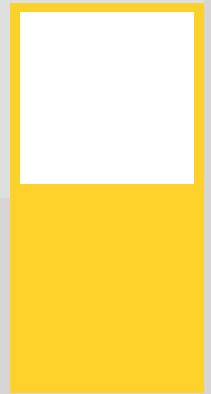




CLYDE TERMINAL CONVERSION PROJECT

APPENDIX D

ECOLOGICAL ASSESSMENT



Ecological Assessment

Clyde Terminal Conversion Environmental Impact Statement

Ecological Assessment

Clyde Terminal Conversion Environmental Impact Statement

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Executive Summary

This Ecological Assessment has been prepared by AECOM on behalf of the Shell Company of Australia Ltd (Shell) to meet the Director General's Requirements (DGRs) for the proposed conversion to the Clyde Terminal (the Project, refer **Figure 1**). More specifically, the aim of the assessment is to determine if there would be, or is likely to be, any significant impacts to critical habitat, threatened species, or to listed populations or ecological communities protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), the *Threatened Species Conservation Act 1995* (TSC Act), and/or the *Fisheries Management Act 1994* (FM Act).

The Project Area is heavily modified and comprises hardstand areas and both remnant and regenerated vegetation including the following:

- Foreshore vegetation adjacent to the Project Area, which has been mapped (SMCMA, 2010) as containing the following vegetation communities (refer **Figure 6**):
 - Mangroves;
 - Coastal Saltmarsh (this vegetation also meets characteristics of the Endangered Ecological Community Themeda grassland);
 - Swamp Oak Forest;
 - Wetlands; and
 - Phragmites Reedland.
- The remnant 'wetland' located at the north-east boundary of the Project Area (refer **Figure 6**) is described by Urban Bushland Management Consultants Pty Ltd, 2007 as being comprised of:
 - Aquatic wetland vegetation, which is dominated by Cumbungi (*Typha* spp.), and dense growth of the introduced Spiny Rush (*Juncus acutus*);
 - A low woodland which has been planted with species that are largely non-indigenous; and
 - Swamp Oak Floodplain Forest and sclerophyll vegetation on the more elevated land surrounding the remnant wetland.
- The boundary fence line adjacent Duck River, in the south western corner of the Project Area, is lined with mature Swamp Oak (*Casuarina glauca*) trees. These trees are often continuous with uneven aged stands of Swamp Oak within the foreshore of the river.

During a Baseline Biodiversity Assessment conducted in 2008, this remnant wetland was again confirmed to contain Swamp Oak Floodplain Forest, planted mixed Eucalyptus woodland, swamp/reedland and mangrove forest and saltmarsh (NGH Environmental, 2009).

There are two recreation areas located in the vicinity of the Project Area: Eric Primrose Reserve and Silverwater Park. Eric Primrose Reserve is located on the opposite side of the Parramatta River, approximately 200 m to the north-east of the Project Area along a strip of land bordering the northern bank of Parramatta River. Silverwater Park is located across the Duck River approximately 200 m to the east of the Project Area. The nearest residential areas are Rydalmere, approximately 900 m north-east and 1.4 km south-east from the Project Area across the Parramatta River, and Rosehill, approximately 1.7 km to the west of the Project Area.

Table 1 and **Table 2** below summarise the results of this Ecological Assessment in accordance with the requirements of the EPBC Act and TSC Act, and the relevantly listed ecological matters that have been identified and considered in this assessment, on the basis of a record within 10 km of the Project Area.

Table 1 Relevant EPBC Act Matters of National Environmental Significance in relation to the Clyde Terminal

Matter of National Environmental Significance	Matters within the vicinity of the Project Area	Potential for Significant Impact
Wetlands of International Importance	The EPBC Protected Matters search tool report produced as part of this Ecological Assessment advised that there are no Wetlands of International Importance within 10 km of the Project Area.	Not Applicable
Nationally Important Wetlands	<p>The EPBC Protected Matters search tool report produced as part of this Ecological Assessment advised that there are two Nationally Important Wetlands 10 km of the Project Area as follows:</p> <ul style="list-style-type: none"> - The Newington Wetlands, around 1.8 km east of the Project Area; and - The Bicentennial Park Wetlands, around 3 km west of the Project Area. 	Not Significant
Listed Threatened Species and Ecological Communities	<p>Threatened Ecological Communities</p> <p>Four threatened ecological communities are listed as known or likely to occur within 10 km of the Project Area:</p> <ul style="list-style-type: none"> - Blue Gum High Forest of the Sydney Basin Bioregion, listed as critically endangered; - Cumberland Plain Shale Woodland and Shale-Gravel Transition Forest (also known in NSW as the Shale Gravel Transition Forest in the Sydney Basin Bioregion), listed as critically endangered; - Shale/Sandstone Transition Forest, listed as endangered; and - Turpentine-Ironbark Forest in the Sydney Basin Bioregion, listed as critically endangered. <p>Threatened Flora</p> <p>Twenty one flora species listed as threatened under the EPBC Act are recorded as being known or likely to occur within 10 km of the Project Area.</p> <p>Threatened Terrestrial Fauna</p> <p>Twenty one threatened terrestrial fauna species (including birds, frogs, mammals and reptiles) are listed as threatened under the EPBC Act and likely or known to occur within 10 km of the Project Area.</p> <p>Threatened Marine Fauna</p> <p>Nine marine fauna species that have been listed as threatened under the EPBC Act as known or likely to occur within 10 km of the Project Area.</p>	Not Significant
Listed migratory species	An additional 24 EPBC listed migratory marine and migratory wetland species of bird and one migratory shark have been recorded as being likely or known to occur within 10 km of the Project Area. The Project Area contains remnant wetlands and mangroves, and therefore provides potential habitat features for these species.	Not Significant
Commonwealth Marine Areas	There are no Commonwealth Marine Areas in the vicinity of the Project Area.	Not Applicable

Table 2 Summary of Ecological Matters Relevant to the TSC Act

Matter of Consideration	Description	Significance
Endangered Ecological Communities	<p>Fourteen Endangered Ecological Communities (EECs), two Critically Endangered Ecological Communities (CEECs) and one Vulnerable Ecological Community listed under the TSC Act (14 ecological communities in total in addition to those returned by the EPBC Protected Matters search tool) were identified as known or likely to occur within 10 km of the Project Area.</p> <p>Five listed ecological communities have been previously recorded within the Project Area:</p> <ul style="list-style-type: none"> - Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions. This EEC occurs as intermittent stands along the foreshore and within the remnant wetland in the Project Area and as intermittent stands along the foreshore of both Duck and Parramatta rivers (refer Figure 6); - Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions is listed as an EEC under the TSC Act. Sclerophyll vegetation has been previously recorded in the forested section of the remnant wetlands in the Project Area; - Sydney Freshwater Wetlands in the Sydney Basin Bioregion. These remnant EEC wetlands occur in the Project Area (refer Figure 6); and - Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions listed as an EEC under the TSC Act. Mapping available from the Sydney Metropolitan Catchment Management Authority (SMCMA, 2010) was consulted, from which it was determined that foreshore vegetation adjacent to the Project Area can also be characterised as the EEC Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions. 	Not Significant
Threatened Flora Species	<p>Forty two listed flora species under the TSC Act (30 in addition to those returned by the EPBC Protected Matters search tool) were identified as known or likely to occur within 10 km of the Project Area.</p> <p>Two listed flora species have been previously recorded within the Project Area:</p> <ul style="list-style-type: none"> - The vulnerable Downy Wattle (<i>Acacia pubescens</i>). There are two known recorded locations of the species occurring within the foreshore fringing the Project Area (refer Figure 6 and Figure 8); and - The vulnerable Narrow-leafed Wilsonia (<i>Wilsonia backhousei</i>). There are six known recorded locations of the species occurring in the intermittent areas of saltmarsh along the foreshore fringing the Project Area (refer Figure 6 and Figure 8). SMCMA mapping also identifies saltmarsh containing Narrow-leafed Wilsonia to occur along the foreshore edges of the Project Area (SMCMA, 2010). <p>An additional three listed flora species have been previously recorded within the Study Area:</p> <ul style="list-style-type: none"> - The vulnerable Netted Bottle Brush (<i>Callistemon linearifolius</i>). The closest known recorded location of the species is at Rosehill around 1.6 km west of the Project Area (refer Figure 8); 	Not Significant

Matter of Consideration	Description	Significance
	<ul style="list-style-type: none"> - The endangered <i>Pomaderris prunifolia</i> in the Parramatta, Auburn, Strathfield and Bankstown Local Government Areas. The closest known recorded location of the species is at Ermington around 1.2 km north of the Project Area (refer Figure 8); and - The vulnerable Glandular Pink-bell (<i>Tetratheca glandulosa</i>). The closest known recorded location of the species is adjacent to Duck River, around 1.9 km south-west of the Project Area (refer Figure 8). <p>An additional seven listed flora species have been previously recorded in the Locality, but not within the Study Area or the Project Area:</p> <ul style="list-style-type: none"> - The vulnerable <i>Dillwynia tenuifolia</i> (refer Figure 8); - The vulnerable <i>Epacris purpurascens var. purpurascens</i> (refer Figure 8); - The endangered Narrow-leaf Finger Fern (<i>Grammitis stenophylla</i>) (refer Figure 8); - The endangered <i>Hibbertia superans</i> (refer Figure 8); - The vulnerable <i>Pimelea curviflora var. curviflora</i> (refer Figure 8); - The endangered <i>Pimelea spicata</i> (refer Figure 8); and - The endangered Creek Triplarina (<i>Triplarina imbricata</i>) (refer Figure 8). 	
Threatened Fauna Species	<p>Threatened Terrestrial Fauna</p> <p>Sixty-eight listed terrestrial fauna species under the TSC Act (58 in additional to those returned by the EPBC Protected Matters search too) were identified as being likely or known to occur within 10 km of the Project Area. Three fauna communities were also identified as being likely or known to occur within 10 km of the Project Area.</p> <p>Two listed fauna species have been previously recorded within the Project Area as follows:</p> <ul style="list-style-type: none"> - The endangered Green and Golden Bell Frog (<i>Litoria aurea</i>) has been previously recorded as occurring in the Project Area, and the Project Area contains a known population of the species (refer Figure 9); and - The endangered Grey-headed Flying-fox (<i>Petaurus poliocephalus</i>) has been previously recorded in the remnant wetlands at the Project Area (refer Figure 10). <p>An additional nine listed fauna species have been previously recorded in the Study Area:</p> <ul style="list-style-type: none"> - The endangered Curlew Sandpiper (<i>Calidris ferruginea</i>). The closest known recorded location of the species is at Newington, around 1.3 km south-east from the Project Area (refer Figure 11); - The vulnerable White-fronted Chat (<i>Epthianura albifrons</i>). The closest known recorded location of the species is at Newington, around 1.3 km south-east of the Project Area (refer Figure 11); - The vulnerable Little Eagle (<i>Hieraaetus morphnoides</i>). The closest known recorded location of the species is at Narawang Wetland 	Not Significant

Matter of Consideration	Description	Significance
	<p>around 1.6 km east of the Project Area (refer Figure 11);</p> <ul style="list-style-type: none"> - The vulnerable Black-tailed Godwit (<i>Limosa limosa</i>). The closest known recorded location of the species is at the Millennium Parklands around 1.9 km east of the Project Area (refer Figure 11); - The vulnerable Powerful Owl (<i>Ninox strenua</i>). The closest known recorded location of the species is at Dundas, around 2 km north of the Project Area (refer Figure 11); - The vulnerable Spot-tailed Quoll (<i>Dasyurus maculatus maculatus</i>). The closest known recorded location of the species is at Granville, around 2 km south-west of the Project Area (refer Figure 11); - The vulnerable Eastern Bentwing Bat (<i>Miniopterus schreibersii oceanensis</i>). The closest known recorded location of the species is at Millennium Parklands around 1.7 km east of the Project Area (refer Figure 10); - The vulnerable Eastern Freetail-bat (<i>Mormopterus norfolkensis</i>). The closest known recorded location of the species is at Millennium Parklands around 1.7 km east of the Project Area (refer Figure 10); and - The vulnerable Yellow-bellied Sheath-tail-bat (<i>Saccolaimus flaviventris</i>). The closest known recorded location of the species is at Millennium Parklands around 1.7 km east of the Project Area (refer Figure 10). <p>An additional 15 listed fauna species have been previously recorded in the Locality. No listed fauna species that were not already recorded as being listed in the Project Area were found to have been previously recorded within the Study Area only. The additional 26 species found within the Locality are as follows:</p> <ul style="list-style-type: none"> - The critically endangered Regent Honeyeater (<i>Anthochaera Phrygia</i>) (refer Figure 11); - The endangered Australasian Bittern (<i>Botaurus poiciloptilus</i>) (refer Figure 11); - The vulnerable Great Knot (<i>Calidris tenuirostris</i>) (refer Figure 11); - The vulnerable Gang-gang Cockatoo (<i>Callocephalon fimbriatum</i>) (refer Figure 11); - The vulnerable Greater Sand-plover (<i>Charadrius leschenaultii</i>) (refer Figure 11); - The vulnerable Little Lorikeet (<i>Glossopsitta pusilla</i>) (refer Figure 11); - The endangered Swift Parrot (<i>Lathamus discolor</i>) (refer Figure 11); - The vulnerable Broad-billed Sandpiper (<i>Limicola falcinellus</i>) (refer Figure 11); - The vulnerable Barking Owl (<i>Ninox connivens</i>) (refer Figure 11); - The vulnerable Eastern Osprey (<i>Pandion cristatus</i>) (refer Figure 11); - The endangered Little Tern (<i>Sternula albifrons</i>) (refer Figure 11); 	

Matter of Consideration	Description	Significance
	<ul style="list-style-type: none"> - The vulnerable Freckled Duck (<i>Stictonetta naevosa</i>) (refer Figure 11); - The vulnerable Eastern Grass Owl (<i>Tyto longimembris</i>) (refer Figure 11); - The vulnerable Terek Sandpiper (<i>Xenus cinereus</i>) (refer Figure 11); - The vulnerable Greater Broad-nosed Bat (<i>Scoteanax rueppellii</i>) (refer Figure 10). <p>Two Fauna populations have also been previously recorded in the Study Area:</p> <ul style="list-style-type: none"> - The endangered White-fronted Chat population in the Sydney Metropolitan Catchment Management Area (<i>Epthianura albifrons</i>). The closest known recorded location of this population is at Newington, around 1.3 km south-east of the Project Area (refer Figure 11); and - <i>Dasyurus maculatus maculatus</i> (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll. The closest known recorded location of the species is at Granville, around 2 km south-west of the Project Area (refer Figure 11). <p>One listed fauna population has also been previously recorded in the Locality but not within the Study Area:</p> <ul style="list-style-type: none"> - The endangered Gang-gang Cockatoo population in the Hornsby and Ku-ring-gai Local Government Areas (<i>Callocephalon fimbriatum</i>). <p>Threatened Marine Fauna</p> <p>The threatened marine fauna listed under the TSC Act and captured in the OEH's Atlas of Wildlife database search had already been captured in the SEWPAC's Protected Matters Search Tool database search (refer Table 1).</p>	

A search of the Fisheries threatened and protected species records viewer yielded no results for endangered or threatened fauna or flora within the Parramatta Local Government Area (Department of Primary Industries Fisheries, 2013).

This Ecological Assessment has determined that the Project, being the conversion of the Clyde Terminal, is not anticipated to have a significant impact on any matters under the EPBC Act, TSC Act or FM Act. The mitigation measures recommended in **Section 5.0** have been developed to reduce and manage the predicted impacts of the Project to the extent reasonably practicable.

At the time of finalising this assessment, a referral to the Commonwealth is also being submitted to SEWPAC, including a significant impact criteria assessment pursuant to the EPBC Act for the EPBC vulnerable listed Green and Golden Bell Frog. This assessment also considers the potential for the Project to impact on the Grey-headed Flying Fox. The purpose of the referral is to determine whether the Project will need formal assessment and approval under the EPBC Act in relation to the potential for impacts, most specifically for Green and Golden Bell Frog. The referral has predicted that the Project would NOT significantly impact on the Grey-headed Flying Fox. The referral also found that the Project is NOT LIKELY to have a significant impact for Green and Golden Bell Frog IF undertaken in a particular manner. This is due to a commitment by Shell, to develop and implement GGBF management strategy (refer **Section 5.1**). The strategy would be developed in consultation with OEH and SEWPAC and prepared in accordance with relevant government guidelines and best practices. A formal

systematic monitoring program would be implemented to ensure the efficacy of mitigation and management activities to the satisfaction of OEH.

Assessments of significance (seven-part tests) have been prepared for the Grey-headed Flying Fox, Microbats and the Green and Golden Bell Frog (refer **Appendix D**). These assessments of significance yielded similar results to those obtained from the significant impact criteria assessment pursuant to the EPBC Act; that the Project is unlikely to significantly impact on these species.

1.0 Introduction

1.1 Project Overview

The Shell Company of Australia Ltd (Shell) is seeking approval for the conversion of the Clyde Terminal for use solely as a finished petroleum products import terminal (the Project, refer **Figure 1**).

Until the recent cessation of refining activities on 5 October 2012, the then Clyde Refinery was used for the receipt and refining of Crude Oil as well as for the receipt of imported finished product from Gore Bay Terminal via a 19 km pipeline. Shell is therefore seeking approval under Division 4.1 of Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to complete the major components of the conversion of the now Clyde Terminal for use solely as a finished fuels terminal.

The key components of the conversion of the Project Area would comprise:

- Demolition of the existing Clyde Terminal processing units and other redundant infrastructure at the Project Area. Existing storage tanks to be retained would be reallocated into final grades of finished petroleum products. Storage tanks surplus to the ongoing operation of the Clyde Terminal would be demolished. This would reduce the capacity and quantity of storage for petroleum fuels at the Clyde Terminal from 638 ML to 264 ML of fuels; and
- Conversion of part of the existing Clyde Terminal assets to more efficiently receive, blend, store and distribute solely imported finished petroleum products. These products would continue to be supplied from the Clyde Terminal to Shell's existing Parramatta Terminal (which lies adjacent to the Clyde Terminal), and directly via existing pipelines from the Clyde Terminal to Sydney Airport and Newcastle.

The proposed Project would also include:

- Geodesmic domes would be installed over Jet fuel storage Tanks 34, 35 and 42, located in Tankfarm B2. These geodesmic domes would be designed so as to retain the majority of potential odours and emissions emitted from these Jet fuel storage tanks;
- Upgrades to tank instrumentation and tank control systems to enable remote and automated control;
- Upgrades to tank bunds where necessary;
- Reduction of the gas storage capacity of the Clyde Terminal from 10,851 cubic metres (m³) to 1,550 m³ metres to accommodate the continued receipt (by road tanker) and storage of Butane. Butane would continue to be blended with winter grades of Gasoline;
- Upgrades to the electrical supply, control and safeguarding systems;
- Increased automation of terminal systems;
- Installation of equipment to provide improved product quality segregation;
- Revised drainage and water treatment to suit reduced operations;
- Changes to the current fire system to provide articulated foam deployment and fire response for the converted Clyde Terminal arrangement;
- Revised internal facility pumping and piping arrangements;
- Associated works to increase the efficiency and effectiveness of the Clyde Terminal and to facilitate safe and efficient operations, such as lighting, safety shutdown systems, control room facilities and amenity upgrades; and
- An overall reduction in the operational footprint of the Clyde Terminal.

The Project would only involve minimal excavation activities, including grading works surrounding existing tankfarms, and foundation works for new substations and firewater tanks and the removal of some existing foundations. No other sub-surface disturbance is anticipated as part of the Project.

The Clyde Terminal would remain operational as a receipt (from the Gore Bay Terminal), storage and distribution facility for finished petroleum products during the proposed works. Once the Project is executed and implemented, the Clyde Terminal would continue to receive, store and distribute finished petroleum products.

Details of these activities are provided in the following sections. For an indication of the location of proposed conversion activities at the Project Area, refer to **Figure 2** and **Figure 3**.

Figure 3 shows the structures that would be demolished as part of the proposed Project. This demolition is proposed to be undertaken in two stages, subject to gaining all required approval (refer **Figure 3**). The project does not include the works related to land restoration and possible redevelopment of the Project Area. This would be the subject of a separate application.

The Project would only involve minimal excavation activities as follows:

- Grading works would be undertaken surrounding Tankfarms B, B1, E1, E2 and K, and also surrounding Tanks 32 and 52 (which are to be demolished) to improve tank bund drainage and general site drainage (refer **Figure 4**). Excavations required as part of these works would be undertaken to an estimated depth of between 0.6 mbgs and 1 mbgs;
- Foundations for new substations to an estimated maximum depth of 1.5 mbgs; and
- Foundations for new firewater tanks to an estimated maximum depth of 1 mbgs.

Conversion activities would generally upgrade the eastern section of the Clyde Terminal to contain the finished product tanks required for continuing Clyde and Parramatta Terminal operations. This area contains Crude Oil tanks, intermediate product tanks and finished product tanks used in the most recent refining operations at the Project Area. Some of these Crude Oil and intermediate product tanks would be repaired for use in finished product service, replacing finished product tanks currently located in the western section of the site to suit the requirements of the converted Clyde Terminal. The remainder of these tanks in the eastern section of the Project Area would be demolished. The western section of the Clyde Terminal mainly contains Crude Oil processing and blending facilities, Crude Oil intermediate product, finished product tanks and associated infrastructure. Following the cessation of refining, these assets and processing units are no longer needed.

Demolition and construction activities would be undertaken from 7am to 6pm, Mondays to Fridays, and 8am to 1pm Saturdays. The demolition and construction works at the Project Area are predicted to result in temporary increases to light vehicle and heavy vehicle numbers during the demolition and construction activities. However, this would not significantly impact the surrounding road network.

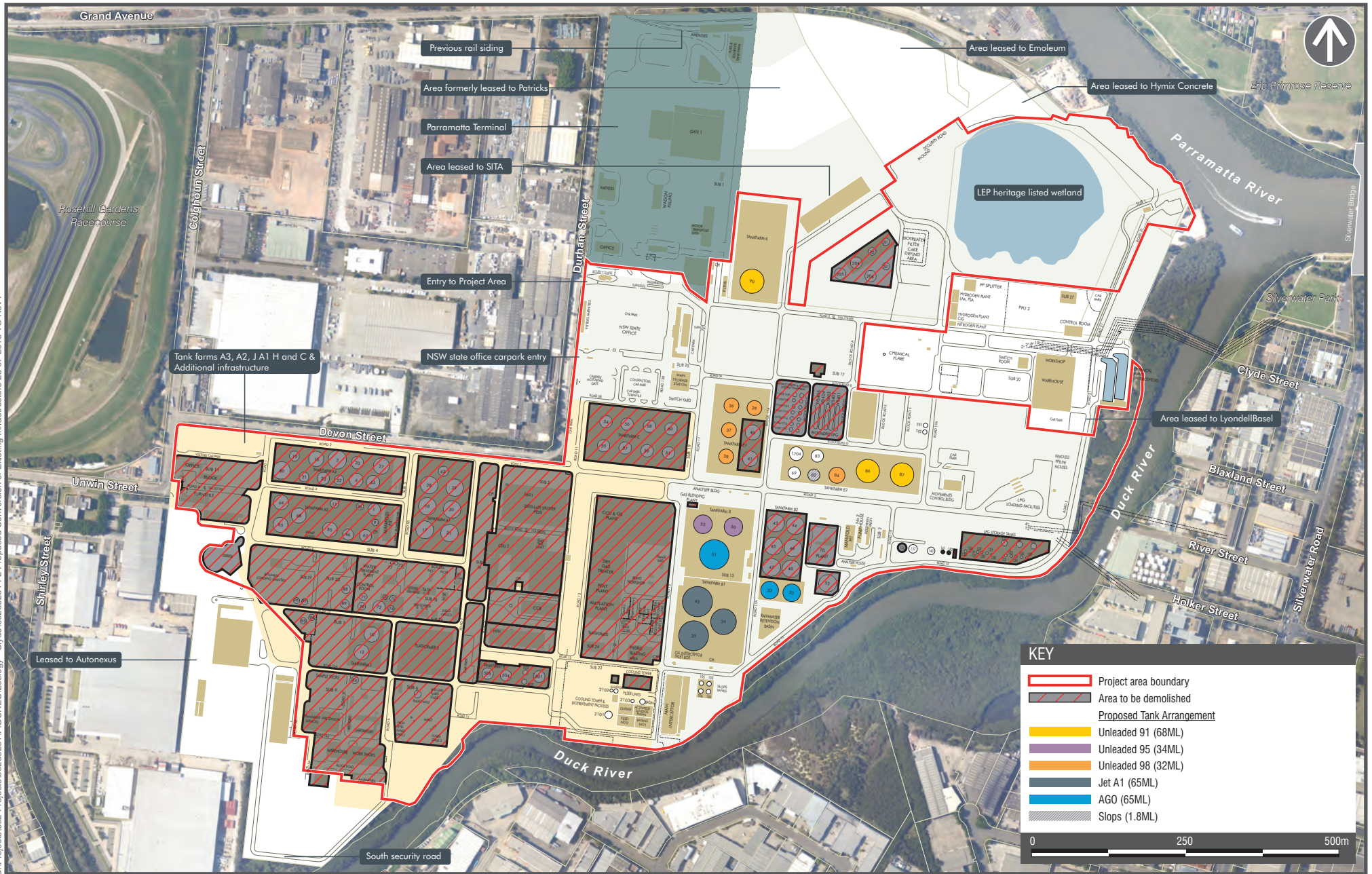
There are sections of the Project Area that are known to contain some extent of contamination, however the full extent of any further potential contamination is not known. Currently the placement of infrastructure at Clyde Terminal makes such a full investigation impractical. Subsequent to this Project, Shell would be able to investigate the Project Area in more detail and locate any further potential contamination in dialogue with the EPA. This EIS therefore does not include the works related to land remediation, restoration and future development, and this would be subject to a separate development application once the potential for contamination has been fully investigated (the Clyde Remediation and Redevelopment application).

G:\Projects\602 Projects\60236231\FIGURES\Ecology - Clyde\60236231 F1-3 The Project Area 13.05.2013 TO Rev F



THE PROJECT AREA
 Clyde Terminal Conversion Project
 Environmental Impact Statement

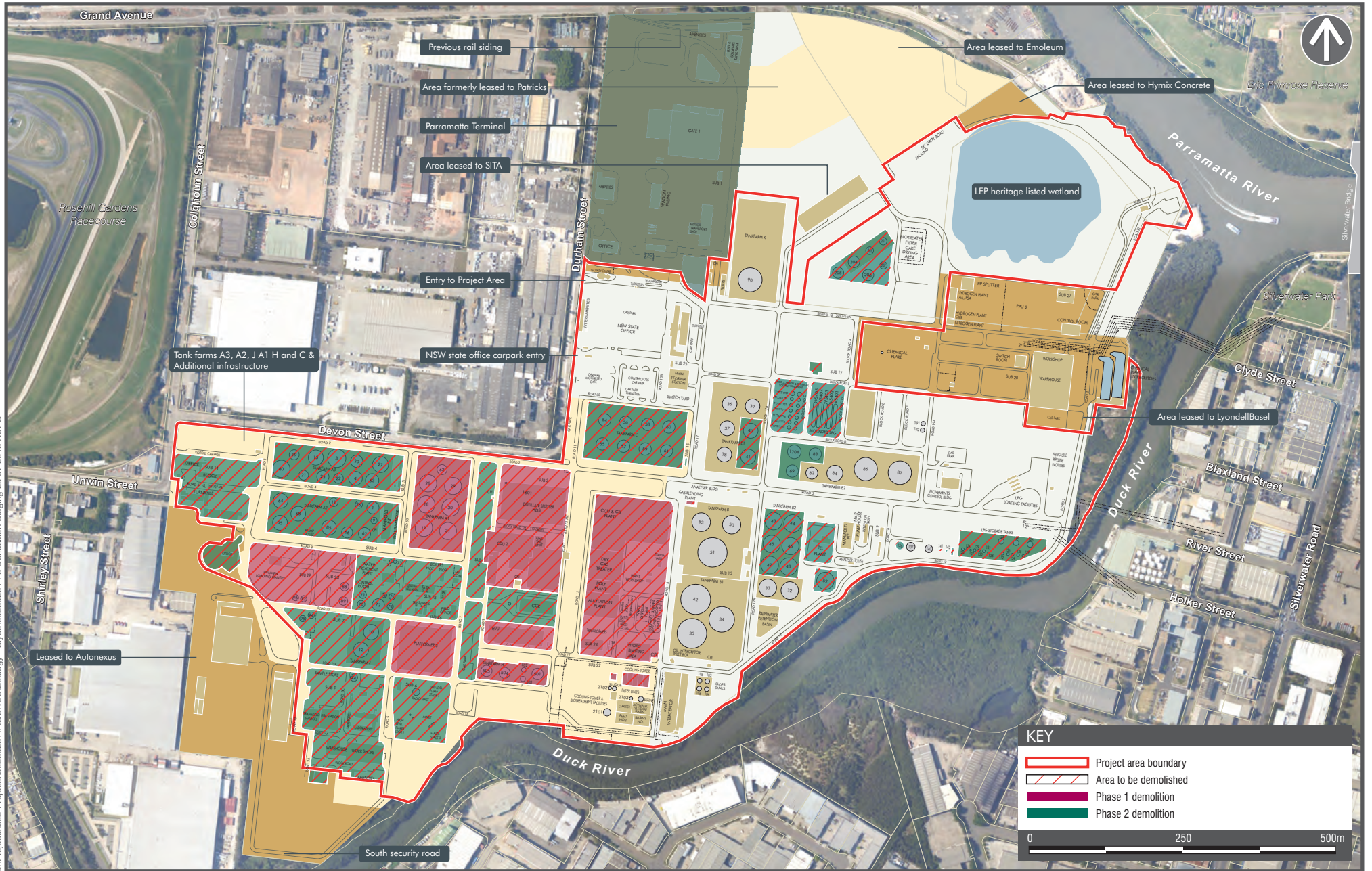
FIGURE 1



PROPOSED CONVERSION OF EXISTING INFRASTRUCTURE
 Clyde Terminal Conversion Project
 Environmental Impact Statement

FIGURE 2

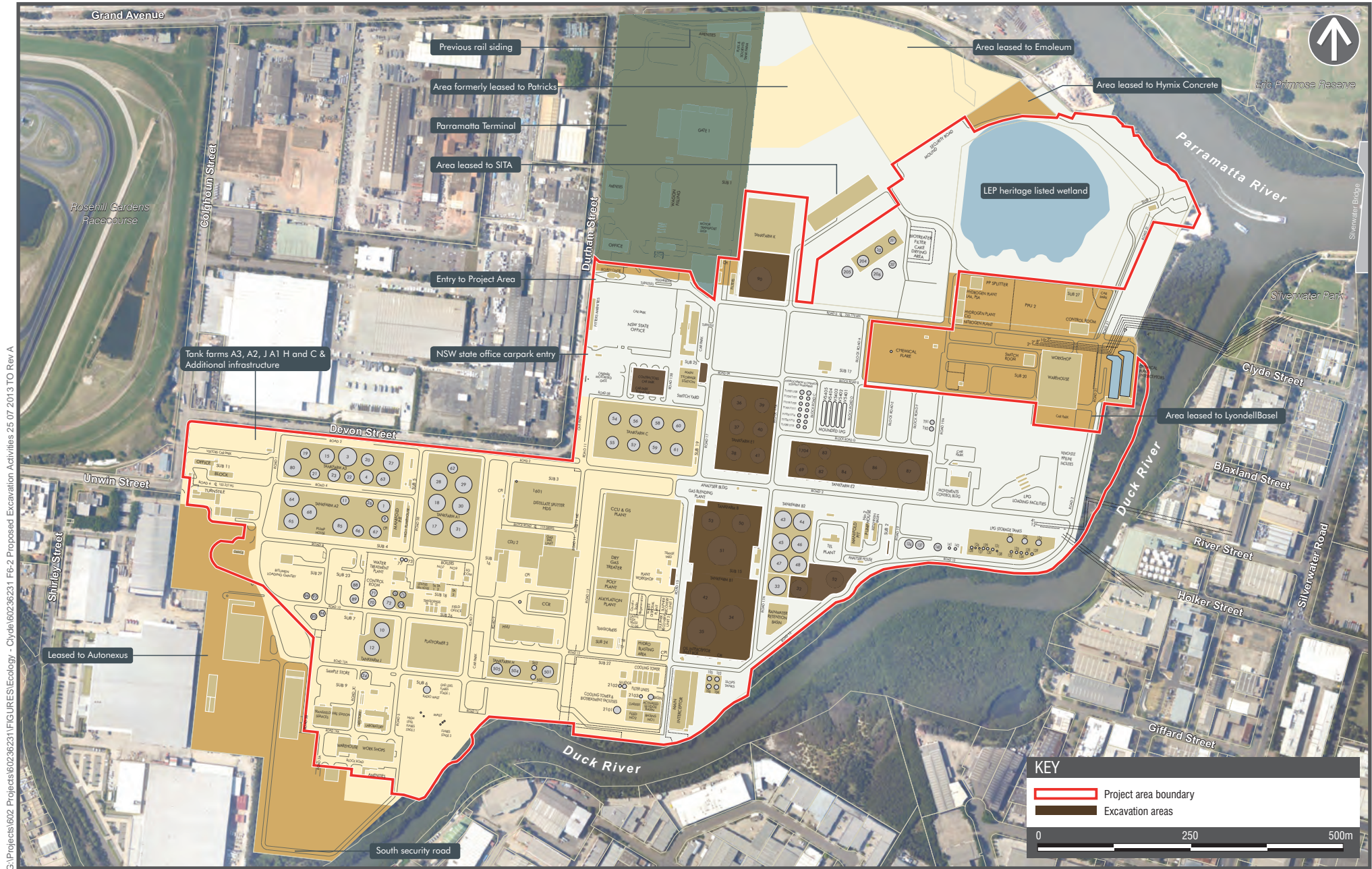
G:\Projects\602 Projects\60236231\FIGURES\Ecology - Clyde\60236231 F3 Demolition Staging 25.07.2013 Rev G



PROPOSED DEMOLITION STAGING OF THE PROJECT

Clyde Terminal Conversion Project
Environmental Impact Statement t

FIGURE 3



G:\Projects\602 Projects\60236231\FIGURES\Ecology - Clyde\60236231 FB-2 Proposed Excavation Activities_25 07 2013 TO Rev A



PROPOSED EXCAVATION ACTIVITIES
Clyde Terminal Conversion Project
Environmental Impact Statement

FIGURE 4

1.2 Assessment Objectives

Shell is seeking development consent from the New South Wales Department of Planning and Infrastructure in relation to its Clyde Terminal to enable it to be used more efficiently as a finished petroleum products import terminal and to remove redundant infrastructure.

The DGRs for the proposed conversion of the Clyde Terminal (the Project) were issued on 16 March 2012. The DGRs relevant to potential impacts to ecology as a result of the Project stated that the EIS must include an assessment of biodiversity that includes impacts to terrestrial and aquatic ecology and ways to maintain and improve intact stands of riparian vegetation to the north-east and east of the Clyde Terminal.

On 8 March 2012 the OEH also issued its Key Issues and Assessment Requirements for the assessment of biodiversity as part of the EIS. These Key Issues and Assessment Requirements are as follows:

- There are a number of recent records of the Green and Golden Bell Frog (GGBF) from within the Clyde Terminal site. The GGBF is listed as an endangered species under the *Threatened Species Conservation Act (1995)* (TSC Act) and this population has been identified by the EPA as a Key Population.
- The study area should include areas of remnant vegetation adjoining the site, if the proposal may cause indirect impacts to this area. Remnant vegetation in the study area includes two endangered ecological communities listed under the TSC Act (Coastal Saltmarsh/Themeda grassland and Swamp Oak Floodplain Forest), and threatened plant species (*Wilsonia backhousei* and *Acacia pubescens*). Therefore, the EIS should include a biodiversity assessment, including assessment of impacts on threatened biodiversity, native vegetation and habitat. This assessment should address the matters included in the following sections:
 - A field survey should be conducted of the site and of any adjoining areas of native vegetation that may be indirectly impacted. The survey should be undertaken and documented in accordance with relevant guidelines, including:
 - *The Green and Golden Bell Frog Environmental Impact Assessment Guidelines* (National Parks and Wildlife Services, 2003);
 - *The Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna – Amphibians* (Department of Environment and Climate Change, 2009);
 - *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft* (Department of Environment and Conservation, 2004); and
 - Threatened species survey and assessment guidelines information on www.environment.nsw.gov.au/threatenedspecies/surveyassessmentgdlns.htm.
 - The EIS should contain the following information as a minimum:
 - Description and mapping of study area, all survey locations, vegetation communities (including classification and methodology used to classify), key habitat features and reported locations of threatened species, populations and ecological communities present in the subject site and study area;
 - Description of survey methodologies used, including timing, location and weather conditions;
 - Details, including qualifications and experience of all staff undertaking the surveys, mapping and assessment of impacts as part of the EIS;
 - Identification of the national and state listed threatened biota known or likely to occur in the study area and their conservation status;
 - Description of the likely impacts of the proposal on biodiversity and wildlife corridors, including direct and indirect construction and operation impacts;
 - Identification of the avoidance, mitigation and management measures that will be put in place as part of the proposal to avoid or minimise impacts, including details about alternative options considered and how long term managed arrangements will be guaranteed. These measures should be developed in accordance with the “Management Plan for the Green and Golden Bell Frog Parramatta Key Population” (Department of Environment and Climate Change, 2008c); and

- Description of the residual impacts of the proposal. If the proposal cannot adequately avoid or mitigate impacts on biodiversity, then a biodiversity offset package is expected (see the requirements for this at point 4 below).
- An assessment of the significance of direct and indirect impacts of the proposal must be undertaken for threatened biodiversity known or considered likely to occur in the study area based on the presence of suitable habitat. This assessment must take into account:
 - The factors identified in section 5A of the EP&A Act; and
 - The guidance provided by the *Threatened Species Assessment Guideline – The Assessment of Significance* (Department of Environment and Climate Change, 2007a).
- Where an offsets package is proposed by a proponent for impacts to biodiversity this package should:
 - Meet OEH's Principles for the use of biodiversity offsets in NSW;
 - Identify the conservation mechanisms to be used to ensure the long term protection and management of the offset sites; and
 - Include an appropriate Management Plan (such as vegetation or habitat) that has been developed as a key amelioration measure to ensure any proposed compensatory offsets, retained habitat enhancement features within the development footprint and/or impact mitigation measures (including proposed rehabilitation and/or monitoring programs) are appropriately managed and funded.
- With regard to the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, the assessment should identify any relevant Matters of National Environmental Significance and whether the proposal has been referred to the Commonwealth or already determined to be a controlled action.

On 3 February 2012 Parramatta City Council also issued its Key Issues and Assessment Requirements for the assessment of biodiversity as part of the EIS. These Key Issues and Assessment Requirements are as follows:

- The site contains a heritage item under Schedule 5 of the *Parramatta Local Environmental Plan 2011*. The site is of significance because it is located on the bank of Parramatta River, and includes a portion of the river bank listed as significant wetlands. The heritage item comprises an area of remnant wetland vegetation located along the foreshore of the Parramatta and Duck rivers and their tributaries; and
- The Sydney Metropolitan Catchment Authority identifies part of the site as containing an Endangered Ecological Community being Swamp Oak Floodplain Forest. Impacts upon any ecologically endangered communities need to be addressed within the EIS.

This Ecological Assessment has been prepared to meet the DGRs, and to more specifically:

- Determine if there would be, or is likely to be any significant impacts to critical habitat, threatened species, populations or ecological communities, or their habitats protected under the EPBC Act, TSC Act, and/or the FM Act;
- Recommend mitigation measures that would minimise the risk of potential impacts to protected ecological values within the vicinity of the Project Area; and
- Recommend any additional assessments that may be required.

The Ecological Assessment was also prepared to take into account the following guidelines:

- *Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna - Amphibians* (Department of Environment, Climate Change and Water, 2009);
- *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities - Working Draft* (Department of Environment and Conservation, 2004);
- *Threatened Species Assessment Guidelines: the Assessment of Significance* (Department of Environment and Climate Change, 2007a);
- *Guidelines for Threatened Species Assessment* (Department of Planning, 2005);

- *NSW State Groundwater Dependent Ecosystem Policy* (Department of Land and Water Conservation, 2002); and
- *Policy & Guidelines - Aquatic Habitat Management and Fish Conservation* (NSW Fisheries, 1999).

1.3 Methods

1.3.1 Study Area Definition

The NSW Office of Environment and Heritage (OEH) *Assessment of Significance* (Department of Environment and Climate Change, 2007a) sets out the relevant terminology for ecological impact assessments which are used throughout this Ecological Assessment as follows:

- The 'Subject Area' – the area to be directly affected by the proposal (refer **Figure 1**, which includes the development footprint as shown in **Figure 3**. For the purposes of this Ecological Assessment, the 'Subject Area' will be known as the 'Project Area;'
- The 'Study Area' – includes the Project Area and any additional areas which may be indirectly affected by the proposal. For the sake of completeness, the Study Area in this Ecological Assessment was taken to be the area that lies within a 5 km radius, or 10 km diameter, of the Project Area (refer **Figure 8** and **Figure 11**); and
- The 'Locality' – for the purpose of this Ecological Assessment, the Locality was taken to mean the area within 10 km of the Project Area, also comprises those areas that were used for the purpose of data searches in government threatened species databases.

1.3.2 Desktop Study

Database Review

A comprehensive desktop study was undertaken which included the following activities:

- Database searches to compile a list of matters protected under the EPBC Act, TSC Act and FM Act that are relevant to the environmental context of the Project Area, including the:
 - NSW Office of Environment and Heritage's BioNet Atlas of Wildlife in October 2012, and in 11 February 2013 to take note of any updated recorded locations of listed species (OEH's Atlas of Wildlife, OEH, 2013a);
 - Commonwealth Department of Sustainability, Environment, Water, Population and Communities' (SEWPAC) Protected Matters Search Tool on 14 September 2012 (SEWPAC, 2012a); and
 - NSW Department of Primary Industries Fisheries threatened and protected species records viewer (Department of Primary Industries Fisheries, 2013).
- Mapping from OEH's Atlas of Wildlife was used to determine if a particular species, community or population had actually been previously recorded in either: the Locality; the Study Area; or the Project Area. Several species, populations and communities were found to have been previously recorded in the Locality and the Study Area. Some were also found to have been previously recorded in the Project Area itself;
- Both the *Threatened Species Profiles* (OEH, 2013b) and the *Species Profile and Threats Database* (SEWPAC, 2012b) were searched to determine the preferred habitats of species, populations and communities that were either known to occur, or that have the potential to occur, within the Locality;
- For each species, population or community, an assessment was then made regarding the likelihood of that species, population or community to occur on the Project Area, based on a combination of previously recorded sightings of each species, population and community, and whether the Project Area contains potential habitat for each species, population or community; and
- An assessment was then undertaken about the likelihood of the Project to result in impacts to species, populations and communities occurring within the vicinity of the Project Area, but outside of the Project Area. This consideration was based on a combination of the presence of potential habitat in the vicinity of the Project Area, the previously recorded sightings of each species, population and community, and whether the Project is likely to result in offsite impacts to those species, populations and communities occurring outside of the Project Area.

Literature Review

A review of available reports and relevant background literature relevant to the Project Area and surrounds, conducted by AECOM, including:

- *Terrestrial Bush Regeneration Proposal for Shell Clyde Refinery Wetlands 2012 – 2013* (Programmed Property Services, 2011);
- *Wetland Management Plan for the Clyde Refinery Wetlands at the Shell Clyde Refinery at Rosehill, NSW* (Urban Bushland Management Consultants, 2007);
- *Baseline Biodiversity Assessment: Shell Clyde Refinery, February 2009* (NGH Environmental, 2009);
- *Estuarine Vegetation Mapping of the Parramatta River Estuary* (Sydney Metropolitan Catchment Management Authority, 2007);
- *Green and Golden Bell Frog *Litoria aurea* (Lesson 1829) Draft Recovery Plan* (Department of Environment and Conservation, 2005);
- *Management Plan for the Green and Golden Bell Frog Key Populations of the Parramatta River* (Department of Environment and Climate Change, 2008c);
- *Best practice Guidelines Green and Golden Bell Frog Habitat* (Department of Environment and Climate Change, 2008a);
- *Management Plan for the Green and Golden Bell Frog Key Population of the Georges River* (Department of Environment and Climate Change, 2008b);
- *Matters of National Environmental Significance, Significant Impact Guidelines 1.1, Environmental Protection Biodiversity and Conservation Act 1999* (Department of the Environment, Heritage, Water and the Arts, 2009);
- *Significant Impact Guidelines for the Vulnerable Green and Golden Bell Frog (*Litoria aurea*) Nationally Threatened Species and Ecological Communities EPBC Act Policy Statement 3.19* (Department of Environment, Water, Heritage and Arts, 2009b);
- *Approved Conservation Advice for *Bothriochloa biloba* Lobed Blue-grass* (SEWPAC, 1999);
- A review of available reports and relevant background literature relating to the presence of Microbat species at the Project Area was also conducted by Eco Logical Australia Pty Ltd (Eco Logical);
- *Sydney Harbour Foreshore and Estuarine Vegetation Maps* (SMCMA, 2010);
- *Threatened Species Profiles* (OEH, 2013b); and
- *Species Profile and Threats Database* (SEWPAC, 2012b).

1.3.3 Site Investigations

Preliminary Assessment

Site investigations were conducted by two AECOM ecologists on the 20 September 2012, which comprised the following:

- Ground truthing of vegetation mapping where access was permissible; and
- Habitat assessment, paying particular regard to potential Green and Golden Bell Frog habitat (refer **Section 3.2.5**).

Site photography and GPS measurements of habitat features were captured using a Motion Computed F5V Tablet with integrated camera and ArcMap v.10.

Green and Golden Bell Frog Investigations

GGBF investigations were undertaken in accordance with the following Commonwealth and State guidelines:

- *Significant Impact Guidelines for the vulnerable Green and Golden Bell Frog *Litoria aurea*: EPBC Act Policy Statement 3.19* (Commonwealth of Australia, 2009);
- *Draft Recovery Plan for the Green and Golden Bell Frog (*Litoria aurea*)* (Department of Environment and Conservation, 2005); and

- *Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna – Amphibians* (Department of Environment and Climate Change, 2009).

Habitat Assessment

Habitat assessment was undertaken on 20 September 2012. Specific attention was paid to identifying all known and potential areas of GGBF habitat within the Project Area. This included each area where OEH's Atlas of Wildlife returned records for the species as well as additional drainage and bunded areas, which have water holding capacity, and the foreshore of Duck and Parramatta Rivers.

Areas containing potential shelter habitat and aquatic vegetation were actively searched for sheltering and basking frogs and tadpoles – where possible. Inaccessible areas were targeted during nocturnal surveys (below) where call detection and call playback were used from fence-lines and other proximal boundaries.

Field Survey

Field surveys were undertaken by two AECOM ecologists in October 2012, during breeding season for this species, using a combination of call detection, call playback and spotlighting for eye shine. These methods were replicated in all areas of potential GGBF habitat (located during diurnal surveys/habitat assessment) with a particular focus on where the species has previously been recorded.

Survey was conducted over two consecutive evenings (10 and 11 October 2012) commencing at dusk and continuing into the night. The *Significant Impact Guidelines for the vulnerable Green and Golden Bell Frog Litoria aurea: EPBC Act Policy Statement 3.19* (Commonwealth of Australia, 2009) recommends that surveys for this species be undertaken over at least four nights. However, given that survey work was performed during optimal frog calling and breeding conditions, two nights were considered sufficient to establish the presence of the GGBF at the Project Area. Any further information obtained from additional night surveys would therefore not have significantly aided the assessment. Conditions on each evening were as follows:

- 10 October 2012: warm and windless, light rain two days prior; and
- 11 October 2012: warm with wind increasing, approximately 7 mm rainfall that day.

Reference Site

The presence of the species in neighbouring water bodies provides an indicator of the likely use of on-site water bodies. The remnant wetland in the northeast of the Project Area is considered primary habitat for the GGBF at the Project Area. The remnant wetland is relatively isolated from the operational areas of the Project Area, and therefore provided a reference site from which activity elsewhere on the Project Area could be related to.

Additionally, contact with Sydney Olympic Park Authority confirmed that male frogs were actively calling, and had been doing so on a regular basis for at least two weeks prior to field surveys conducted for this assessment. GGBF's at the Sydney Olympic Park are one of the three key populations within the Parramatta River.

Limitations

The Clyde Terminal at the time of detailed surveys had already ceased refining operations, although adjacent industrial operations contributed significant background noise on the evening of 10 October 2012, rendering call back in some areas was not possible until the evening of 11 October 2012.

In accordance with Shell's health and safety procedures, intrinsically safe torches were provided by Shell for use during 10 October nocturnal surveys. However these were not powerful enough to search for eye shine from safe distances outside bunded and fenced private property areas.

Appropriately, preclearance gas testing and an amended work permit was issued for use of AECOM supplied torches from which spot lighting was significantly improved for nocturnal searches during 11 October 2012. Prior to dusk on 11 October, bunded areas were also able to be entered and searched (under escort), in particular Tankfarm B, Tankfarm E1 and Tank 52. The Mobil Tankfarm was accessible during all surveys.

A remnant wetland located in the north-east of the Project Area is accessible via a number of informal trails which are currently used by bush regenerators (Programmed Property Services, 2011). This area at night time is not suitably safe for intensive survey with call detection, call playback and spotlighting undertaken only.

Notwithstanding safety limitations on contractors at the Project Area, which restricted both access to certain areas and the use of certain field monitoring equipment, within two nights of survey work AECOM was able to establish the presence of the GGBF in areas with suitable habitat. Areas where the GGBF was not detected

lacked standing water and emergent macrophytes (in particular dense stands of Cumbungi) – with the exception of the Mobil Tankfarm. Given the proximity of this tankfarm to the remnant wetland, it must be assumed that the GGBF is present. Therefore further survey work was considered unnecessary for the purpose of this assessment.

The personnel undertaking this Ecological Assessment include:

- Kathryn Duchatel of AECOM, who holds a Bachelor of Science (Environmental) and has over 16 years of experience in the assessment and management of estuarine and coastal environments in south eastern Australia, including the preparation of EPBC referrals. Kathryn undertook survey work and prepared the Ecological Assessment;
- Greg Kirby of AECOM, who holds a Bachelor of Environmental Management and Diploma in Natural Resource Management has over nine years' experience in environmental assessment and management, including employment with the NSW National Parks and Reserve and Wildlife Conservation Branch of the then DECC. Greg undertook nocturnal survey work with Kathryn.
- Jessica Miller of AECOM, who holds a combined Bachelor of Arts/Laws and an Advanced Diploma in Applied Environmental Management and has over 2.5 years of experience in preparing environmental impact assessment reports. Jessica undertook desktop research and assisted Kathryn Duchatel in preparing the Ecological Assessment report;
- Tim Osborne of AECOM, who holds a Diploma of Business and has over 11 years of experience with mapping/Geographic Information Services. Tim prepared the mapping for the Ecological Assessment; and
- Ruth Baker of AECOM, who holds a Master of Arts (Hons) in Archaeology and has over 15 years of experience in environmental impact assessment work including the preparation of EPBC referrals. Ruth undertook a peer review of the Ecological Assessment.

Microbat Investigations

During field surveys (10 and 11 October 2012) conversation with Shell personnel resulted in anecdotal evidence of the presence of small bats nesting in an area of external casing to a tall concrete stack within the Project site. The bats were evident up to five years ago but have not been seen since.

Shell facilitated appropriately trained personnel to inspect the areas of concern. This being the only practical course of action, given the significance risk posed due to 'working from heights' external to available safe working platforms. No evidence of roosting/sheltering bats was found.

The buildings within the Project site are subject to extensive heat and noise, and various gas emissions, which are unlikely to provide important habitat for most bat species that are known to roost in buildings and other man-made structures. Regardless, further specialist advice was sought from Eco Logical. A brief report based on desktop assessment is provided in **Appendix C**.

2.0 Legislation

2.1 Overview

Environmental legislation instruments relevant to the biodiversity and ecological value of the Project Area and its surrounds have been considered, namely:

- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- NSW *Threatened Species Conservation Act 1995* (TSC Act);
- NSW *Fisheries Management Act 1994* (FM Act);
- *National Parks and Wildlife Act 1974*; and
- *Noxious Weeds Act 1993*.

2.1.1 *Environment Protection and Biodiversity Conservation Act 1999*

The EPBC Act governs the Commonwealth environmental assessment and approvals process. It provides protection for matters of National Environmental Significance (NES), including:

- World Heritage Properties;
- National Heritage Places;
- Wetlands of International Importance (known as the Ramsar convention);
- Listed Threatened Species and Ecological Communities;
- Migratory Species protected under International Agreements;
- Commonwealth Marine Areas;
- The Great Barrier Reef Marine Park; and
- Nuclear actions (including uranium mines).

If a Project would have, or is likely to have, a significant impact on a matter of NES, a determination from SEWPAC is required. If determined to be a controlled action, approval for any such activity is required from the Commonwealth Minister for the Environment.

In addition to matters of NES, the EPBC Act protects Commonwealth land and places of Commonwealth Heritage. The Project Area is not located on Commonwealth land and would not directly or indirectly affect Commonwealth land or Commonwealth waters.

A search of the EPBC Protected Matters Search Tool (refer **Appendix A**) within 10 km of the Project reported:

- Two Nationally Important Wetlands within 10 km of the Project Area, including the Newington Wetlands around 1.8 km east of the Project Area, and the Bicentennial Park Wetlands, around 3 km west of the Project Area;
- Four threatened ecological communities (discussed in **Sections 3.2.1** and **4.1**, and provided in **Table 5** and **Table 12** of **Appendix B**);
- Twenty one threatened flora species (discussed in **Sections 3.2.2** and **4.1**, and provided in **Table 5** and **Table 12** of **Appendix B**);
- Twenty one threatened terrestrial fauna species (discussed in **Sections 3.2.3** and **4.1**, and provided in **Table 13** of **Appendix B**);
- Nine threatened marine fauna species (discussed in **Sections 3.3** and **4.2** and provided in **Table 14** of **Appendix B**); and
- Twenty three additionally listed migratory marine and wetland species that were not recognised as threatened (discussed in **Sections 3.4** and **4.3** and provided in **Table 15** of **Appendix B**). An additional migratory species has been previously recorded at the Project Area during fauna surveys conducted by Urban Bushland Management Consultants (2007), which same species was not returned via the EPBC Protected matters search query.

2.1.2 **Threatened Species Conservation Act 1995**

The TSC Act provides for the protection of threatened species, populations, ecological communities and critical habitat in NSW. The TSC Act is administered by the OEH. Under section 5A of the *Environmental Planning and Assessment Act 1979* (EP&A Act), an assessment of significance (seven-part test) may be required to determine the likely significance of impacts on threatened species, populations or ecological communities.

A Search of the OEH's Atlas of Wildlife within a 10 km radius of the Project Area produced the following:

- Fourteen EECs, two CEECs and one Vulnerable Ecological Community listed under the TSC Act (discussed in **Sections 3.2.1** and **4.1** and provided in **Table 5** and **Table 12** of **Appendix B**);
- Forty two vulnerable, endangered and critically endangered terrestrial flora species (discussed in **Sections 3.2.2** and **4.1** and provided in **Table 5** and **Table 12** of **Appendix B**);
- Sixty-eight vulnerable, endangered and critically endangered terrestrial fauna species (discussed in **Sections 3.2.3** and **4.1** and provided in **Table 13** of **Appendix B**);
- Three endangered fauna populations (discussed in **Sections 3.2.3** and **4.1** and provided in **Table 13** of **Appendix B**); and
- Three vulnerable or endangered marine species (discussed in **Sections 3.3** and **4.2** and provided in **Table 14** of **Appendix B**).

On closer inspection, some of the species that were returned by the EPBC Protected Matters search but which were not returned by the OEH's Atlas of Wildlife were nevertheless found to be listed under both the EPBC Act and the TSC Act. Conversely, some species that were returned by the OEH's Atlas of Wildlife search only, and not by the EPBC Protected Matters search tool were also found to be listed under both the EPBC Act and the TSC Act. A search was therefore undertaken to definitely determine both the Commonwealth and NSW status of each species that was returned via the EPBC Protected Matters search tool and the OEH's Atlas of Wildlife. The complete status of each returned species is provided in **Table 5**, **Table 8** and **Table 9** regardless of whether that species was returned through only one of the search tools, or by both.

2.1.3 **Fisheries Management Act 1994**

The FM Act provides for the conservation, protection and management of fisheries, marine systems and habitats in NSW. The Department of Primary Industries manages the majority of the FM Act, with input from the OEH who hold some responsibilities in regards to endangered species and habitats. The FM Act applies to all waters within the limits of the State of NSW, and regulates certain activities that have the potential to impact on marine habitats.

The objects of the FM Act are to:

- Conserve fish stocks and key fish habitats;
- Conserve threatened species, populations and ecological communities of fish and marine vegetation; and
- Promote ecologically sustainable development, including the conservation of biological diversity.

Under the FM Act, approval may be required, before carrying out any of the following:

- Dredging or reclamation works;
- Works that would block the passage of fish in a bay, inlet, river or creek; and
- The construction of structures within marine habitats (e.g. bridges, roads, causeways, pipelines).

The FM Act also requires the approval and issuing of a permit (to any person) for the undertaking of activities that would cause any damage to or destruction of saltmarshes, mangroves, seagrasses and/or seaweeds that are established in public waters or on the foreshore of any such waters.

A search of the Fisheries threatened and protected species records viewer yielded no results for endangered or threatened marine fauna or flora within the Parramatta Local Government Area (Department of Primary Industries Fisheries, 2013). Furthermore, the Project would not directly involve any activities that require an approval under the FM Act. The potential for marine species to be affected by the Project are discussed in **Sections 3.3** and **4.2**.

2.1.4 National Parks and Wildlife Act 1974

The National Parks and Wildlife Act 1974 (NPW Act) provides a framework to conserve native terrestrial flora and fauna species and manage areas of conservation value such as Nature Reserves and National Parks. Under Part 7 (98) of the NPW Act it is an offence to harm, pick, trade or possess, or damage habitat of, threatened species, endangered populations or endangered ecological communities, unless authorised in accordance with licensing or approvals under the NPW Act or the TSC Act. Threatened species present within the Project area are discussed in **Section 3.0**.

2.1.5 Noxious Weeds Act 1993

The Noxious Weeds Act establishes a system for the identification and control of noxious weeds in NSW. The Act divides noxious weeds into five categories which determine the level of control required. Responsibility for the control of noxious weeds lies with the owner and/or occupier of private land and Crown land, local councils and other public authorities.

Several noxious weeds were observed within the Project area (refer **Section 3.2.1**).

3.0 Existing Environment

3.1 Site Description

Shell's Clyde Terminal is located on 9 Devon Street, Rosehill, in the Sydney Metropolitan area on the upper reaches of Sydney Harbour in NSW. The Project Area is situated within the Camellia Industrial Estate in the suburb of Rosehill and lies at the confluence of Parramatta River and Duck River¹ (refer **Figure 1**), which is approximately 15 km west of the Sydney Central Business District.

The Clyde Terminal comprises 86 hectares and is located in the Parramatta Local Government Area (LGA) on parts of Lot 1, DP 109739, Lot 1 DP 383675, Lot 101 DP 809340, and Lot 2 DP 224288 which are owned by Shell. Shell's Clyde Terminal operations also take place on a small parcel of land adjoining Parramatta River (Lot 1 DP 534905) that is leased by Shell from Roads and Maritime Service (RMS). On this parcel of land Shell operates a small wharf area including administrative buildings and a small jetty extending into the Parramatta River (refer **Figure 1**). The Project Area includes the Shell Refinery Warehouse which is located on Lot 1, DP 109739, but which is surrounded by Shell's Parramatta Terminal operations.

Shell also owns parcels of land adjacent to the Project Area, and which are currently leased to third parties. A section of Lot 101 DP 809340 forms part of Shell's operations at the Project Area. However, much of this lot is currently leased to tenants. Lot 1, DP 109739 also includes Shell's operations at the adjoining Parramatta Terminal that are not included as part of this assessment. Lot 398 DP 41324 is a small parcel of land that also comprises Shell's operations at the Parramatta Terminal which adjoins the Project Area. A small section of Lot 1, DP 109739 surrounded by the Parramatta Terminal operations is also leased to Jemena.

The Project Area also contains remnant wetlands that receive clean stormwater and process water runoff. For more details on the ecological value of these remnant wetlands, refer to **Section 3.2.1**.

The area surrounding the Project Area is comprised of industrial properties within the Camellia Industrial Estate in the suburb of Rosehill. Business activities within close proximity to the Project Area include recycling services, building products, waste services, gas supplies and product transport. The nearest residential areas are Rydalmere, approximately 900 m north-east and 1.4 km south-east from the Project Area across the across Parramatta River, and Rosehill, approximately 1.7 km to the west of the Project Area. Riparian vegetation, which includes both remnants and subsequent plantings by Shell during the 1980s and 1990s as part of rehabilitation, runs along the south-eastern boundary of the Project Area (refer **Figure 1**).

The Project area is located in the Central Lowlands topographic zone within the Sydney Basin geological province. According to Chapman and Murphy (1989), two soil landscapes are present within the Project Area: Disturbed Terrain (xx) and the Ettalong (et) swamp landscape (Chapman and Murphy, 1989). The Project Area generally consists of fill material to depths of approximately 1.0 to 1.5 mbgs and is underlain by a low-permeability clay which has been observed to the maximum depth of ERM investigations to date (8.0 mbgs). The geology of the Project Area has historically been characterised into four units, being fill material, estuarine sediments, alluvial sediments, and residual clay (ERM, 2012a).

The Project Area itself was cleared of vegetation before the site was first used as a shale oil refinery in 1918. The Project Area continues to be largely hard stand. The surface of the Project Area has been reshaped over time with the use of fill to provide a relatively flat site.

Surface water and runoff is directed towards the drainage network system on the site which is comprised of:

- A clean water drainage system that discharges to:
 - The remnant wetlands onsite; or
 - The Parramatta and Duck Rivers.
- Accidentally Oil Contaminated (AOC) and Continually Oil Contaminated (COC) drainage network.

¹ SMCMA recognises this body of water as being part of the 'Duck River' sub-catchment of the Sydney Harbour Catchment (SCMCA, 2012). Locally, this body of water is also sometimes referred to as 'Duck Creek,' or 'Duck Creek River.' For the sake of consistency, this Ecological Assessment will refer to the water body to the south and south-east of the Project Area as 'Duck River.'

The AOC and COC drainage systems deliver contaminated water to on-site wastewater interceptors. This system treats the wastewater prior to being re-used as cooling water, and discharged to the trade waste system or to Duck River.

A summary of the marine and terrestrial fauna and flora identified within 10 km of the Project Area from searches of the EPBC Protected Matters Search Tool and OEH's Atlas of Wildlife is provided in **Table 3** below. As outlined in **Section 2.1.2** above, some of the species returned by the Commonwealth search tool only were subsequently found to be listed under both the Commonwealth and NSW legislation, and vice versa. **Table 3** takes this overlap into account.

Table 3 Vulnerable, Endangered and Critically Endangered Terrestrial and Marine Flora and Fauna Identified within 10 km of the Project Area

Category	Listed Under Both the EPBC Act and TSC Act	Listed under the TSC Act only	Listed under the EPBC Act only	Total
Terrestrial Fauna (including Migratory Species)				
Birds	7	39	1	47
Frogs	5	3	0	8
Mammals	8	8	1	17
Reptiles	1	1	0	2
Gastropods	0	1	0	1
Fauna Communities	0	3	1	4
Total	21	55	3	79
Terrestrial Flora				
Flora Species	34	14	2	50
Flora Communities	3	15	0	18
Total	37	29	2	68
Marine Fauna (including Migratory Species)				
Birds	0	0	1	1
Reptiles	3	0	2	5
Bony Fish	0	0	3	3
Total	3	0	6	9
Migratory and Wetland Species not listed in any other category				
Birds	0	0	23	23
Sharks	0	0	1	1
Total	0	0	24	24

3.2 Terrestrial Ecology

3.2.1 Vegetation and Ecological Communities

A summary of the vulnerable, endangered and critically endangered flora known or predicted to occur in the vicinity of the Project Area is outlined in **Table 5** and **Table 12** of **Appendix B** provides an analysis of the likelihood of each of these species and communities to occur on the actual Project Area. Two listed flora species and five listed ecological communities were found to have been previously recorded at the Project Area. All other listed flora species and ecological communities identified in **Table 5** were ultimately found to have a low likelihood of occurrence at the Project Area (refer **Table 12** of **Appendix B**).

Local Vegetation

Vegetation within the boundaries of the Project Area comprises planted native and exotic trees and large shrubs which line external roadways, car parking areas and some buildings. Native species include Spotted Gum (*Corymbia maculata*), Prickly-leaf Paperbark (*Melaleuca styphelioides*), Swamp Oak (*Casuarina glauca*), and Bottlebrush species (*Callistemon* sp). There are numerous introduced planted species present at the Project Area include Monterey Pine Tree (Monterey Pine Tree) and *Camellia* and *Rhododendrum* species, with occasional grassed areas that are maintained by mowing.

Remnant vegetation present at the Project Area is limited to the following areas:

- Foreshore vegetation adjacent to the Project Area, which has been mapped (SMCMA, 2010) as containing the following vegetation communities (refer **Figure 6**):
 - Mangroves;
 - Coastal Saltmarsh (this vegetation also meets characteristics of the Endangered Ecological Community Themeda grassland);
 - Swamp Oak Forest;
 - Wetlands; and
 - Phragmites Reedland.
- The remnant 'wetland' located at the north-east boundary of the Project Area (refer **Figure 5** and **Figure 6**) is described by Urban Bushland Management Consultants, 2007 as being comprised of:
 - A wetland, which is dominated by Cumbungi (*Typha* spp), and dense growth of the introduced Spiny Rush (*Juncus acutus*);
 - A low woodland that has been planted with species that are largely non-indigenous. Ordinarily such species would be regarded as weeds, however the majority of this vegetation provides habitat for other native fauna and enhances local landscape values. For these reasons, this non-indigenous vegetation is conserved at the Project Area; and
 - Swamp Oak Floodplain Forest and sclerophyll vegetation on the more elevated land surrounding the remnant wetland.
- The boundary fence line adjacent Duck River, in the south western corner of the Project Area, is lined with mature Swamp Oak (*Casuarina glauca*) trees. These trees are often continuous with uneven aged stands of Swamp Oak within the foreshore of the river.

During a Baseline Biodiversity Assessment conducted in 2008, this remnant wetland was again confirmed to contain Swamp Oak Floodplain Forest, planted mixed Eucalyptus woodland, swamp/reedland and mangrove forest and saltmarsh. At that time the aquatic component of this remnant wetland was described as consisting of five large interconnected ponds as well as smaller ponds located to the west, with depth ranging from 40 cm to over 1 m. Areas of open water were present as well as areas covered by dense emergent vegetation (mostly *Typha*). Around 75 percent of the aquatic environment was found to be covered by emergent vegetation. These reed beds were observed along the banks of the ponds and also within them. Submerged vegetation was also observed (NGH Environmental, 2009).

The remnant wetland system is moderately to highly disturbed given the following factors (NGH Environmental, 2009):

- Poor water quality;
- High levels of garbage, especially along Duck River and the southern bank of Parramatta River adjacent to the Project Area;
- Weed infestations; and
- Presence of feral animals and pest species (e.g. plague minnow at the remnant wetlands).

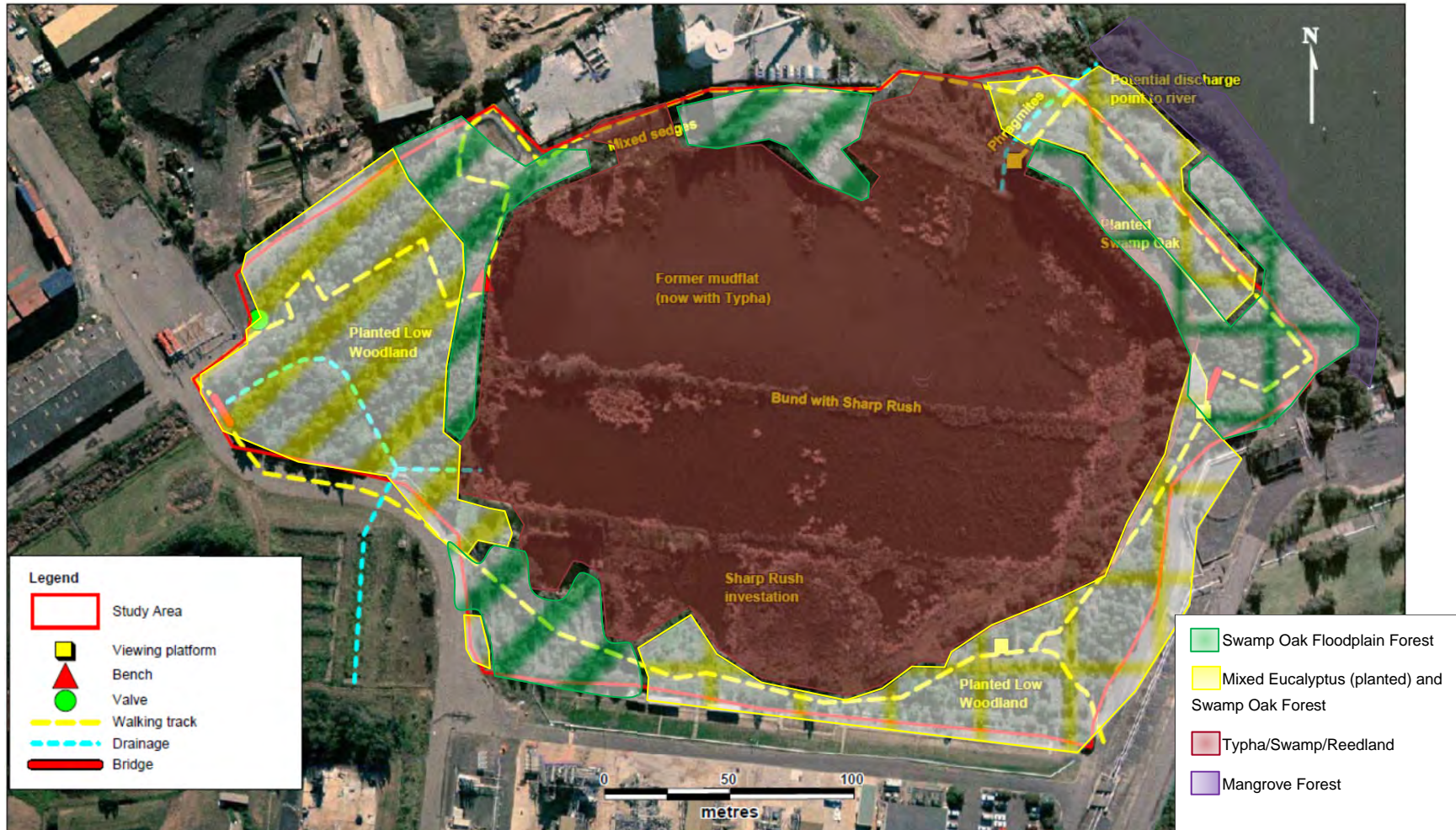


Figure 5 Wetland Vegetation at the Project Area (original figure courtesy of Urban Bushland Management Consultants, 2007: figure has been overlaid with survey findings courtesy of NGH Environment, 2009)

It is relevant to note that, within the *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011* which applies to the Project Area, Swamp Oak Floodplain Forest is listed as a high priority endangered ecological vegetation community.

The remnant wetland area was originally covered in dense vegetation, including Mangroves, and contained salt flats along the Parramatta River. It has been concluded that this Mangrove community survived into the 1970s, and photographs from that era suggest that shallow depressions formed were trees has been cleared, filling with water after rain events. It has been established, however, that by 1978 these wetlands consisted of three pools, which were possibly ephemeral (Urban Bushland Management Consultants, 2007). By 1980, the wetlands were filled with water, and they have remained approximately in that form ever since. The land surrounding this wetland has been historically raised to form an embankment, which has been cut in several places to accommodate the flow of drainage lines, and to provide access to the wetlands themselves. Given these historical anthropological influences, along with the fact that the remnant wetlands have only contained permanent water since 1980s (Gunninah Consultants, 1990), these wetlands at the Project Area can therefore be considered artificial as well as remnant (Urban Bushland Management Consultants, 2007).

Urban Bushland Management Consultants described these remnant wetlands as containing very sparse tree cover reaching to around 10 m high. Shrub layers have also been described as sparse, at around 1.5 m high. Groundcover was described as being moderate to dense, being up to 1 m tall (Urban Bushland Management Consultants, 2007). Common flora species identified during previous surveys undertaken by Urban Bushland Management Consultants included:

- Scattered stands, individuals and occurrences of Swamp Oak (*Casuarina glauca*);
- Spotted Knotweed (*Persicaria decipiens*);
- Pale Knotweed (*Persicaria lapathifolia*);
- Lantana (*Lantana camara*);
- Crofton Weed (*Ageratina adenophora*);
- Water Couch (*Paspalum distichum*);
- *Bolboschoenus caldwellii*;
- Water Primrose (*Ludwigia peploides* ssp *montevidensis*);
- Kurnell's Curse (*Hydrocotyle bonariensis*);
- Umbrella Sedge (*Cyperus eragrostis*);
- Cumbungi (*Typha orientalis*); and
- Sharp Rush (*Juncus acutus*).

Whilst the remnant wetlands do contain vegetation that is typical of both freshwater and salt marsh environments, the majority of the vegetation occurring at the remnant wetlands is considered to consist of freshwater species. Thus, the remnant wetlands predominately meet the definition of Sydney Freshwater Wetlands in the Sydney Basin Bioregion (Urban Bushland Management Consultants, 2007). Mapping from SMCMA also describes these remnant wetlands as being brackish (SMCMA, 2010). However for the purposes of recognising the potential and likely classification of these remnant wetlands as Sydney Freshwater Wetlands in the Sydney Basin Bioregion, this Ecological Assessment will consider these remnant wetlands to be predominately freshwater. In 2007, Urban Bushland Management Consultants estimated the extent of these remnant wetlands in the north-east section of the Project Area to be around 3.4 ha in size. It is not possible to know the extent of vegetation occurring at the remnant wetlands currently that was planted from artificially introduced native or non-native species, and to what extent indigenous flora species has naturally re-established themselves at this site (Urban Bushland Management Consultants, 2007).

The low woodland is mostly comprised of introduced plantings, and it is unclear to what extent the Swamp Oak Floodplain Forest has also been planted. In 2007, Urban Bushland Management Consultants identified the following vegetation occurring as part of this low woodland community:

- Uniformly planted trees to 10 m in height. Understorey to 2 m, with the plants being of a medium to high density, being a mixture of planted native and self-seeded exotic species. Some naturally regenerating

native shrubs occur. The ground cover consists of a high density layer of exotic grasses and weeds, around 1 m in height. Leaf litter and natural ground debris is present, as is some windblown urban refuse;

- Mixture of locally indigenous and non-indigenous native trees;
- Forest Red Gum (*Eucalyptus tereticornis*);
- Grey Box (*E. moluccana*);
- Red Mahogany (*E. resinifera*);
- Grey Ironbark (*E. paniculata*);
- Queensland Brush Box (*Lophostemon confertus*);
- Sydney Blue Gum (*E. saligna*);
- Sickle-wattle (*Acacia falcata*);
- Parramatta Green Wattle (*Acacia parramattensis*);
- Sally Wattle (*Acacia floribunda*);
- Paperbarks (*Melaleuca* spp);
- African Olive (*Olea africana* subsp *cuspidata*);
- Lantana (*Lantana camara*);
- Common Couch Grass (*Cynodon dactylon*);
- Kikuyu Grass (*Pennisetum clandestinum*);
- Matt Rush (*Lomandra longifolia*);
- Saloop (*Einadia hastata*);
- White Moth Vine (*Araujia sericifer*); and
- Asparagus Fern (*Asparagus densiflorus*).

Urban Bushland Management Consultants, in 2007, estimated that the coverage of Swamp Oak Floodplain Forest to be around 0.5 ha, and identified it as containing the following vegetation:

- Dense layer of canopy trees up to 15 m in height. The shrub layer is generally very sparse, up to 2 m in height. The groundcover is also generally sparse, reaching up to 0.5 m in height;
- Swamp Oak (*Casuarina glauca*) – mature trees, saplings and seedlings;
- Lantana (*Lantana camara*);
- Ochna (*Ochna serrulata*);
- White Moth Vine (*Araujia sericifera*);
- Common Couch Grass (*Cynodon dactylon*);
- Kikuyu Grass (*Pennisetum clandestinum*); and
- Balloon Vine (*Cardiospermum grandiflorum*).

Figure 6 and **Figure 8** illustrate the extent of vegetation within the Project Area and mapped vegetation communities within the adjacent foreshore areas.

A butyl membrane was installed adjacent to the remnant wetlands during 1972-1973 in response to concerns about the inflow of chromates and other pollutants (Gunninah Consultants, 1990).

Threatened Ecological Communities

The EPBC Protected Matters search tool identified four threatened ecological communities that are listed as known or likely to occur within 10 km of the Project Area:

- Blue Gum High Forest of the Sydney Basin Bioregion, listed as critically endangered;
- Cumberland Plain Shale Woodland and Shale-Gravel Transition Forest (also known in NSW as the Shale Gravel Transition Forest in the Sydney Basin Bioregion), listed as critically endangered;

- Shale/Sandstone Transition Forest, listed as endangered; and
- Turpentine-Ironbark Forest in the Sydney Basin Bioregion, listed as critically endangered.

The OEH's Atlas of Wildlife search tool identified 17 endangered ecological communities as being known or likely to occur within 10 km of the Project Area. This includes 14 Endangered Ecological Communities (EECs), two Critically Endangered Ecological Communities (CEECs) and one Vulnerable Ecological Community as listed under the TSC Act. Three of these EECs listed under the TSC Act were also returned in the EPBC search outlined above. The search indicated that the following EECs are known to occur within the Study Area (**Table 12 in Appendix B**):

- Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion;
- Duffys Forest Ecological Community in the Sydney Basin Bioregion;
- Shale/Sandstone Transition Forest;
- Southern Sydney sheltered forest on transitional sandstone soils in the Sydney Basin Bioregion;
- Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions;
- Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions;
- River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions;
- Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions;
- Sydney Freshwater Wetlands in the Sydney Basin Bioregion;
- Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions;
- Blue Gum High Forest in the Sydney Basin Bioregion;
- Cumberland Plain Woodland in the Sydney Basin Bioregion;
- Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion; and
- Western Sydney Dry Rainforest in the Sydney Basin Bioregion.

Mapping available from the Sydney Metropolitan Catchment Management Authority (SMCMA, 2010) was also consulted, from which it was determined that foreshore vegetation adjacent to the Project Area contains the EEC Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions. The vegetation present here can also meet characteristics of the EEC Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions.

Five of these ecological communities listed under the TSC Act have also been previously recorded within the Project Area:

- Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions. This EEC occurs as intermittent stands along the foreshore and within the remnant wetland in the Project Area and as intermittent stands along the foreshore of both Duck and Parramatta rivers (refer **Figure 6**);
- Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions is listed as an EEC under the TSC Act. Sclerophyll vegetation has been previously recorded in the forested section of the remnant wetlands in the Project Area;
- Sydney Freshwater Wetlands in the Sydney Basin Bioregion. These remnant EEC wetlands occur in the Project Area (refer **Figure 6**); and
- Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions. This riparian vegetation also meets characteristics of Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregion. These EEC saltmarshes occur along the foreshore vegetation fringing the Project Area (refer **Figure 6**).

Weeds

Twenty weeds of national significance were returned in the EPBC Protected Matters search tool report generated for the Project Area (refer **Table 4** and **Appendix B**). A search was also conducted of the Department of Primary Industries' Noxious Weeds Declaration database to determine the weed species that have been declared as noxious within the Parramatta LGA specifically (Department of Primary Industries, 2013). The declared noxious weed species for the Parramatta LGA are in addition to those weeds that have already declared to be noxious within NSW as a whole. The weeds of national significance that are known or predicted to occur within the Locality, and the declared noxious weed species within the Parramatta LGA, are outlined in **Table 4**.

Table 4 Weeds of National Significance and Declared Noxious Weeds Known or Predicted to Occur in the Locality/Parramatta LGA

Weed	Commonwealth Status	NSW Class
African Boxthorn (<i>Lycium ferocissimum</i>)	Weed of national significance	3
Alligator Weed (<i>Alternanthera philoxeroides</i>)	Weed of national significance	3
Asparagus Fern (<i>Asparagus asparagoides</i>)	Weed of national significance	4
Balloon Vine (<i>Cardiospermum grandiflorum</i>)	Weed of national significance	4
Bitou Bush (<i>Chrysanthemoides monilifera</i> subsp. <i>rotundata</i>)	Weed of national significance	3
Blackberry (<i>Rubus fruticosus</i> aggregate)	Weed of national significance	4
Boneseed (<i>Chrysanthemoides moniliger</i> subspecies <i>monilifera</i>)	Weed of national significance	2
Bridal Creeper (<i>Asparagus aethiopicus</i> , <i>A. densiflorus</i> , <i>Protasparagus aethiopicus</i>)	Weed of national significance	4
Broom (<i>Genista</i> sp X <i>Genista monspessulana</i>)	Weed of national significance	3
Cabomba (<i>Cabomba caroliniana</i>)	Weed of national significance	5
Cape Broom (<i>Genista monspessulana</i>)	Weed of national significance	3
Cape Ivy (<i>Delaorea odorata</i>)	NA	4
Castor Oil Plant (<i>Ricinus communis</i>)	NA	4
Cat's Claw Creeper (<i>Dolichandra unguis-cati</i>)	Weed of national significance	4
Chilean Needle Grass (<i>Nassella neesiana</i>)	Weed of national significance	4
Climbing Asparagus Fern (<i>Asparagus plumosus</i>)	Weed of national significance	4
East Indian Hygrophila (<i>Hygrophila polysperma</i>)	NA	4
Giant Reed (<i>Arundo donax</i>)	NA	4
Gorse (<i>Ulex europaeus</i>)	Weed of national significance	3
Green Cestrum (<i>Cestrum parqui</i>)	NA	3
Hygro (<i>Hygrophila polysperma</i>)	NA	3
Hygrophila (<i>Hygrophila costata</i>)	NA	2
Lantana (<i>Lantana camara</i>)	Weed of national significance	4
Long-leaf Willow Primrose (<i>Ludwigia longifolia</i>)	NA	3

Weed	Commonwealth Status	NSW Class
Ludwigia (<i>Ludwigia peruviana</i>)	NA	3
Madeira Vine (<i>Anredera cordifolia</i>)	NA	4
Morning Glory (<i>Ipomoea cairica</i>)	NA	4
Morning Glory (<i>Ipomoea indica</i>)	NA	4
African Olive (<i>Olea europaea</i> ssp. <i>Cuspidata</i>)	NA	4
Pampass Grass (<i>Cortaderia species</i>)	Weed of national significance	3
Pellitory (<i>Parietaria judacia</i>)	NA	4
Privet (Broad-leaf) (<i>Ligustrum lucidum</i>)	NA	4
Privet (Narrow-leaf) (<i>Ligustrum sinense</i>)	NA	4
Radiata Pine, Monterey Pine (<i>Pinus radiata</i>)	Weed of national significance	NA
Rhizomatous Bamboo (<i>Phyllostachys species</i>)	NA	4
<i>Salvinia molesta</i> Salvinia	Weed of national significance	2
Scotch Broom (<i>Cytisus scoparius</i>)	Weed of national significance	4
Serrated Tussock (<i>Nassella trichotoma</i>)	Weed of national significance	4
St John's Wort (<i>Hypericum perforatum</i>)	NA	4
Tropical Soda Apple (<i>Solanum viarum</i>)	NA	2
Water Hyacinth (<i>Eichhornia crassipes</i>)	Weed of national significance	2
Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow (<i>Salix spp. Except S. babylonica, S. x calodendron & S. x reichardtii</i>)	Weed of national significance	5

The relevant weed control classes under the *Noxious Weeds Act 1993* as referred to in **Table 4** are as follows:

- Class 1, State Prohibited Weeds - Class 1 noxious weeds are plants that pose a potentially serious threat to primary production or the environment and are not present in the State or are present only to a limited extent;
- Class 2, Regionally Prohibited Weeds - Class 2 noxious weeds are plants that pose a potentially serious threat to primary production or the environment of a region to which the order applies and are not present in the region or are present only to a limited extent;
- Class 3, Regionally Controlled Weeds - Class 3 noxious weeds are plants that pose a serious threat to primary production or the environment of an area to which the order applies, are not widely distributed in the area and are likely to spread in the area or to another area;
- Class 4, Locally Controlled Weeds - Class 4 noxious weeds are plants that pose a threat to primary production, the environment or human health, are widely distributed in an area to which the order applies and are likely to spread in the area or to another area; and
- Class 5, Restricted Plants - Class 5 noxious weeds are plants that are likely, by their sale or the sale of their seeds or movement within the State or an area of the State, to spread in the State or outside the State.

A noxious weed that is classified as a Class 1, 2 or 5 noxious weed under the *Noxious Weeds Act 1993* is a notifiable weed.

The following weeds listed under the EPBC Act and/or the *Noxious Weeds Act 1993* that were identified during field surveys at the Project Area:

- Bitou Bush (*Chrysanthemoides monilifera subsp. rotundata*);
- Lantana (*Lantana camara*). This species was also recorded throughout most locations of the site that were surveyed during 2008 (NGH Environmental, 2009);
- Blackberry (*Rubus fruticosus aggregate spp except cultivars*);
- Asparagus Fern (*Asparagus aethiopicus, A. densiflorus, Protasparagus aethiopicus*). This species was also recorded around the perimeter fence at several locations during flora surveys conducted in 2008 (NGH Environmental, 2009);
- Balloon Vine (*Cardiospermum grandiflorum*). This species was also recorded around the perimeter fence growing up into the canopy of the Swamp Oak Forest within the remnant wetland during surveys conducted in 2008 (NGH Environmental, 2009);
- Bridal Creeper (*Asparagus asparagoides*); and
- Radiata Pine, Monterey Pine (*Pinus radiata*).

In addition, the following weed species were identified at the Project Area by Urban Bushland Management Consultants, in 2007:

- Pellitory (*Parietaria judacia*). This species was also recorded around the perimeter fence at several locations during flora surveys conducted in 2008 (NGH Environmental, 2009);
- Pampass Grass (*Cortaderia species*);
- Boneseed (*Chrysanthemoides moniliger subspecies monilifera*);
- Castor Oil Plant (*Ricinus communis*);
- Broad-leaved Privet (*Ligustrum lucidum*). This species was also recorded within the Swamp Oak Forest within the remnant wetland during surveys conducted in 2008 (NGH Environmental, 2009); and
- Green Cestrum (*Cestrum parqui*).

The Class 4 noxious weed Prickly Pear (*Opuntia stricta*) was also recorded by NGH Environmental during survey work conducted in 2008 (NGH Environmental, 2009). This weed was not captured in the Department of Primary Industries' Noxious Weeds Declaration database for the Parramatta LGA (Department of Primary Industries, 2013).

During the vegetation study undertaken at the Project Area by Urban Bushland Management Consultants in 2007, a diagram was prepared to indicate the most abundant weeds within each weed polygon at the remnant wetland/low woodland/Swamp Oak Floodplain Forest area. This is reproduced in **Figure 7** below.

Overall the native vegetation in the remnant wetlands, low woodlands and Swamp Oak Floodplain Forest supports a high proportion of weed species. However, many of these weed species present are not considered to be keystone or target weed species (Urban Bushland Management Consultants, 2007).



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VEGETATION COMMUNITIES AND THREATENED FLORA SPECIES

Clyde Terminal Conversion Project
Biodiversity Assessment

Flora Record Data Source: State of NSW through the Office of Environment and Heritage
Urban Bushland Management Consultants (UBMS, 2007)
Vegetation Data Source: Sydney Metropolitan Catchment Authority (2008)

FIGURE 6



Figure 7 Weed Coverage at the Wetland in the North-East of the Project Area (Figure Courtesy of Urban Bushland Management Consultants, 2007)

3.2.2 Threatened Flora

A summary of the vulnerable, endangered and critically endangered flora known or predicted to occur in the vicinity of the Project Area is outlined in **Table 5** and **Table 12 of Appendix B** provides an analysis of the likelihood of each of these species and communities to occur on the actual Project Area. The majority of species and communities were ultimately determined to have a low likelihood of occurring on the Project Area. The EPBC Protected Matters search tool identified 21 flora species listed under the EPBC Act that are known or likely to occur within the Locality. The OEH's Atlas of Wildlife search identified 42 flora species listed under the TSC Act as being known or likely to occur within 10 km of the Project Area. A cross check between these two searches (refer **Table 3**) indicates that a total of 50 vulnerable, endangered or critically endangered flora species are known or predicted to occur within the Locality (refer **Table 5**). As per **Table 12 in Appendix B**, there were two that have been previously recorded in the Project Area:

- The vulnerable Downy Wattle (*Acacia pubescens*). There are two known recorded locations of the species occurring within the foreshore fringing the Project Area (refer **Figure 6** and **Figure 8**); and
- The vulnerable Narrow-leafed Wilsonia (*Wilsonia backhousei*). There are six known recorded locations of the species occurring in the intermittent areas of saltmarsh along the foreshore fringing the Project Area (refer **Figure 6** and **Figure 8**).

An additional three listed flora species have been previously recorded within the Study Area:

- The vulnerable Netted Bottle Brush (*Callistemon linearifolius*). The closest known recorded location of the species is at Rosehill around 1.6 km west of the Project Area (refer **Figure 8**);
- The endangered *Pomaderris prunifolia* in the Parramatta, Auburn, Strathfield and Bankstown Local Government Areas. The closest known recorded location of the species is at Ermington around 1.2 km north of the Project Area (refer **Figure 8**); and
- The vulnerable Glandular Pink-bell (*Tetratheca glandulosa*). The closest known recorded location of the species is adjacent to Duck River, around 1.9 km south-west of the Project Area (refer **Figure 8**).

An additional seven listed flora species have been previously recorded in the Locality, but not within the Study Area or the Project Area:

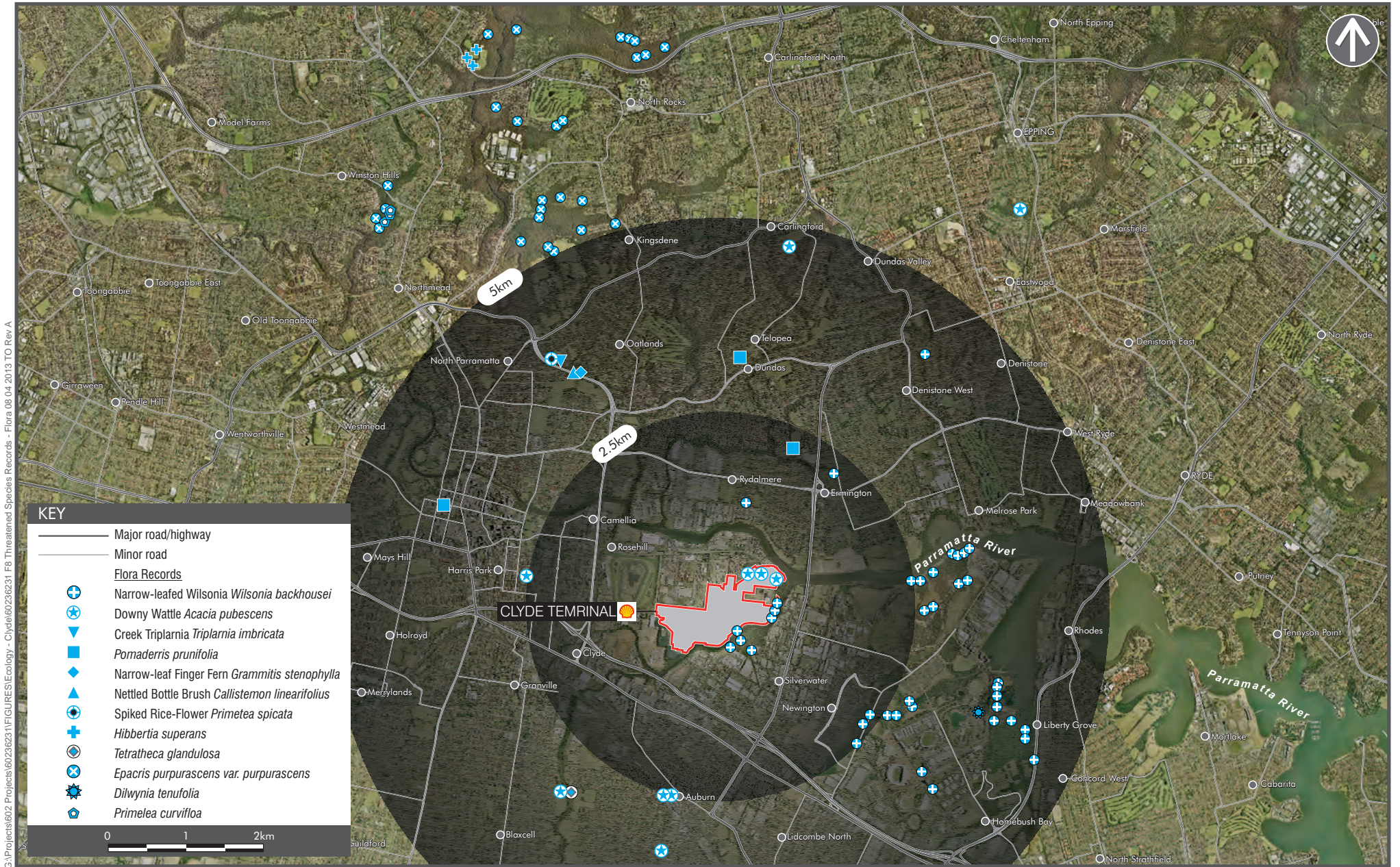
- The vulnerable Dillwynia tenuifolia (refer **Figure 8**);
- The vulnerable *Epacris purpurascens* var. *purpurascens* (refer **Figure 8**);
- The endangered Narrow-leaf Finger Fern (*Grammitis stenophylla*) (refer **Figure 8**);
- The endangered *Hibbertia superans* (refer **Figure 8**);
- The vulnerable *Pimelea curviflora* var. *curviflora* (refer **Figure 8**);
- The endangered *Pimelea spicata* (refer **Figure 8**); and
- The endangered Creek Triplariana (*Triplariana imbricata*) (refer **Figure 8**).

As indicated in **Table 12 of Appendix B**, all other listed flora species besides the vulnerable Downy Wattle and the Narrow-leafed Wilsonia were ultimately found to have a low likelihood of occurrence at the Project Area.

The Project Area has also been previously recorded as containing two flora species of regional significance:

- Blue Box (*Eucalyptus baueriana*), which has been recorded in the Eucalypt Woodland in the south-east of the remnant woodland (NGH Environmental, 2009; refer **Figure 5**); and
- *Halosarcia pergranulata* subsp. *pergranulata*, which has been previously recorded at various locations within saltmarsh at the Project Area.

Neither of these species are recorded as threatened under the TSC Act or the EPBC Act.



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ENDANGERED, VULNERABLE AND CRITICALLY ENDANGERED SPECIES RECORDS - FLORA
 Clyde Terminal Conversion Project
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Table 5 Flora listed as Vulnerable, Endangered and Critically Endangered Flora under the EPBC Act and/or TSC Act within 10 km of the Project Area

Listed Under the EPBC Act and TSC Act				Listed under the TSC Act Only			Listed under the EPBC Act only		
Scientific Name	Common Name	Conservation Status (Cth)	Conservation Status (NSW)	Scientific Name	Common Name	Conservation Status	Scientific Name	Common Name	Conservation Status
Species									
<i>Acacia bynoeana</i>	Bynoe's Wattle	Vulnerable	Endangered	<i>Callistemon linearifolius</i>	Netted Bottle Brush	Vulnerable	<i>Bothriochloa biloba</i>	Lobed Blue-grass	Vulnerable
<i>Acacia pubescens</i>	Downy Wattle	Vulnerable	Vulnerable	<i>Chamaesyce psammogeton</i>	Sand Spurge	Endangered	<i>Streblus pendulinus</i>	Siah's Backbone, Isaac Wood	Endangered
<i>Acacia terminalis</i> subsp. <i>Terminalis</i>	Sunshine Wattle	Endangered	Endangered	<i>Dillwynia tenuifolia</i>		Vulnerable			
<i>Allocasuarina glareicola</i>		Endangered	Endangered	<i>Epacris purpurascens</i> var. <i>purpurascens</i>		Vulnerable			
<i>Allocasuarina portuensis</i>	Nielsen Park She-oak	Endangered	Endangered	<i>Genoplesium baueri</i>	Bauer's Midge Orchid	Endangered			
<i>Asterolasia elegans</i>		Endangered	Endangered	<i>Grammitis stenophylla</i>	Narrow-leaf Finger Fern	Endangered			
<i>Caladenia tessellata</i>	Thick Lip Spider Orchid	Vulnerable	Endangered	<i>Gyrostemon thesioides</i>		Endangered			
<i>Cryptostylis hunteriana</i>	Leafless Tongue-orchid	Vulnerable	Vulnerable	<i>Hibbertia puberula</i>		Endangered			
<i>Cynanchum elegans</i>	White-flowered Wax Plant	Endangered	Endangered	<i>Hibbertia superans</i>		Endangered			

Listed Under the EPBC Act and TSC Act				Listed under the TSC Act Only			Listed under the EPBC Act only		
Scientific Name	Common Name	Conservation Status (Cth)	Conservation Status (NSW)	Scientific Name	Common Name	Conservation Status	Scientific Name	Common Name	Conservation Status
<i>Darwinia biflora</i>		Vulnerable	Vulnerable	<i>Maundia triglochinooides</i>		Vulnerable			
<i>Deyeuxia appressa</i>		Endangered	Endangered	<i>Pomaderris prunifolia</i> in the Parramatta, Auburn, Strathfield and Bankstown LGAs		Endangered			
<i>Eucalyptus camfieldii</i>	Camfield's Stringybark	Vulnerable	Vulnerable	<i>Pultenaea pedunculata</i>	Matted Bush-pea	Endangered			
<i>Grevillea caleyi</i>	Caley's Grevillea	Endangered	Endangered	<i>Wahlenbergia multicaulis</i>	Tadgell's Bluebell in the LGAs of Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield	Endangered			
<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	Small-flower Grevillea	Vulnerable	Vulnerable	<i>Wilsonia backhousei</i>	Narrow-leaved Wilsonia	Vulnerable			
<i>Haloragodendron lucasii</i>		Endangered	Endangered						
<i>Hibbertia</i> sp. <i>Bankstown</i>		Critically Endangered	Critically Endangered						

Listed Under the EPBC Act and TSC Act				Listed under the TSC Act Only			Listed under the EPBC Act only		
Scientific Name	Common Name	Conservation Status (Cth)	Conservation Status (NSW)	Scientific Name	Common Name	Conservation Status	Scientific Name	Common Name	Conservation Status
<i>Hypsela sessiliflora</i>		Extinct	Endangered						
<i>Leucopogon exolasius</i>	Woronora Beard-heath	Vulnerable	Vulnerable						
<i>Leptospermum deanei</i>		Vulnerable	Vulnerable						
<i>Melaleuca biconvexa</i>	Biconvex Paperbark	Vulnerable	Vulnerable						
<i>Melaleuca deanei</i>	Deane's Paperbark	Vulnerable	Vulnerable						
<i>Microtis angusii</i>	Angus's Onion Orchid	Endangered	Endangered						
<i>Pelargonium sp. striatellum</i>	Omeo Stork's-bill	Endangered	Endangered						
<i>Persoonia nutans</i>	Nodding Geebung	Endangered	Endangered						
<i>Pimelea curviflora</i> var. <i>curviflora</i>		Vulnerable	Vulnerable						
<i>Pimelea spicata</i>	Spiked Rice-flower	Endangered	Endangered						
<i>Prasophyllum fuscum</i>	Slaty Leek Orchid	Vulnerable	Critically Endangered						
<i>Prostanthera marifolia</i>	Seaforth Mintbush	Critically Endangered	Critically Endangered						

Listed Under the EPBC Act and TSC Act				Listed under the TSC Act Only			Listed under the EPBC Act only		
Scientific Name	Common Name	Conservation Status (Cth)	Conservation Status (NSW)	Scientific Name	Common Name	Conservation Status	Scientific Name	Common Name	Conservation Status
<i>Pterostylis gibbosa</i>	Illawarra Greenhood, Rufa Greenhood, Pouched Greenhood	Endangered	Endangered						
<i>Pterostylis</i> sp. <i>Botany Bay</i>	Botany Bay Bearded Orchid	Endangered	Endangered						
<i>Pterostylis saxicola</i>	Sydney Plains Greenhood	Endangered	Endangered						
<i>Syzygium paniculatum</i>	Magenta Lilly Pilly	Vulnerable	Endangered						
<i>Tetradlea glandulosa</i>	Glandular Pink-bell	Vulnerable	Vulnerable						
<i>Triplariana imbricata</i>	Creek Triplariana	Endangered	Endangered						
Communities									
Eastern Suburbs Banksia Scrub in the Sydney Basin Bioregion		Endangered Ecological Community	Endangered Ecological Community	Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion		Endangered Ecological Community			
Shale Gravel Transition Forest in the Sydney Basin Bioregion, also known as the Cumberland Plain Shale Woodland and Shale-Gravel Transition Forest		Critically Endangered Ecological Community	Endangered Ecological Community	Duffys Forest Ecological Community in the Sydney Basin Bioregion		Endangered Ecological Community			

Listed Under the EPBC Act and TSC Act				Listed under the TSC Act Only			Listed under the EPBC Act only		
Scientific Name	Common Name	Conservation Status (Cth)	Conservation Status (NSW)	Scientific Name	Common Name	Conservation Status	Scientific Name	Common Name	Conservation Status
Sydney Turpentine-Ironbark Forest		Critically Endangered Ecological Community	Endangered Ecological Community	Shale/Sandstone Transition Forest		Endangered Ecological Community			
				Southern Sydney sheltered forest on transitional sandstone soils in the Sydney Basin Bioregion		Endangered Ecological Community			
				Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions		Endangered Ecological Community			
				Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions		Endangered Ecological Community			
				River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions		Endangered Ecological Community			
				Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions		Endangered Ecological Community			
				Sydney Freshwater Wetlands in the Sydney Basin Bioregion		Endangered Ecological Community			

Listed Under the EPBC Act and TSC Act				Listed under the TSC Act Only			Listed under the EPBC Act only		
Scientific Name	Common Name	Conservation Status (Cth)	Conservation Status (NSW)	Scientific Name	Common Name	Conservation Status	Scientific Name	Common Name	Conservation Status
				Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions. This riparian vegetation also meets characteristics of Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregion		Endangered Ecological Community			
				Blue Gum High Forest in the Sydney Basin Bioregion		Critically Endangered Ecological Community			
				Cumberland Plain Woodland in the Sydney Basin Bioregion		Critically Endangered Ecological Community			
				Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion		Vulnerable Ecological Community			
				Western Sydney Dry Rainforest in the Sydney Basin Bioregion		Endangered Ecological Community			

3.2.3 Threatened Terrestrial Fauna

A summary of the vulnerable, endangered and critically endangered terrestrial fauna known or predicted to occur in the vicinity of the Project Area is outlined in **Table 8** and **Table 13** of **Appendix B** provides an analysis of the likelihood of each of these species and populations to occur on the actual Project Area. A cross check between the EPBC Protected Matters search and the Atlas of Wildlife search (refer **Table 3**) indicates that a total of 79 vulnerable, endangered or critically endangered flora species are known or predicted to occur within the Locality (refer **Table 5**). As outlined in **Table 8**, some of those terrestrial fauna species are also listed migratory and/or wetland species under the EPBC Act (refer **Section 3.4**). Two listed fauna species were found to have been previously recorded at the Project Area: GGBF and Grey-headed Flying-fox. Six other listed fauna species were deemed to have a medium likelihood of occurring at the Project Area as follows:

- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*);
- Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*);
- Southern Myotis (*Myotis macropus*);
- Greater Broad-nosed Bat (*Scoteanax rueppellii*);
- Large-eared Pied Bat (*Chalinolobus dwyeri*); and
- Eastern Freetail-bat (*Mormopterus norfolkensis*).

As per **Table 13** of **Appendix B**, the remaining listed fauna species were ultimately determined to have a low likelihood of occurring on the Project Area.

The EPBC Protected Matters search tool identified 21 terrestrial fauna species listed under the EPBC Act that are known or likely to occur within the Locality.

The OEH's Atlas of Wildlife search identified 68 terrestrial fauna species listed under the TSC Act (58 additional to those returned via the EPBC Protected Matters search) were identified as being likely or known to occur within 10 km of the Project Area. A cross check between these two searches (refer **Table 3**) indicates that a total of 79 vulnerable, endangered or critically endangered fauna species and populations are known or predicted to occur within the Locality (refer **Table 3**).

As per **Table 13** in **Appendix B**, there were two listed fauna species that have been previously recorded in the Project Area as follows:

- The endangered Green and Golden Bell Frog (*Litoria aurea*). The Project Area also contains a known population of the species (refer **Figure 9**); and
- The endangered Grey-headed Flying-fox (*Petaurus poliocephalus*) (refer **Figure 11**).

An additional nine listed fauna species have been previously recorded in the Study Area:

- The endangered Curlew Sandpiper (*Calidris ferruginea*). The closest known recorded location of the species is at Newington, around 1.3 km south-east from the Project Area (refer **Figure 11**);
- The vulnerable White-fronted Chat (*Epthianura albifrons*). The closest known recorded location of the species is at Newington, around 1.3 km south-east of the Project Area (refer **Figure 11**);
- The vulnerable Little Eagle (*Hieraaetus morphnoides*). The closest known recorded location of the species is at Narawang Wetland around 1.6 km east of the Project Area (refer **Figure 11**);
- The vulnerable Black-tailed Godwit (*Limosa limosa*). The closest known recorded location of the species is at the Millennium Parklands around 1.9 km east of the Project Area (refer **Figure 11**);
- The vulnerable Powerful Owl (*Ninox strenua*). The closest known recorded location of the species is at Dundas, around 2 km north of the Project Area (refer **Figure 11**);
- The vulnerable Spot-tailed Quoll (*Dasyurus maculatus maculatus*). The closest known recorded location of the species is at Granville, around 2 km south-west of the Project Area (refer **Figure 11**);
- The vulnerable Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*). The closest known recorded location of the species is at Millennium Parklands around 1.7 km east of the Project Area (refer **Figure 10**);
- The vulnerable Eastern Freetail-bat (*Mormopterus norfolkensis*). The closest known recorded location of the species is at Millennium Parklands around 1.7 km east of the Project Area (refer **Figure 10**); and

- The vulnerable Yellow-bellied Sheath-tail-bat (*Saccolaimus flaviventris*). The closest known recorded location of the species is at Millennium Parklands around 1.7 km east of the Project Area (refer **Figure 10**).

An additional 15 listed fauna species have also been previously recorded in the Locality. No listed fauna species that were not already recorded as being listed in the Project Area were found to have been previously recorded within the Study Area only. The additional 26 species found within the Locality are as follows:

- The critically endangered Regent Honeyeater (*Anthochaera Phrygia*) (refer **Figure 11**);
- The endangered Australasian Bittern (*Botaurus poiciloptilus*) (refer **Figure 11**);
- The vulnerable Great Knot (*Calidris tenuirostris*) (refer **Figure 11**);
- The vulnerable Gang-gang Cockatoo (*Callocephalon fimbriatum*) (refer **Figure 11**);
- The vulnerable Greater Sand-plover (*Charadrius leschenaultii*) (refer **Figure 11**);
- The vulnerable Little Lorikeet (*Glossopsitta pusilla*) (refer **Figure 11**);
- The endangered Swift Parrot (*Lathamus discolor*) (refer **Figure 11**);
- The vulnerable Broad-billed Sandpiper (*Limicola falcinellus*) (refer **Figure 11**);
- The vulnerable Barking Owl (*Ninox connivens*) (refer **Figure 11**);
- The vulnerable Eastern Osprey (*Pandion cristatus*) (refer **Figure 11**);
- The endangered Little Tern (*Sternula albifrons*) (refer **Figure 11**);
- The vulnerable Freckled Duck (*Stictonetta naevosa*) (refer **Figure 11**);
- The vulnerable Eastern Grass Owl (*Tyto longimembris*) (refer **Figure 11**);
- The vulnerable Terek Sandpiper (*Xenus cinereus*) (refer **Figure 11**); and
- The vulnerable Greater Broad-nosed Bat (*Scoteanax rueppellii*) (refer **Figure 10**).

Two Fauna populations have also been previously recorded in the Study Area:

- The endangered White-fronted Chat population in the Sydney Metropolitan Catchment Management Area (*Epthianura albifrons*). The closest known recorded location of this population is at Newington, around 1.3 km south-east of the Project Area (refer **Figure 11**); and
- *Dasyurus maculatus maculatus* (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll. The closest known recorded location of the species is at Granville, around 2 km south-west of the Project Area (refer **Figure 11**).

In addition, one listed fauna population has also been previously recorded in the Locality but not within the Study Area:

- The endangered Gang-gang Cockatoo population in the Hornsby and Ku-ring-gai Local Government Areas (*Callocephalon fimbriatum*) (refer **Figure 11**).

3.2.4 Terrestrial Habitat Values

Sections of the Project Area, particularly the remnant wetland areas, provide good quality habitat features for a range of fauna. Urban Bushland Management Consultants previously identified these remnant wetlands as providing the following habitat types:

- An aquatic environment;
- A low woodland; and
- A Swamp Oak forest.

During previous surveys conducted at the Project Area, the aquatic features of this remnant wetland environment have been identified as providing a variety of habitat resources for several native wetland birds. In 2005, water birds were observed foraging and sheltering within these remnant wetlands, and evidence of breeding was also detected. Prior to the colonisation of Sharp Rush at the remnant wetlands, this site was actually considered to provide regionally significant habitat, being one of the larger freshwater bodies within the area (Urban Bushland Management Consultants, 2007). This was the case as long ago as 1990, when a study undertaken by Gunninah

found that that freshwater nature and size of these remnant wetlands provided resources not otherwise available within the region (Gunninah Consultants, 1990).

The low Eucalypt woodland within this remnant wetland environment has not changed significantly since survey work was performed during 2005. This community is located to the east, south and west of the remnant wetlands themselves, and has resulted from plantings and landscaping undertaken on raised embankments. During survey work conducted in 2008, NGH Environmental also described the habitat values of the remnant wetlands at the Project Area, and found only a limited numbers of hollow-bearing trees. Where these were found to occur, they tended to be small in size. The canopy of these trees is largely uniform, and provides connectivity with the adjacent Swamp Oak Floodplain Forest and other flora communities. The understorey and ground cover in the low woodlands is fairly dense, providing foraging opportunities for native bird species. Furthermore, seasonal foraging by nectivorous birds and mammals is also likely to take place in this area (Urban Bushland Management Consultants, 2007).

The Swamp Oak Floodplain Forest surrounding the remnant wetland appears to be comprised of a remnant stand of naturally occurring vegetation. These *Casuarina* trees are around 8 m tall, forming a continuous canopy. The understorey and groundcover are limited due to this dense canopy shade, and the *Casuarina* needles which are known to suppress the growth of other flora species. This flora community contains a range of foraging, sheltering and nesting opportunities for fauna species (Urban Bushland Management Consultants, 2007).

During survey work conducted in 2008, NGH Environmental also described the following habitat values of the remnant wetlands at the Project Area:

- The foreshore area surrounding the riparian vegetation and adjacent to open water (i.e. Duck and Parramatta Rivers) provides ideal foraging habitat for diving bird species such as Cormorants and Darters;
- At low tide the exposed muddy banks and mangrove roots provide foraging habitat for species such as Sharp-tailed Sandpiper, Herons, Egrets and Plovers;
- Habitat for fish species, particularly for breeding and juvenile fish within the mangroves;
- Saltmarsh supporting macroinvertebrates such as crabs and snails;
- Boulders present in some sections of the Project Area offer some limited habitat value for reptilian species. Tidal flushing prevents leaf litter build up, and so reptile habitat is limited in mangroves;
- Only limited numbers of hollow-bearing trees have been recorded at the Project Area, and where these do occur they tend to be small in size; and

The remnant wetland area contains some logs and fallen branches which could provide some habitat value for certain species.

NGH Environmental also conducted a bird survey at the remnant wetland in 2008. The results of this survey as they relate to wetland bird species are as follows:

- Native insectivorous and nectivorous birds indicative of better quality remnant vegetation were recorded in the wetlands (i.e. Silvereye (*Zosterops lateralis*), Red-browed Finch (*Neochmia temporalis*), White-browed Scrub Wren (*Sericornis frontalis*), and White-plumed Honeyeater (*Lichenostomus penicillatus*));
- Common native species normally associated with urban and altered environments were recorded in the wetlands (e.g. Magpie (*Cracticus tibicen*), Raven (*Corvus coronoides*), Noisy Miner (*Manorina melanocephala*), Rainbow Lorikeet (*Trichoglossus haematodus*) and Red Wattlebird (*Anthochaera carunculata*)); and
- Introduced species not native to Australia and prone to excluding native birds were recorded in the wetlands (e.g. Indian Myna (*Acridotheres tristis*), Red-whiskered Bulbul (*Pycnonotus jocosus*), Common Starling (*Sturnus vulgaris*), and Spotted Turtle-dove (*Spilopelia chinensis*)).

The remainder of the Project Area, where the Clyde Terminal infrastructure is currently placed, provides limited habitat for terrestrial fauna. Nevertheless, this highly modified area is also observed to contain some habitat for the GGBF, and birds have been observed perched on existing infrastructure at the Clyde Terminal whilst moving between habitat sites. Indeed, the Project Area's various drainage lines and ponded areas within tankfarms provide some limited habitat features for frogs and water birds. A range of water birds were also evident during field inspections, including: Purple Swamphen (*Porphyrio porphyria*); Eurasian Coot (*Fulica atra*); Australian White

Ibis (*Threskiornis molucca*); Pacific Black Duck (*Anas superciliosa*); Spoonbill (*Platalea regia*); and Welcome Swallow (*Hirundo neoxena*).

As outlined in **Section 3.2.1**, the remnant wetland system is moderately to highly disturbed given the following factors (NGH Environmental, 2009):

- Poor water quality;
- High levels of garbage, especially along Duck River and the southern bank of Parramatta River adjacent to the Project Area;
- Weed infestations; and
- Presence of feral animals and pest species (e.g. plague minnow at the remnant wetlands).

These disturbances likely contribute to the reduced level of fauna species richness and numbers observed compared to similar wetlands located at the Sydney Olympic site nearby. However, the remnant wetlands nevertheless provide some important habitat values for a range of species (NGH Environmental, 2009).

Urban Bushland Management Consultants have previously concluded that the Project Area does not comprise a significant component of any regionally or locally important corridors for fauna dispersion. A band of Mangrove riparian vegetation does extend toward the south from the Project Area along Duck River, and also toward the west along Parramatta River for a few kilometres. However, only fauna species that are adaptable to surrounding urban conditions are likely to use this corridor for dispersion (Urban Bushland Management Consultants, 2007).

Frogs heard calling from the remnant wetland in the northeast of the Project Area included: Common Toadlet (*Crinia signifera*); Striped Marsh Frog (*Limnodynastes peronei*); and the GGBF. The GGBF was also detected from within Tankfarm B during the site visits (refer **Figure 9**). No other evidence of frog species was found elsewhere from within the Project Area and its surrounds. The Common Toadlet and Striped Marsh Frog are not listed as threatened under the TSC Act or the EPBC Act and as such, are not considered further as part of this Ecological Assessment.

3.2.5 Green and Golden Bell Frog

The Project Area is reported to contain a key Parramatta population of the GGBF (Department of Environment and Climate Change, 2008c). As per the *Significant Impact Guidelines for the vulnerable Green and Golden Bell Frog* *Litoria aurea*: *EPBC Act Policy Statement 3.19* (Department of Environment, Water, Heritage and Arts, 2009b), a current population of GGBF is considered to be present on a site where one or more GGBF individuals have been detected on at least one occasion since 1995, even if they have not been recently discovered at the site. Of the eight previously recorded locations of GGBF occurring at the Project Area, four individuals were recorded in 1999, two individuals in 2000, and two individuals in 2005 (OEH, 2013a; Urban Bushland Management Consultants, 2007). Two sites at the Project Area were also been found to contain live frogs during surveys conducted in October 2012. However in the past, operational management has required that most banded tanks and associated drainage lines are routinely drained following rainfall. Thus potential habitat for frogs is no longer present in a number of locations where they have been previously recorded.

Sites within the Project Area, where the GGBF has been detected or where potential habitat may occur, include the areas shown in **Figure 9**. Areas of previous GGBF sightings that are to be directly impacted on by the proposed Project are outlined in **Table 6**. One previous record of GGBF in 1999 (refer to **Figure 9**; OEH, 2013a) occurred at Tankfarm K, which would not be demolished or excavated as part of the conversion works and is therefore not considered further in this assessment. There is also another recorded location of GGBF at the Project Area during 1999 which occurs along the road boundary to the north of the Mobil Tankfarm (refer to **Figure 9**; OEH, 2013). Again this road boundary area is outside of the direct impact of demolition and excavation works, and so this recorded location is not considered further as part of the assessment. As such not all previously recorded locations of GGBF at the Project Area prior to the survey work in 2012 are included in **Table 6**.

Table 6 Summary of GGBF Detected or Where Potential Habitat May Occur

Area	GGBF Previous Records	GGBF Potential Habitat
Remnant wetlands	<p>Four male GGBFs were heard actively calling during surveys in October 2012.</p> <p>One GGBF individual was recorded at this location in 1999, and another two in 2005 (OEH, 2013a; Urban Bushland Management Consultants, 2007).</p>	<p>Man-made and designed to receive clean waste water from the Project Area.</p> <p>Based on past and current records, the remnant wetland is the primary location of GGBF on the Project Area.</p> <p>This area was therefore used as a reference site during the October 2012 GGBF surveys.</p>
Tankfarm B	<p>Two male GGBFs were heard actively calling during surveys in October 2012.</p> <p>There is anecdotal evidence of tadpoles (species unknown) previously occurring in the waters in the base of Tankfarm B.</p>	<p>Tankfarm B is one of the two tankfarms at the Project Area that retains ponded rain water because drainage appears to have been blocked by a small dense stand of <i>Typha orientalis</i> (Cumbungi).</p> <p>Accumulated sediment and soil waste on the floor of the tankfarm also appears to have promoted creation of an artificial pool of water inside the northern bund wall, suggesting that the area may no longer provide suitable GGBF habitat.</p> <p>Tankfarm B is not hydrologically connected to the remnant wetland in the north east of the Project Area. The closest native vegetation to Tankfarm B is a stand of Swamp Oak floodplain forest fringing Duck River, situated around 170 m to the south-east beyond the rainwater retention basin. However, GGBF are also known to move between sites that have terrestrial connections, and have a relatively large dispersion (the species is known to have travelled between 1-3 km in a single day or night: Department of Environment, Water, Heritage and Arts, 2009b). It is therefore possible that GGBF at Tankfarm B travel through terrestrial corridors (such as the mangroves along Duck and Parramatta Rivers, or throughout the Clyde Terminal site itself) as it moves throughout the Locality.</p> <p>The mangroves and riverside floodplain forest are not impacted by the works in the terminal and would benefit from the improved environmental controls to be implemented as part of the project.</p>
Tank 52	<p>No evidence of GGBF presence was recorded in this location during surveys in October 2012.</p> <p>There are no previous records of GGBFs occurring at this location (OEH, 2013a).</p>	<p>Tank 52 contains a very shallow ponded area with emergent vegetation dominated by the introduced (Umbrella Sedge (<i>Cyperus eragrostis</i>)). In the absence of rainfall, the ponded area appears to be fed by moisture venting from external tank pipes which condenses into the area as warm water. The surrounding non-ponded areas are a combination of concrete bunds and introduced grasses which are controlled during regular maintenance programs. Ponded water around Tank 52 is also known to be relatively oily (pers.comm. Ian Bell).</p> <p>Due to the presence of ponded water, and given the fact that the area seems to retain water between rainfall events, it is possible that the area is or has been used as GGBF habitat at some point, although this it is considered unlikely for the area to currently provide suitable habitat.</p>

Area	GGBF Previous Records	GGBF Potential Habitat
Mobil Tankfarm	<p>No evidence of GGBF presence was recorded in this location during surveys in October 2012. The only signs observed of aquatic fauna were resting water birds.</p> <p>One GGBF individual was recorded at this location in 1999 (OEH, 2013a).</p>	<p>Tanks 201, 203 and 204 lie within a bund in the centre of the six tanks at this tankfarm. On occasion, shallow ponded water has been present at this Tankfarm.</p> <p>The condition of tanks 201-204 beneath the ground surface is unknown. Groundwater and surface waters at this location may contain chromium as a legacy of land use prior to Shell's use of the Project Area for refining and related activities. However visual observations and analytical sampling of the standing water within the bund do not indicate contamination (ERM, 2012a).</p> <p>The degraded nature of the Mobil Tankfarm ponded water suggests that the area may not provide suitable GGBF habitat. This may be the reason that the GGBF was not detected during 2012 surveys, when animals were actively calling at two other locations at the Project Area.</p>
Tankfarm E1 (including Tanks 36-41)	<p>No evidence of GGBF presence was recorded in this location during surveys in October 2012.</p> <p>One individual GGBF was recorded in this location in 2000 (OEH, 2013a).</p>	<p>During survey work conducted in 2012, no suitable GGBF habitat was identified in Tankfarm E1.</p>

Plate 1 to Plate 4 below provide examples of the range of GGBF habitats that are provided within the Mobil Tankfarm (i.e. artificial GGBF habitats) compared to the remnant wetlands (i.e. more natural GGBF habitats).



Plate 1 View of Mobile Tankfarm from the north, including neighbouring industrial properties



Plate 2 Mobil Tankfarm from the east



Plate 3 Remnant Wetlands around 50 m North East of the Mobil Tankfarm



Plate 4 Remnant Wetlands, view from the East



G:\Projects\602 Projects\60236231\FIGURES\Ecology - Clyde\60236231 F9 Green and Golden Bell Frog Records 08 04 2013 TO Rev D



Data Sources: State of NSW through the Office of Environment and Heritage (Bionet)
Urban Bushland Management Consultants (UBMS, 2007)

KEY

- Project area boundary
- Green and Golden Bell Frog habitat areas
- ◆ Green and Golden Bell Frog *Litoria aurea* (Bionet Records)
- ◆ Green and Golden Bell Frog *Litoria aurea* (AECOM survey, Oct 2012)
- ◆ Green and Golden Bell Frog *Litoria aurea* (UBMS, 2007)

0 250 500m

GREEN AND GOLDEN BELL FROG (GGBF) RECORDS
Clyde Terminal Conversion Project
Biodiversity Assessment

3.2.6 Grey-headed Flying-fox

The Grey-headed Flying-fox is known to have been previously recorded at several locations near the Project Area. It has also potentially been observed overflying the Project Area (refer **Figure 10**). This species is known to occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy (OEH, 2013b). The remnant wetland and large Fig tree within the Project Area may provide foraging habitat for the species. However, this habitat would not be disturbed as a result of the Project. The report prepared by Eco Logical (refer **Appendix C**) also found that, in relation to this species, the Project Area does not contain suitable roosting habitat. Overall this species is therefore unlikely to be affected directly or indirectly by the proposed Clyde Terminal conversion. However individuals of this species may dwell opportunistically at the Project Area, and there is some residual potential for the species to use the limited habitat available in the remnant wetlands. Therefore an assessment of significance (seven-part test) test pursuant to the TSC Act (refer **Appendix D**), and a significant impact criteria assessment pursuant to the EPBC Act were prepared for this species. Both of these additional assessments found that it is unlikely that the Project would significantly impact on this species. At the time of finalising this Ecological Assessment, the significant impact criteria assessment pursuant to the EPBC Act has been prepared for submission to SEWPAC.

3.2.7 Microbats

There is historical anecdotal evidence of small bats nesting in an area of external casing to a tall concrete stack within the Project Area. Further anecdotal information from Shell staff regarding the presence of Microbats at the Project Area was provided to Eco Logical as follows:

- Bat species were observed in stacks at the Project Area some years ago;
- Bat species have not been observed in this part of the Project Area since; and
- Bats are generally seen flying up from the mangroves adjacent to the Clyde Terminal, and are generally easily visible in this area.

There was further investigation by Eco Logical (refer **Appendix C**). Due to safety concerns, the area of interest was not able to be safely accessed by sub-contractors to be able to conduct an ecological survey. Furthermore, electronic devices could not be used at the Project Area due to the risks associated with sparks and ignition. As such, the use of Anabats to record bat species at the Project Area could not be undertaken, and Shell personnel undertook the actual site inspections at the relevant areas of interest. This involved a Shell employee scaling the stacks at the Project Area and performing an inspection on 18 October 2012. These inspections were reported to have included searches of the exterior casings and insulations on these stacks, and found no evidence or roosting Microbats. Eco Logical staff then provided a desktop assessment to determine the likelihood for any threatened Microbat species to be present at the Project Area. This report (refer **Appendix C**) provides:

- Information about previous records of bats in the Locality;
- A list of likely bat species that could be found roosting within the stacks and/or abandoned buildings at the Project Area, and in particular within the external casings of these stacks;
- An indication of whether the demolition of these structures would impact on the roosting behaviours of these species; and
- A brief summary of relevant mitigation measures in the event that bat species are found at the Project Area, and therefore require relocation as a result of the Project.

The Eco Logical desktop assessment identified a number of records of bat species within the Locality (refer **Plate 5** and **Figure 10**), which includes both species that are, and are not, listed under the TSC Act.

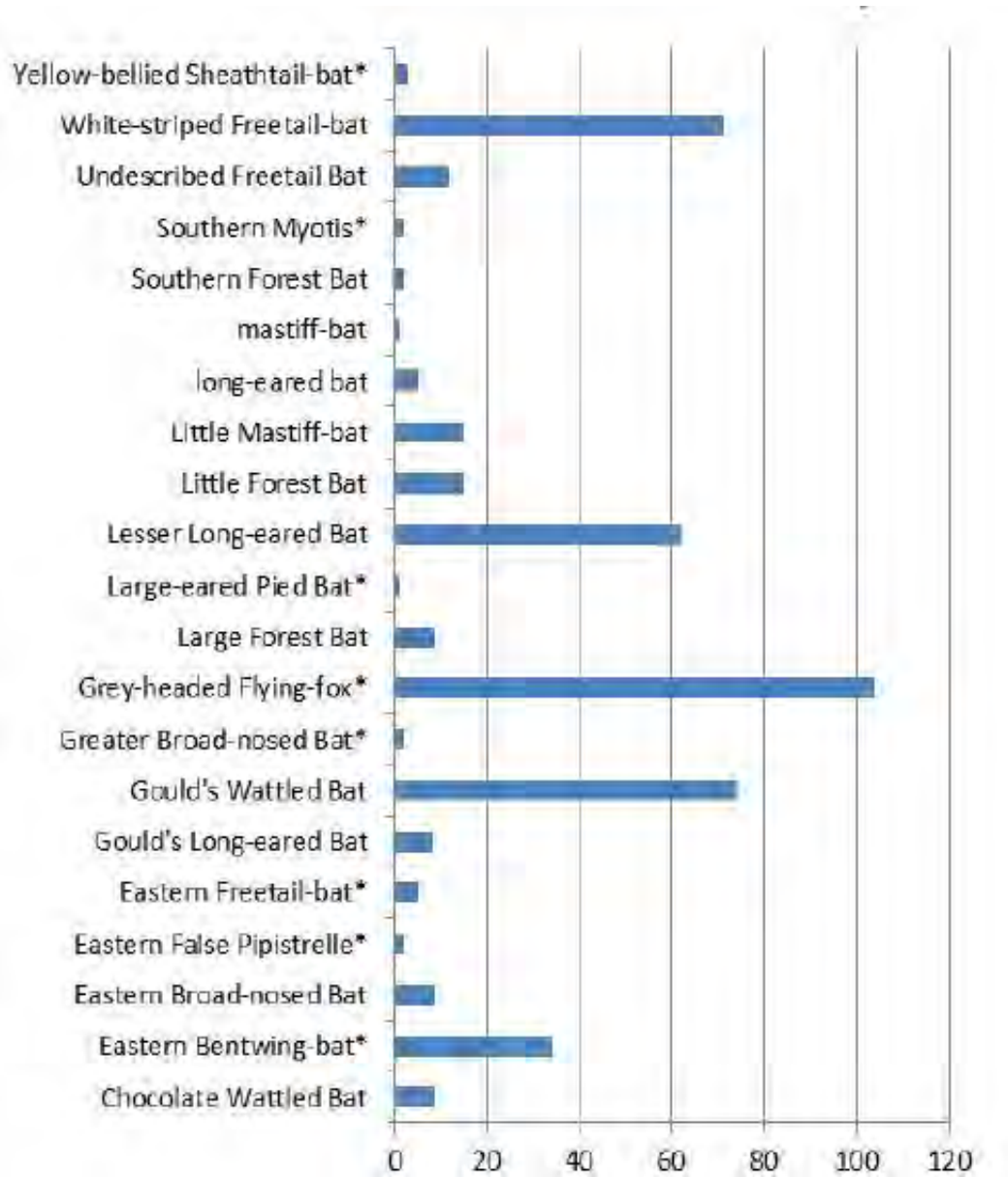


Plate 5 OEHS Atlas of Wildlife Bat Species Records Within the Locality

Note: * Listed under the TSC Act



Figure 10 OEH's Wildlife Atlas Bat Species Records

Microbats require both diurnal and nocturnal roosting locations. Generally, Microbat species can therefore be separated into two main groups based on the types of roosting habitats that they prefer to use: cave dwelling species; and tree hollow dependent species. It should be noted that anthropogenic structures such as buildings, bridges and culverts are considered to fall within the roosting habitat of cave dwelling Microbat species. The use of such sites for roosting may vary depending on factors such as weather and seasons, meaning that species may only be present on certain days, and at certain times of the year (Department of Environment and Climate Change, 2007b).

To definitely determine the significance of roost sites, assessments may therefore be required over a number of seasons (Department of Environment and Climate Change, 2007b). Significant subterranean roost sites often have a combination of mainly near-horizontal tunnels that may range from several metres long to deep complex mines or caves with interconnecting passageways. Vertical shafts are infrequently used and the vertical alignment of the stacks at the Project Area would therefore not be considered ideal (Department of Environment and Climate Change, 2007b). Based on the site location and roosting habitat available within the stacks it is likely that the Microbat species in **Table 7** could occasionally roost within the stack(s) at the Project Area.

Table 7 Potential Stack Roosting Bat Species at the Project Area

Common Name	Scientific Name	Records Within 10 km of the Project Area	EPBC Act Status	TSC Act Status
Gould's Wattled Bat	<i>Chalinolobus gouldii</i>	74	NA	NA
Chocolate Wattled Bat	<i>Chalinolobus morio</i>	9	NA	NA
Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>	2	NA	Vulnerable
Eastern Bentwing Bat	<i>Miniopterus schreibersii oceanensis</i>	34	NA	Vulnerable
Southern Myotis	<i>Myotis macropus</i>	2	NA	Vulnerable
Lesser Long-eared Bat	<i>Nyctophilus geoffroyi</i>	62	NA	NA
Greater Broad-nosed Bat	<i>Scoeanax rueppellii</i>	2	NA	Vulnerable
Eastern Broad-nosed Bat	<i>Scotorepens orion</i>	9	NA	NA
Large Forest Bat	<i>Vespadelus darlingtoni</i>	9	NA	NA
Southern Forest Bat	<i>Vespadelus regulus</i>	2	NA	NA

Indeed, according to fauna surveys conducted in 2005 by Urban Bushland Management Consultants, the Gould's Wattled Bat was found to occur at the Project Area. Furthermore, the White-striped Freetail Bat (*Nyctinomus australis*), which is not listed under the TSC Act or the EPBC Act, was also recorded at the Project Area during these investigations (Urban Bushland Management Consultants, 2007).

Ultimately the report prepared by Eco Logical (refer **Appendix C**) identified that, based on the Project Area's location and the roosting habitat available there, it is likely that Microbat species could occasionally roost within the stacks at the Project Area. More information about these vulnerable listed bat species with the potential to utilise structures at the Project Area for roosting as per **Table 7** is provided below. Slightly more detail has been provided for the Large-footed Myotis, as it is suspected of being the more likely bat species that would have utilised the site given the location of the Project Area next to Duck River. Ultimately this report found that the Project Area contains limited roosting habitat for Microbats, although it does contain a large amount of foraging habitat (mangroves) and other man-made structures (such as bridges and culverts) that contain potential roosting habitat occur along Duck River for both the Eastern Bentwing-bat and Large-footed Myotis. It was therefore concluded that there is unlikely to be significant impacts to Microbat habitat as a result of the Project, due to:

- The stacks and buildings currently being absent of bats;
- The likely historic use of the stacks being opportunistic and in response to a local food source;
- The availability of other man-made or potential artificial bat roosts in the area (e.g. along Duck River); and
- The highly industrialised and urbanised context and lack of native vegetation in the vicinity of the Project Area.

Nevertheless, mitigation measures have been recommended for the Project (refer **Section 5.2**), including monitoring for evidence of Microbats prior to demolition works commencing, which, if found, would trigger the need for further investigation.

Large-eared Pied Bat

The Large-eared Pied Bat (*Chalinolobus dwyeri*) although listed under TSC and EPBC Acts, recorded in the locality, and being known to roost in caves and abandon mines, has not been recorded in man-made structures (Department of Environment and Climate Change, 2007b; Department of Environment and Resource Management, 2011). This bat has been known to roost in disused mine shafts, caves, overhangs and abandoned fairy martin *Hirundo ariel* nests (Schulz, 1998). Almost all records are within several kilometres of cliff lines or rocky terrain and the structure of maternity roosts appears to be very specific -arch caves with dome roofs (Department of Environment and Resource Management, 2011). It was therefore considered unlikely for this species to use anthropogenic structures at the Project Area for roosting habitat.

Southern Myotis

There is a level of uncertainty relating to the taxonomic status of the Large-footed or Southern Myotis. Published taxonomic work suggests it comprises a species complex in Australia, with at least two species occurring in NSW (Kitchener et al, 1995). The previously used species name *adversus* does not apply to Australian Myotis. However, it is not clear whether *M. macropus* is the only species occurring in NSW, or whether another species *M. moluccarum* also occurs. Recent advice is to refer to *M. macropus* as the Myotis that occurs in NSW (Gilmore & Parnaby, 1994). Other common names include the Large-footed Mouse-eared Bat.

The Large-footed Myotis is listed as Vulnerable under the TSC Act and is found in eastern Australia at the Top End, from far south-east South Australia, through Victoria New South Wales and Queensland, and into northern parts of the Northern Territory and northern Western Australia (Gilmore & Parnaby, 1994).

It occurs in a disjunct manner throughout this distribution and is considered to be uncommon to rare (Lumsden et al., 1999, Anderson et al, 2006). It is widely but sparsely distributed in coastal regions and adjacent foothills of eastern NSW, extending to the Murray River. It is found along forested streams, rivers and estuaries and also on reservoirs and lakes. Clearing for agriculture and urban development have reduced and fragmented much of its coastal habitat but a number of core habitats are protected within national parks and nature reserves.

The Large-footed Myotis is a habitat specialist with specific foraging and roosting requirements. Foraging always occurs around permanent water, mostly at low elevations in flat or undulating terrain, usually surrounded by riparian vegetation (Anderson et al, 2006). Large streams are assumed to be crucial foraging habitat during times of low stream flow, particularly in drought. A shortage of suitable roost locations brought about by extensive clearing of its preferred habitat is presumed to limit its distribution and occurrence.

In NSW the Large-footed Myotis is known to roost in suitable voids such as caves, disused mines, tunnels, tree hollows, under bridges, in cracks and holes in drainage culverts and even in buildings (Richards, 1995; Lumsden and Menkhorst, 1995). It forms roosting colonies, commonly comprising up to two (2) dozen individuals, but recorded at up to several hundred individuals. Colony roosts are typically close to bodies of water and site selection is presumed to vary with season and reproductive status, with winter roosts often differing from maternity sites (Dwyer, 1970; Jones and Rayner, 1991).

Home range is a concept that is not applicable to this species. It roosts in colonies and forages on suitable water bodies that are accessible from the roost. Relatively little data is available about travel distance but it has been recorded up to 10 km from a known roost and there are indications that waterways are important as conduits (flyways) to facilitate movement (Barclay et al, 2000). However, the use of potentially suitable habitat appears to be limited by the proximity of suitable roost sites. Little is known of this species' dispersal behaviour or migration patterns (if any), but it is highly likely that riparian corridors facilitate dispersal.

The Large-footed Myotis forages over the surface of open, smooth-flowing or still water (Dwyer, 1970; Jones and Rayner, 1991; Richards, 1995) and uses its large feet to trawl for aquatic invertebrates and small fish that dwell on the surface of water bodies (e.g. Law and Urquhart, 2000). Trawling involves flying 5-100cm above the water before dipping to contact and briefly rake the surface, (Dwyer, 1970; Jones and Raynor, 1991). Bats may forage in convoy along the same riparian reach using similar flight paths (Jones and Raynor, 1991). There is little indication of whether foraging occurs within adjacent riparian vegetation (Anderson et al, 2006), but vegetation plays an important role in providing suitable habitat for aquatic insects and fish upon which Myotis feed, and can be assumed to directly influence foraging habitat for this species.

Adult male Large-footed Myotis are considered to be territorial within breeding colonies, each defending a territory within the breeding cave and guarding a harem of females, equivalent to one male and up to 12 females (Churchill, 2008). In Victoria and most of NSW a single young is born to each female around November–December, but in middle latitudes (south-east Queensland and possibly north-east NSW) two offspring may be born each year; one in early October and the other in late January (Richards, 1995).

The Large-footed Myotis' specialised foraging and roosting requirements and restricted occurrence make it susceptible to a number of on-going threats. These threats include direct disturbance at roost sites and indirect impacts of activities that impinge on habitat quality and quantity. Specific threats to the species include:

- Disturbance of cave roosts by recreational caving and tourism: Communal roosting sites are particularly vulnerable and maternity caves are of the utmost conservation significance;
- Clearing of coastal and foothill vegetation: Land clearing has been and remains a significant threat to this species throughout its range. Direct habitat loss and the fragmentation of remnant habitats reduce the viability of populations. The clearing of riparian vegetation may be a specific threat as it is likely to impact this species' aquatic insect and small fish prey base;
- Removal or destruction of caves, old timber bridges, other bridges, old mines, culverts and other potentially suitable habitat structures: Loss of an important communal roost site could have serious ramifications for a local population;
- Loss of large mature trees supporting hollows: Activities such as logging and clearing that lead to the loss of large mature trees supporting suitable hollows are likely to impact this species along with a suite of other hollow-dependent fauna;
- Changes in water quality: Water quality is impacted by vegetation clearing and logging (sedimentation), sewage and fertilizer runoff (eutrophication), pesticide/herbicide leakage (chemical pollution) and altered flow regimes (changes to river ecology) (Lumsden et al, 1999). These may impact the preferred prey of the Large-footed Myotis;
- Disturbance to riparian habitats within the vicinity of roosts: Wildfires, frequent control burns, vegetation clearing and indiscriminate stock grazing have the potential to degrade riparian vegetation leading to impacts on water quality and the prey base of the Large-footed Myotis; and
- Feral predators: Fox predation at roost sites has been reported for *Miniopterus schreibersii* (Dwyer, 1970) and could also affect this species. It is also possible that cats and possibly rats could predate this species at roost sites.

Eastern Bentwing Bat

There is currently taxonomic assessment underway for this subspecies, and it may be upgraded to full species status. It occurs along the east coast of Australia extending into the Great Dividing Range, from Cape York to Geelong in Victoria (Churchill, 2008).

Eastern Bentwing bats are cave dwellers, but are also known to take advantage of man-made structures, such as abandoned mines and road culverts. Populations are centred on a maternity cave that is used annually for the birth and development of young, with each population dispersing to other caves within its own territorial range during the year. Movement between territories is unusual, though has been recorded (Churchill, 2008). In the southern Australian winter, Eastern Bentwing hibernate in caves with an ambient temperature cold enough to keep their body temperature low, thereby reducing their metabolic rate and prolonging fat reserves that have built up during the summer.

Eastern Bentwing bats inhabit rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, *Melaleuca* forests, and open grasslands. In forested areas they fly high, whereas in more open areas they may fly within a few metres of the ground. Flight is very fast and relatively level, with swift, shallow dives. This species forages predominantly on moths, with flies, cockroaches, and beetles supplementing the diet. The Eastern Bentwing can forage long distances from the roost site, with some tagged females recorded as having travelled as far as 65 km in one night (Churchill, 2008).

Eastern False Pipistrelle

The Eastern False Pipistrelle is found on the south-east coast and ranges of Australia, from southern Queensland to Victoria and Tasmania (OEH, 2013b).

The species occurs in sclerophyll forests from the Great Dividing Range to the coast, and generally prefers wet habitats where trees are more than 20 m high. Roosting occurs in hollow trunks of eucalypt trees, usually in single sex colonies in colonies of three to 80 (Churchill, 2008), but the species has been recorded roosting in caves under loose bark and occasionally in old wooden buildings (Churchill, 2008). Single young are born in later December. Their flight pattern is high and fast and they forage within or just below the tree canopy. They feed on a variety of prey including moths, rove beetles, weevils, plant bugs, flies and ants (OEH, 2013b).

Greater Broad-nosed Bat

The Greater Broad-nosed Bat is found mainly in the gullies and river systems that drain the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland. It extends to the coast over much of its range. In NSW it is widespread on the New England Tablelands, however does not occur at altitudes above 500 m (OEH, 2013b).

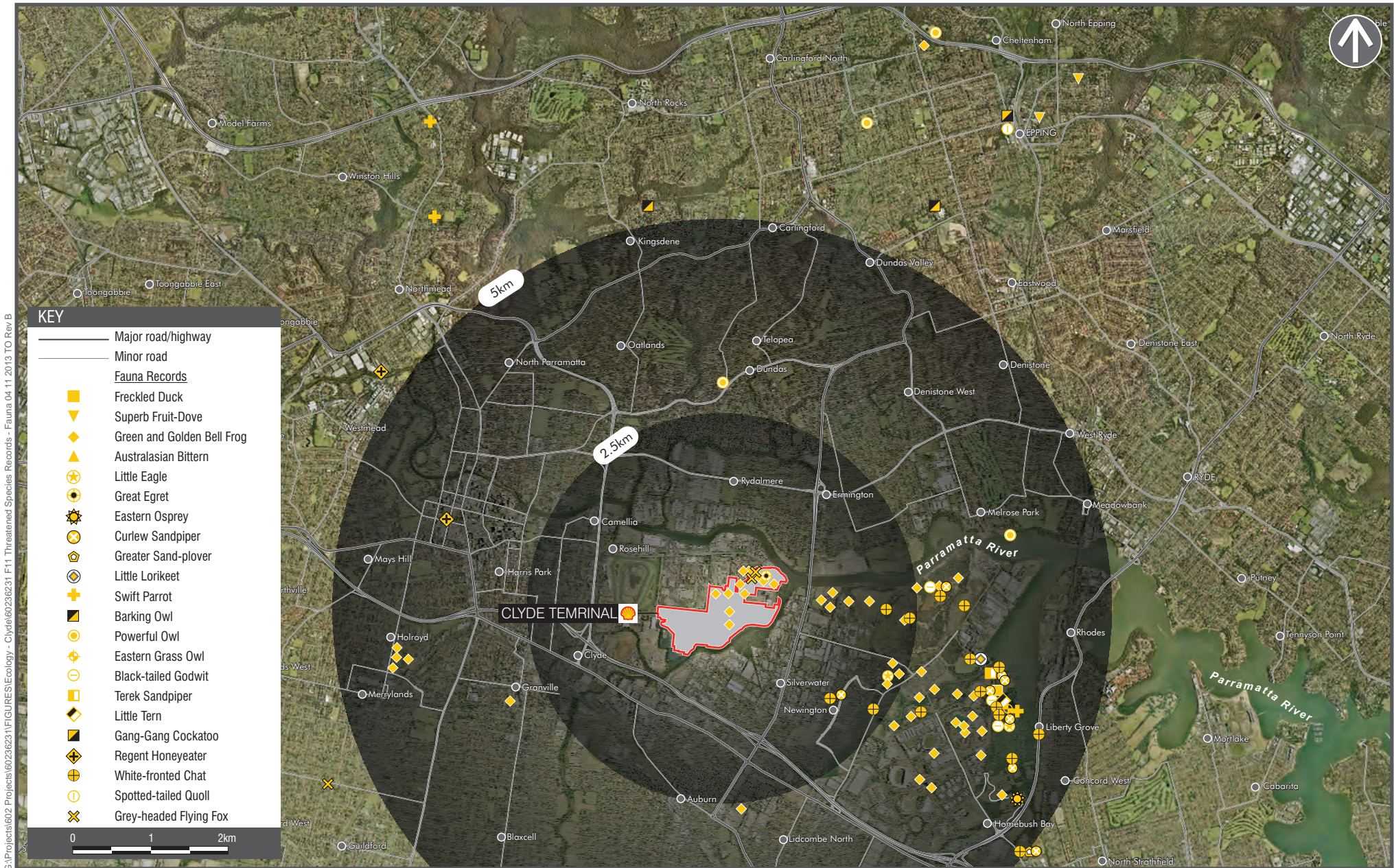
The Greater Broad-nosed Bat utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Although this species usually roosts in tree hollows, it has also been found in buildings (OEH, 2013b).

Open woodland habitat and dry open forest suits the direct flight of this species as it searches for beetles and other large, slow-flying insects; this species has been known to eat other bat species where they forage along creek and river corridors at an altitude of 3-6 m (OEH, 2013b).

Little is known of its reproductive cycle, however a single young is born in January; prior to birth, females congregate at maternity sites located in suitable trees, where they appear to exclude males during the birth and raising of the single young (OEH, 2013b).

Overall Impacts for Microbat Species

As outlined in this **Section 3.2.7**, it is unlikely that Microbat species would be directly impacted on by the Project. However, there is some residual potential for these species to use the limited habitat available in the remnant wetlands. Therefore an assessment of significance (seven-part test) test pursuant to the TSC Act (refer **Appendix D**) was prepared for these species.



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Note: The Clamorous Reed-warbler (*Acrocephalus stentoreus*), an EPBC Act-listed migratory species has previously been identified as being present north-east of the Project Area by Urban Bushland Management Consultants in 2005. As this species was not returned by a search of the EPBC Protected Matters Search Tool query in September 2012, it has not been shown on this figure.

Data Sources: State of NSW through the Office of Environment and Heritage (Bionet)
Urban Bushland Management Consultants (UBMS, 2007)

ENDANGERED, VULNERABLE AND CRITICALLY ENDANGERED SPECIES RECORDS - FAUNA
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FIGURE 11

Table 8 Terrestrial Fauna (including Aves) listed as Vulnerable, Endangered and Critically Endangered under the EPBC Act and/or TSC Act within 10 km of the Project Area

Listed Under the EPBC Act and TSC Act				Listed under the TSC Act Only			Listed under the EPBC Act only		
Scientific Name	Common Name	Conservation Status (Cth)	Conservation Status (NSW)	Scientific Name	Common Name	Conservation Status	Scientific Name	Common Name	Conservation Status
Avian Species									
<i>Anthochaera Phrygia (Mi)</i>	Regent Honeyeater	Endangered	Critically Endangered	<i>Burhinus grallarius</i>	Bush Stone-curlew	Endangered	<i>Sternula nereis</i> subsp. <i>nereis</i>	Fairy Tern	Vulnerable
<i>Botaurus poiciloptilus</i>	Australasian Bittern	Endangered	Endangered	<i>Calidris alba</i>	Sanderling	Vulnerable			
<i>Dasyornis brachypterus</i>	Eastern Bristlebird	Endangered	Endangered	<i>Calidris ferruginea (Mi) (W)</i>	Curlew Sandpiper	Endangered			
<i>Erythrotriorchis radiatus</i>	Red Goshawk	Vulnerable	Critically Endangered	<i>Calidris tenuirostris</i>	Great Knot	Vulnerable			
<i>Lathamus discolor</i>	Swift Parrot	Endangered	Endangered	<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	Vulnerable			
<i>Neophema chrysogaster (Mi)</i>	Orange-bellied Parrot	Critically Endangered	Critically Endangered	<i>Calyptorhynchus lathamii</i>	Glossy-black Cockatoo	Vulnerable			
<i>Rostratula australis (Mi)</i>	Australian Painted Snipe	Vulnerable	Endangered	<i>Charadrius leschenaultii</i>	Greater Sand-plover	Vulnerable			
				<i>Charadrius mongolus (W)</i>	Lesser Sand-plover	Vulnerable			
				<i>Chthonicola sagittata</i>	Speckled Warbler	Vulnerable			
				<i>Circus assimilis</i>	Spotted Harrier	Vulnerable			
				<i>Climacteris picumnus</i> subsp. <i>victoriae</i>	Brown Treecreeper	Vulnerable			

Listed Under the EPBC Act and TSC Act				Listed under the TSC Act Only			Listed under the EPBC Act only		
Scientific Name	Common Name	Conservation Status (Cth)	Conservation Status (NSW)	Scientific Name	Common Name	Conservation Status	Scientific Name	Common Name	Conservation Status
				<i>Daphoenositta chrysoptera</i>	Varied Sittella	Vulnerable			
				<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	Endangered			
				<i>Epthianura albifrons</i>	White-fronted Chat	Vulnerable			
				<i>Esacus magnirostris</i>	Beach stone-curlew	Critically Endangered			
				<i>Glossopsitta pusilla</i>	Little Lorikeet	Vulnerable			
				<i>Grantiella picta</i>	Painted Honeyeater	Vulnerable			
				<i>Haematopus fuliginosus</i>	Sooty Oystercatcher	Vulnerable			
				<i>Haematopus longirostris</i>	Pied Oystercatcher	Endangered			
				<i>Hieraaetus morphnoides</i>	Little Eagle	Vulnerable			
				<i>Ixobrychus flavicollis</i>	Black Bittern	Vulnerable			
				<i>Limicola falcinellus</i>	Broad-billed Sandpiper	Vulnerable			
				<i>Limosa limosa</i>	Black-tailed Godwit	Vulnerable			
				<i>Melanodryas cucullata</i> subsp. <i>cucullata</i>	Hooded Robin	Vulnerable			

Listed Under the EPBC Act and TSC Act				Listed under the TSC Act Only			Listed under the EPBC Act only		
Scientific Name	Common Name	Conservation Status (Cth)	Conservation Status (NSW)	Scientific Name	Common Name	Conservation Status	Scientific Name	Common Name	Conservation Status
				<i>Melithreptus gularis</i> subsp. <i>gularis</i>	Black-chinned Honeyeater	Vulnerable			
				<i>Nettapus coromandelianus</i>	Cotton Pygmy-Goose	Endangered			
				<i>Ninox connivens</i>	Barking Owl	Vulnerable			
				<i>Ninox strenua</i>	Powerful Owl	Vulnerable			
				<i>Pandion cristatus</i>	Eastern Osprey	Vulnerable			
				<i>Petroica boodang</i>	Scarlet Robin	Vulnerable			
				<i>Petroica phoenicea</i>	Flame Robin	Vulnerable			
				<i>Pezoporus wallicus</i> subsp. <i>wallicus</i>	Eastern Ground Parrot	Vulnerable			
				<i>Ptilinopus superbus</i>	Superb Fruit Dove	Vulnerable			
				<i>Stagonopleura guttata</i>	Diamond Firetail	Vulnerable			
				<i>Sternula albifrons</i>	Little Tern	Endangered			
				<i>Stictonetta naevos</i>	Freckled Duck	Vulnerable			
				<i>Tyto longimembris</i>	Eastern Grass Owl	Vulnerable			
				<i>Tyto novaehollandiae</i>	Masked Owl	Vulnerable			

Listed Under the EPBC Act and TSC Act				Listed under the TSC Act Only			Listed under the EPBC Act only		
Scientific Name	Common Name	Conservation Status (Cth)	Conservation Status (NSW)	Scientific Name	Common Name	Conservation Status	Scientific Name	Common Name	Conservation Status
				<i>Xenus cinereus</i>	Terek Sandpiper	Vulnerable			
Frogs									
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	Vulnerable	Vulnerable	<i>Crinia tinnula</i>	Wallum Froglet	Vulnerable			
<i>Litoria aurea</i>	Green and Golden Bell Frog	Vulnerable	Endangered	<i>Pseudophryne australis</i>	Red-crowned Toadlet	Vulnerable			
<i>Litoria raniformis</i>	Growling Grass Frog, Southern Bell Frog, Green and Golden Frog, Warty Swamp Frog	Vulnerable	Endangered	<i>Litoria brevipalmata</i>	Green-thighed Frog	Vulnerable			
<i>Mixophyes balbus</i>	Stuttering Frog	Vulnerable	Endangered						
<i>Mixophyes iteratus</i>	Giant Barred Frog	Endangered	Endangered						
Mammals									
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	Vulnerable	Vulnerable	<i>Cercartetus nanus</i>	Eastern Pygmy-possum	Vulnerable	<i>Pseudomys novaehollandiae</i>	New Holland Mouse	Vulnerable
<i>Dasyurus maculatus</i> subsp. <i>maculatus</i>	Spotted-tail Quoll	Endangered	Vulnerable	<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	Vulnerable			

Listed Under the EPBC Act and TSC Act				Listed under the TSC Act Only			Listed under the EPBC Act only		
Scientific Name	Common Name	Conservation Status (Cth)	Conservation Status (NSW)	Scientific Name	Common Name	Conservation Status	Scientific Name	Common Name	Conservation Status
<i>Isoodon obesulus</i> subsp. <i>obesulus</i>	Southern Brown Bandicoot	Endangered	Endangered	<i>Miniopterus australia</i>	Little Bentwing-bat	Vulnerable			
<i>Petaurus norfolcensis</i>	Squirrel Glider	Vulnerable	Vulnerable	<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat	Vulnerable			
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	Vulnerable	Endangered	<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	Vulnerable			
<i>Phascolarctos cinereus</i>	Koala	Vulnerable	Vulnerable	<i>Myotis macropus</i>	Southern Myotis	Vulnerable			
<i>Potorous tridactylus</i> subsp. <i>tridactylus</i>	Long-nosed Potoroo	Vulnerable	Vulnerable	<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	Vulnerable			
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	Vulnerable	Vulnerable	<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	Vulnerable			
Reptiles									
<i>Hoplocephalus bungaroides</i>	Broad-headed Snake	Vulnerable	Endangered	<i>Varanus rosenbergi</i>	Rosenberg's Goanna	Vulnerable			
Gastropods									
				<i>Meridolum corneovirens</i>	Cumberland Land Snail	Endangered			

Listed Under the EPBC Act and TSC Act				Listed under the TSC Act Only			Listed under the EPBC Act only		
Scientific Name	Common Name	Conservation Status (Cth)	Conservation Status (NSW)	Scientific Name	Common Name	Conservation Status	Scientific Name	Common Name	Conservation Status
Populations									
				Gang-gang Cockatoo population in the Hornsby and Ku-ring-gai Local Government Areas (<i>Callocephalon fimbriatum</i>)		Endangered	<i>Dasyurus maculatus maculatus</i> (SE mainland population)	Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll	Endangered
				Long-nosed Bandicoot population in inner western Sydney (<i>Perameles nasuta</i>)		Endangered			
				White-front Chat population in the Sydney Metropolitan Catchment Area (<i>Epthianura albifrons</i>)		Endangered			

(Mi) = migratory species as per the EPBC Act; (W) = migratory wetland species as per the EPBC Act

3.3 Marine Ecology

3.3.1 Threatened Marine Fauna

A summary of the vulnerable, endangered and critically endangered marine fauna known or predicted to occur in the vicinity of the Project Area is outlined in **Table 9**. **Table 14** of **Appendix B** provides an analysis of the likelihood of each of these species to occur on the actual Project Area.

The EPBC Protected Matters search tool identified nine marine fauna species listed under the EPBC Act that are known or likely to occur within the Locality. Some of those marine fauna species are also listed as migratory species under the EPBC Act (refer **Table 9**). The OEH's Atlas of Wildlife search did not identify any additional listed marine fauna species that have been listed under the TSC Act in addition to those returned via the EPBC Protected Matters search, as known or likely to occur within the Locality.

In total, the nine marine fauna species that were returned by the EPBC Protected Matters search tool, including:

- One bird species;
- Five reptile species; and
- Three bony fish.

There are no records of these marine fauna having been previously recorded in the Locality. All of these marine species were therefore ultimately assigned a low likelihood of occurring adjacent to, or at, the Project Area.

3.3.2 Marine Habitat Values

Typical marine flora that occurs in estuarine intertidal and subtidal habitats of Parramatta River – Sydney Harbour is predominantly comprised of saltmarsh, mangroves and seagrasses. As outlined in **Section 3.2.1** and demonstrated in **Figure 6**, the foreshore vegetation adjacent to the Project Area, as mapped by SMCMA (SMCMA, 2010) includes:

- Grey Mangroves (*Avicennia marina*);
- Coastal Saltmarsh (this vegetation also meets characteristics of the Endangered Ecological Community Themeda grassland);
- Swamp Oak Forest;
- Wetlands; and
- Phragmites Reedland.

There is also a remnant wetland located at the north-east boundary of the Project Area (refer **Figure 6**) and dominated by Swamp Oak and sclerophyll vegetation on the more elevated land surrounding the remnant wetland. Vegetation in the remnant wetland is dominated by Cumbungi (*Typha* spp), and dense growth of the introduced Spiny Rush (*Juncus acutus*).

Based on these flora assemblages, the following EECs providing marine habitat are therefore present at the Project Area:

- Sydney Freshwater Wetlands in the Sydney Basin Bioregion. These remnant EEC wetlands occur in the Project Area (refer **Figure 6**); and
- Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions. This riparian vegetation also meets characteristics of Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregion. These EEC saltmarshes occur along the foreshore vegetation fringing the Project Area (refer **Figure 6**).

Table 9 Marine Fauna listed as Vulnerable, Endangered and Critically Endangered under the EPBC Act and/or TSC Act within 10 km of the Project Area

Listed Under the EPBC Act and TSC Act				Listed under the TSC Act Only			Listed under the EPBC Act only		
Scientific Name	Common Name	Conservation Status (Commonwealth)	Conservation Status (NSW)	Scientific Name	Common Name	Conservation Status	Scientific Name	Common Name	Conservation Status
Birds									
							<i>Rostratula benghalensis (sensu lato)</i>	Painted Snipe (Mi)	Vulnerable
Marine Reptiles									
<i>Caretta caretta</i>	Loggerhead Turtle (Mi)	Endangered	Endangered				<i>Eretmochelys imbricata</i>	Hawksbill Turtle (Mi)	Vulnerable
<i>Chelonia mydas</i>	Green Turtle (Mi)	Vulnerable	Vulnerable				<i>Natator depressus</i>	Flatback Turtle (Mi)	Vulnerable
<i>Dermochelys coriacea</i>	Leatherback Turtle (Mi)	Endangered	Endangered						
Bony Fish									
							<i>Epinephelus daemeli</i>	Black Rockcod	Vulnerable
							<i>Prototroctes maraena</i>	Australian Grayling	Vulnerable
							<i>Macquaria australasica</i>	Macquarie Perch	Endangered

(Mi) = migratory species as per the EPBC Act

3.4 Migratory Species

3.4.1 Migratory Fauna

Searches using the EPBC Protected Matters search tool identified eight migratory species in addition to those that were already captured in the search for vulnerable, endangered or critically endangered as occurring within 10 km of the Project Area comprising:

- Fork-tailed Swift (*Apus pacificus*);
- Porbeagle, Mackerel Shark (*Lamna nasus*);
- White-bellied Sea-Eagle (*Haliaeetus leucogaster*);
- White-throated Needletail (*Hirundapus caudacutus*);
- Rainbow Bee-eater (*Merops ornatus*);
- Black-faced Monarch (*Monarcha melanopsis*);
- Satin Flycatcher (*Myiagra cyanoleuca*); and
- Rufous Fantail (*Rhipidura rufifrons*).

There were an additional 15 migratory wetland species also identified using the EPBC Protected Matters search tool as follows:

- Great Egret, White Egret (*Ardea alba*);
- Cattle Egret (*Ardea ibis*);
- Ruddy Turnstone (*Arenaria interpres*);
- Sharp-tailed Sandpiper (*Calidris acuminata*);
- Red Knot (*Calidris canutus*);
- Red-necked Stint (*Calidris ruficollis*);
- Double-banded Plover (*Charadrius bicinctus*);
- Latham's Snipe (*Gallinago hardwickii*);
- Grey-tailed Tattler (*Heteroscelus brevipes*);
- Bar-tailed Godwit (*Limosa lapponica*);
- Whimbrel (*Numenius phaeopus*);
- Pacific Golden Plover (*Pluvialis fulva*);
- Little Curlew, Little Whimbrel (*Numenius minutus*);
- Eastern Curlew (*Numenius madagascariensis*); and
- Marsh Sandpiper (*Tringa stagnatilis*).

Table 15 of Appendix B provides an analysis of the likelihood of each of these migratory and wetland species to occur on the actual Project Area.

The Great Egret has been previously recorded at the remnant wetlands in the north-east of the Project Area (refer **Figure 11**) during surveys conducted by Urban Bushland Management Consultants in 2005 (Urban Bushland Management Consultants, 2007).

Previous surveys conducted by Urban Bushland Management Consultants in 2005 also identified the Clamorous Reed-warbler (*Acrocephalus stentoreus*) as being present in these remnant wetlands (Urban Bushland Management Consultants, 2007). This species is listed as migratory under the EPBC Act, but was not returned by the EPBC Protected Matters search tool query of the Locality in September 2012.

None of the other migratory species listed above are known to have been previously recorded within the vicinity of the Project Area, and these remaining species were therefore all assigned a low likelihood of occurring at the Project Area.

3.4.2 Migratory Species Habitat Values

In addition to the habitat values detailed in **Section 3.2.4** in relation to terrestrial fauna and flora, migratory and/or wetland fauna species are known to rely on a range of habitats, including the following (SEWPAC, 2012b):

- Inland plains;
- Foothills;
- Billabongs;
- Saltpans;
- Inundated floodplains;
- Marine environments;
- Estuarine environments such as wetlands, mangroves, swamps, intertidal mudflats and saltmarshes;
- Sheltered coastal environments such as lagoons, estuaries, river mouths, deltas, lakes and inlets, coral reefs, platforms and shelves, tidal pools, beaches, cliffs, estuaries, bays, rocky islands, coastal scrub, and sand dune systems; and
- A variety of inland vegetated areas including wooded areas, open forests, rainforests, woodlands, grasslands and agricultural lands and shrub lands.

A variety of marine, estuarine, sheltered coastal and inland vegetated environments occur within the vicinity of the Project Area. The Project Area does contain estuarine and other inland vegetated areas. Most significantly, the Project Area contains the remnant wetlands in the north-eastern corner of the Project Area. Due to the wide-ranging nature of wetland and migratory species, it is therefore possible that individuals of these species may occur on the Project Area.

NGH Environmental also conducted a bird survey at the remnant wetland in 2008. This survey found that some of the wetland birds recorded at the Project Area represent those bird species that are only present when certain habitat requirements are fulfilled (i.e. Eurasian Coot (*Fulica atra*), Nankeen Night Heron (*Nycticorax caledonicus*), Black-fronted Dotterel (*Elseyornis melanops*) and species of Cormorants). Juvenile Eurasian Coots (*Fulica atra*) were also observed, confirming that the remnant wetland provides suitable breeding habitat for some wetland bird species. Other wetland bird species such as Egrets, Herons and Swans may also breed in such a wetland. The vegetated margins of the remnant wetland would provide excellent nesting habitat as well as sheltering habitat and protection from predators. The open water expanse of the remnant wetlands also provides foraging habitat for diving species such as Ducks, Coots, Grebes and Cormorants.

The remnant wetlands may therefore provide suitable habitat for a range of wetland bird species. However, the Project Area overall provides only limited habitat for these species.

The 2008 NGH Environmental survey also assessed the suitability of the Project Area to provide habitat for migratory shorebirds. This investigation found that the freshwater wetlands, mangroves and saltmarshes within and surrounding the Project Area provide important foraging, roosting and breeding habitat for a diverse range of bird species. Large numbers of migratory birds arrive in Sydney each spring as part of their annual return migration along the East Asia-Australasian Flyway (NGH Environmental, 2009). Sites such as the nearby Sydney Olympic Parkland provide known regular roosting and foraging sites for flocks of these birds. Relative to such high quality habitat, the mangroves of the Duck and Parramatta Rivers along the Project Area boundary are of lesser importance. However, given the highly industrialised and developed nature of the area, such environments are rare and are of value to species' foraging and breeding requirements that cannot be provided elsewhere (NGH Environmental, 2009).

The adjacent Duck River foreshores, some of which occur within the property boundary, contain a narrow fringe of swamp oak forest, bordered by mangroves and interspersed patches of saltmarsh and smaller areas of intertidal mudflats, which may provide habitat for wetland and wader birds. However these areas do not represent significant habitat for any of the migratory bird species considered. Furthermore, no direct or indirect disturbance of these habitats would result from the conversion works. As a precaution, mitigation measures outlined in **Section 5.0** would be implemented to avoid any indirect or residual impacts occurring for these species.

4.0 Impact Assessment

4.1 Potential Impacts to Terrestrial Flora and Fauna

Table 12 of Appendix B indicates the potential for each listed flora species and community identified within the Locality to actually occur on the Project Area. Of the 68 listed flora species and communities mapped as either predicted or being known to occur within the Locality, only seven have been previously recorded within the Project Area. **Table 13 of Appendix B** indicates the potential for each listed fauna species and population identified within the Locality to actually occur on the Project Area. Of the 79 listed fauna species and populations mapped as either predicted or being known to occur within the locality, only two of them have been previously recorded within the Project Area, with a further six listed fauna species having a medium likelihood of occurring on the Project Area.

4.1.1 Threatening Processes

Schedule 3 of the TSC Act identifies key threatening processes in NSW that are most likely to jeopardise the survival of threatened species, populations and ecological communities within NSW. The OEH's Atlas of Wildlife, (OEH, 2013a) was searched to determine the key threatening processes that are relevant to the Locality. These were found to be as follows:

- Alteration of habitat following subsidence due to longwall mining;
- Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands (as described in the final determination of the Scientific Committee to list the threatening process);
- Anthropogenic Climate Change;
- Bushrock removal;
- Clearing of native vegetation;
- Competition and grazing by the feral European Rabbit, *Oryctolagus cuniculus*;
- Competition and habitat degradation by Feral Goats, *Capra hircus*;
- Competition from feral honey bees, *Apis mellifera*;
- Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners;
- Herbivory and environmental degradation caused by feral deer;
- High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition;
- Importation of Red Imported Fire Ants *Solenopsis invicta*;
- Infection by Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species and populations;
- Infection of frogs by amphibian chytrid causing the disease *chytridiomycosis*;
- Infection of native plants by *Phytophthora cinnamomi*;
- Introduction of the Large Earth Bumblebee *Bombus terrestris*;
- Invasion and establishment of exotic vines and scramblers;
- Invasion and establishment of Scotch Broom (*Cytisus scoparius*);
- Invasion and establishment of the Cane Toad (*Bufo marinus*);
- Invasion of native plant communities by African Olive *Olea europaea* L. subsp. *cuspidata*;
- Invasion of native plant communities by *Chrysanthemoides monilifera*, which same species has also been previously recorded at the Project Area (by Urban Bushland Management Consultants, 2007);
- Invasion of native plant communities by exotic perennial grasses;
- Invasion of the Yellow Crazy Ant, *Anoplolepis gracilipes* (Fr. Smith) into NSW;

- Invasion, establishment and spread of Lantana (*Lantana camara* L. *sens. lat.*), which same species has also been previously recorded at the Project Area (by Urban Bushland Management Consultants, 2007);
- Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants;
- Loss of hollow-bearing trees;
- Loss or degradation (or both) of sites used for hill-topping by butterflies;
- Predation and hybridisation by Feral Dogs, *Canis lupus familiaris*;
- Predation by *Gambusia holbrooki* Girard, 1859 (Plague Minnow or Mosquito Fish), which same species has also been previously recorded at the Project Area (by Urban Bushland Management Consultants, 2007);
- Predation by the European Red Fox *Vulpes vulpes*; Predation by the Feral Cat *Felis catus*;
- Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa*; and
- Removal of dead wood and dead trees.

4.1.2 Potential Project Impacts

Of the potential key threatening processes listed in **Section 4.1.1**, the following were considered relevant to the current Project and are assessed in more detail within this **Section 4.1.2**.

Vegetation Clearing and Fragmentation

Many of the threats listed above in **Section 4.1.1** relate to direct impacts to terrestrial flora and fauna species through, for example, vegetation and habitat clearing. Shell undertakes ongoing bush regeneration in and around the vicinity of the Project Area (Programmed Property Services, 2011). Existing vegetation within the Project Area has also been historically subject to routine weed maintenance, including slashing and the safe use of herbicides to reduce potential fire hazards as part of the existing operation of the Clyde Terminal.

However the Project scope does not include removal of existing landscaping, peripheral trees or large shrubs. It is possible that occasional trees or shrubs may however be impacted due to their proximity to buildings and structures that are to be demolished. Any such clearing or root damage or retained vegetation would:

- Only be minimal and does not include any significant flora species, and
- Not lead to increased fragmentation of vegetation communities within the locality.

Likewise, habitat features beyond the boundary of the Project Area such as fallen timber, dead standing trees, termite mounds and rocks would not be removed as part of the Project. The current Project would remain within the environmental footprint of Shell's existing facilities at the Clyde Terminal. Native vegetation and existing habitats occurring outside of the Project Area would therefore not be cleared.

Deadwood and bushrock removal would not occur as part of the Project activities.

Staff and contractors would continue to access the Project Area using designated roads, as road access to the Clyde Terminal is well established, with the existing transport infrastructure adequate to service the construction activities that would occur at the Clyde Terminal during the demolition and construction activities. Project related traffic movements would be largely along the local high density industrial roads Devon, Durham and Colquhoun Streets.

Water Quality, Erosion and Sediment Control

The Project would also involve improvements to existing drainage and wastewater treatment systems, and is therefore not anticipated to impact water quality in the vicinity of the Project Area, or for the Duck and Parramatta River catchments.

The *Clyde Terminal Conversion Project: Clyde Waste Water Management System* (Shell, 2012) provides an overview of these proposed upgrades to wastewater management at the Project Area that would be undertaken as part of the Project. The catchment areas proposed for continued use would undergo minimal changes to their existing treatment facilities in order to ensure that wastewater continues to be effectively managed at the Project Area. Each catchment area currently in use has a combination of drainage classification as follows:

- Clean drain lines (underground) for clean stormwater would be directly discharged to the river;

- Continuous Oil Contaminated (COC) water would be captured via tank drainage; and
- Accidentally Oil Contaminated (AOC) water would be captured by open drains or underground drains, and then directed towards retention basins or the main interceptor header box (Shell, 2012).

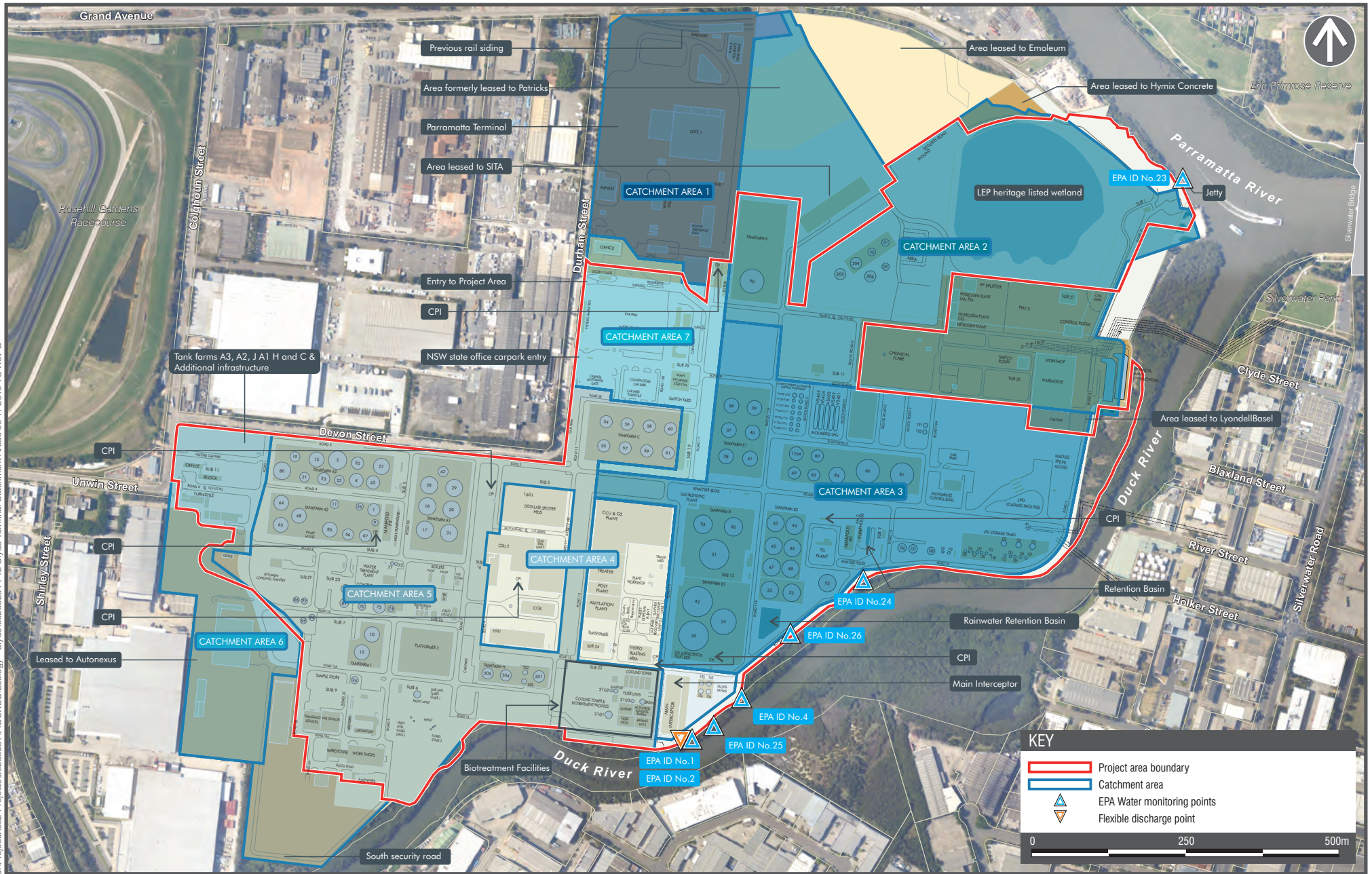
Drainage arrangements would be upgraded where required as part of the Project to minimise both COC and AOC waters. In particular, each bulk storage tank would be fitted with a quick flush tank to ensure tank bottoms and sumps are kept water free particularly after transfer from Gore Bay. Any water found in sumps would be diverted into the corresponding Corrugated Plate Interceptor (CPI) via pneumatic pumps. Clean and dry product would be returned to the tank from the quick flush tank via a sealed system and a separate pneumatic pump set (Shell, 2012).

Despite the upgrades to wastewater management at the Project Area, there is anticipated to be little change in stormwater runoff overall as the Project Area is largely hard surfaced already, and the volume of stormwater runoff generated at the Project Area is therefore not anticipated to increase or decrease significantly as a result of the Project. Potentially contaminated stormwater at the Project Area would continue to be captured and treated onsite, before being subsequently discharged offsite.

The demolition and construction activities also have the potential to generate dust and sediment runoff impacting on surface water quality at the Project Area. This can reduce the primary productivity of nearby plants and trees (i.e. through coating of leaves and reducing photosynthesis). However, a temporary elevation of dust levels would be unlikely to have a significant impact on the health of individual plants or flora species. Dust levels generated through demolition and construction activities also have the potential to further directly impact on surface water quality as treated process water that cannot be reused at the Clyde Terminal would continue to be discharged offsite to Duck River. However it is anticipated that the management measures outlined in **Section 5.6** would be adequate to mitigate any such impacts to a negligible level. Specific management measures to prevent asbestos dust being released at the Project Area are outlined in **Section 5.6**.

Shell's EPL 570 for the Clyde Terminal identifies pollutants of concern and related monitoring requirements in relation to water quality management at the Project Area. It also outlines the EPL 570 requirements for annual load limits, concentration limits for water quality parameters, and daily volume limits for water discharge from the Project Area. Shell would continue to undertake water quality and volume monitoring throughout the life of the Project as per these requirements of EPL 570 or any replacement EPLs as provided under the *Protection of the Environment Operations Act 1997*.

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CLYDE TERMINAL CATCHMENT AREAS
 Clyde Terminal Conversion Project
 Environmental Impact Statement

FIGURE 12

Changes to Landform

The Project would not result in significant changes to the natural landforms in the vicinity of the Project Area, for instance through longwall mining, altering natural flow regimes or by changing hilltop habitat areas.

Weed and Pathogen Disposal

Weed species within the Project Area are continually suppressed through regular site maintenance practices with weed infestations predominating on land external to the Project Area. Nevertheless, there remains the potential for site soils to contain weed seeds and propagules, and pathogens. Movement of soil by machinery can lead to transport of weeds and pathogens. Disturbance of soils can increase the amount of suitable habitat for the establishment and spread of weeds, which is a Key Threatening Process under the TSC Act.

Weed invasion can degrade fauna habitats and result in a reduction of plant species diversity. Weed thickets may reduce native wildlife diversity and can harbour feral animals such as foxes and rabbits. The adjacent foreshore areas and remnant wetland already suffers from serious weed infestations. Shell implements a weed control program at the Project Area which is necessary to reduce the build-up of potential fuel loads which pose a fire hazard risk. Shell has also implemented a bush regeneration program within the remnant wetland (Programmed Property Services, 2011). These programs will continue on an ongoing basis.

In combination with mitigation measures outlined in **Section 5.0**, it is unlikely that the proposed demolition activities and ongoing operation of the Clyde Terminal would result in the spread of weeds into, nor exacerbate existing weed infestations within, adjacent foreshore areas.

Soil borne pathogens include Root Rot Fungus *Phytophthora cinnamomi*, which is a Key Threatening Process under the TSC Act. Provided the recommended mitigation measures outlined in **Sections 5.4** and **5.5** are implemented, it is unlikely that the Project would result in the spread of potential pathogens.

Noise Levels

Noise and vibration impacts of the proposed Project are considered in **Section 22** of the EIS. Construction and demolition noise (including construction-generated traffic noise) is predicted to result in only minor temporary exceedances of relevant construction noise criteria, and construction and demolition vibration is predicted to cause only negligible impacts. It is not expected that the proposed modified operation would increase the noise impact compared to the current operation of the Clyde Terminal. Furthermore, prior operation of the Clyde Refinery included more noise sources which have already been decommissioned, therefore any resident fauna would be somewhat tolerant of current level of noise. Therefore any impacts from noise during construction and ongoing operation of the Project Area for fauna would be minimal.

Additional Potential Terrestrial Impacts

The Project is not anticipated to result in significant impacts for threatened terrestrial flora and fauna species based on assessment of the additional threatening processes listed in **Section 4.1.1** due to the following:

- Any excavation activities undertaken at the Project Area as part of the Project would be minimal, and as such no significant land filling would be required. Mitigation measures have been identified in the unlikely event that excavation works would intercept acid sulphate soils (refer **Section 5.6**);
- Shell has in place an extensive waste management plan to manage wastes that are generated onsite, and to prevent practices such as illegal dumping;
- The increase to traffic movements to and from the Project Area would be temporary for the demolition and construction phases of the Project, and would not result in a significantly increased risk to fauna mortality through vehicle collision;
- The Project is not anticipated to significantly impact on, nor itself be impacted by, climate change;
- The Project would not involve the commissioning of significant new infrastructure at the Project Area so would not alter the potential for flighted species to collide with fences, windows, powerlines and nets, etc.;
- As the Project is not anticipated to result in the loss of habitat to surrounding areas, it is also not anticipated to encourage the colonisation by invasive fauna species of nearby areas;
- Garden variety flora species would not be planted at the Project Area, reducing the possibility for escaped garden plants to colonise their habitats;
- The Project would have a negligible impact on recreational use of surrounding natural areas; and

- The Project is also unlikely to increase the chances of feral fauna species being present in the Project Area or its surrounds.

4.1.3 Likelihood of Occurrence

The analysis conducted in **Table 12** and **Table 13** of **Appendix B** confirms that the majority of terrestrial species identified as being known or predicted to occur within the Locality have a low likelihood of actually occurring on the Project Area. However, seven listed flora species and communities and two listed fauna species have been previously recorded at the Project Area. A further six listed fauna species were designated a medium likelihood of occurring at the Project Area.

As explained in detail below, none of these seven flora species and communities would be significantly affected from the demolition and construction activities of the Project, or operation of the modified terminal. Furthermore, the majority of fauna species are also considered unlikely to be impacted on by the Project works, or by the ongoing operation of the converted Clyde Terminal. This is largely due to the absence of significant habitat features for those species within the Project Area.

The Project was considered to have some residual potential to impact on Microbat species as well as the Grey-headed Flying-fox. However, these impacts are unlikely, would not be significant, and are furthermore capable of being mitigated to an extremely low and unlikely level of impact.

The GGBF is the only fauna species that was considered to have the potential to experience significant impacts as a result of the Project. However, with the mitigation measures in **Section 5.1** in place, the Project is ultimately considered to not significantly impact on that species. A significant impact criteria assessment has been prepared as per the EPBC Act for GGBF, in order to confirm whether the Project thereby constitutes a controlled activity in relation to GGBF. An assessment of significance (seven-part test) pursuant to the TSC Act has also been prepared for this species and is included as **Appendix D**. The EPBC referral also considered the residual potential for the Project to result in significant impacts for Grey-headed Flying Fox. The EPBC referral found that this species would not be significantly impacted on as a result of the Project. Assessments of significance (seven-part test) pursuant to the TSC Act were also prepared for Grey-headed Flying Fox and several Microbat species. These seven-part tests also found that no significant impacts are predicted for those species.

4.1.4 Downy Wattle (*Acacia pubescens*)

This species is known from the remnant wetland in the northeast of the Project Area and would not be affected by the proposed demolition and ongoing operational activities of the Project. Further an ongoing bush regeneration program at this location provides for the protection and ongoing conservation of the species (Programmed Property Services, 2011). On this basis, an assessment of significance (seven-part test) pursuant to the TSC Act and a significant impact criteria assessment pursuant to the EPBC Act are not required for this species (refer **Figure 6** and **Figure 8**).

4.1.5 Narrow-leafed Wilsonia (*Wilsonia backhousei*)

This species occurs within the intermittent areas of saltmarsh along the foreshore fringing the Project Area and would not be affected by the proposed demolition and ongoing operational activities of the converted Clyde Terminal (refer **Figure 6** and **Figure 8**).

As per **Sections 4.1.2** and **4.2** it is unlikely that this species would be impacted upon as a result of the Project. Therefore an assessment of significance (seven-part test) pursuant to the TSC Act is not required for this species.

4.1.6 Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

This EEC occurs as intermittent stands along the foreshore and within the remnant wetland in the Project Area and as intermittent stands along the foreshore of both Duck and Parramatta Rivers (refer **Figure 6**). Remnant Swamp Oak trees also line the boundary fence line adjacent Duck River, in the south western corner of the site. As these trees are continuous with vegetation within the foreshore, they are considered constituent of this community. These trees would not be removed as part of the Project (refer **Section 4.1.2**), and providing the mitigation measures outlined in **Section 5.0** are implemented, the Project would not have a significant impact on this EEC. Therefore an assessment of significance (seven-part test) pursuant to the TSC Act is not required for this EEC.

4.1.7 Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions is listed as an EEC under the TSC Act.

Sclerophyll vegetation has been previously recorded in the forested section of the remnant wetlands in the Project Area. However this would not be removed as part of the Project (refer **Section 4.1.2**), and providing the mitigation measures outlined in **Section 5.0** are implemented, the Project would not have a significant impact on this EEC. Therefore an assessment of significance (seven-part test) pursuant to the TSC Act is not required for this EEC.

4.1.8 Sydney Freshwater Wetlands in the Sydney Basin Bioregion

Remnant EEC wetlands occur in the north-east section of the Project Area (refer **Figure 6**). However this vegetation would not be directly impacted on during the Project as vegetation clearing at the remnant wetlands would not be undertaken. Clean water only would continue to be discharged to these remnant wetlands. With the mitigation measures outlined in **Section 5.0** the Project would therefore not have a significant impact on this EEC. Therefore an assessment of significance (seven-part test) pursuant to the TSC Act is not required for this EEC.

4.1.9 Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregion/Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions.

These EEC saltmarshes occur as intermittent patches along the foreshore of both Duck and Parramatta Rivers but are not within the direct footprint of the proposed project works (refer **Figure 3**). As per **Sections 4.1.2** and **4.2** it is unlikely that this EEC would be indirectly impacted upon as a result of the Project. Therefore an assessment of significance (seven-part test) pursuant to the TSC Act is not required for this EEC.

4.1.10 Grey-headed Flying-fox (*Petaurus poliocephalus*)

The Grey-headed Flying-fox is known to have been previously recorded at several locations near the Project Area. It has also potentially been observed overflying the Project Area. This species is known to occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy (OEH, 2013b). The remnant wetland and large Fig tree within the Project Area may provide foraging habitat for the species (refer **Section 3.2.6**).

Overall this species is therefore unlikely to be affected directly or indirectly by the proposed Clyde Terminal conversion. However individuals of this species may dwell opportunistically at the Project Area, use the limited habitat available in the remnant wetlands, and to occasionally roost within the stacks at the Project Area. An assessment of significance (seven-part test) pursuant to the TSC Act (refer **Appendix D**) and an assessment of significant impact pursuant to the EPBC Act were prepared for this species. As per the significant impact criteria assessment pursuant to the EPBC Act for Grey-headed Flying Fox, the following assessment was undertaken:

Would the Project:

- **Lead to a long term decrease in the size of an important population of the species?**
- **Reduce the area of occupancy of an important population?**
- **Fragment an existing important population into two or more populations?**

No/Unlikely:

As per the assessment conducted by Eco Logical (refer **Appendix D** and **Section 3.2.6**), the Project Area was not found to contain significant habitat for the Grey-headed Flying-fox, and therefore no important population of the species can be said to be reliant upon habitat at the Project Area. This species is therefore unlikely to be affected directly or indirectly by the proposed Clyde Terminal conversion. Nevertheless, Grey-headed Flying-fox individuals may still use the Project Area opportunistically, and as such, mitigation measures have been recommended to ensure that the species is not impacted on by the Project.

- **Adversely affect habitat critical to the survival of the species?**

No:

Given that Grey-headed Flying Foxes are likely to only use the Project Area opportunistically, and also given the quality of alternative nearby habitat for the species, it is unlikely that any Grey-headed Flying Fox habitat impacted as a result of the Project would be critical to the survival of this species.

- ***Disrupt the breeding cycle of an important population?***
- ***Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?***

No:

There is limited potential breeding habitat for the species available at the Project Area (e.g. in the remnant wetlands). However this is considered unlikely: Grey-headed Flying Foxes tend to breed in camps of hundreds of individuals. Any such activity is therefore likely to have been noticed by Shell personnel or during ecological surveys conducted in the past. It is therefore highly unlikely that the Project would disrupt the breeding cycle of this species, notwithstanding that no important population of Grey-headed Flying Fox has been recorded at the Project Area.

- ***Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat?***

No:

The Project is not predicted to result in the increased presence of any invasive species that are harmful to the presence of Grey-headed Flying Fox. Feral species such as cats, foxes, mice and weeds have been previously recorded at the Project Area, but their presence would increase from the Project activities.

- ***Introduce disease that may cause the species to decline?***

No:

This is not considered to be relevant for Grey-headed Flying Fox at the Project Area.

- ***Interfere substantially with the recovery of the species?***

No:

This is not considered to be relevant for Grey-headed Flying Fox at the Project Area.

4.1.11 Microbats

Historical (anecdotal) evidence of small bats nesting in an area of external casing to a tall concrete stack within the Project Area was further investigated by Eco Logical Australia (2012). As the area of interest is not able to be accessed safely by sub-contractors, Shell personnel undertook site inspections and Eco Logical Australia (2012) provided a desktop assessment to determine the likelihood of any potential for threatened Microbat species to still use the Project Area.

Eco Logical Australia (2012) found that the Project Area contains limited roosting habitat for certain species of Microbats including Eastern False Pipistrelle, Eastern Bentwing-bat, Southern Myotis and Greater Broad-nosed Bat. Although a large amount of foraging habitat (mangroves) and other man-made structures such as bridges and culverts that contain potential roosting habitat occur along Duck River for both the Eastern Bentwing-bat and Large-footed Myotis (refer **Section 3.2.3**). The full report is appended (**Appendix C**). An assessment of significance (seven-part test) test pursuant to the TSC Act has also been prepared for these species (refer **Appendix D**). These assessments have concluded that there is unlikely to be significant impacts to Microbat habitat as a result of the Project, due to the following factors:

- The stacks and buildings currently being absent of bats;
- The likely historic use of the stacks being opportunistic and in response to a local food source;
- The availability of other man-made or potential artificial bat roosts in the area (e.g. along Duck River); and
- The highly industrialised and urbanised context and lack of native vegetation in the vicinity.

Additionally, mitigation measures (refer **Section 5.2**) including monitoring for evidence of Microbats prior to demolition works commencing, which, if found, would trigger the need for further investigation.

4.1.12 Green and Golden Bell Frog (*Litoria aurea*)

As outlined in **Section 3.2.5**, the Project Area is reported to contain a key Parramatta population of the GGBF (Department of Environment and Climate Change NSW, 2008c). Several past records of the GGBF from within the Project Area were recorded in 1999, 2000 and 2005. Two sites were found to contain live frogs in October 2012. However in the past, operational management has required that most bunded tanks and

associated drainage lines are routinely drained following rainfall. Thus potential habitat for frogs is no longer present in a number of locations where they have been previously recorded.

Under Commonwealth policy (Department of Environment, Water, Heritage and Arts, 2009b), the possibility of a significant impact on the GGBF, prompting a referral under the EPBC Act, should be considered if the action may result in:

- The removal or degradation of aquatic or ephemeral habitat either where the GGBF has been recorded since 1995 or habitat that has been assessed as being suitable according to the Policy statement;
- The removal or degradation of terrestrial habitat within 200 metres of suitable habitat; or
- Breaking the continuity of vegetation-fringing ephemeral or permanent waterways or other vegetated corridors linking habitats meeting the criteria above.

It is noted that the *Significant Impact Guidelines for the Vulnerable Green and Golden Bell Frog (Litoria aurea) Nationally Threatened Species and Ecological Communities EPBC Act Policy Statement 3.19* (Department of Environment, Water, Heritage and Arts, 2009b) recognises that relocation of GGBF individuals cannot be considered to be a mitigation measure, as it does not of itself reduce the impact of an action. This Project would involve the relocation of potentially impacted GGBFs into the remnant wetlands at the Project Area as part of managing Project impacts to the species. Given the fact that the areas where GGBF would be removed from do not provide overly suitable habitat values, and that the maintenance of these areas of habitat would not be reasonable and feasible, relocation is considered a suitable management option for the species at this location. The action of relocation itself would not constitute a significant impact (i.e. controlled action) when compared against the significant impact assessment criteria outlined below.

The remnant wetland, where GGBF were detected during October 2012, is not the subject of the proposed conversion works, and it does not form part of its works footprint (refer **Figure 3**). Changes to runoff and drainage volumes to the remnant wetland are not expected to occur as a result of the Project, as clean surface water only would continue to be discharged to this area. Furthermore a groundwater barrier (constructed from butyl sheeting to a maximum depth of 3m) was installed by Shell in the mid-1980s, directly west, northwest and north of the remnant wetlands to inhibit potential groundwater and contaminant migration into those remnant wetlands (ERM, 2012a). A recent assessment of chromium conditions within stormwater and surface water drainage lines in 2010, at the request of EPA, have not identified conditions considered significant enough to warrant further investigation (ERM, 2012a). It is therefore considered unlikely that the remnant wetland/mangrove sites along the boundary of the Project Area, being partially groundwater dependent ecosystems, would be significantly impacted on through chromium contamination at the Project Area. The cleansing of demolition and construction plant and equipment to reduce the likelihood of the spread of pathogens and diseases also has the potential to contaminate waterways and aquatic ecosystems at the Project Area. However, such plant and equipment would be undertaken at a safe distance from the remnant wetland, so that excess disinfecting solution or material does not contaminate those ecosystems. This remnant wetland in the north-east of the Project Area is also not connected via industrial drainage to the operational sections of the Clyde Terminal, further reducing the likelihood of such impacts to occur.

The GGBF individuals would be relocated to the remnant wetlands which contain natural, suitable GGBF breeding habitats (refer to **Plate 3** and **Plate 4**), the removal of artificial GGBF habitat (refer to **Plate 1** and **Plate 2**) that may be used for breeding purposes would not significantly impact on the species.

It is noted that the *Significant Impact Guidelines for the Vulnerable Green and Golden Bell Frog (Litoria aurea) Nationally Threatened Species and Ecological Communities EPBC Act Policy Statement 3.19* (Department of Environment, Water, Heritage and Arts, 2009b) recognises that relocation of GGBF individuals cannot be considered to be a mitigation measure, as it does not of itself reduce the impact of an action. This Project would involve the relocation of potentially impacted GGBFs into the remnant wetlands at the Project Area as part of managing Project impacts to the species. Given the fact that the areas where GGBF would be removed from do not provide overly suitable habitat values, and that the maintenance of these areas of habitat would not be reasonable and feasible, relocation is considered a suitable management option for the species at this location. The action of relocation itself would not constitute a significant impact (i.e. controlled action) when compared to the significant impact assessment criteria outlined below.

As indicated in **Table 6** the GGBF surveys conducted in October 2012 did not establish evidence of GGBFs being present around Tank 52, the Mobil Tankfarm, and Tankfarm E1. However, these survey findings cannot definitely rule out the possibility of GGBF being present in those sections of the Project Area, either now or in the future.

Due to the scientific uncertainty that this presents, the precautionary principle should therefore be applied. As such, it has been recommended that a suitably qualified ecologist be engaged prior to the issue of final plans for demolition to identify any GGBFs in these locations. This EPBC referral therefore considers that the proposed Project is more likely than not to cause impacts to GGBF, but that these impacts would not be significant impacts given:

- The intensity, duration, magnitude and geographic extent of the impacts would be limited to the Project Area, within which the GGBFs would be relocated to better suited habitat. Whilst the demolition and construction works would take around 2.5 years to complete, the demolition of tanks and modification works for the drainage of tankfarms providing potential GGBF habitat features would be undertaken over a much shorter timeframe (a few months);
- The sensitivity, value and quality of the environment on and around the site: as noted above, any GGBF habitat around tankfarms as identified above is not compatible with supporting viable sub-populations of GGBF into the future, and it is not feasible to promote the conservation of this species at the Project Area into the future through the preservation of redundant tankfarms. The relocation of GGBFs to the remnant wetlands and the ongoing preservation and enhancement of the remnant wetland area provides better suited habitat for the GGBFs at the Project Area, and is more capable of promoting their long-term survival than through the use of tankfarm habitat;
- The impacts of the proposed Project are not considered to result in cumulative effects either onsite or offsite for the GGBFs. This is due to the fact that the predicted impacts of the Project for GGBF are confined to direct onsite impacts. The most ideal, remnant wetland GGBF habitat at the Project Area would also not be directly or indirectly impacted on as vegetation clearing in the remnant wetlands would not be undertaken. Clean water only would continue to be discharged to these remnant wetlands as part of the surface water management of the converted Clyde Terminal. The EIS has further considered the potential for the Project to result in cumulative environmental impacts given other planned developments proposed within the vicinity of the Camellia Industrial Estate, where the Clyde Terminal is located. These developments are considered unlikely to result in cumulative impacts for the Camellia key population of GGBFs; and
- There are no other matters of NES that are predicted to be impacted on as a result of the proposed Project.

The tankfarms representing the locations of GGBF sightings since 1995 do not represent pristine habitat (refer to **Plate 1** and **Plate 2**). The proposal includes the demolition of some of the tankfarms or modification works to improve drainage in tankfarms containing operational tanks (converted for the proposed fuels). It is not viable to retain tanks proposed to be demolished as redundant infrastructure for the purposes of providing potential GGBF habitat given the potential occupational health and safety considerations.

In addition, once translocated by a qualified ecologist (if indeed found to be at the tankfarm areas) and the tank areas are modified or demolished, those areas will cease to represent preferred habitat. The remnant wetlands, which would not be impacted by this project and to which any identified frogs would be translocated, represents far superior habitat for a GGBF population. It also represents an area that can be maintained and managed by Shell as viable habitat for this purpose.

Specifically with regards to GGBF, this Ecological Assessment has concluded that while the Project would impact previously identified GGBF sighting locations, those impacts would not be significant. This is due to the fact that the minimising and management mitigation measures proposed in **Section 5.1** are anticipated to bring the unavoidable predicted impacts below the level of significant impact. It is therefore concluded that the Project is properly characterised as not being a controlled action, provided that those recommended mitigation measures are undertaken. Furthermore, the assessment of significance (seven-part tests) prepared for this species under the TSC Act (refer to **Appendix D**) has also confirmed that, while the Project would impact on the species, these impacts would not be significant with the proposed mitigation measures in place.

As per the significant impact criteria assessment pursuant to the EPBC Act for GGBF, the following assessment was undertaken:

Would the Project:

- ***Lead to a long term decrease in the size of an important population of the species?***

Unlikely:

Based on the factors considered below, it is considered unlikely that the Project would lead to a long term decrease in the GGBF population size at the Project Area or within the Camellia Industrial Estate. The demolition

and construction works themselves would only be temporary, and the ongoing operation of the Clyde Terminal would not cause significant impacts to the population that are above and beyond the operational effects of the Clyde Terminal on the population currently (i.e. operational noise, vibration, lighting and vehicular movements).

- **Reduce the area of occupancy of an important population?**

Yes:

The environment within the tankfarms is an artificial environment for the GGBF. These areas are currently subjected to significant operational activities both in routine operations and with weekly, monthly, annual and longer term maintenance activities which will not change. The Project activities have been assessed as unlikely to have a significant effect on the natural habitats of the GGBF as the natural habitats of these frogs will remain untouched by the project works and the continuing operations and maintenance activities.

Of the known and potential habitat areas for the GGBF, only Tank 52 and the Mobil Tankfarm lie within the proposed Project conversion footprint scheduled for demolition works. Tank 52 is unlikely to provide suitable ongoing habitat for GGBF and, no prior records of the species occurring at this location exist. Regardless, all potential habitat areas that are scheduled for works within the Project Area would be subject to pre-demolition surveys, including Tank 52. There are no records of GGBF occurring at the Mobil Tankfarm since 1999, and the degraded nature of the Mobil Tankfarm ponded water currently provides less than optimal habitat conditions for GGBF. For a summary of the areas of known and potential GGBF habitat that would be impacted on, refer to **Table 10**.

Table 10 Summary of Impacts to Known and Potential Green and Golden Bell Frog Habitat at the Project Area

Area	Impact on GGBF
Remnant wetlands	Habitat would not be directly removed or degraded by the Project. No indirect impacts to habitat are anticipated, as clean water only would continue to be discharged to these remnant wetlands as part of the surface water management of the Clyde Terminal. Due to the groundwater barrier currently in place, it is not anticipated that potential groundwater contamination at the Camellia Industrial Estate would impact on these remnant wetlands. No in-soil contaminants migration is anticipated as there is underground barrier works existing between the remnant wetlands and the rest of the site.
Tankfarm B	Habitat removal through minor changes to improve water drainage within Tankfarm B.
Tank 52	Habitat removal due to the potential demolition of Tank 52. However, this area is currently considered unsuitable for GGBF.
Mobil Tankfarm	Habitat removal due to the removal of ponded water, and the demolition of all tanks.
Tankfarm E1 (including Tanks 36-41)	Tanks 40 and 41 are proposed to be demolished. However, this area is currently considered unsuitable for GGBF.
Eastern portion of the site subject to demolition	No impacts anticipated. No GGBF were identified during the surveys and no potential habitat is present. Current status of the site is sealed roads and hardstand. Demolition of infrastructure would be to grade and the site would remain sealed and stable.
Shoreline comprising terminal boundary along Duck River	No impacts anticipated as no direct works will be undertaken in this area and any potential secondary impacts (water run-off etc.) would be controlled as part of the works. In addition, there have been no previous sightings of the GGBF along this shoreline and the recent survey by AECOM did not identify any GGBF.

Any such GGBF habitat around tankfarms as identified above is not compatible with supporting viable sub-populations of GGBF into the future as they lay over ground cover by clay to make the area impervious as requested by the NSW Liquid Chemical Storage, Handling and Spill Management practices. Therefore, it is not feasible to promote the conservation of this species at the Project Area into the future. Prior to the issue of final plans for Project execution, a suitably qualified ecologist would therefore be engaged by Shell to identify and, if necessary, relocate frogs from these areas proposed for demolition or modification works for tank bund draining. These GGBF individuals would be relocated to the remnant wetlands within the Project Area, which is where this sub-population is most likely to be centred around. As noted above, this remnant wetland area is not part of the project activities and would not be impacted by construction or operations. The remnant wetland, where GGBF were detected during October 2012, is not the subject of the proposed conversion works, and it does not form part of its works footprint (refer **Figure 3**). Changes to runoff and drainage volumes to the remnant wetland are not expected to occur as a result of the Project, as clean surface water only would continue to be discharged to this area. Furthermore a groundwater barrier (constructed from butyl sheeting to a maximum depth of 3m) was installed by Shell in the mid-1980s, directly west, northwest and north of the remnant wetlands to inhibit potential groundwater and contaminant migration into those remnant wetlands (ERM, 2012a). A recent assessment of chromium conditions within stormwater and surface water drainage lines in 2010, at the request of EPA, have not identified conditions considered significant enough to warrant further investigation (ERM, 2012a). It is therefore considered unlikely that the remnant wetland/mangrove sites along the boundary of the Project Area, being partially groundwater dependent ecosystems, would be significantly impacted on through soil and groundwater contamination at the Project Area.

The cleansing of demolition and construction plant and equipment to reduce the likelihood of the spread of pathogens and diseases also has the potential to contaminate waterways and aquatic ecosystems at the Project Area. However, such plant and equipment would be undertaken at a safe distance from the remnant wetland, so that excess disinfecting solution or material does not contaminate those ecosystems. This remnant wetland in the north-east of the Project Area is also not connected via industrial drainage to the operational sections of the Clyde Terminal, further reducing the likelihood of such impacts to occur.

Whilst the Project would impact on known and potential GGBF habitats (refer **Table 10**), with the proposed mitigation measures in place it is unlikely that these impacts would be significant.

- ***Fragment an existing important population into two or more populations?***

No:

The species is also generally known to have the potential to disperse widely (it is known to have travelled between 1-3 km in a single day or night: DEWHA, 2009b), and the species is known to utilise both aquatic and terrestrial corridors for movement between habitats. The remnant wetlands in the north-east corner of the Project Area are known to be the primary location of GGBF at the Project Area. It is therefore most likely that the dispersion of GGBF within the Project Area is centred on the remnant wetlands in the north-east, and takes place throughout select sections of the eastern half of the Project Area on occasion. Indeed, it is unlikely that GGBF disperses into the western half of the Project Area, given that there are no previous records of GGBF occurring there (GGBF has only been previously recorded in the eastern half of the Project Area) and also that there are no suitable habitat locations within that section of the Project Area. The infrastructure in the western portion of the Project Area would be almost completely demolished, whereas only selected pieces of infrastructure in the eastern half of the Project Area would be demolished.

As already stated, GGBF is known to disperse along both aquatic and terrestrial corridor. However due to the fact that vegetation clearing would not occur at the remnant wetlands or mangrove areas, there would be no breaking of the continuity of waterways or established terrestrial and aquatic corridors as a result of conversion works.

As such, the Project is unlikely to fragment existing GGBF populations into separate sub-populations, as corridors of GGBF dispersion would not be impacted on.

- ***Adversely affect habitat critical to the survival of the species?***

No:

The known and potential GGBF habitats at the Project Area that would be affected by the Project (refer **Table 10**) are not considered to be critical to the survival of this species.

- ***Disrupt the breeding cycle of an important population?***

Unlikely:

The GGBF individuals would be relocated to the remnant wetlands which contain natural, suitable GGBF breeding habitats, the removal of artificial GGBF habitat that may be used for breeding purposes would not significantly impact on the species.

- ***Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?***

No:

The artificial GGBF habitat around tankfarms identified in **Table 10** is not compatible with supporting viable sub-populations of GGBF into the future as they lay over ground cover by clay to make the area impervious as requested by the NSW Liquid Chemical Storage, Handling and Spill Management practices. Therefore, it is not feasible to promote the conservation of this species at the Project Area into the future. GGBF individuals found at tankfarms before demolition and modification works would be relocated to the remnant wetlands within the Project Area, which is where this sub-population is most likely to be. This remnant wetland is actually considered to provide better quality habitat for the species. As such, the species would not decline in the area as a result of the Project.

- ***Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat?***

No:

There is some potential for the Project to result in the introduction of more weeds into the Project Area. However, with the mitigation measures outlined in **Section 5.4**, this is considered unlikely.

- ***Introduce disease that may cause the species to decline?***

Unlikely:

It should also be noted that any type of demolition and construction activities have the potential to spread pathogens and diseases that may be harmful to native species. In relation to frogs, the spread of Chytrid Fungus is considered to be a key threatening process under the *Threatened Species Conservation Act 1995* (NSW). The OEH's Atlas of Wildlife, (OEH, 2013a) was searched to determine the key threatening processes that are relevant to the Locality, and Chytrid Fungus was recognised to be a key threatening process relevant to the Locality. However the Project would be undertaken in accordance with the *Frog Hygiene Protocol* (Department of Environment and Climate Change, 2008d) in order to prevent the potential for Chytrid Fungus to be spread to individual GGBFs at the Project Area. Further details of measures that would be implemented as per the Frog Hygiene Protocol are provided in **Section 5.1**.

- ***Interfere substantially with the recovery of the species?***

No.

4.2 Potential Impacts to Marine Species

4.2.1 Marine Fauna Species

Table 14 of **Appendix B** indicates the potential for each marine fauna species identified within the Locality to actually occur adjacent to the Project Area. Of the nine marine fauna species mapped as either predicted or being known to occur within the Locality, none of them have been previously recorded within the Locality or the Study Area.

4.2.2 Likelihood of Occurrence

Ultimately all of those nine marine species were determined to have a low likelihood of occurring on the Project Area. It is unlikely that these marine species would commonly occur within the waters adjacent to the Project Area or, that if they did, they would not be directly impacted by the Project during the demolition and construction phase or the operation of the modified terminal. The greatest risk would relate to rare events resulting in offsite emissions derived from an unplanned release or discharge which is managed through fuel farm tank design, management plans and operational measures.

4.2.3 Threatening Processes

There are no identified threats unique to marine species under the EPBC Act that are relevant to species within the Locality, and which have not already been discussed within **Sections 4.1.1** and **4.1.2** (SEWPAC, 2012b).

Potential indirect impacts to aquatic ecology from the proposed demolition activities could only result from sedimentation and erosion from construction areas and/or the spillage of fuels and chemicals.

Structures that are proposed to be demolished are currently protected by a combination of bunds and internal drainage interceptors where spills can be contained and prevented from entering adjacent watercourses and thereafter the estuary. In combination with the implementation of recommended mitigation measures outlined in **Section 5.0** it is unlikely that any indirect impacts on adjacent watercourses would occur as a result of the Project.

The adjacent foreshore contains dense stands of mangroves. Mangroves are, by definition 'marine vegetation' and protected under the FM Act. Mangroves are sensitive to water pollution, particularly smothering of pneumatophores (breathing tubes) of mangroves by sedimentation. No direct disturbance of mangroves would result from the Project. Due to the current program of water quality management onsite (refer **Section 4.1.2**) in combination with the implementation of recommended mitigation measures outlined in **Section 5.0** it is unlikely that mangroves would be impacted upon as a result of the Project and approval under the FM Act is not required.

4.3 Potential Impacts to Migratory and Wetland Species

4.3.1 Migratory and Wetland Fauna Species

Table 15 of Appendix B indicates the potential for each migratory and/or wetland species that was identified within the Locality, other than those that have already been assessed as threatened species, to actually occur on the Project Area. Of the 24 migratory and wetland species mapped as either predicted or being known to occur within the Locality, only two of these migratory species have been previously recorded at the Project Area.

4.3.2 Likelihood of Occurrence

Great Egret (Ardea alba)

The Great Egret has been previously recorded at the remnant wetlands in the north-east of the Project Area during surveys conducted by Urban Bushland Management Consultants in 2005 (Urban Bushland Management Consultants, 2007). The species is known to occur in freshwater wetland habitats. However, the wetland habitat that is likely to be used by this species would not be impacted on during the Project. As such, the Project would not impact on this species.

Clamorous Reed-warbler (Acrocephalus stentoreus)

The Clamorous Reed-warbler has been previously recorded at the remnant wetlands in the north-east of the Project Area during surveys conducted by Urban Bushland Management Consultants in 2005 (Urban Bushland Management Consultants, 2007). This species is also known to utilise wetland habitats. Again, as the Project would not impact on the quality of this remnant wetland habitat, no impacts are predicted for this species.

None of the other identified migratory and wetland species have been previously recorded in the Locality, the Study Area or the Project Area. As outlined in **Section 3.4.2**, the Project Area does contain estuarine and other inland vegetated areas which provide some suitable habitat features for many migratory and migratory wetland species. However the remainder of the Project Area contains limited habitat for these migratory bird species. Due to the wide-ranging nature of wetland and migratory species, it is acknowledged that individuals of these species may occur on the Project Area during movement between other sites, or occasionally for opportunistic foraging. In some circumstances, migratory bird species may also utilise the remnant wetlands for breeding and foraging habitat. However, no direct or indirect disturbance of these habitats would result from the conversion works. As a precaution, mitigation measures outlined in **Section 5.0** would be implemented to avoid any indirect or residual impacts occurring for these species.

4.3.3 Threatening Processes

There are no identified threats unique to migratory and/or wetland species under the EPBC Act that are relevant to species within the Locality, and which have not already been discussed within **Sections 4.1.1 and 4.1.2** (SEWPAC, 2012b). With the mitigation measures outlined in **Section 5.0** the Project is considered to have a negligible impact on migratory and wetland species in the vicinity of the Project Area. As per the significant impact criteria assessment pursuant to the EPBC Act for the two EPBC listed migratory bird species listed in **Section 4.3.2**, the Project would therefore not:

- Lead to a long term decrease in the size of an important population of the species;
- Reduce the area of occupancy of an important population;
- Fragment an existing important population into two or more populations;
- Adversely affect habitat critical to the survival of the species;
- Disrupt the breeding cycle of an important population;
- Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
- Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat;
- Introduce disease that may cause the species to decline; and
- Interfere substantially with the recovery of the species.

5.0 Mitigation Measures

Potential impacts on the GGBF and other biota likely to be within the Project Area would be managed through development of the following mitigation measures. For the conversion works, measures shall be incorporated into a Construction Environmental Management Plan (CEMP), which is to be developed specifically for the proposed conversion works. The proponent would be responsible for ensuring that conversion works comply with the CEMP and that, during the operations of the converted Clyde Terminal, plans are adopted for management of biota as part of the ongoing Operational Environment Management Plan (OEMP) for the site. The following mitigation measures also would form part of the proponent's Summary of Mitigation Measures within the proposal's EIS.

5.1 Green and Golden Bell Frog

Broadly, the key principles for mitigation measures in relation to GGBF in the *Significant Impact Guidelines for the Vulnerable Green and Golden Bell Frog (Litoria aurea) Nationally Threatened Species and Ecological Communities EPBC Act Policy Statement 3.19* (Department of Environment, Water, Heritage and Arts, 2009b) are:

- Avoid;
- Minimise; and
- Manage.

Avoidance of Impacts

The Project has been designed so as to avoid impacts to the remnant wetland in the north-east of the Project Area, and also to the riparian vegetation running along Duck and Parramatta Rivers. These remnant wetlands provide the most superior habitat values for GGBF at the Project Area, and the riparian vegetation along the rivers is likely to provide corridors for GGBF dispersion.

As per **Figure 3**, these environments are located outside of the area of direct impact of the Project.

It is, however, not possible to avoid all of the anticipated impacts to GGBF habitat resulting from this Project, as it is impractical from an operational, environmental and safety point of view to continue to maintain redundant tank infrastructure providing artificial GGBF habitat, particularly given that the Project Area already contains suitable GGBF habitat within its remnant wetland area. Indeed, existing habitat within the Project Area, external to the managed remnant wetland, appears incompatible with supporting viable populations of the GGBF into the future, and cannot feasibly be managed long term to balance species conservation and site operations through the use of tankfarm.

Indeed, operational safeguards at the Clyde Terminal discourage the ponding of tankfarms as this decreases the ability of bunds to manage tank spills and overflows. The upgrading of these tank bund drainage systems is yet another safety and environmental improvement that Shell is seeking to implement as part of the proposed Project.

Minimisation of Impacts

It is, however, possible to minimise the predicted impacts of the proposed Project as outlined herein. The measures recommended here have been used successfully to mitigate impacts on the GGBF under similar circumstances (e.g. Sydney Olympic Park, Homebush Bay).

The proposed mitigation measures aim to:

- Improve upon existing known core habitat and known populations at the remnant wetland;
- Remove other threats to the long term viability of the species at the Project Area; and
- Promote the species' occupancy of a location which is isolated from the operations of the Clyde Terminal, while retaining linkages to littoral conditions and corridors within the security of controlled tenure on the Project Area. Under these conditions the GGBFs present at the Project Area can be better managed over time.

Appropriate design to compensate for loss of potential GGBF habitat within certain tankfarms stated in **Section 3.2.5** would be developed in consultation with NSW OEH and SEWPAC. The most practical method to minimise and manage the unavoidable loss of ephemeral waters ponded within tank bunds would be additional restoration and improvement of existing core GGBF habitat within and surrounding the likely population centred

on the Project Area, being the remnant wetland. That remnant, within the Project Area boundary, can be conserved into the future to provide with greater habitat certainty for the GGBF without:

- Impacting on existing established Clyde Terminal operations, or
- Being directly impacted on by future anticipated commercial development of the Project Area, either by Shell or future landowners.

A GGBF specific mitigation strategy is to be prepared and included as a sub-plan to the CEMP for the proposed Clyde Terminal conversion, in consultation with the NSW Office of Environment and Heritage (OEH).

The CEMP GGBF sub-plan shall include, but not be limited to:

- Design and implementation of pre-works surveys (conducted by a suitably qualified ecologist) to identify and, if necessary, relocate frogs found and other potential habitat within the footprint of the actual conversion works. Ecologists conducting pre-clearance surveys must have current section 132C licence (NP&W Act) and pre-clearance survey experience;
- It is proposed that any frogs found would be relocated to the remnant wetland (within the Project Area boundary), so therefore would not require licensing for translocation of threatened species under the NSW TSC Act. Licensing would be required if, alternatively, frogs are proposed to be relocated to another location external to the Project Area (pers.comm. A. White 2012);
- The Frog Hygiene Protocol (Department of Environment and Climate Change, 2008d) is to be followed at all times if and when frogs are being handled, rescued or relocated. This is to minimise the risks associated with Chytrid Fungus spores or other pathogens between aquatic habitats and sites of frog habitation, which would include, amongst other things, following such key frog hygiene practices as:
 - Recognising and demarcating boundaries of site works so that measures can be undertaken to prevent the spread of infections;
 - The cleansing and disinfecting of footwear, equipment and vehicles when moving between different areas of the Project Area, or when moving such equipment on and off of the Project Area itself;
 - Handling GGBF individuals only when necessary, and the separation of individual GGBFs from each other during transit; and
 - Use of the cleansing and disinfecting agents specified in the Frog Hygiene Protocol.

Compensatory actions considered to date for the loss of opportunistic habitat sites within certain tankfarm bunds include those in accordance with Shell's *Wetland Management Plan – Clyde Wetlands Shell Refinery Rosehill, 2007*. This management plan would be updated to include management measures for GGBF, and would continue to be applied to the remnant wetlands as follows:

- Creation and management of refuge habitat such as rock piles (being a less complicated refuge habitat option) for long term placement within the subject areas to provide over-wintering habitat;
- Replacement of non-endemic vegetation such as *Juncus acutus* (Spiny rush) within the remnant wetland with alternative native sedges, rushes and grasses to provide GGBF shelter habitat;
- Additional enhancement of land within the boundary of the remnant wetland to suit GGBF habitat such as developing additional pondage and/or by the placement of smaller prefabricated ponds (illustrated in DECCW, 2008b, and successfully demonstrated at Sydney Olympic Park) to provide additional habitat during breeding season; and
- Design and implementation of a systematic monitoring, reporting and feedback program to assess GGBF relocation, mitigation measures undertaken, and population dynamics for this site as part of the Parramatta Key Population, in accordance with the *Management Plan for the Green and Golden Bell Frog Parramatta Key Population* (Department of Environment and Climate Change, 2008c).

Management of Impacts

A suitably qualified ecologist is to be engaged prior to the issue of plans for demolition and modification works to improve tankfarm drainage to advise on the following:

- The final proposed works reduce the risk of potential impacts to GGBF, and
- A GGBF specific mitigation strategy, included as a sub-plan to the CEMP for the proposed Clyde Terminal conversion, in consultation with the NSW Office of Environment and Heritage (OEH).

The CEMP GGBF sub-plan is to be prepared in accordance with the following documents:

- *Green and Golden Bell Frog Litoria aurea (Lesson 1829) Draft Recovery Plan* (Department of Environment and Conservation, 2005a);
- *Threatened Species Assessment Guidelines: the Assessment of Significance* (Department of Environment and Climate Change, 2007);
- *Management Plan for the Green and Golden Bell Frog Key Population of the Georges River* (Department of Environment and Climate Change, 2008b);
- *Best practice Guidelines Green and Golden Bell Frog Habitat* (Department of Environment and Climate Change, 2008a); and
- *Threatened Species Management Information Circular No. 6: Hygiene Protocol for the Control of Disease in Frogs* (Department of Environment and Climate Change, 2008d).

CEMP GGBF sub-plan is also to include:

- Management of site demolition and construction works such that disinfection of demolition and construction plant and equipment is carried out at a safe distance from the remnant wetland, so that excess disinfecting solution or material does not contaminate waterways; and
- Site inductions for all workers are to include emphasis on the special requirements for identifying and protecting GGBF. Inductions are to be mandatory prior to access permission to the construction site. Routine updates of the induction are to be provided at routine 'toolbox' meetings.

5.2 Grey-headed Flying-Fox/Microbat Inspections

Prior to demolition works, inspection of exterior casings and insulations on stacks (i.e. potential habitat where Microbats have historically been observed) is to be undertaken by a qualified ecologist for buildings scheduled for demolition which are not subject to heat and gas emissions common to the stacks (e.g. disused buildings). After demolition and construction works have been undertaken, regular inspections should also be undertaken by Shell staff for signs of Microbat presence in Terminal infrastructure. Evidence of Grey-headed Flying-fox/Microbat presence, which should be reported and further investigated if found, are summarised in **Table 11**.

Table 11 Grey-headed Flying-fox/Microbat Inspection Signs (Eco Logical, 2012)

Microbat Sign	Evidence
Visual	Obvious clusters of bats or singular dark spots should be investigated as potential roosting bats.
	Bats may be seen leaving and returning to roosts around dusk and dawn.
Audible	Bats, when roosting, will periodically emit a chatter type noise.
Guano	If bats are utilising a roost, even as intermittent roost, guano will occur immediately under the roost site, large permanent roosts will accumulate considerable volumes of material.
Staining	Where bats frequently access a roost this area become stained over time by guano and urine.
Bird Nests	Earth constructed bird nests of swallow or fairy martin are relatively common structures as some bat species will utilise disused nests as an interim roost.

5.3 Protection of Flora

While it is recognised that the proposed Clyde Terminal conversion would require negligible vegetation clearing, the following measures are recommended to ensure that minimal potential impacts occur to vegetation in and adjacent to the proposed works areas:

- There is to be clear marking and delineation of the boundaries between the designated construction sites and “no-go” zones, including vegetation that is to be retained, prior to the commencement of construction. This is to include signage, barrier fencing and tree guards, wherever they would be appropriate. There is to be no storage of soil, building materials, tools, paints, fuel or contaminants, etc. within the no-go areas;
- The Australian Standard 4970 (AS4970) for the protection of trees on development sites should be adopted to reduce the impact of incursions into the root zone of trees to be retained;
- Shell would continue to undertake ongoing bush regeneration in and around the vicinity of the Project Area;
- If any damage occurs to vegetation beyond the nominated work area the Project Manager should be notified so that appropriate remediation strategies can be developed and implemented; and
- The riparian vegetation along the southern and eastern borders of the Project Area would continue to be preserved as follows:
 - Contaminated stormwater and wastewater generally would continue to be treated before they are discharged in the vicinity of this riparian buffer zone;
 - Infrastructure at the Project Area would continue to be located outside of this riparian buffer zone; and
 - The Project would not result in a reduction of wetland or riparian vegetation.

5.4 Weed Management

The following measures would be put in place to manage weeds:

- Any weed infestations found within the Project Area would be removed or controlled prior to works commencing;
- Earth-working equipment and vehicles would be cleaned of excess soil by brushing and/or hosing at the start and finish of construction works to minimise the risk of spreading of weed seeds and plant pathogens;
- Sediment fences and sediment traps would be installed for the duration of the construction works and stabilisation of disturbed areas by rehabilitation works. This is to contain any sediments containing weed seeds, propagules or plant pathogens at the Project Area;
- Any soil and vegetation removed would be covered during transport and taken to approved disposal sites to minimise the risks of spreading weeds and pathogens beyond the work sites;
- Weeds (including vegetation, fruit and seed) removed during clearance would be disposed at an approved green waste site. Weed seed heads or flowers should be carefully removed and bagged immediately onsite before appropriate disposal;
- Where applicable, weed control would be undertaken in accordance with NSW Agriculture’s noxious and environmental weeds control handbook; and
- Contractors undertaking weed removal or control would be trained or experienced in weed identification and removal (as per the *Pesticide Act 1999*).

5.5 Plant Pathogen Hygiene

Phytophthora cinnamomi is not known to be present in the Project Area and there is little likelihood that the proposed Project would lead to its establishment or spread. However, the consequences of infection can be severe. Therefore, the mitigation proposed for consideration for weed management would also provide a precautionary measure for limiting the risk of spread of soils and vegetation of origin other than the Clyde Terminal.

5.6 Protection of Aquatic Environments

The following measures are recommended to minimise potential impacts to aquatic flora and fauna and water quality of the aquatic environment of the Duck and Parramatta Rivers.

- The *Clyde Terminal Conversion Project: Clyde Waste Water Management System* (Shell, 2012a) would be revised once the demolition and construction activities are complete, so that it is up to date for the operation of the fully converted Clyde Terminal;
- A detailed sediment and erosion management plan is to be compiled and included in the Construction Environmental Management Plan;
- Construction and demolition waste would be stored in an undercover enclosed facility or on a sealed and bunded surface whilst awaiting transfer or processing;
- Dust suppression and sediment runoff prevention would be undertaken during the demolition and construction phases of the Project to prevent impacts to surface water quality as follows:
 - Areas of demolition and construction activities would be watered down as required in order to suppress the migration of dust;
 - In the event that excess industrial water is required, e.g. for dust suppression, sediment traps would be employed around the Project Area to prevent runoff and ensure that any contaminated water is treated and managed appropriately;
 - Where excavation activities are undertaken soil exposure would be minimised where possible and land disturbance would occur for the shortest time possible. Access to the demolition and construction areas would be controlled and vehicles and machinery would be kept to well defined areas away from excavation sites;
 - Runoff generated outside of demolition and construction areas would be diverted away from those areas to decrease the potential for contaminated runoff to migrate throughout the Project Area; and
 - Stockpiles of excavated material would be clearly labelled, located away from trafficked areas and other potential disturbances, placed on geo-fabric lining and covered to prevent leachate and erosion, be no more than 3-5 m tall, and allow adequate room for transport around and management of each stockpile.
- Any wastewater that has been potentially contaminated during the demolition and construction phases of the Project would be directed via CPIs to allow for sediment and oil to be removed;
- Surface water quality and volume limits for discharge from the Project Area would continue to be monitored, for example as per the sampling of discharge points identified in EPL 570, or any replacement EPLs as provided under the POEO Act;
- Temporary stormwater management measures (such as sandbags, sediment fences and berms), are to be used to minimise the risks of sediment-laden runoff and other construction pollutants entering downstream systems;
- During demolition works, all potential chemical pollutants (e.g. fuels, oils, lubricants, paints, herbicides, etc.) are to be stored in appropriate containers within bunded areas within construction compounds to minimise the risk of spillages and mobilisation of these pollutants into aquatic environments;
- Any wastewater that has been potentially contaminated during the demolition and construction phases of the Project would be directed via CPIs to allow for sediment and oil to be removed;

- All fuel products and other potentially hazardous substances at the Project Area would continue to be stored in sealed, bunded areas that would prevent their migration offsite in the event that a storm surge or flood event impacts the Project Area;
- Acid sulphate soils (ASS) would be managed according to an Acid Sulphate Soils Management Plan (ASSMP) which would be incorporated into the existing *Soil and Groundwater Management Plan Shell Clyde Refinery and Parramatta Terminal, Durham Street, Rosehill, NSW* (Shell, 2010), the *Waste Management Procedure: Shell Clyde Refinery (Australia) Pty Ltd* and the CEMP to be prepared for the conversion works. Confirmation of the presence of ASS at the Project Area is a data gap that Shell would investigate further before excavation activities are undertaken. If ASS is excavated at the Project Area, it would be kept wet at all times until it is disposed of, and generally managed in accordance with the *Waste Classification Guidelines Part 4: Acid Sulphate Soils* (Department of Environment and Climate Change, 2008e). Any residual impacts caused by lapses in the effectiveness of the ASSMP are likely to be identified through the continued implementation of the Soil and Groundwater Management Plan. The ASSMP would also include a contingency plan to manage impacts that have the potential to occur if specified management strategies fail, and to outline any remediation and restoration actions that may therefore be required. This would ensure that the ASSMP addresses its own effectiveness and reliability in managing any residual ASS impacts; and
- The riparian buffer zone along the southern and eastern borders of the Project Area, which has the potential to further minimise the impacts of flooding at the Project Area, would continue to be preserved as follows:
 - Contaminated stormwater and wastewater generally would continue to be treated before they are discharged in the vicinity of this riparian buffer zone;
 - Infrastructure at the Project Area would continue to be located outside of this riparian buffer zone; and
 - The Project would not result in a reduction of wetland or riparian vegetation.

6.0 Conclusion

This Ecological Assessment has determined that the Project is unlikely to have a significant impact on any matters protected under the EPBC Act, TSC Act, or FM Act, providing the mitigation measures recommended in **Section 5.0** are implemented. These measures have been developed to avoid, minimise, mitigate and manage the potential impacts of the Project.

At the time of finalising this assessment, a referral to the Commonwealth has also been prepared for submission to SEWPAC. The purpose of the referral is to determine whether the Project will need formal assessment and approval under the EPBC Act in relation to the potential for impacts to GGBF. There are a number of possible decisions that can be made in relation to the referral, as follows:

1. The proposed action is NOT LIKELY to have a significant impact and does NOT NEED approval.
No further consideration is required under the environmental assessment provisions of the EPBC Act and the action can proceed (subject to any other Commonwealth, state or local government requirements).
2. The proposed action is NOT LIKELY to have a significant impact IF undertaken in a particular manner.
The action can proceed if undertaken in a particular manner (subject to any other Commonwealth, state or local government requirements). The particular manner in which you must carry out the action will be identified as part of the final decision. You must report your compliance with the particular manner to the Department.
3. The proposed action is LIKELY to have a significant impact and does NEED approval.
If the action is likely to have a significant impact a decision will be made that it is a controlled action. The particular matters upon which the action may have a significant impact (such as World Heritage values or threatened species) are known as the controlling provisions.
The controlled action is subject to a public assessment process before a final decision can be made about whether to approve it. The assessment approach will usually be decided at the same time as the controlled action decision.
4. The proposed action would have UNACCEPTABLE impacts and CANNOT proceed.
The Minister may decide, on the basis of the information in the referral, that a referred action would have clearly unacceptable impacts on a protected matter and cannot proceed.

The referral has predicted that the Project is NOT LIKELY to have a significant impact IF undertaken in a particular manner. This is due to a commitment by Shell, to develop and implement GGBF management strategy (refer **Section 5.1**). The strategy would be developed in consultation with OEH and SEWPAC and prepared in accordance with relevant government guidelines and best practices. A formal systematic monitoring program would be implemented to ensure the efficacy of mitigation and management activities to the satisfaction of OEH.

The referral also considered potential impacts to Grey-headed Flying Fox, and concluded that the Project would not result in any significant impacts to this species.

Assessments of significance (seven-part tests) were also prepared for the Grey-headed Flying Fox, Microbats and the Green and Golden Bell Frog (refer **Appendix D**). These assessments of significance yielded similar results to those obtained from the significant impact criteria assessment pursuant to the EPBC Act; that the Project is unlikely to significantly impact on these species.

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