controlled outlet will be constructed to draw-down water from the cap surface (SMEC 2020). At this concept design stage, the outlet is assumed to be via a gravity pipe flowing into Windmill Road Channel (K100A); or via a pump with discharge into the NCIG rail corridor drain, which eventually outlets into Long Pond (K100E) adjacent Cormorant Road (SMEC 2020).

K100A is a deep permanent wetland alongside Windmill Road, on the eastern edge of the Industrial Zone. It is surrounded by dense stands of Casuarina trees and contains Gambusia in very high densities. It often has relatively large numbers of GGBF but does not appear to support breeding (UoN 2019). This status is similar to the Long Pond along Cormorant Road (K100E) which also has historically reported low numbers of males, and no confirmed breeding (UoN 2017).

Green and Golden Bell Frog (*Litoria aurea*) (Vulnerable species EPBC Act)

The habitat within the Eastern Ponds is not considered critical habitat for the GGBF. The University of Newcastle has reported regular encounters of frogs in the Eastern Ponds (K108) from surveys conducted between 2011-16. Since 2013-14 the overall pattern of GGBF in the Eastern Ponds has been one of decline (UoN 2019), and frogs were absent during dry years in 2016-17 and 2017-18 (UoN 2019). Very low numbers were reported in the following wetter season of 2019-20 however these number remain low compared to the ponds in the remainder of the KIWE (McHenry 2020).

McHenry (2020) describes the Eastern Ponds as ephemeral and semi-permanent wetlands, considered to have limited 'refuge' habitat value for GGBF due to the lack of open water. While the UoN (2019) describes that ephemeral and semi-permanent ponds such as these are preferred as breeding sites elsewhere on Kooragang Island, however the key indicator has been that 'all wetlands in which breeding has been detected have areas of open water' (UoN 2019) a condition which is absent at the Eastern Ponds. The site is therefore considered suitable for dispersal and foraging, but not breeding habitat.

On this basis the proposal will temporarily remove an area of marginal foraging habitat at the Eastern Ponds occupied by a small proportion of the Kooragang Island population. The removal of this habitat is not expected to have a long-term impact on the size of the Kooragang Island population.

The work proposed at the Eastern Ponds is not expected to fragment the Kooragang Island GGBF population. Monitoring of this population has shown the GGBF is effective at movements and dispersal across spatially separated ponds (UoN 2019). The Eastern Ponds do not provide an important linkage to other areas of habitat for the species. The majority of the works will be in disturbed areas dominated by exotic species, with very limited surface water present and railway lines and associated embankments that limit dispersal. Wetlands areas and open lands to the south and west of the ponds that are known to be used by this species and provide potential movement opportunities, will not be impacted and no fragmentation of the population is anticipated.

The discharge of surface water from Eastern Ponds would transfer to the Windmill Road drain (K100A) and Long Pond (K100E), and these two ponds also provide non-breeding habitat for GGBF. This discharge would only be required during periods of prolonged high rainfall when the capped Eastern Ponds have filled. At this time, the existing drainage system would be charged and receiving flow from a variety of surface runoff sources, suggesting that a change in water quality or inundation levels would already be expected. These habitats do not represent key breeding areas for the GGBF, and any temporary hydrology changes are not expected to have a long-term negative impact on the GGBF population.

Australasian Bittern (*Botaurus poiciliptilus*) (Endangered species EPBC Act)

There is a moderate likelihood that this species could use the habitat within the eastern ponds on occasion for foraging and breeding. The lack of open water and associated food resources would suggest that the habitat is only marginal or low quality and not likely to support resident birds.

The species occurs from south-east Queensland to south-east South Australia, Tasmania and the south-west of Western Australia. The Australasian Bittern's preferred habitat is comprised of wetlands with tall dense vegetation, where it forages in still, shallow water up to 0.3 m deep, often at the edges of pools or waterways, or from platforms or mats of vegetation over deep water. It favours permanent and seasonal freshwater habitats, particularly those dominated by sedges, rushes and reeds (e.g. Phragmites, Cyperus, Eleocharis, Juncus, Typha, Baumea, Bolboschoenus) or cutting grass (Gahnia) growing over a muddy or peaty substrate.

Australian Painted Snipe (*Rostratula australis*) (Endangered and Migratory species EPBC Act)

There is a moderate likelihood that this species could use the habitat within the eastern ponds on occasion for foraging and breeding. The lack of open water and associated food resources would suggest that the habitat is only marginal or low quality and not likely to support resident birds.

Most records are from south east Australia, particularly the Murray Darling Basin, with scattered records across northern Australia. They generally inhabit shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire; often with scattered clumps of lignum *Muehlenbeckia* or canegrass. Breeding habitat requirements may be quite specific; shallow wetlands with areas of bare wet mud and both low cover and canopy cover nearby; nest records nearly all from or near small islands in freshwater wetlands. Has also been recorded nesting in and near swamps, canegrass swamps, flooded areas including samphire, grazing land, among cumbungi, sedges and grasses; one nest has been found in the centre of a cow-pat in a clump of long grass.

5.3.1 Assessment of significance

An assessment of significance is provided in Appendix B, the significance assessments have been completed in accordance with the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines* (Department of Environment, 2013). Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment that is affected, and upon the intensity, duration, magnitude and geographic extent of the impacts (Department of Environment, 2013). Importantly, for a 'significant impact' to be 'likely', it is not necessary for a significant impact to have a greater than 50 per cent chance of happening; it is sufficient if a significant impact on the environment is a real or not remote chance or possibility (Department of Environment, 2013). This advice has been considered while undertaking the assessments.

The conclusion of these assessments has indicated that the proposed activity is not likely to have a significant impact on populations of the three assessed threatened fauna species. This is determined in the content of the size and low to marginal condition of the habitats present, and the range of better quality habitats available across the broader, KIWEF, Kooragang Island and Hunter Wetlands National Park.

6. Summary of mitigation measures that form part of the Project

Mitigation measures applied to previous stages of closure would be implemented. In particular, the Flora and Fauna Management Plans and Rehabilitation Management Plans conditioned under referral 2016/7670 would be implemented. These are reproduced with minor edits to make them relevant to the Eastern Ponds in Appendix C and Appendix D respectively.

Table 6.1 outlines the environmental safeguards and management measures applicable to the overall proposal to assist in minimising any potential adverse impacts arising from the proposed works on the surrounding environment.

Table 6.1: Summary of mitigation measures

Sequence of Work Activities	Controls/Mitigation Measures
Tender and award	<ul style="list-style-type: none"> ▪ Establish all required approvals under EPBC Act, EPA Act, POEO Act and other agency and neighbours (traffic, access, monitoring data); ▪ Integrate above requirements into EMP describing the series of specific management plans for construction and site management for inclusion in tender specifications. ▪ Tender documents shall prescribe that Principal Contractor(s) shall have demonstrated capability to develop and implement suitable EMP systems, procedures and measures for the works. (Environmental Management System has been accredited under the NSW Government Environmental Management Systems Guidelines (EMS Guidelines) or equivalent).
Pre-earthworks monitoring and ongoing EPL Surrender Notice monitoring.	<ul style="list-style-type: none"> ▪ Update relevant GGBF abundance survey data and water level and salinity logger data. ▪ Undertake annual surface and groundwater monitoring as per EPL Surrender notice.
Pre-earthworks planning meeting/toolbox talk	<ul style="list-style-type: none"> ▪ Principal Contractor to incorporate Principal's EMP requirements as necessary and undertake all necessary environmental inductions prior to proceeding with works. ▪ A primary focus of inductions should be the GGBF, hygiene protocols, installing and maintaining temporary fencing (including vegetation suppressant buffers) and erosion and sediment control.
Site Establishment	<ul style="list-style-type: none"> ▪ Implement hygiene protocol as required for the Closure Works area (NSW Threatened Species Management Information Circular No.6 (April 2008)). ▪ Temporary frog exclusion fencing to surround the proposal site and ensure adjacent GGBF habitat is protected from unauthorised access prior to works commencing. ▪ Temporary frog fencing will include passive release system consisting of ramps on inside of the exclusion fence to allow egress of any GGBF caught within the exclusion fence prior to commencement ▪ Temporary frog fencing will include the establishment of a vegetation suppressant buffer (minimum 1m wide) on the exterior side of the fence. The buffer will be maintained to suppress vegetation growth and ensure any objects that may provide a potential GGBF access route over the exclusion fencing are removed. ▪ Conduct pre-clearance surveys by a qualified ecologist prior to works commencing works in areas or their parts. ▪ Apply erosion and sediment controls as per sensitive environments (Managing Urban Stormwater – Soils and Construction (Landcom 2004)).

Sequence of Work Activities	Controls/Mitigation Measures
	<ul style="list-style-type: none"> ▪ Flocculants or other chemicals proposed to be used on site are required to be known and verified as being safe in sensitive environments and particularly in relation to amphibians. ▪ Prepare stockpile area with adequate space for “topsoil” level 1, 2 and 3 material and erosion and sediment controls as per ESCP and Materials Management Plan (RCA Australia 2012). ▪ Level 2 and level 3 interim stockpile areas are to be lined in accordance with materials management plan (RCA Australia 2012) as necessary. ▪ Store all hazardous liquids and chemicals in covered, bunded areas with capacity to retain 110% of largest container in the event of a spill. Proprietary available spill mats, drip trays and pallets can be used as appropriate. ▪ Provide fully stocked spill kit/s and ensure that operators are aware of the location of these kits and are trained in their use.
Bulk earthworks	<ul style="list-style-type: none"> ▪ Use of imported capping material assessed as having a low risk of containing Chytrid Fungus. ▪ Use of revegetation medium materials demonstrated to be low in added nutrients (eg manufactured soils boosted with fertilisers, or waste exempt sludges and processed topsoils (eg recycled waste) which are high risk of causing eutrophication in enclosed waters) and assessed as having a low risk of containing Chytrid Fungus. ▪ Works are to be staged to reduce area of exposure and minimise dust, infiltration and sediment laden run-off. ▪ Qualified ecologist to be available on call during earthworks in the event that any GGBF individuals are encountered during works, the ecologist must be called in to capture and relocate the individuals. ▪ Materials will be managed in accordance with the approved Materials Management Plan and GGBF management plan ▪ Topsoil to be stored separately in prepared stockpile areas as per detailed design documentation. ▪ Stockpiles to be stored for long periods are to be wrapped, covered, re-seeded or wet to minimise dust generation as necessary. ▪ Cut to base of excavations as per detailed design documentation insuring minimum 1% grade. Cut material to be used as fill and capping in accordance with materials management plan decision matrix. ▪ The final surface of both capped and uncapped areas will be protected by a vegetative layer. ▪ Upon completion of the works, the works areas must be rehabilitated with local native vegetation species. ▪ Dispose of materials unsuitable for reuse in accordance with materials management plan. ▪ All waste to be removed upon completion. ▪ Upon completion, site facilities, frog exclusion fencing and security fencing shall be removed as necessary. ▪ Non-permanent erosion and sediment controls are to remain in place until they are no-longer required. ▪ Sediment basins and drains will remain in place as landscape features until they are no longer required.

Sequence of Work Activities	Controls/Mitigation Measures
	<ul style="list-style-type: none"> ▪ Refuelling is not to occur in the vicinity of sediment dams, drainage lines or water bodies. ▪ Refuel plant using drip trays/spill mats and other spill containment devices. ▪ Store all hazardous liquids and chemicals in covered, bunded areas with capacity to retain 110% of largest container in the event of a spill. Proprietary available spill mats, drip trays and pallets can be used as appropriate. ▪ Do not leave chemical containers open outside or inside of the bunded areas. ▪ Provide fully stocked spill kit/s and ensure that operators are aware of the location of these kits and are trained in their use. ▪ Spills are to be immediately contained and absorbed using materials provided in the spill kit. ▪ All personnel are to be trained in the appropriate use and disposal of spill kit materials.
Construction Monitoring	<ul style="list-style-type: none"> ▪ Daily prestart checks on amphibian disease hygiene station, to confirm the station is functioning; and weather forecasting to be reviewed noting predicted wind and rain. ▪ Real-time classification of soils to nominated thresholds in accordance with the Materials Management Plan decision matrix. ▪ Post rainfall checks of sediment dam water level and water quality and erosion and sediment control functioning. ▪ Weekly site inspection checklist covering sediment dam water levels and water quality, erosion and sediment control structures, frog fences, fuel and chemical storage, stockpile bunding and covers. ▪ Pre-discharge physical water quality condition (temperature; dissolved oxygen; pH; electrical conductivity (EC)) and chemical water quality condition in sediment dams. ▪ Noise monitoring of any out of hours construction works in accordance with interim construction noise guidelines.
Defect Liability period	<ul style="list-style-type: none"> ▪ Check and maintain the erosion and sediment controls regularly, especially after rainfall, to ensure that they remain effective including: ▪ Collected sediment is to be removed from the controls as necessary to ensure they remain effective. ▪ Collected sediment is to be combined with planting medium for reuse on the site – if appropriate. ▪ All vehicle wheels, tracks and undercarriages must be cleaned prior to exiting the site and travelling on public roads. ▪ Three month vegetation maintenance program to include, watering, weeding as appropriate but excluding the use of fertilisers and pesticides and herbicides. ▪ Pre and post discharge surface water monitoring in sediment dams and receiving waters. ▪ Revegetation monitoring and maintenance to ensure adequate cover.

7. Conclusions

HCCDC is working to complete its requirement to close the former landfill areas referred to as the KIWEF Eastern Ponds. The Action would complement the previous rehabilitation of adjacent land and result in improved habitat and connectivity outcomes for MNES species. The Action would establish a rehabilitation area that provides a semi-permanent waterbody.

While there would be some environmental impacts as a consequence of the proposed Action such as short term biodiversity and traffic impacts and minor long term changes to hydrology, they have been avoided or minimised wherever possible through design and site-specific safeguards. The beneficial effects of the Proposed Action in providing the final rehabilitation of the KIWEF site, fostering biodiversity connectivity and improved contamination management is considered to outweigh the temporary adverse construction impacts and risks.

The proposed action is not likely to have a significant impact on matters of national environmental significance or the environment of Commonwealth land within the meaning of the *Environment Protection and Biodiversity Conservation Act 1999*. A referral to the Australian Department of Agriculture, Water and the Environment is not required.

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Appendix A. Protected Matters and likelihood of occurrence

The following table of threatened flora and fauna species have all been identified from the Protected Matters Search Report (PMST). The report identifies species that have confirmed records within a 10 km radius of the assessment site, or their presence has been modelled based on the location and types of habitat expected in the locality. The likelihood that each species would occur in the habitats of the Eastern Ponds has been assessed individually considering the type and condition of the habitat present. In assessing the 'likelihood of occurrence' the following criteria are used:

- **Unlikely** - Species highly restricted to certain geographical areas not within the proposal area; specific habitat requirements are not present in the study area
- **Low** - Species not recorded during field surveys and fit one or more of the following criteria: 1. Have not been recorded previously in the study area/surrounds and for which the study area is beyond the current distribution range; 2. Use specific habitats or resources not present in the study area
- **Moderate** - Species not recorded during the field surveys that fit one or more of the following criteria: 1. Have infrequently been recorded previously in the study area/surrounds; 2. Use specific habitats or resources present in the study area but in a poor or modified condition; 3. Are unlikely to maintain sedentary populations, however may seasonally use resources within the study area opportunistically or during migration; 4. Are cryptic flowering flora species that were not seasonally targeted by surveys and that have not been recorded
- **High** - Species recorded during the field surveys or species not recorded that fit one or more of the following criteria: 1. Have frequently been recorded previously in the study area/surrounds; 2. Use habitat types or resources that are present in the study area that are abundance and/or in good condition within the study area; 3. Are known or likely to maintain resident populations surrounding the study area; 4. Are known or likely to visit the site during regular seasonal movements or migration

A.1 Threatened Flora

Scientific name	Common name	Status EPBC Act	Distribution and habitat requirements*	Likelihood to occur at the study site
FLORA				
Angophora inopina	Charmhaven Apple	V	Endemic to the Central Coast region of NSW. The known northern limit is near Karuah where a disjunct population occurs; to the south populations extend from Toronto to Charmhaven with the main population occurring between Charmhaven and Morisset. There is an unconfirmed record of the species near Bulahdelah. Approximately 1250 ha of occupied habitat has been mapped in the Wyong–southern Lake Macquarie area. This species is a member of the <i>A. bakeri</i> complex, which also includes <i>A. crassifolia</i> , <i>A. paludosa</i> and <i>A. exul</i> . It is most similar to <i>A. crassifolia</i> from which it is distinguished by the broader leaves with shorter petioles. None of these related species are known from the same area as <i>A. inopina</i> , although <i>A. bakeri</i> does occur sporadically in the ranges to the west, and near Kurri Kurri. Occurs most frequently in four main vegetation communities: (i) <i>Eucalyptus haemastoma</i> – <i>Corymbia gummifera</i> – <i>Angophora inopina</i> woodland/forest; (ii) <i>Hakea teretifolia</i> – <i>Banksia oblongifolia</i> wet heath; (iii) <i>Eucalyptus resinifera</i> – <i>Melaleuca sieberi</i> – <i>Angophora inopina</i> sedge woodland; (iv) <i>Eucalyptus capitellata</i> – <i>Corymbia gummifera</i> – <i>Angophora inopina</i> woodland/forest.	Unlikely

Scientific name	Common name	Status EPBC Act	Distribution and habitat requirements*	Likelihood to occur at the study site
<i>Caladenia tessellata</i>	Thick-lipped Spider-orchid	V	The Thick Lip Spider Orchid is known from the Sydney area (old records), Wyong, Ulladulla and Braidwood in NSW. Populations in Kiama and Queanbeyan are presumed extinct. It was also recorded in the Huskisson area in the 1930s. The species occurs on the coast in Victoria from east of Melbourne to almost the NSW border. Generally found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil.	Unlikely
<i>Commersonia prostrata</i>	Dwarf Kerrawang	E	Dwarf Kerrawang occurs on the Southern Highlands and Southern Tablelands (one plant at Penrose State Forest, one plant at Tallong, a small population near the Corang and about 2000 plants at Rowes Lagoon), a larger population in the Thirlmere Lakes area (within 10 km of the study area), and on the North Coast (less than 100 plants at the Tomago sandbeds north of Newcastle). It is also found in Victoria. Occurs on sandy, sometimes peaty soils in a wide variety of habitats: Snow Gum (<i>Eucalyptus pauciflora</i>) Woodland and Ephemeral Wetland floor at Rowes Lagoon; Blue leaved Stringybark (<i>E. agglomerata</i>) Open Forest at Tallong; and in Brittle Gum (<i>E. mannifera</i>) Low Open Woodland at Penrose; Scribbly Gum (<i>E. haemostoma</i>)/ Swamp Mahogany (<i>E. robusta</i>) Ecotonal Forest at Tomago. Associated native species may include <i>Imperata cylindrica</i> , <i>Empodisma minus</i> and <i>Leptospermum continentale</i> . Appears to respond positively to some forms of disturbance (e.g. some Victorian records are from gravel road surfaces and the Tomago population is on an area previously subject to sandmining), however, there are conflicting reports about the response of the species to fire.	Low, not observed
<i>Cryptostylis hunteriana</i>	Leafless Tongue-orchid	V	The Leafless Tongue Orchid has been recorded from as far north as Gibraltar Range National Park, south into Victoria around the coast as far as Orbost. Does not appear to have well defined habitat preferences and is known from a range of communities, including swamp-heath and woodland. The larger populations typically occur in woodland dominated by Scribbly Gum (<i>Eucalyptus sclerophylla</i>), Silvertop Ash (<i>E. sieberi</i>), Red Bloodwood (<i>Corymbia gummifera</i>) and Black Sheoak (<i>Allocasuarina littoralis</i>); appears to prefer open areas in the understorey of this community and is often found in association with the Large Tongue Orchid (<i>C. subulata</i>) and the Tartan Tongue Orchid (<i>C. erecta</i>).	Unlikely
<i>Cynanchum elegans</i>	White-flowered Wax Plant	E	Occurs from the Gloucester district to the Wollongong area and inland to Mt Dangar. Typically occurs in rainforest gullies, scrub and scree slopes and at the ecotone between dry rainforest vegetation and dry subtropical forest/woodland communities. Other associated vegetation types include littoral rainforest; Coastal Tea-tree (<i>Leptospermum laevigatum</i>) – Coastal Banksia (<i>Banksia integrifolia</i> subsp. <i>integrifolia</i>) coastal scrub; Forest Red Gum (<i>Eucalyptus tereticornis</i>) aligned open forest and woodland; Spotted Gum (<i>Corymbia maculata</i>) aligned open forest and woodland; and Bracelet Honeymyrtle (<i>Melaleuca armillaris</i>) scrub to open scrub.	Unlikely

Scientific name	Common name	Status EPBC Act	Distribution and habitat requirements*	Likelihood to occur at the study site
<i>Diuris praecox</i>	Newcastle Doubletail	V	Known from between Bateau Bay and Smiths Lake. Grows on hills and slopes of near-coastal districts in open forests which have a grassy to fairly dense understorey. Exists as subterranean tubers most of the year. It produces leaves and flowering stems in winter.	Low
<i>Eucalyptus camfieldii</i>	Camfield's Stringybark	V	Restricted distribution in a narrow band with the most northerly records in the Raymond Terrace area south to Waterfall. Poor coastal country in shallow sandy soils overlying Hawkesbury sandstone. Coastal heath mostly on exposed sandy ridges. Occurs mostly in small scattered stands near the boundary of tall coastal heaths and low open woodland of the slightly more fertile inland areas. Associated species frequently include stunted specimens of <i>E. oblonga</i> (Narrow-leaved Stringybark), <i>E. capitellata</i> (Brown Stringybark) and <i>E. haemastoma</i> (Scribbly Gum).	Unlikely
<i>Eucalyptus parramattensis</i> subsp. <i>decadens</i>	Earp's Gum	V	There are two separate meta-populations of <i>E. parramattensis</i> subsp. <i>decadens</i> . The Kurri Kurri meta-population is bordered by Cessnock—Kurri Kurri in the north and Mulbring—Abedare in the south. Large aggregations of the subspecies are located in the Tomalpin area. The Tomago Sandbeds meta-population is bounded by Salt Ash and Tanilba Bay in the north and Williamtown and Tomago in the south. Generally occupies deep, low-nutrient sands, often those subject to periodic inundation or where water tables are relatively high. It occurs in dry sclerophyll woodland with dry heath understorey. It also occurs as an emergent in dry or wet heathland. Often where this species occurs, it is a community dominant. In the Kurri Kurri area, <i>E. parramattensis</i> subsp. <i>decadens</i> is a characteristic species of 'Kurri Sand Swamp Woodland in the Sydney Basin Bioregion', an endangered ecological community under the BC Act. In the Tomago Sandbeds area, the species is usually associated with the 'Tomago Swamp Woodland' as defined by NSW NPWS (2000). Very little is known about the biology or ecology of this species. Flowers from November to January. Propagation mechanisms are currently poorly known. Seed dispersal is likely to be effected by wind and animals.	Low, not observed
<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	Small-flower Grevillea	V	Sporadically distributed throughout the Sydney Basin with the main occurrence centred around Picton, Appin and Bargo. Separate populations are also known further north from Putty to Wyong and Lake Macquarie on the Central Coast, and Cessnock and Kurri Kurri in the Lower Hunter. Grows in sandy or light clay soils usually over thin shales. Occurs in a range of vegetation types from heath and shrubby woodland to open forest. Found over a range of altitudes from flat, low-lying areas to upper slopes and ridge crests. Often occurs in open, slightly disturbed sites such as along tracks.	Unlikely

Scientific name	Common name	Status EPBC Act	Distribution and habitat requirements*	Likelihood to occur at the study site
<i>Grevillea shiressii</i>	-	V	Known from two populations near Gosford, on tributaries of the lower Hawkesbury River north of Sydney (Mooney Mooney Creek and Mullet Creek). Both populations occur within the Gosford Local Government Area. There is also a naturalised population at Newcastle. Grows along creek banks in wet sclerophyll forest with a moist understorey in alluvial sandy or loamy soils. Flowers mainly late winter to Spring (July-December), with seed released at maturity in October. Flowers are bird pollinated and seeds are dispersed by ants. A fire sensitive obligate seeder that is highly susceptible to local extinction due to frequent fire, however, fire is likely to be relatively infrequent in the habitat of <i>G. shiressii</i> . Seed germination does occur in the absence of fire, however some physical disturbance is likely to promote seed germination.	Unlikely
<i>Melaleuca biconvexa</i>	Biconvex Paperbark	V	Found only in NSW, with scattered and dispersed populations found in the Jervis Bay area in the south and the Gosford-Wyong area in the north. Generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects.	Low, not observed
<i>Persicaria elatior</i>	Tall Knotweed	V	Tall Knotweed has been recorded in south-eastern NSW (Mt Dromedary (an old record), Moruya State Forest near Turlinjah, the Upper Avon River catchment north of Robertson, Bermagui, and Picton Lakes. In northern NSW it is known from Raymond Terrace (near Newcastle) and the Grafton area (Cherry Tree and Gibberagee State Forests). This species normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance.	Low, not observed
<i>Phaius australis</i>	Lesser Swamp-orchid	E	Occurs in Queensland and north-east NSW as far south as Coffs Harbour. Historically, it extended farther south, to Port Macquarie. Swampy grassland or swampy forest including rainforest, eucalypt or paperbark forest, mostly in coastal areas.	Unlikely
<i>Prasophyllum</i> sp. Wybong (C.Phelps ORG 5269)	-	CE	Endemic to NSW, it is known from near Ilford, Premer, Muswellbrook, Wybong, Yeoval, Inverell, Tenterfield, Currabubula and the Pilliga area. A perennial orchid, appearing as a single leaf over winter and spring. Flowers in spring and dies back to a dormant tuber over summer and autumn. Known to occur in open eucalypt woodland and grassland.	Unlikely
<i>Pterostylis gibbosa</i>	Illawarra Greenhood	E	Known from a small number of populations in the Hunter region (Milbrodale), the Illawarra region (Albion Park and Yallah) and the Shoalhaven region (near Nowra). It is apparently extinct in western Sydney which is the area where it was first collected (1803). All known populations grow in open forest or woodland, on flat or gently sloping land with poor drainage. In the Hunter region, the species grows in open woodland dominated by Narrow-leaved Ironbark (<i>Eucalyptus crebra</i>), Forest Red Gum (<i>Eucalyptus tereticornis</i>) and Black Cypress Pine (<i>Callitris endlicheri</i>).	Unlikely

Scientific name	Common name	Status EPBC Act	Distribution and habitat requirements*	Likelihood to occur at the study site
<i>Rutidosia heterogama</i>	Heath Wrinklewort	V	Recorded from near Cessnock to Kurri Kurri with an outlying occurrence at Howes Valley. On the Central Coast it is located north from Wyong to Newcastle. There are north coast populations between Woolli and Evans Head in Yuraygir and Bundjalung National Parks. It also occurs on the New England Tablelands from Torrington and Ashford south to Wandsworth south-west of Glen Innes. Grows in heath on sandy soils and moist areas in open forest, and has been recorded along disturbed roadsides.	Unlikely
<i>Syzygium paniculatum</i>	Magenta Lilly Pilly	V	The Magenta Lilly Pilly is found only in NSW, in a narrow, linear coastal strip from Upper Lansdowne to Conjola State Forest. On the south coast it occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the central coast it occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities.	Low, not observed
<i>Tetratheca juncea</i>	Black-eyed Susan	V	Confined to the northern portion of the Sydney Basin bioregion and the southern portion of the North Coast bioregion in the local government areas of Wyong, Lake Macquarie, Newcastle, Port Stephens, Great Lakes and Cessnock. It is usually found in low open forest/woodland with a mixed shrub understorey and grassy groundcover. However, it has also been recorded in heathland and moist forest. The majority of populations occur on low nutrient soils associated with the Awaba Soil Landscape. While the species has a preference for cooler southerly aspects, it has been found on slopes with a variety of aspects. It generally prefers well-drained sites and occurs on ridges, although it has also been found on upper slopes, mid-slopes and occasionally in gullies.	Unlikely

A.2 Threatened Fauna

Scientific name	Common name	Status EPBC Act	Distribution and habitat requirements*	Likelihood to occur at the study site
BIRDS				
<i>Anthochaera phrygia</i>	Regent Honeyeater	CE	The Regent Honeyeater that has a patchy distribution between south-east Queensland and central Victoria. It mostly inhabits inland slopes of the Great Dividing Range, in areas of low to moderate relief with moist, fertile soils. It is most commonly associated with box-ironbark eucalypt woodland and dry sclerophyll forest, but also inhabits riparian vegetation such as sheoak (<i>Casuarina</i> spp) where it feeds on needle-leaved mistletoe and sometimes breeds. It sometimes utilises lowland coastal forest, which may act as a refuge when its usual habitat is affected by drought. It also uses a range of disturbed habitats within these landscapes including remnant patches in farmland and urban areas and roadside vegetation. It feeds primarily on the nectar of eucalypts and mistletoes and, to a lesser extent, lerps and honeydew; it prefers taller and larger diameter trees for foraging. It is nomadic and partly migratory with its movement through the landscape being governed by the flowering of select eucalypt species. There are four known key breeding areas: three in NSW and one in Victoria. Breeding varies between regions, and corresponds with flowering of key eucalypt and mistletoe species. It usually nests in horizontal branches or forks in tall mature eucalypts and Sheoaks.	Unlikely
<i>Botaurus poiciloptilus</i>	Australasian Bittern	E	Occurs from south-east Queensland to south-east South Australia, Tasmania and the south-west of Western Australia. The Australasian Bittern's preferred habitat is comprised of wetlands with tall dense vegetation, where it forages in still, shallow water up to 0.3 m deep, often at the edges of pools or waterways, or from platforms or mats of vegetation over deep water. It favours permanent and seasonal freshwater habitats, particularly those dominated by sedges, rushes and reeds (e.g. <i>Phragmites</i> , <i>Cyperus</i> , <i>Eleocharis</i> , <i>Juncus</i> , <i>Typha</i> , <i>Baumea</i> , <i>Bolboschoenus</i>) or cutting grass (<i>Gahnia</i>) growing over a muddy or peaty substrate	Moderate
<i>Calidris canutus</i>	Red Knot	E, M	Common in all the main suitable habitats around the coast of Australia. Mainly inhabit intertidal mudflats, sand flats and sandy beaches of sheltered coasts, in estuaries, bays, inlets, lagoons and harbours; sometimes on sandy ocean beaches or shallow pools on exposed wave-cut rock platforms or coral reefs.	Unlikely

Scientific name	Common name	Status EPBC Act	Distribution and habitat requirements*	Likelihood to occur at the study site
<i>Calidris ferruginea</i>	Curlew Sandpiper	CE	In Australia, Curlew Sandpipers occur around the coasts of all states and are also quite widespread inland, though in smaller numbers. They occur in Australia mainly during the non-breeding period but also during the breeding season when many non-breeding one year old birds remain. Curlew Sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They generally roost on bare dry shingle, shell or sand beaches, sandspits and islets in or around coastal or near-coastal lagoons and other wetlands, occasionally roosting in dunes during very high tides and sometimes in saltmarsh and in mangroves.	Low
<i>Calidris tenuirostris</i>	Great Knot	CE, M	In NSW, the species has been recorded at scattered sites along the coast down to about Narooma. It has also been observed inland at Tullakool, Armidale, Gilgandra and Griffith. Occurs within sheltered, coastal habitats containing large, intertidal mudflats or sand flats, including inlets, bays, harbours, estuaries and lagoons. Often recorded on sandy beaches with mudflats nearby, sandy spits and islets and sometimes on exposed reefs or rock platforms. Migrates to Australia from late August to early September, although juveniles may not arrive until October-November.	Low
<i>Charadrius leschenaultii</i>	Greater Sand-plover	V	The Greater Sand-plover breeds in central Asia from Armenia to Mongolia, moving further south for winter. In Australia the species is commonly recorded in parties of 10-20 on the west coast, with the far northwest being the stronghold of the population. The species is apparently rare on the east coast, usually found singly. In NSW, the species has been recorded between the northern rivers and the Illawarra, with most records coming from the Clarence and Richmond estuaries. Almost entirely restricted to coastal areas in NSW, occurring mainly on sheltered sandy, shelly or muddy beaches or estuaries with large intertidal mudflats or sandbanks. Roosts during high tide on sandy beaches and rocky shores; begin foraging activity on wet ground at low tide, usually away from the edge of the water; individuals may forage and roost with other waders.	Low

Scientific name	Common name	Status EPBC Act	Distribution and habitat requirements*	Likelihood to occur at the study site
<i>Charadrius mongolus</i>	Lesser Sand-plover	E	The Lesser Sand-plover breeds in central and north eastern Asia, migrating further south for winter. In Australia the species is found around the entire coast but is most common in the Gulf of Carpentaria, and along the east coast of Queensland and northern NSW. Individuals are rarely recorded south of the Shoalhaven estuary, and there are few inland records. Almost entirely coastal in NSW, favouring the beaches of sheltered bays, harbours and estuaries with large intertidal sand flats or mudflats; occasionally occurs on sandy beaches, coral reefs and rock platforms. Highly gregarious, frequently seen in flocks exceeding 100 individuals; also often seen foraging and roosting with other wader species. Roosts during high tide on sandy beaches, spits and rocky shores; forage individually or in scattered flocks on wet ground at low tide, usually away from the water's edge.	Low
<i>Erythrotriorchis radiatus</i>	Red Goshawk	V	This unique Australian endemic raptor is distributed sparsely through northern and eastern Australia, from the western Kimberley Division of northern Western Australia to north-eastern Queensland and south to far north-eastern NSW, and with scattered records in central Australia. The species is very rare in NSW, extending south to about 30°S, with most records north of this, in the Clarence River Catchment, and a few around the lower Richmond and Tweed Rivers. Formerly, it was at least occasionally reported as far south as Port Stephens. Red Goshawks inhabit open woodland and forest, preferring a mosaic of vegetation types, a large population of birds as a source of food, and permanent water, and are often found in riparian habitats along or near watercourses or wetlands. In NSW, preferred habitats include mixed subtropical rainforest, Melaleuca swamp forest and riparian Eucalyptus forest of coastal rivers.	Unlikely
<i>Grantiella picta</i>	Painted Honeyeater	V	Lives in dry forests and woodlands. Primary food is the mistletoes in the genus <i>Amyema</i> , though it will take some nectar and insects. Its breeding distribution is dictated by presence of mistletoes which are largely restricted to older trees. Less likely to be found in in strips of remnant box-ironbark woodlands, such as occur along roadsides and in windbreaks, than in wider blocks (Garnett and Crowley, 2000).	Unlikely
<i>Hirundapus caudacutus</i>	White-throated Needletail	V, M	Widespread in eastern and south-eastern Australia. Almost exclusively aerial, from heights of less than 1 m up to more than 1000 m above the ground. They also commonly occur over heathland but less often over treeless areas, such as grassland or swamps.	Low

Scientific name	Common name	Status EPBC Act	Distribution and habitat requirements*	Likelihood to occur at the study site
<i>Lathamus discolor</i>	Swift Parrot	CE	The swift parrot breeds in Tasmania during the summer and the entire population migrates north to mainland Australia for the winter. Whilst on the mainland the swift parrot disperses widely to forage on flowers and psyllid lerps in eucalypt species, with the majority being found in Victoria and NSW. In NSW they forage in forests and woodlands throughout the coastal and western slopes regions each year. Coastal regions tend to support larger numbers of birds when inland habitats are subjected to drought. Non-breeding birds preferentially feed in inland box-ironbark and grassy woodlands, and coastal swamp mahogany (<i>E. robusta</i>) and spotted gum (<i>Corymbia maculata</i>) woodland when in flower; otherwise often in coastal forests. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as <i>Eucalyptus robusta</i> , <i>Corymbia maculata</i> , <i>C. gummifera</i> , <i>E. sideroxylon</i> , and <i>E. albens</i> . Commonly used lerp infested trees include <i>E. microcarpa</i> , <i>E. moluccana</i> and <i>E. pilularis</i> .	Unlikely
<i>Limosa lapponica baueri</i>	Bar-tailed godwit (western Alaskan)	V	The bar-tailed godwit (both subspecies combined) has been recorded in the coastal areas of all Australian states. During the non-breeding period, the distribution of bar-tailed godwit (western Alaskan) is predominately New Zealand, northern and eastern Australia. The migratory bar-tailed godwit (western Alaskan) does not breed in Australia. The bar-tailed godwit (western Alaskan) occurs mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays.	Low
<i>Limosa lapponica menzbieri</i>	Bar-tailed godwit (northern Siberian)	CE	The bar-tailed godwit (both subspecies combined) has been recorded in the coastal areas of all Australian states. During the non-breeding period, the distribution of <i>L. l. menzbieri</i> is predominantly in the north and north-west of Western Australia and in south-eastern Asia. The migratory bar-tailed godwit (northern Siberian) does not breed in Australia. The bar-tailed godwit (northern Siberian) occurs mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays.	Low
<i>Numenius madagascariensis</i>	Eastern Curlew	CE, M	Within Australia, the Eastern Curlew has a primarily coastal distribution. The species is found in all states, particularly the north, east, and south-east regions including Tasmania. The Eastern Curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sand flats, often with beds of seagrass.	Low

Scientific name	Common name	Status EPBC Act	Distribution and habitat requirements*	Likelihood to occur at the study site
<i>Rostratula australis</i>	Australian Painted Snipe	E, M	Most records are from south east Australia, particularly the Murray Darling Basin, with scattered records across northern Australia. They generally inhabit shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire; often with scattered clumps of lignum <i>Muehlenbeckia</i> or canegrass. Breeding habitat requirements may be quite specific; shallow wetlands with areas of bare wet mud and both low cover and canopy cover nearby; nest records nearly all from or near small islands in freshwater wetlands. Has also been recorded nesting in and near swamps, canegrass swamps, flooded areas including samphire, grazing land, among cumbungi, sedges and grasses; one nest has been found in the centre of a cow-pat in a clump of long grass.	Moderate
<i>Sternula nereis nereis</i>	Australian Fairy Tern	V, M	Within Australia, the Fairy Tern occurs along the coasts of Victoria, Tasmania, South Australia and Western Australia; occurring as far north as the Dampier Archipelago near Karratha. The subspecies has been known from New South Wales (NSW) in the past, but it is unknown if it persists there. The Fairy Tern (Australian) nests on sheltered sandy beaches, spits and banks above the high tide line and below vegetation. The subspecies has been found in embayments of a variety of habitats including offshore, estuarine or lacustrine (lake) islands, wetlands and mainland coastline. The bird roosts on beaches at night.	Unlikely
<i>Thinornis rubricollis</i>	Hooded Plover (eastern)	V, M	The Hooded Plover is endemic to southern Australia and is nowadays found mainly along the coast from south of Jervis Bay, NSW, south through Victoria and Tasmania to the western side of the Eyre Peninsula (South Australia). In south-eastern Australia Hooded Plovers prefer sandy ocean beaches, especially those that are broad and flat, with a wide wave-wash zone for feeding, much beach cast seaweed, and backed by sparsely vegetated sand-dunes for shelter and nesting. Occasionally Hooded Plovers are found on tidal bays and estuaries, rock platforms and rocky or sand-covered reefs near sandy beaches, and small beaches in lines of cliffs. They regularly use near-coastal saline and freshwater lakes and lagoons, often with saltmarsh.	Unlikely
FISH				

Scientific name	Common name	Status EPBC Act	Distribution and habitat requirements*	Likelihood to occur at the study site
<i>Epinephelus daemeli</i>	Black Cod	V	In Australia, the distribution of black cod ranges from southern Queensland through NSW to northern Victoria. However, records from Queensland and Victoria are rare, and the NSW coastline forms the species' main range, both in Australia and internationally. It generally inhabits near-shore reefs at depths down to 50 m from southern Queensland through NSW to northern Victoria. Small juvenile black cod are often found in coastal rock pools while slightly older juveniles are often found in estuary systems. The use of estuaries may be an important part of the ecology of juvenile black cod in NSW waters.	Unlikely
FROGS				
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	V	The Giant Burrowing Frog is distributed in south eastern NSW and Victoria, and appears to exist as two distinct populations: a northern population largely confined to the sandstone geology of the Sydney Basin and extending as far south as Ulladulla, and a southern population occurring from north of Narooma through to Walhalla, Victoria. Found in heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based. Spends more than 95% of its time in non-breeding habitat in areas up to 300 m from breeding sites. Whilst in non-breeding habitat it burrows below the soil surface or in the leaf litter. Individual frogs occupy a series of burrow sites, some of which are used repeatedly. The home ranges of both sexes appear to be non-overlapping suggesting exclusivity of non-breeding habitat. Home ranges are approximately 0.04 ha in size.	Unlikely
<i>Litoria aurea</i>	Green and Golden Bell Frog	V	Since 1990 there have been approximately 50 recorded locations in NSW, most of which are small, coastal, or near coastal populations. These locations occur over the species' former range, however they are widely separated and isolated. Large populations in NSW are located around the metropolitan areas of Sydney, Shoalhaven and mid north coast (one an island population). There is only one known population on the NSW Southern Tablelands. Ephemeral and permanent freshwater wetlands, ponds, dams with an open aspect and fringed by Typha and other aquatics, free from predatory fish.	High - known population
<i>Litoria littlejohni</i>	Littlejohn's Tree Frog	V	Distribution includes the plateaus and eastern slopes of the Great Dividing Range from Watagan State Forest (90 km north of Sydney) south to Buchan in Victoria. This species breeds in the upper reaches of permanent streams and in perched swamps. Non-breeding habitat is heath based forests and woodlands where it shelters under leaf litter and low vegetation, and hunts for invertebrate prey either in shrubs or on the ground.	Unlikely
INVERTEBRATES				

Scientific name	Common name	Status EPBC Act	Distribution and habitat requirements*	Likelihood to occur at the study site
Synemon plana	Golden Sun Moth	CE	The Golden Sun Moth's NSW populations are found in the area between Queanbeyan, Gunning, Young and Tumut. The species' historical distribution extended from Bathurst (central NSW) through the NSW Southern Tablelands, through to central and western Victoria, to Bordertown in eastern South Australia. Occurs in Natural Temperate Grasslands and grassy Box-Gum Woodlands in which groundlayer is dominated by wallaby grasses Austrodanthonia spp. Grasslands dominated by wallaby grasses are typically low and open - the bare ground between the tussocks is thought to be an important microhabitat feature for the Golden Sun Moth, as it is typically these areas on which the females are observed displaying to attract males. Habitat may contain several wallaby grass species, which are typically associated with other grasses particularly spear-grasses Austrostipa spp. or Kangaroo Grass Themeda australis.	Unlikely

Note: This habitat assessment table does not consider habitat for species such as migratory marine birds (i.e. albatross and petrels), marine fish, whales, dolphins, sharks, rays, or turtles as the proposal will not impact on habitat for these species.

* Distribution and habitat requirement information adapted from:

- Australian Government Department of the Environment <http://www.environment.gov.au/biodiversity/threatened/index.html>
- NSW Department of Planning, Industry and Environment <http://www.environment.nsw.gov.au/threatenedspecies/>
- Department of Primary Industries – Threatened Fish and Marine Vegetation http://pas.dpi.nsw.gov.au/Species/All_Species.aspx

+ Data source includes

- Identified from the Protected Matters Search Tool (PMST) Australian Government Department of Sustainability, Environment, Water, Populations and Community <http://www.environment.gov.au/epbc/pmst/index.html>

Key:

- EP = endangered population
- CE = critically endangered
- E = endangered
- V = vulnerable
- M = migratory

Appendix B. Assessment of Significance

Tests of significance have been conducted for threatened species, populations and communities that have been identified as having a moderate or high potential to occur in the study area based on the presence of habitat (see Appendix A).

Significance assessments have been completed in accordance with the EPBC Act Policy Statement 1.1 Significant Impact Guidelines (Department of Environment, 2013). Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment that is affected, and upon the intensity, duration, magnitude and geographic extent of the impacts (Department of Environment, 2013). Importantly, for a 'significant impact' to be 'likely', it is not necessary for a significant impact to have a greater than 50 per cent chance of happening; it is sufficient if a significant impact on the environment is a real or not remote chance or possibility (Department of Environment, 2013). This advice has been considered while undertaking the assessments.

B.1 Endangered Species

Australasian Bittern (*Botaurus poliocephalus*)

1) Lead to a long-term decrease in the size of a population

The Australasian Bittern (*Botaurus poiciloptilus*) inhabits temperate freshwater wetlands and occasionally estuarine reedbeds (NSW Scientific Committee, 2009). The species has been rarely recorded from Kooragang Island, although is known to be present and recorded from targeted surveys conducted around areas of permanent water (HBOC, 2006 and 2010). The BioNet/Atlas of NSW Wildlife (2020) database records for Kooragang Island also indicate that the species inhabits locations predominantly near permanent water.

The habitat within the Eastern Ponds is of low quality and marginal for this species, which prefers open water for foraging resources and adjacent reed beds for shelter, and breeding. There is a lack of water at the Eastern Ponds and any use of the site by this species would likely be limited to temporary shelter from transient birds. The clearing of the reed beds within the eastern ponds is not expected to lead to a long-term decrease in local populations of this species.

The discharge of surface water from Eastern Ponds would transfer to the Windmill Road drain (K100A) and Long Pond (K100E), and these two habitats also provide non-breeding habitat for GGBF. This discharge would only be required during periods of prolonged high rainfall when the capped Eastern Ponds have filled. At this time, the existing drainage system would be charged and receiving flow from a variety of surface runoff sources, suggesting that a change in water quality or inundation levels would already be expected. These habitats do not represent key breeding areas for the GGBF, and any temporary hydrology changes are not expected to have a long-term negative impact on the GGBF population.

2) Reduce the area of occupancy of the species

Considering the absence of recent records for the species at the Eastern Ponds (monitoring results since 2008) and the limited disturbance to potential wetland habitat for the species, the Closure Works are considered very unlikely to disrupt the lifecycle of the species or a local viable population.

The habitat within the Eastern Ponds is around 2 hectares of regrowth reed land of low quality and considered marginal for this species, which prefers open water for foraging resources and adjacent reed beds for shelter, and breeding. There is a lack of water at the Eastern Ponds and any use of the site by this species would likely be limited to temporary shelter from transient birds. The removal of this small area of potential habitat is not expected to reduce the area of occupancy across the Hunter estuary wetlands.

3) Fragment an existing population into two or more populations

Importantly, the action would not result in fragmentation of habitat for the Australasian Bittern. This species is highly mobile and the action would not affect the movement of birds between habitat patches or fragment a population.

4) Adversely affect habitat critical to the survival of a species

The habitat in the eastern ponds and discharge receiving ponds do not represent critical habitat for the Australasian Bittern. The closure of the Eastern Ponds is restricted to the cells K108a and K108b, as well as the adjacent stockpile site. There is potential for overflow from the ponds during prolonged extreme weather events to be discharged to an artificial drainage channel and small wetland to the south. This would occur during periods of water charge in the system. The areas assessed in this report are not considered critical to the survival of the species.

The discharge of surface water from Eastern Ponds would transfer to the Windmill Road drain (K100A) and Long Pond (K100E), and these two ponds are not known sites for Australasian Bittern and provide marginal habitat and any temporary hydrology changes are not expected to have a long-term negative impact on the Australasian Bittern population.

5) Disrupt the breeding cycle of a population

The habitat at the Eastern Ponds has been described as low quality and marginal for this species, and this is due to the absence of open water and fringing emergent reeds. There are large areas of suitable habitat for this species associated with the wider Kooragang Island and Hunter Wetlands National Park. The Eastern Ponds are unlikely to be favoured for breeding.

The habitat within the Windmill Road drain (K100A) and Long Pond (K100E) impacted by occasional discharge of surface water, are not known breeding sites for Australasian Bittern.

6) Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The total area of the Eastern Ponds is around 4.3 hectares including the raised walls and the proposed activity would remove around 1.5 hectares of native regrowth vegetation comprising predominantly rushes, *Phragmites australis* and *Typha orientalis* (0.8 ha) and regrowth Swamp Oak (0.7 ha). All areas of native vegetation occur within the lower parts of the cells. The remaining areas of disturbance associated with the cell walls, access roads and stockpile area, comprise only exotic and non-indigenous plant species that are not characteristic of native plant communities. The reed land habitat is considered marginal and of low quality, and the removal of this habitat will not lead to a decline in the species.

7) Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered species' habitat

The vegetation at the site will be removed, and as described in the report there is a high density of weeds present that will need to be removed and disposed of. Mitigation procedures have been described in this report that provide guidance on the correct procedure for avoiding dispersal of weeds from the site.

8) introduce disease that may cause the species to decline, or

There are no known disease issues affecting this species in relation to the action. The action would be unlikely to increase the potential for significant disease vectors to affect local populations.

9) interfere substantially with the recovery of the species.

The *Draft National Recovery Plan for the Australasian Bittern *Botaurus poiciliptilus** (Department of Environment Climate Change and Water, 2019) outlines the following actions:

1. Implement management strategies to reduce threats to Australasian Bittern and their habitat
2. Enhance protection, improve the quality and increase the extent of suitable habitat for the Australasian Bittern

3. Improve knowledge of the biology and ecology of Australasian Bittern and implement a monitoring strategy to identify population trends
4. Increase stakeholder participation in Australasian Bittern conservation and management
5. Coordinate, review and report on recovery process

The recovery actions listed above are largely not applicable to the action and the action is not expected to interfere substantially with the recovery of the species.

Conclusion

No breeding habitat or other important habitat would be impacted by this activity. The action would not interfere with the recovery of the Australasian Bittern and would not contribute to the key threats to this species. After consideration of the factors above, an overall conclusion has been made that the action is unlikely to result in a significant impact to the *Australasian Bittern*.

Australian Painted Snipe (*Rostratula australis*)

1) Lead to a long-term decrease in the size of a population

The Australian Painted Snipe is considered to occur in a single, contiguous breeding population (Garnett & Crowley 2000) and the total population size has been estimated to range from a few hundred individuals to 5000 breeding adults (Garnett & Crowley 2000).

The habitat within the Eastern Ponds is of low quality and marginal for this species, which prefers open water for foraging resources and adjacent reed beds for shelter, and breeding. There is a lack of water at the Eastern Ponds and any use of the site by this species would likely be limited to temporary shelter from transient birds. The clearing of the reed beds within the eastern ponds is not expected to lead to a long-term decrease in the size of the population.

2) Reduce the area of occupancy of the species

The area of occupancy of the Australian Painted Snipe is estimated, with low reliability, to be 1000 km² (Garnett & Crowley 2000). The Eastern Ponds provide 0.8 ha of low quality, marginal habitat and the removal of this is not expected to reduce the area of occupancy across the species range.

3) Fragment an existing population into two or more populations

Importantly, the action would not result in fragmentation of habitat for the Australasian Painted Snipe. This species is highly mobile and the action would not affect the movement of birds between habitat patches or fragment a population.

4) Adversely affect habitat critical to the survival of a species

The total area of the Eastern Ponds is around 4.3 hectares including the raised walls and the proposed activity would remove around 1.5 hectares of native regrowth vegetation comprising predominantly rushes, *Phragmites australis* and *Typha orientalis* (0.8 ha) and regrowth Swamp Oak (0.7 ha). All areas of native vegetation occur within the lower parts of the cells. The remaining areas of disturbance associated with the cell walls, access roads and stockpile area, comprise only exotic and non-indigenous plant species that are not characteristic of native plant communities. The reed land habitat within the Eastern Ponds is considered marginal and of low quality, and is not critical to the survival of the Australian Painted Snipe. .

5) Disrupt the breeding cycle of a population

The Australian Painted Snipe is considered to occur in a single, contiguous breeding population (Garnett & Crowley 2000) and the total population size has been estimated to range from a few hundred individuals to 5000 breeding adults (Garnett & Crowley 2000). The Eastern Ponds provide 0.8 ha of low quality, marginal habitat and the removal of this is not expected to disrupt the breeding cycle of the population.

6) Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The total area of the Eastern Ponds is around 4.3 hectares including the raised walls and the proposed activity would remove around 1.5 hectares of native regrowth vegetation comprising predominantly rushes, *Phragmites australis* and *Typha orientalis* (0.8 ha) and regrowth Swamp Oak (0.7 ha). All areas of native vegetation occur within the lower parts of the cells. The remaining areas of disturbance associated with the cell walls, access roads and stockpile area, comprise only exotic and non-indigenous plant species that are not characteristic of native plant communities. The reed land habitat is considered marginal and of low quality, and the removal of this habitat will not modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

7) Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered species' habitat

The vegetation at the site will be removed, and as described in the report there is a high density of weeds present that will need to be removed and disposed of. Mitigation procedures have been described in this report that provide guidance on the correct procedure for avoiding dispersal of weeds from the site.

8) Introduce disease that may cause the species to decline, or

There are no known disease issues affecting this species in relation to the action. The action would be unlikely to increase the potential for significant disease vectors to affect local populations.

9) Interfere substantially with the recovery of the species.

The primary factor in the decline of the Australian Painted Snipe has probably been a loss and alteration of wetland habitat. The two major sources of this have been the drainage of wetlands and the diversion of water to agriculture and reservoirs, the latter process reducing flooding and precluding the formation of temporary shallow wetlands (Garnett & Crowley 2000). The Eastern Ponds provide 0.8 ha of low quality, marginal habitat and the removal of this is not expected to interfere with the recovery of the species.

Conclusion

No breeding habitat or other important habitat would be impacted by this activity. The action would not interfere with the recovery of the Australasian Painted Snipe and would not contribute to the key threats to this species. After consideration of the factors above, an overall conclusion has been made that the action is unlikely to result in a significant impact to the Australian Painted Snipe.

B.2 Vulnerable species

Green and Golden Bell Frog (*Litoria aurea*)

1) Lead to a long-term decrease in the size of an important population

The Green and Golden Bell Frog population within Kooragang Island can be considered an important population and one of the Key Populations in the Lower Hunter, for which there is a draft Management Plan (OEH 2007). The University of Newcastle (UoN 2019) has conducted regular monitoring of the Green and Golden Bell Frog (GGBF) population over the KIWEF since 2011. This work involves repeated visual encounter surveys during the breeding season targeting a range of artificially created ponds which has included the Eastern Ponds (K108 wetland located in SE cell of the Eastern Ponds). From these surveys the UoN (2019) has reported regular encounters of frogs in K108 (Eastern Ponds) from surveys conducted between 2011-16 leading to assessment in 2014 that this pond comprises a healthy population (Clulow 2014). Since 2013-14 however, the overall pattern of GGBF in the Eastern Ponds has been one of decline (UoN 2019), a phenomenon that is consistent with the reported gradual reduction in the area of open water available to frogs over this same period. Indeed both 2016-17 and 2017-18 were dry years and no GGBF were recorded in the Eastern Ponds at this time (UoN 2019). Very low numbers were reported in the following wetter season of 2019-20 however these numbers remain low compared to the ponds in the remainder of the KIWEF (McHenry 2020).

The most recent surveys in 2019-20 describe the pattern of a gradual retreat of open water within Eastern Ponds and identify that as a consequence the habitat in the Eastern Pond is being infrequently occupied by GGBF, with

no evidence of breeding taking place within them in recent years. This is consistent with data from the University's annual monitoring program which shows that for the last five consecutive years (2015-20) the Eastern Ponds have provided terrestrial and ephemeral aquatic habitat that is only occasionally occupied by GGBF (McHenry, 2020). These data suggest the ponds do continue to provide foraging habitat for a small proportion of the GGBF population, although the ponds are not important breeding sites. Indeed, McHenry (2020) describes the Eastern Ponds as ephemeral and semi-permanent wetlands, considered to have limited 'refuge' habitat value for GGBF due to the lack of open water.

The proposal will therefore temporarily remove an area of marginal foraging habitat at the Eastern Ponds occupied by a small proportion of the Kooragang Island population. However, the removal of this habitat is not expected to have a long-term impact on the size of the Kooragang Island population.

2) Reduce the area of occupancy of an important population

The proposed activity at the Eastern Ponds will remove an area of around 2 hectares of identified marginal foraging habitat used by this population, and so will reduce the area of occupancy of an important population.

The most recent surveys in 2019-20 have described the habitat in the Eastern Pond as being infrequently occupied by GGBF and there is no evidence of breeding taking place within them. This is consistent with data from the University's annual monitoring program over the broader KWIEF which shows that for the last five consecutive years (2015-20) the Eastern Ponds have provided terrestrial and ephemeral aquatic habitat that is only occasionally occupied by GGBF (McHenry, 2020). Therefore, the area of habitat to be removed is not considered breeding habitat or high quality refuge and foraging habitat.

3) Fragment an existing important population into two or more populations

The work proposed at the Eastern Ponds is not expected to fragment the Kooragang Island GGBF population. Monitoring of this population has shown the GGBF is effective at movements and dispersal across spatially separated ponds (UoN 2019). The Eastern Ponds do not provide an important linkage to other areas of habitat for the species. The majority of the works will be in disturbed areas dominated by exotic species, with very limited surface water present and railway lines and associated embankments that limit dispersal. Wetlands areas and open lands to the south and west of the ponds that are known to be used by this species and provide potential movement opportunities, will not be impacted and no fragmentation of the population is anticipated.

4) Adversely affect habitat critical to the survival of a species

Habitat critical to the survival of a species refers to areas that are necessary:

- For activities such as foraging, breeding, roosting, or dispersal
- For the long-term maintenance of the species
- To maintain genetic diversity and long-term evolutionary development, or
- For the reintroduction of populations or recovery of the species.

The habitat within the Eastern Ponds is not considered critical habitat for the species. The most recent surveys in 2019-20 have described the habitat in the Eastern Pond as being infrequently occupied by GGBF and there is no evidence of breeding taking place within them. This is consistent with data from the University's annual monitoring program which shows that for the last five consecutive years (2015-20) the Eastern Ponds have provided terrestrial and ephemeral aquatic habitat that is only occasionally occupied by GGBF (McHenry, 2020).

The University of Newcastle has conducted regular monitoring of the Green and Golden Bell Frog (GGBF) population over the KIWEF since 2011, which has included the Eastern Ponds. It is evident from this work, that critical habitat is present and dispersed throughout the KIWEF and broader Kooragang Island and Ash Island. This includes breeding ponds, as well as foraging areas and open areas between ponds that are used for dispersal.

5) Disrupt the breeding cycle of an important population

The most recent surveys in 2019–20 have described the habitat in the Eastern Pond as being infrequently occupied by GGBF and there is no evidence of breeding taking place within them. This is due to the lack of open water in the Eastern Ponds. The UoN (2019) identifies that ephemeral and semi-permanent ponds such as these are preferred as breeding sites on Kooragang Island, however the key indicator has been that 'all wetlands in which breeding has been detected have areas of open water' (UoN 2019) a condition which is absent at the Eastern Ponds. On this basis, the Eastern Ponds are not considered important breeding habitat for the GGBF population and the removal of this habitat will not disrupt the breeding cycle of the population.

6) Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The proposed closure works will temporarily remove an area of marginal foraging habitat (2.0 ha) for the GGBF population. The most recent surveys in 2019–20 have described the habitat in the Eastern Pond as being infrequently occupied by GGBF and there is no evidence of breeding taking place within them.

After the works are complete the area will be capped and new ponds established, therefore the loss of habitat is considered temporary. This area impacted represents a small proportion of the total potential foraging habitat available to the species in the KIWEF and it is likely that the temporary loss of a small proportion of foraging habitat will not result in a decline to the GGBF population.

7) Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

Weeds are prevalent at the Eastern Ponds and dominant within areas of terrestrial habitat, including noxious weeds. The works provide an opportunity to reduce the prevalence of noxious weeds within the capping area, upon revegetation. Appropriate controls will be implemented to vehicles and equipment to avoid the introduction of any other invasive species to the site. The wetland areas should be considered restricted areas for personnel and no material should be exchanged between other wetland areas which may transport Eastern Gambusia, an invasive species which predated tadpoles.

8) Introduce disease that may cause the species to decline, or

The Project is not expected to introduce any diseases that may cause the species to decline. Chytrid fungus has been linked to declines in the GGBF, however the pathogen is considered widespread on Kooragang island (DECC 2007) and therefore it is unlikely that the proposed works will cause any further spread.

Nevertheless hygiene procedures will be implemented for personnel and equipment in order to prevent any spread of the disease. The proposed works are considered unlikely to change the hydrological conditions and water quality parameters to a level that would constitute an impact on the GGBF population through spread of Chytrid fungus.

9) Interfere substantially with the recovery of the species.

The decline of this species can be attributed to a number of likely factors including Chytrid fungus, predation of tadpoles by the Eastern Gambusia and habitat loss. The proposed works will not impact on an identified area of important habitat and breeding habitat will remain unaffected by this proposal. It is anticipated that the proposal will not affect the recovery of the species and the carrying capacity of the habitat within the area will remain largely unchanged. Appropriate mitigation measures and hygiene controls will prevent other factors such as Chytrid fungus and Gambusia becoming prevalent in the species habitat. The proposed works are considered a low risk to the species recovery.

Conclusion

The proposed closure of the Eastern Ponds avoids impacts to important breeding and refuge habitat for the Kooragang Island important population of Green and Golden Bell Frog. Based on the results of long-term monitoring of the population by University of Newcastle (UoN 2019) it is evident that potential impacts will be limited to the temporary removal of an area of marginal foraging habitat only. The site is considered to be of low

value as refuge habitat and breeding has not been recorded here since around 2014-15 as a result of changes in the quality of the habitat.

B.3 Migratory Species

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- 1) Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a Migratory species;
- 2) Result in an invasive species that is harmful to the Migratory species becoming established in an area of important habitat for the Migratory species; or
- 3) Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a Migratory species.

Under the EPBC Act, 'important habitat' is a key concept for migratory species. According to the EPBC Act Significant Impact Guidelines (SIG 1.1) (Commonwealth of Australia 2013), an area of 'important habitat' for a migratory species is defined as:

- habitat used by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species; and/or
- habitat that is of critical importance to the species at particular life-cycle stages; and/or
- habitat used by a migratory species which is at the limit of the species range; and/or
- habitat within an area where the species is declining.

The widely accepted and applied approach to identifying internationally important shorebird sites throughout the world has been through the use of criteria adopted under the Ramsar Convention on Wetlands (Commonwealth of Australia 2009). According to this approach, a wetland should be considered internationally important if it regularly supports:

- one per cent of the individuals in a population of one species or subspecies of waterbird; or
- a total abundance of at least 20,000 waterbirds; or
- or 0.1 % of the flyway population.

Given the short timeframe of the project, a targeted survey for shorebirds was not conducted, rather the assessment has relied on existing data and reports to assess the potential importance of the Eastern Ponds for migratory shorebirds. The Hunter Estuary Wetlands Ramsar site comprises two parts: the former Kooragang Nature Reserve and the Hunter Wetlands Centre Australia. This Hunter Estuary Wetlands Ramsar site is well known and reported to be a major international non-breeding foraging site for migratory waders.

The Eastern Ponds are located outside of the Hunter Estuary Wetlands Ramsar site and are not a formal part of the site. Herbert (2007) provides a detailed account of significant wetlands in the Hunter Estuary for migratory birds, based on long-term monitoring which has identified the species visiting these wetlands and the abundance of birds. Several of these wetlands are mapped to the east, west and north of the Eastern Ponds although the Eastern Ponds and surrounding lands have not been identified as important foraging or roosting habitat.

Typically, the types of habitats consistently reported at important wetland sites for migratory shorebirds include:

- estuarine waters
- inter-tidal mud, sand or salt flats
- Inter-tidal marshes; includes salt marshes, salt meadows, saltings, raised salt marshes; includes tidal and brackish marshes
- Inter-tidal forested wetlands; includes mangrove swamps, tidal and freshwater swamp forests (I)

- tree-dominated wetlands.

The Eastern Ponds are not in a tidal area and are characterised as a freshwater ephemeral habitat, as described in the report, the area of open water within these ponds has gradually transitioned to a more vegetated cell. While the occasional visitation from a migratory shorebird species may occur at the Eastern Ponds, it is reasonable to expect that these ponds do not constitute an area of 'important habitat' for listed migratory shorebirds.

On this basis it is concluded that the site does not constitute 'important habitat' as defined under the EPBC Act Policy Statement 1.1 Significant Impact Guidelines (DoE 2013), in that the study area does not contain:

- a region that supports an ecologically significant proportion of a population of migratory species; or
- habitat utilised by a migratory species which is at the limit of the species range; or
- habitat within an area where the species is declining.

As such, it is unlikely that the action would significantly affect migratory species.

Appendix B: Biodiversity Management Plan

Biodiversity Management Plan	
Objective	To comply with contractual and legislative requirements and ensure that native fauna and flora are protected from construction activities.
Targets	No death or injury to fauna including the Green and Golden Bell Frog No unapproved destruction of habitat
Legal, Contractual & Other Requirements	<i>Environmental Protection and Biodiversity Conservation Act 1999</i> <i>Biodiversity Conservation Act 2016</i>
Site specific planning / approval conditions / licence conditions	<p>State Documents</p> <p>NSW EPA (2010), Approval of the Surrender of a Licence – License 6437, (Ref: 1111840, and as varied by notice number 1510956 and 1520063)</p> <p>Golders (2011), KIWEF Closure Works, Green and Golden Bell Frog Management Plan (Ref: 117623029-001-R-Rev0)</p> <p>Jacobs (2020) KIWEF Eastern Ponds Closure Works Review of Environmental Factors (IS330300_02)</p> <p>Commonwealth Documents</p> <p>Jacobs (2020), KIWEF Eastern Ponds Closure Works EPBC Self-Assessment (IS330300_01)</p>
General Flora and Fauna Mitigation Measures and Controls	<p>General mitigation measures to be considered include:</p> <ul style="list-style-type: none"> ▪ Adequate run-off, erosion and sedimentation controls should be in place during construction, particularly in areas where run-off has the potential to impact on nearby waterways, surrounding native vegetation, EEC regrowth, and existing drainage line and dam areas ▪ Care should be taken that any noxious weeds occurring on the site are not further dispersed as a result of the Proposal. A follow up Weed Control Program may be necessary to control the encroachment of these species into surrounding areas. The landowner has a legal responsibility to control and suppress these species on their property under the <i>Biosecurity Act 2015</i>. The Weed Control Program should require removal of weeds by physical means and avoid the use of herbicides ▪ Stockpiling of soil that may contain seeds of exotic species shall be stockpiled away from adjacent vegetation or drainage lines where they could be spread during rainfall events ▪ Placement of soil stockpiles away from vegetated areas ▪ Utilising existing disturbed corridors such as cleared areas, roads, tracks and existing easements, where possible for set up of equipment, stockpile areas and site facilities ▪ Noxious weeds to be managed in accordance with the expectations under the <i>Biosecurity Act 2018</i>. It is recommended that the plants be removed by physical removal where practicable, as herbicides may impact GGBFs and their habitat

Biodiversity Management Plan	
	<ul style="list-style-type: none"> ▪ Open excavations and storage areas to be inspected regularly for the presence of fauna species ▪ Plant and equipment brought on to site must be cleaned and free of deleterious material, mud and other material that may harbour weed seeds ▪ Standard construction hours are to be maintained to restrict noise and light impacts on nocturnal fauna, to the extent practical. Any after hour activities will be limited to delivery of materials, environmental surveys, or other action that has been assessed to have a minimal impact to nocturnal fauna ▪ Utilise an onsite ecologist during construction to re-locate any native fauna which may be displaced ▪ Avoid rubbish and other waste build up to deter feral animals ▪ Habitat features such as woody debris that may be utilised by fauna within the construction area would be retained and set-aside during the construction period for reinstatement at completion of works ▪ Any water required for dust suppression will be drawn from ponds established for the purpose. No water for dust suppression will be drawn from existing ponds on the site. The establishment of dedicated dust suppression ponds will be undertaken to prevent the potential spread of Plague Minnow into ponds currently free of this species. The location and procedure for those dedicated dust suppression ponds will be communicated during the site induction and training ▪ No night works are permitted without additional assessment of potential noise and light impacts ▪ Lighting of site compounds, if required for safety and security, will avoid light spill outside of the construction works footprint and will be undertaken in accordance with <i>Australian Standard 4282—1997 Control of the obtrusive effects of outdoor lighting</i>.
GGBF Management	<p>GGBF impact avoidance is to be based on the following:</p> <ul style="list-style-type: none"> ▪ Establishment and use of Chytrid Hygiene procedures such that the Chytrid fungus is not brought to site or transferred between areas of the site as described in the following row ▪ GGBF pre-clearance/disturbance surveys and relocation to ensure to the extent possible that direct disturbance areas are free of GGBF on commencement of works in each area ▪ Establishment of GGBF exclusion fencing such that the risk of GGBF re-entering surveyed areas is prevented ▪ Establishment and maintenance of a vegetation/structure buffer (nominally 1-2m wide) outside of the GGBF exclusion fencing to minimise potential for GGBF to use overgrown vegetation or existing fencing to gain access into the works footprint. The buffer is to be managed proactively, through implementing lessons learnt from prior incidents and to minimise potential for frogs to become trapped and exposed which may include provision of habitat refuge, mulch cover over exposed surfaces, watering and regular inspections ▪ Establishment of clear boundaries of works areas such that unnecessary disturbance is avoided, particularly adjacent to existing ponds

Biodiversity Management Plan	
	<ul style="list-style-type: none"> ▪ Establishment of appropriate erosions and sediment controls to prevent sedimentation and pollution of waters ▪ Implementation of GGBF risk consideration to all decision making such that unintended consequences to GGBF can be avoided. This includes in considering suitability of imported materials from a Chytrid risk and nutrient perspective and use of chemicals including flocculants, herbicides and pesticides ▪ Where unintended impacts to GGBF are identified all necessary efforts to reduce the severity and avoid reoccurrence are to be implement ▪ Rehabilitation using species preferred by GGBF (refer to rehabilitation management plan).
Chytrid Fungus hygiene protocol	<p>A Chytrid Hygiene procedure in accordance with the NSW Threatened Species Management Information Circular No.6 – Service Hygiene Protocol for the Control of Disease in Frogs (April (2008) or most recent revision of that document, must be implemented on the Closure Works site during all works and any other activities undertaken as part of the action. This procedure is to include:</p> <ul style="list-style-type: none"> ▪ Dedicated disinfection bays established at site entry and all vehicles required to enter via this bay ▪ All disinfection processes will be monitored and controlled at the Closure Works entry point ▪ The location of these disinfection bays, and the obligations of disinfection, will be communicated during the site induction and training ▪ Cleaning and disinfection of workers boots upon entry and exit from the site ▪ Procedures will be implemented to inspect mobile plant entering the Project site during construction activities to control soil and/or organic matter and to disinfect tyres and wheels of vehicles entering the Project site ▪ Vehicles arriving at site muddy will be sent away for more intensive cleaning prior to disinfection.
Chytrid Fungus Risk Assessment Process	<p>The contractor is to demonstrate that suitable risk assessment has been undertaken by an appropriately qualified and experienced ecologist on all imported capping and revegetation materials to demonstrate that it contains a low risk of containing Chytrid. Risk assessment should consider as a minimum:</p> <ul style="list-style-type: none"> ▪ Material not sourced from known, suspected or likely amphibian habitat areas, or material has been isolated for sufficient period to eliminate chytrid risk ▪ Material unlikely to have had contact with amphibians and no amphibians present in material ▪ Material are not to be stored in, or come in contact with material sourced from, areas of known, suspected or likely amphibian habitat prior to transport ▪ Material has been subject to temperature exceeding 28 degree which is considered to exceed the thermal tolerance of chytrid fungus.
Pre-clearance survey design	<p>The Contractor will be responsible for developing a pre-clearance survey and clearing methodology suitable for implementation with the contractors specific</p>

Biodiversity Management Plan	
and clearance methodology.	<p>construction methods that minimises potential harm to GGBF species. The survey methodology should give consideration to the following factors:</p> <ul style="list-style-type: none"> ▪ Level of effort warranted in different areas and habitats ▪ Seasonal factors on GGBF use of habitat ▪ Need for night time surveys ▪ Survey effort required is likely to include: <ul style="list-style-type: none"> Targeted active searches of potential GGBF habitat located within the disturbance footprint Conducted to minimise disruption of breeding activities: relocated tadpoles or metamorphs ▪ Be conducted in accordance with hygiene protocol ▪ Habitat resources including all wet areas as well as rocks, logs, tussock forming vegetation, and other cover will be searched during diurnal visual inspections ▪ A nocturnal habitat search including visual search, spotlighting and call playback may be conducted to assess nocturnal use (breeding/calling) in the habitat supported in disturbance area, if the surveys are conducted during core breeding season (spring/summer) ▪ Any GGBF observed within the disturbance footprint will be relocated in accordance with relocation procedure provided in the GGBF Management Plan (or procedure otherwise endorsed by HCCDC in consultation with the University of Newcastle) prior to commencement of disturbance ▪ The survey methodology implemented should allow the qualified and experienced ecologist to confirm that the risk of GGBF mortality has been reduced to the extent reasonable and feasible for the applicable habitat type/area. <p>The clearing methodology should include the following:</p> <ul style="list-style-type: none"> ▪ Consideration of most appropriate time to install frog exclusion fences ▪ Presence of an appropriately qualified and experienced ecologists during clearing ▪ Gradual degradation of higher risk habitat areas progressing from areas furthest away from pond towards areas of refuge ▪ Relocation of cleared vegetation to areas away from immediate works that allow remaining amphibians to escape ▪ Construction of ramps on the internal side of the exclusion fence to allow for GGBF to escape from within the site, whilst maintaining a perimeter and restricting fauna entry to the work site.
Amphibian Relocation	<p>If any frog specimens thought to be a GGBF are observed and are within project disturbance area the following relocation procedure will be implemented:</p> <ul style="list-style-type: none"> ▪ Observer to notify Site supervisor who in turn is to notify the HCCDC, a suitably qualified ecologist, and the Contractor's supervisor of the frog's location immediately ▪ Contractor supervisor to halt work in the immediate vicinity to prevent accidental interaction with the frog

Biodiversity Management Plan	
	<ul style="list-style-type: none"> ▪ The ecologist or HCCDC's environmental representative will determine whether the frog is likely to be harmed by works or is likely to migrate to an area that it could be harmed ▪ If likely to be harmed by works the GGBF will be captured by the ecologist or suitably trained frog handler following GGBF handling and Hygiene procedures ▪ A one frog per bag policy will be observed with disinfection of all equipment undertaken immediately following any contact with frogs of any description ▪ If healthy the frog will be relocated outside the impact footprint as soon as possible to a nearby wetland with suitable habitat and water (note that the requirement of the GGBF Management Plan to hold frogs until night time has been superseded by advice from the University of Newcastle) ▪ GGBF showing Chytrid symptoms will be handled in accordance with the GGBF management requirements unless otherwise agreed with HCCDC in consultation with the University of Newcastle.
Actions	The contractors CEMP is required to establish the actual pre-clearance and clearance methodology, exclusion fence designs and Chytrid Risk assessment and documentation proposed.
Responsibilities	<p>Contractor's Ecologist is responsible for ensuring risks to Fauna is minimised to the extent reasonable and feasible.</p> <p>Contractor's Project Manager is responsible for allowing sufficient time within program to conduct pre-clearance and clearance in a manner that maximises survival of GGBF and other fauna following the advice of the Ecologist.</p> <p>Contractor is responsible for notifying the Principal of any sick or dead GGBF.</p> <p>All personnel are responsible for ensuring that the clearing limits are addressed and native flora and fauna species are protected.</p> <p>All site personnel to undertake toolbox talks in relation to the reporting process for injury/ death to fauna or clearing of flora occurring beyond the required limits for construction.</p>
Timeframe	Duration of the works.
Monitoring & Reporting	<p>Daily visually monitoring by site supervisors for obvious signs of fauna and the functioning of controls including fences and Chytrid hygiene stations.</p> <p>Inspection of inside and outside of exclusion fencing and provision of water in microhabitats when temperature is forecast to exceed 30 degrees with less than 50% humidity.</p> <p>Weekly inspections to be documented on a Weekly Environmental Inspection Checklist.</p> <p>Outcomes of pre-clearance surveys are to be documented and provided to the HCCDC.</p> <p>Observed sick or dead GGBF are to be notified to the Principal immediately.</p>

Appendix C: Rehabilitation management plan

Rehabilitation Management Plan	
Objective	<p>To comply with State and Commonwealth approvals requirements and related conditions.</p> <p>To provide a post construction environment that is revegetated to stabilise the capping surface; and planted with species known to be favoured by GGBF.</p>
Targets	<p>The capped surface is stabilised and vegetated within 12 months of construction completion.</p> <p>Provide a revegetated capped surface that includes species of flora known to be favoured by GGBF.</p>
Key Documents	<p>State Documents</p> <p>NSW EPA (2010), Approval of the Surrender of a Licence – License 6437, (Ref: 1111840, and as varied by notice number 1510956 and 1520063)</p> <p>Golders (2011), KIWEF Closure Works, Green and Golden Bell Frog Management Plan (Ref: 117623029-001-R-Rev0)</p> <p>GHD (2009), Report on KIWEF, Revised Final Landform and Capping Strategy (Ref: 22/14371/85882 R4).</p>
Mitigation Measures and Controls	<p>General mitigation measures to be considered include:</p> <ul style="list-style-type: none"> ▪ Care should be taken that any noxious weeds occurring on the site are not further dispersed as a result of the Proposal. A follow up Weed Control Program may be necessary to control the encroachment of these species into surrounding areas. The landowner has a legal responsibility to control and suppress these species on their property under the <i>Noxious Weeds Act 1995</i>. The Weed Control Program should be remove weeds by physical means and avoid the use of herbicides ▪ Stockpiling of soil that may contain seeds of exotic species shall be stockpiled away from adjacent vegetation or drainage lines where they could be spread during rainfall events ▪ Placement of soil stockpiles away from vegetated areas ▪ Utilising existing disturbed corridors such as cleared areas, roads, tracks and existing easements, where possible for set up of equipment, stockpile areas and site facilities ▪ Bitou Bush and Crofton Weed would be managed by following the Local Noxious Weed Control Plans (NCC 2006). It is recommended that the plants be removed by physical removal, as herbicides may impact GGBFs and their habitat ▪ Plant and equipment brought on to site must be cleaned and free of deleterious material, mud and other material that may harbour weed seeds ▪ Works associated with the closure of the KIWEF must only occur within the closure works area (project footprint); and must be restricted to the extent required to satisfy the Surrender Notice requirements ▪ All disturbed surfaces will be revegetated within 1 month of final land forming and in compliance with the landscaping plans

Rehabilitation Management Plan	
	<ul style="list-style-type: none"> ▪ Any capping materials that are imported from outside the KIWEF facility must be sourced from an area that is assessed as having a low risk of containing Chytrid Fungus. ▪ The contractor is to demonstrate that suitable risk assessment has been undertaken by an appropriately qualified and experienced ecologist on all imported capping and revegetation materials to demonstrate that it contains a low risk of containing chytrid. Risk assessment should consider as a minimum: <ul style="list-style-type: none"> ○ Material not sourced from known, suspected or likely amphibian habitat areas, or material has been isolated for sufficient period to eliminate chytrid risk ○ Material unlikely to have had contact with amphibians and no amphibians present in material ○ Material stored in a dry location prior to transport ○ Material has been subject to temperature exceeding 28 degree which is considered to exceed the thermal tolerance of chytrid fungus. ▪ Topsoil to be used for surface layers must be sourced from within KIWEF to the extent possible and will otherwise be assessed as low in added nutrients (manufactured soils and boosted with fertilisers, or waste exempt sludges and processed topsoils (eg recycled waste) which are high risk of causing eutrophication in enclosed waters) and having a low risk of containing Chytrid Fungus to be protective of adjacent MNES habitat ▪ Upon completion of works, the works area will be rehabilitated with vegetation species known to be favoured by GGBF ▪ Open stormwater infrastructure across the KWIEF site will be planted with species known to be favoured by GGBF. This revegetation and rehabilitation strategy will include a 2m wide buffer on either side of the stormwater drains. The intention is to provide movement corridors for GGBF across the site ▪ Drainage culverts will, where practicable, be vegetated and lined with rocks and objects that may provide temporary frog refuge, in the event that a frog seeks to traverse the future capped area of KIWEF ▪ Habitat features such as woody debris that may be utilised by fauna within the construction area would be retained and set-aside during the construction period for reinstatement at completion of works <p>Prior to the Construction Completion dates the Contractor is required to seed the vegetation layer above the capping layer and reseed areas where sparse vegetation coverage is achieved by the end of the care and maintenance period.</p>
Species Mix	<p><u>Aquatic vegetation:</u></p> <ul style="list-style-type: none"> ▪ Selection of reeds that provide good habitat cover such as Typha, Bolboshoenus, Phragmites, and Juncus ▪ A mixed community is preferable to single species stands

Rehabilitation Management Plan	
	<ul style="list-style-type: none"> ▪ GGBF prefer wetlands with sections of open water. Water depth should be deep enough to prevent Typha spreading across the entire pond area; the reeds should be mainly at the edge of ponds ▪ Substrate at edges should be suitable for reed growth (i.e. not too many pebbles, sandbags, etc.) ▪ Areas of low blanketing vegetation are also desirable for GGBF breeding, for example, Paspalum grass and Shoenoplectus rush; ▪ Establishing aquatic plants with planting after Closure Works: will maximise structural suitability of wetland to immigrating GGBF as soon as construction is completed. <p><u>Terrestrial vegetation:</u></p> <ul style="list-style-type: none"> ▪ Stabilise new works with suitable seasonal available terrestrial species of seed that are compatible with the capping ▪ Retain seed bank in fill taken from site (to be reused) ▪ Avoid large tree species unless identified as compatible with capping ▪ Allow terrestrial species to re-colonise. <p>Drainage culverts will, where practicable, be vegetated and lined with rocks and objects that may provide temporary frog refuge, in the event that a frog seeks to traverse the future capped area of KIWEF.</p>
Performance Criteria	<p>Establish adequate vegetation coverage across the closure area. Where vegetation regrowth is sparse (ie less than 50% growth) in areas of greater than 10m², the performance criteria will be considered to have failed and contingency measures are required.</p> <p>No deep-rooted vegetation (ie large shrubs or trees) on top of capped surface</p>
Contingency Measures	<p>Where Vegetation Coverage has been identified to be insufficient, the area will be reseeded.</p> <p>Where deep-rooted vegetation is identified on top of capped surface. The vegetation will be removed (mechanically where possible).</p>
Responsibilities	<p>The Contractor is responsible for undertaking the work, monitoring and maintenance of all elements of the revegetation management plan, until the completion of the construction maintenance period (indicatively 3 months post construction completion).</p> <p>The State (or its agent) is responsible for the monitoring and maintenance of all elements of the revegetation management plan and any rectification works, following the completion of the construction maintenance period.</p>
Timeframe	<p>For the duration of the construction works; and the construction maintenance period.</p>
Monitoring & Reporting	<p>Vegetation establishment will be visually monitored monthly during the construction works and construction maintenance period to identify any areas where vegetation is failing to establish. Should vegetation not establish within the construction maintenance period then targeted seeding and/or planting would be undertaken.</p>

