Modification Report

Viva Energy Clyde Terminal SSD 5147 Modification Works (MOD1)

14-Jan-2019
Prepared for – Viva Energy Australia Pty Ltd – ABN: 46 004 610 459

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Client: Viva Energy Australia Pty Ltd

ABN: 46 004 610 459

Prepared by

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Statement of Validity

Submission of Modification Report

Prepared to support the application to modify State Significant Development 5147 under section 4.55 (1A) of the *Environmental Planning and Assessment Act 1979.*

Submission of Modification Report prepared by:

Role	**Project Director**	**Project Manager**	**Lead EIS Author**
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Address	AECOM Australia Pty Ltd Level 21 420 George Street Sydney NSW 2000		

In respect of:

Applicant and Land Details

Applicant	Viva Energy Australia Pty Ltd Durham Street Rosehill NSW 2142
Subject	Viva Energy is seeking to modify the development consent for the Clyde Terminal Conversion Project (State Significant Development (SSD) 5147) under section 4.55 (1A) of the *Environmental Planning and Assessment Act 1979.*
Project Summary	Viva Energy is proposing to modify development consent SSD 5147 to allow for: • demolition of six additional structures; • retention of two storage tanks; and • amendment or removal of 14 conditions of consent and 5 other updates to the development consent. The additional demolition works are all located within the Project Area for SSD 5147.
Lot and DP	Lot 100/DP1168951

Modification Report

A Modification Report (MR) is attached. The MR assesses the likely environmental impacts of the modification under Section 4.12(8) of the *Environmental Planning and Assessment Act 1979*.

Declaration

I certify that I have prepared the contents of this MR in accordance with the requirements of the *Environmental Planning and Assessment Act 1979* and *Environmental Planning and Assessment Regulation 2000* and that, to the best of my knowledge, the information contained in this report is not false or misleading.

Signature: **Date:** January 2018

Name: William Miles

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Abbreviations

Key terms	Definition
the 'Conversion Project'	The conversion of the Clyde Refinery for use as an efficient finished petroleum products terminal capable of supporting the growth of the NSW economy through the efficient storage and distribution of finished petroleum products. The Conversion Project was consented under SSD 5147.
the 'modification works'	These works involve the demolition and removal of additional redundant infrastructure including: • State office building; • MTS1 33 kV switch yard; • Tank 106 (slops tank); • two LPG spheres; and • LPG truck loading gantry. The works also include: • the retention of Tanks 40 and 41 in tank farm E1 (previously consented under SSD 5147 for demolition); and • amendments or deletion of several conditions of consent.
the 'Conversion Project Area'.	The Clyde Terminal consisting of parts of the lots located at 9 Devon Street Rosehill: • Lot 100, DP 1168951 • Lot 1, DP 383675 • Lot 101, DP 809340 • Lot 2, DP 224288 Note: Lot 100 of DP 1168951, forming the majority of the Site was formerly Lot 1 of DP 109739 and was subdivided into Lot 100 and Lot 101 of DP11 DP 1168951.

Acronym	Definition
AEP	Annual Exceedance Probability
ASS	Acid Sulfate Soils
BC Act	*Biodiversity Conservation Act 2016*
BLEVE	Boiling Liquid Expanding Vapour Explosion
BMP	Biodiversity Management Plan
Burra Charter	*The Australian ICOMOS Charter for Places of Cultural Significance*
Coastal Management SEPP	*State Environmental Planning Policy (Coastal Management) 2018*
COCs	Contaminants of Concern
CSM	Conceptual Site Model
dB	Decibel
DoEE	Commonwealth Department of Environment and Energy
DP	Deposited Plan
DPE	NSW Department of Planning and Environment
DWP	Demolition Work Plan
EEC	Endangered Ecological Community

Acronym	Definition
EIS	Environmental Impact Statement
EMM	Environmental Management Manual
EMS	Environmental Management Strategy
EP&A Act	*Environmental Planning and Assessment Act 1979*
EP&A Regulation	*Environmental Planning and Assessment Regulation 2000*
EPA	NSW Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPL	Environment Protection Licence
ERA	Environmental Risk Assessment
ESD	Ecologically Sustainable Development
FHA	Final Hazard Analysis
GGBF	Green and Golden Bell Frog
Heritage Act	*Heritage Act 1977*
HIPAP	*Hazardous Industry Planning Advisory Papers No. 4 – Risk Criteria for Land Use Safety Planning*
ICNG	*EPA Interim Construction Noise Guidelines*
IPC	Independent Planning Commission
IAQM	Institute of Air Quality Management
km	Kilometre
kV	Kilovolt
LEP	*Parramatta Local Environmental Plan 2011*
LGA	Local Government Area
LNAPL	Light Non Aqueous Phase Liquids
LPG	Liquefied Petroleum Gas
m	Metre
mbgl	Metres Below Ground Level
MHF	Major Hazard Facility
ML	Megalitres
MNES	Matters of National Environmental Significance
MR	Modification Report
NML	Noise Management Level
NW Act	*Noxious Weeds Act 1993*
OEH	Office of Environment and Heritage
PCC	Parramatta City Council
PM_{10}	Particulate matter with an aerodynamic diameter less than or equal to 10 micrometres
POEO Act	*Protection of Environment Operations Act 1997*
PoM	Green and Golden Bell Frog Plan of Management (Biosphere, 2013)

Acronym	Definition
SEPP	State Environmental Planning Policy
SEPP 33	*State Environmental Planning Policy 33 – Hazardous and Offensive Development*
SEPP 55	*State Environmental Planning Policy 55 – Remediation of Land*
Sherpa	Sherpa Consulting Pty Ltd
Shell	Shell Refining (Australia) Pty Ltd
SoHI	Statement of Heritage Impact
SSD	State Significant Development
Sydney Harbour SREP	*Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005*
Viva Energy	Viva Energy Australia Pty Ltd
WH&S Act	*Work Health and Safety Act 2011*

Executive Summary

ES 1 Introduction

Viva Energy Australia Pty Ltd (Viva Energy) owns and operates the Clyde Terminal on land associated with the former Clyde Refinery. The refinery was previously used for refining operations including hydrocarbon processing, fuel storage and fuel transfer. In 2015, development consent was granted for the Clyde Terminal Conversion Project (State Significant Development (SSD) 5147) (the 'Conversion Project'). The objective of the Conversion Project was to establish an efficient finished petroleum products terminal, capable of supporting the growth of the NSW through the efficient storage and distribution of finished petroleum products.

The process to convert the refinery to a terminal has involved a number of related activities including upgrades and improvements to operational infrastructure and demolition and removal of redundant tanks and other infrastructure. The Conversion Project is almost complete and the majority of terminal assets have been consolidated and/or upgraded where necessary, and much of the redundant refinery infrastructure has been demolished and removed.

Following internal review of future operations at the Site, Viva Energy has identified additional works that are required to achieve the objectives of the Conversion Project including demolition of six redundant structures and retention of two tanks (the 'modification works'). In addition, Viva Energy would like to modify condition of consent B6 to extend the approved period for completing construction works from 4 years to 5 years. Viva Energy is also proposing to amend or delete a number of conditions.

Viva Energy is seeking a modification to development consent SSD 5147 under section 4.55 (1A) of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the proposed modification works. This modification is sought as the works are a continuation of the Conversion Project, are likely to be the same scale as previously consented and would only result in minimal environmental impacts. The end result of these works would be substantially the same development as the approved Conversion Project under SSD 5147.

This Modification Report (MR) has been prepared to support the modification application for the demolition works. This MR considers a range of relevant environmental, safety, legal, social and economic impact related to the modification works. Potential impacts are identified and where necessary avoided, mitigated or offset.

ES 2 Modification Need and Alternatives

Review of the future operations at the Clyde Terminal by Viva Energy has resulted in the requirement for the modification works outlined in this MR. The modification works share the objective of the Conversion Project in that the purpose of the works is to ensure that Viva Energy operate an efficient finished petroleum product terminal at Clyde.

Maintaining redundant infrastructure would require ongoing maintenance which would have an associated cost. Maintaining infrastructure which serves no purpose would not be in line with the objective of the Conversion Project as it would affect the efficiency of the terminal and could potentially impact worker safety.

The retention of two tanks originally proposed for demolition under the Conversion Project is also proposed. As such these tanks would not be demolished as previously consented by SSD 5147. The retention of additional tanks would improve operational flexibility thereby allowing the terminal to operate more efficiently.

The modification to condition of consent B6 is proposed to allow the GGBF habitat restoration works at the Wetland Area to be completed following delays in finalising the design.

The other conditions proposed to be deleted or amended have been completed or are largely complete and these changes would simplify compliance requirements in the future.

ES 3 Site Location and Existing Environment

The Clyde Terminal is located on the Camellia peninsular, approximately 16 kilometres (km) west of the Sydney Central Business District, within the Parramatta Local Government Area (LGA). The terminal is surrounded by a mixture of land uses but is primarily in an industrial setting. The main access to the terminal is located on Durham Street in Rosehill, NSW. The terminal includes the Conversion Project Area, which is the land to which SSD 5147 applies. The Conversion Project Area is legally described under six Lot and deposited plan (DP) numbers, as listed in **Section 2.1.1** of this MR. The modification works would be located in the central and eastern portions of the Conversion Project Area (**Figure 1-1**).

ES 4 Project and Modification Works Description

Approved Project

Viva Energy received development consent for the Conversion Project in January 2015 (SSD 5147). The majority of terminal assets have been consolidated into the new terminal footprint and have been upgraded where necessary. The demolition works were split into two phases. The majority of the phase 1 works are now complete. The phase 2 works will be completed in the next six to nine months.

Modification Works

The modification works would broadly involve the following activities:

- Demolition of the state office building – the main administrative building for the terminal. This building is a three storey brick and concrete office building built in 1986. It is located in the northwest part of the Conversion Project Area;
- Demolition of MTS1 33 kV switch yard – located immediately to the south of the state office building;
- Demolition of Tank 106 (slops tank) – located in the southern part of the Conversion Project Area towards Duck River;
- Demolition of Two LPG spheres (V137 and V140) – located in the southeast of the Conversion Project Area towards Duck River;
- Demolition of the LPG truck loading gantry – located in the east of the Conversion Project Area close to the banks of Duck River; and
- Retention of Tanks 40 and 41 and continued use for gasoline storage.

The demolition elements of the modification works would commence alongside or just after the consented phase 2 demolition works and be completed as part of the Conversion Project. These additional demolition works are expected to commence in the first quarter of 2019 and are anticipated to occur over eight weeks. The modification works would be undertaken in accordance with the existing Demolition Work Plan (DWP) and associated sub-plans where applicable.

In addition, Viva Energy are proposing to modify condition of consent B6 to allow the GGBF habitat restoration works at the Wetland Area to be completed following delays in finalising the design. Viva Energy is also proposing to amend or delete a number of conditions to simplify compliance requirements in the future.ES 5 Legislation and Planning Policy

A modification through section 4.55 (1A) of the EP&A Act, requires that aspects of the modification works that may have environmental, social or economic impacts that differ from those previously assessed for SSD 5147, are required to undergo assessment in line with section 4.15 of the EP&A Act.

Under section 4.15 of the EP&A Act, the modification works must be evaluated against a range of considerations including environmental planning instruments, NSW *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation), the likely environmental, social and economic impacts of that development, the suitability of the Site, and the public interest. In order to comply with the requirements for assessing this type of modification, a MR must be prepared and submitted alongside the Modification Application.

A complete account of relevant Commonwealth, State and local government legislation and policy is provided in **Chapter 5.0 Legislation**.

ES 6 Consultation

The objective of consultation to date has been to provide information to, and understand the concerns of, the various key stakeholders.

Chapter 6.0 Consultation presents a list of the key comments raised during the consultation process and identifies where issues have been addressed in this MR.

ES 7 Environmental Scoping Assessment

In order to assess the potential environmental impact of the modification works, a number of key environmental issues have been identified through a scoping process. A qualitative risk assessment was then undertaken to determine the key issues and prioritise the scope of work for each environmental aspect. This risk assessment considered issues raised by relevant stakeholders and in main EIS. This assessment guided the assessments presented within this MR.

ES 8 Hazards and Risk

Sherpa Consulting Pty Ltd (Sherpa) updated the Final Hazard Analysis (FHA) Report for the Conversion Project to incorporate the modification works (Sherpa, 2018). The FHA provides detailed risk analysis for potential hazards related to the Conversion Project including the relevant modification works. It identifies possible causes of potential incident scenarios and their consequences to public safety and the biophysical environment.

The FHA concludes that as a result of the proposed modification works the terminal would continue to comply with all relevant risk criteria. Under SEPP 33, the terminal continues to be considered potentially hazardous and potentially offensive.

The removal of the LPG infrastructure has resulted in a reduction in the risk profile for the Site compared to the Conversion Project SSD 5147. The LPG Boiling Liquid Expanding Vapour Explosion (BLEVE) hazard from operation of LPG infrastructure was previously identified as one of the main contributors to offsite fatality risk. This risk would be reduced as part of this modification.

As part of the process of analysing the hazards relevant to the demolition works a number of risk reduction measures were identified and are summarised in **Chapter 15.0 Revised Management and Mitigation Measures**.

ES 9 Air Quality and Odour

Air emissions associated with the modification works are likely to be generated by a variety of on-site activities relating to the demolition of redundant structures. The primary emissions identified for such works consist of dust particulates.

Through applying the assessment methodology outlined by the United Kingdom (UK) Institute of Air Quality Management (IAQM), the unmitigated risk of air quality impacts during demolition has been predicted to be negligible for dust soiling on people and property, and human health.

The implementation of mitigation measures listed in **Chapter 15.0 Revised Management and Mitigation Measures** would ensure minimal offsite impact from the proposed modification works.

ES 10 Noise and Vibration

The activities and equipment proposed for the demolition works are consistent with those assessed for the Conversion Project. The works would be undertaken within the program of the approved Conversion Project. While the specific works locations are not the same, the modification works are located within the SSD 5147 boundary previously assessed. The noise impacts of the modification works are not expected to be significantly different to those reported in the original assessment.

In addition, the modification works would be undertaken over a limited duration of up to 8 weeks and as such, any additional impacts over consented conversion works would be of a relatively short duration. Whilst the modification works are predicted to at times result in minor exceedances of noise management levels at the closest residential receivers, the predicted noise levels are anticipated to be short in duration, during standard daytime construction hours and do not exceed the highly noise affected 75 dBA noise criterion from the Interim Construction Noise Guideline.

Noise from the modification works would be managed in accordance with measures included in the existing Demolition Noise Management Plan including the measures specified in **Chapter 15.0 Revised Management and Mitigation Measures**.

ES 11 Ecology

The proposed modification works would predominantly take place on parts of the Conversion Project Area that have been subject to historical vegetation clearing. The demolition of the State office building would require clearing of planted exotic and native vegetation, consisting of landscaped gardens that do not constitute any recognised plant community type. Nonetheless, vegetation clearing would be minimised as far as practical during demolition activities.

The majority of the Conversion Project Area is highly modified with generally very low habitat value for native fauna including the Green and Golden Bell Frog (GGBF) and Grey-headed Flying-fox. The loss of vegetation around the State Office Building is unlikely to result in a significant impact upon the Grey-headed Flying-fox. A target GGBF habitat assessment was undertaken which also concluded that the landscaped areas around the State Office Building contain a low GGBF habitat value based on the absence of relevant habitat features.

It is suspected that the main GGBF population on the Conversion Project Area inhabit the wetland area in the northeast. Given there will be no impact upon the wetland area as a result of the modification works the potential for impacts upon GGBFs arising from these works is considered to be negligible.

Impacts to ecology would be managed through the implementation of the relevant measures contained within the existing DWP, associated Biodiversity Management Plan and GGBF Plan of Management for the approved Conversion Project. Measures to include in the relevant plans are identified in **Chapter 15.0 Revised Management and Mitigation Measures**.

ES 12 Non-Aboriginal Heritage

A Statement of Heritage Impact (SoHI) was undertaken as part of this MR to assess the likely impacts of the modification works on historic (non-Aboriginal) heritage values. The SoHI involved a reassessment of the heritage significance of the site along with an assessment of the potential impacts the modification works may have on the heritage character of the Clyde Terminal. The assessments were undertaken in accordance with the relevant State and federal legislation, policies and guidelines.

The proposed demolition activities for the modification works are considered to result in a minor negative impact to the heritage significance of Clyde Terminal. Additionally the loss of the LPG spheres would have a minor visual impact to the terminal's heritage value. The retention of storage Tanks 40 and 41 are considered to be a minor but positive impact as it reinstates the scientific and aesthetic value of the site.

The adaptation and conservation of these structures is not considered viable due to economic and practical reasons relating to maintenance and potential hazards associated with the terminal. The demolition works associated with SSD 5147 was previously assessed as a negative impact on the heritage significance of the site. Considering the scale of these modifications and their impact, the proposed works are considered minor in comparison.

Impacts to the heritage fabric of the terminal would be managed in accordance with the measures identified in **Chapter 15.0 Revised Management and Mitigation Measures**. A photographic archival recording would be undertaken for items proposed for demolition.

ES 13 Other Issues

Soil, Water and Contamination

The additional demolition works would extend only to grade and would not require excavations below ground level. As such impacts to soils are expected to be minor and the likelihood of encountering contamination, including acid sulfate soils (ASS) and hydrocarbons is considered low. The modification works are not anticipated to intercept any groundwater.

Potential soil and groundwater impacts from the modification works may include:

- Demolition workers encountering contaminated soil during demolition of redundant structures, including the removal of footings, and mobilising or dispersing it across the site and local environment;
- Encountering asbestos during the demolition of redundant structures, particularly the State office building;
- Newly disturbed areas subject to erosion and sediment control issues;
- Spills and leaks from demolition equipment potentially contaminating soil and groundwater; and
- Vehicles dispersing contaminated materials across the site and off-site.

The potential soil, groundwater and contamination impacts arising from the modification works would be largely consistent with those identified and managed within the DWP for the Conversion Project. The DWP includes a Soil and Water Management Plan which includes measures for managing potential impacts associated with contamination and erosion and protecting soils and groundwater.

Viva Energy would maintain their existing risk reduction measures in place across the Conversion Project Area. Viva Energy requires all contractors and employees to obtain a work permit for all work in areas where potential soil and groundwater contamination exists.

Transport and Access

The development consent for SSD 5147 was approved based on a demolition and construction workforce not exceeding 133 contractors. The required contractors for the modification works would not result in the total number of workers exceeding this limit.

The modification works would be undertaken within the boundary of the Clyde Terminal. As no additional staff or equipment is required an increase in traffic over the consented movements per day as a result of the modification works is not anticipated.

The heavy vehicle movements for the modification works, should they be required, can be accommodated within the maximum heavy vehicle movements for the approved demolition works (20 per day). It is therefore considered unlikely that these works would have additional adverse impacts on the local road network.

In general, impacts upon the capacity and operations of the existing road network would be negligible. Despite this, works would be undertaken in accordance with the measures outlined in the existing Traffic Management Plan developed for the Conversion Project.

Waste Management

During the modification works the key activities expected to generate waste are the demolition of redundant infrastructure including the State office building, MTS1 switch yard, tank 106, LPG spheres V137 and V140 and the LPG loading gantry. Conversely, the retention of Tanks 40 and 41 would result in decrease in total waste generated over what was assessed and consented as part of SSD 5147. Waste types would generally include waste classified as general solid (non-putrescible) wastes and consist of steel and steel alloys and concrete. Other waste streams that would be generated in relatively minor quantities include:

- General Solid Waste (Non-putrescible) including packaging waste, and asphalt waste; and
- General Solid Waste (Putrescible) food waste from demolition workers.

Measures to ensure appropriate waste management during the modification works would be consistent with those documented within the existing DWP and the Waste and Resource Recovery Management Plan.

ES 14 Cumulative Impacts

The assessments within this MR have concluded that the modification works are unlikely to result in significant adverse cumulative impacts on the surrounding community or environmental receptors. The majority of the potential impacts related to the modification works would be avoided or mitigated through the implementation of the measures outlined in **Chapter 15.0 Revised Management and Mitigation Measures**.

ES 15 Evaluation and Justification

The modification works are consistent with and contribute directly to the objectives of the overall Conversion Project to convert the Site into a safe and efficient finished petroleum product terminal.

This MR provides a comprehensive assessment of the modification works and includes investigations regarding all relevant environmental issues. Potential impacts have been assessed and strategies to avoid, minimise and mitigate those impacts are provided.

The modification works have, to the extent feasible, been designed to address the key issues of concern. Viva Energy has also considered impacts on the surrounding environment and community. Viva Energy believes it can undertake the modification works in a manner which would safeguard and prevent damage to the local environment.

This MR has concluded that the modification works should proceed because they would:

- Result in no long term adverse impacts to the environment;
- Ensure the primary objectives of the Conversion Project continue to be achieved; and
- Satisfy the principles of Ecologically Sustainable Development as described in the EP&A Regulation.

On the basis of the findings detailed within this Modification Report, the modification works are considered to be justified and should proceed.

1.0 Introduction

1.1 Overview

Viva Energy Australia Pty Ltd (Viva Energy) owns and operates the Clyde Terminal on land associated with the former Clyde Refinery. The terminal is located in the Camellia Industrial Estate at Durham Street, in the suburb of Rosehill, NSW (refer to **Figure 1-1**). The refinery was previously used for refining operations including hydrocarbon processing, fuel storage and fuel transfer. In 2015, development consent was granted for the Clyde Terminal Conversion Project (State Significant Development (SSD) 5147) (the 'Conversion Project'). The objective of the Conversion Project was to establish an efficient finished petroleum products terminal, capable of supporting the growth of the NSW through the efficient storage and distribution of finished petroleum products.

The process to convert the refinery to a terminal has involved a number of related activities including upgrades and improvements to operational infrastructure and demolition and removal of redundant tanks and other infrastructure. The Conversion Project is almost complete and the majority of terminal assets have been consolidated and/or upgraded where necessary, and much of the redundant refinery infrastructure has been demolished and removed.

Following internal review of future operations at the terminal, Viva Energy has identified additional works are required to achieve the objectives of the Conversion Project. These additional works including demolition of six redundant structures and retention of two tanks (the 'modification works').

SSD 5147 includes demolition, dismantling and removal of redundant infrastructure within part of the terminal referred as the Conversion Project Area (the land where SSD 5147 applies). The modification works would include the demolition of the following six additional structures:

- State office building - the main administration building for the terminal. The building is a three storey brick and concrete office building built in 1986. It is located in the northwest of the Conversion Project Area;
- MTS1 33 kV switch yard - located immediately to the south of the State office building;
- Tank 106 (slops tank) - located in the south of the Conversion Project Area adjacent to the banks of Duck River;
- Two LPG spheres - located in the southeast of the Conversion Project Area adjacent to the banks of Duck River; and
- LPG truck loading gantry - located in the east of the Conversion Project Area adjacent to the banks of Duck River.

In addition, Tanks 40 and 41 located in tank farm E1 in the central portion of the Conversion Project Area are proposed to be retained for continued use as gasoline storage and would not be demolished as previously consented by SSD 5147. Finally a number of conditions of consent are proposed to be amended or deleted as part of this modification application.

Viva Energy is seeking a modification to development consent SSD 5147 under section 4.55 (1A) of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the proposed modification works. This modification is sought as the works are a continuation of the Conversion Project, are likely to be the same scale as previously consented and would only result in minimal environmental impacts. The end result of these works would be substantially the same development as the approved Conversion Project under SSD 5147.

This Modification Report (MR) has been prepared to support the modification application for the demolition works. In line with the requirements of section 4.55 (1A) of the EP&A Act, this MR provides the information required by clause 115 of the *Environmental Planning and Assessment Regulations 2000* (EP&A Regulation). This MR considers a range of relevant environmental, safety, legal, social and economic impact related to the modification works. Potential impacts are identified and where necessary avoided, mitigated or offset to provide an improved outcome for the local environment and surrounding community.

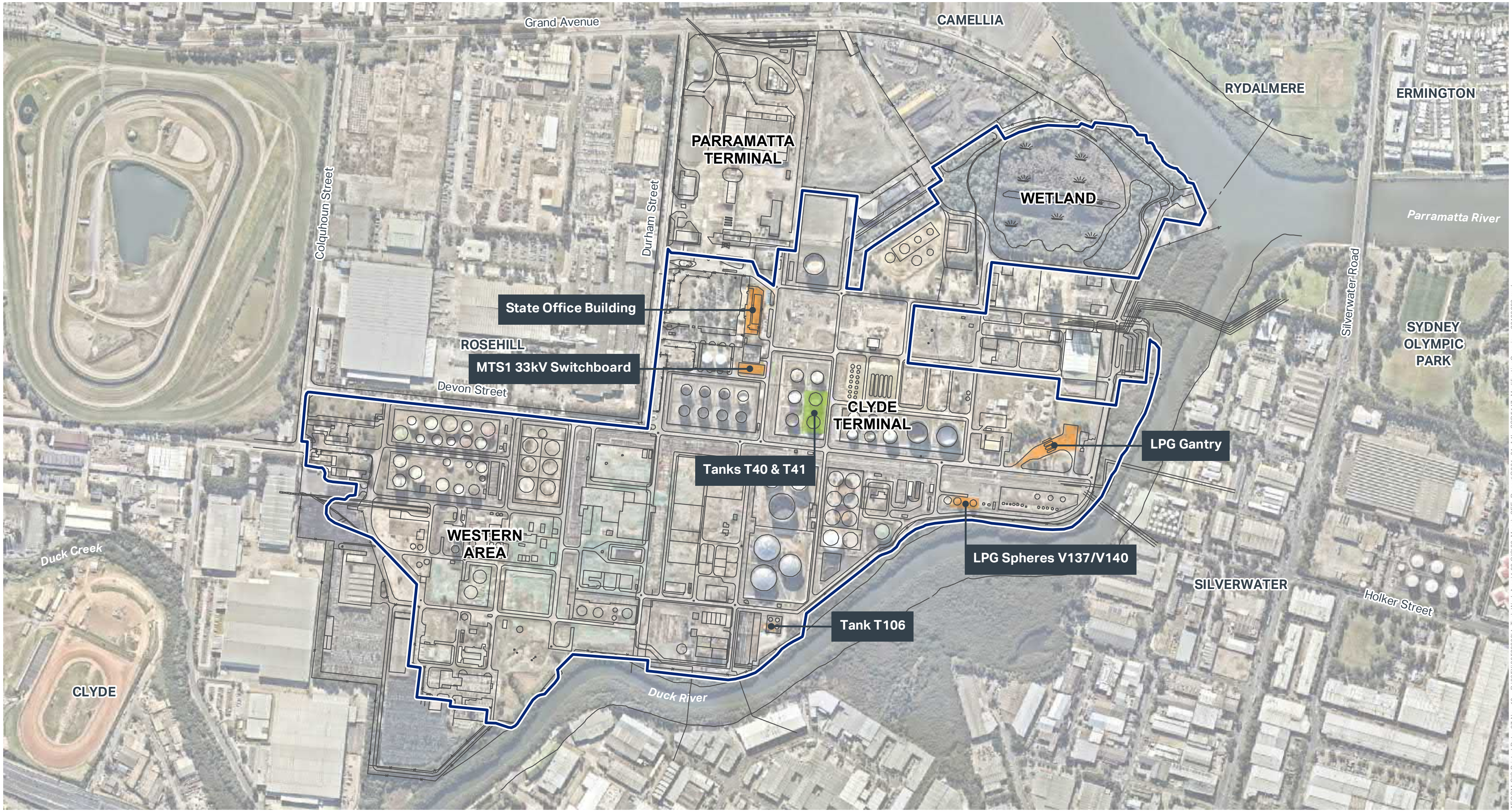

FIGURE 1-1: SSD 5147 MODIFICATION 1 – MODIFICATION OVERVIEW

AECOM

0 100 200 300 m

KEY

Conversion project area boundary

Site Modifications

Retain

Demolish

1.2 Proponent and Team

The proponent and landowner is Viva Energy. The relevant contact is:

Erica Salazar
Viva Energy Australia Pty Ltd
Durham Street
Rosehill NSW 2142
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This MR has been prepared by AECOM Australia Pty Ltd, ABN 20 093 846 925, Level 21, 420 George Street, Sydney NSW 2000, Tel: (02) 8934 0000. The environmental planning and assessment coordinator is William Miles, CEnvP IA and Associate Director - Environment.

1.3 Project Need and Alternatives

1.3.1 Background

From 1918 to 2012 the Site was used for refining operations including hydrocarbon processing, fuel storage and fuel transfer. Shell Refining (Australia) Pty Ltd (Shell) was owner and operator of the Clyde Refinery from January 1928. Since 2012, the Site has predominantly operated as the Clyde Terminal. It is currently owned and operated by Viva Energy and receives stores and distributes fuel products including diesel, jet fuel and gasoline products.

In 2015 development consent was granted for the Conversion Project (SSD 5147). SSD 5147 is the dominant consent for the Clyde Terminal. This consent allowed for the demolition of redundant tanks and other infrastructure and upgrades and improvements to Site infrastructure. The majority of terminal assets have been consolidated into the new terminal footprint and have been upgraded where necessary. The demolition works were split into two phases. The majority of the phase 1 works are now complete. The phase 2 works will be completed in the next six to nine months.

The Clyde Terminal continues to receive and distribute finished petroleum products, operating under Development Consent (DC) SSD 5147 issued under Section 89E (now Section 4.38) of the *Environmental Planning and Assessment Act 1979 (NSW)* (EP&A Act) and Environment Protection Licence (EPL) No. 570 issued under the *Protection of Environment Operations Act 1997 (NSW)* (POEO Act). The Clyde Terminal is also a Major Hazard Facility (MHF) under the *Work Health and Safety Regulation 2011 (NSW)*.

1.3.2 Need and Objectives of the Project

As noted within the Environmental Impact Statement (EIS) for SSD 5147, due to a variety of factors including regional competition with modern, larger scale and more efficient refineries in the Asian region, deregulation of the Australian refining industry and increased cost of Crude Oil importation, Shell decided to cease refining operations at the Site in 2012 and to service the NSW market under a different business model.

The Clyde Terminal is one of a few key fuel supply operations servicing the NSW economy and is located adjacent to the major distribution terminal at Rosehill (Parramatta Terminal). Petroleum products received at the Clyde Terminal are stored and subsequently distributed via direct pipelines, or via road tanker from the neighbouring Parramatta terminal for delivery to the NSW market. The Clyde Terminal also supplies jet fuel directly to Sydney Airport via pipeline. The retention of the Clyde Terminal is therefore critical in ensuring continued liquid fuel supply security for the NSW market.

The objective of the Conversion Project was and remains to convert the Clyde Terminal into a more efficient finished petroleum products terminal capable of supporting the growth of the NSW economy through the efficient storage and distribution of finished petroleum products. The converted Clyde Terminal has enhanced environmental performance and improved safety systems compared to the former Clyde Refinery.

1.3.3 Need and Objectives of the Modification Works

Review of the future operations at the Clyde Terminal by Viva Energy has resulted in the requirement for the modification works outlined in this MR. SSD 5147 approved the demolition, dismantling or removal of redundant tanks and other infrastructure. The six additional structures that are proposed to be demolished were not considered as part of SSD 5147. At the time, the future requirement for these structures was unclear and they were therefore retained.

Following an ongoing review of their assets at the Site, Viva Energy decided that the six additional structures are no longer required. As such they are seeking consent to remove these assets. Maintaining redundant infrastructure requires ongoing maintenance which would have an associated cost. Maintaining infrastructure which serves no purpose would not be in line with the objective of the Conversion Project as it would affect the efficiency of the terminal and could potentially impact worker safety.

Tanks 40 and 41 located in tank farm E1 in the central portion of the Conversion Project Area are proposed to be retained for continued use as gasoline storage and not demolished as previously consented by SSD 5147. The retention of additional tanks would improve operational flexibility thereby allowing the terminal to operate more efficiently.

In addition, Viva Energy is proposing to amend or delete a number of conditions of consent. A modification to condition of consent B6 is proposed to allow the GGBF habitat restoration works at the Wetland Area to be completed following delays in finalising the design. The other conditions to be deleted or amended have been proposed to simplify compliance requirements in the future (refer to **Chapter 16 Revised Conditions of Consent**).

The modification works would allow Viva Energy to operate an effective and efficient finished petroleum products terminal, improve environmental performance and safety and continue to serve the NSW economy.

Viva Energy is seeking to modify the development consent for SSD 5147 to ensure that the Project objective for this consent can be successfully achieved and the Conversion Project continued.

1.4 Section 4.55 (1A) Modification

Modifications to development consents are provided for by section 4.55 of the EP&A Act. Section 4.55 (1A) relates to modifications involving minimal environmental impact. To progress the modification works in accordance within section 4.55 (1A), the proposed works must be substantially the same development as approved under SSD 5147 and would be likely to result in minimal environmental impact.

The modification works considered to be a minor change to the activities consented under SSD 5147 as the works involve the additional demolition of redundant infrastructure and retention of tanks previously consented. The modification works share a similar needs case and purposes and are in line with the objectives of the Conversion Project to provide an effective and efficient finished product terminal at the Clyde Terminal. Based on the connection with previously consented activities, the modification works are considered to be ‘substantially the same development’ as consented under SSD 5147.

As demonstrated within this MR, the modification works are likely to result in impacts which are of ‘minimal environmental impact’ (i.e. impacts that are expected to be within the same scale as those that have been previously approved and would result in “very small” or “negligible” overall environmental impacts). The management and mitigation measures that were approved for the Conversion Project (SSD 5147) would continue to apply for the additional demolition works.

While minor and temporary environmental impacts could occur, the additional removal of redundant infrastructure would have a long term beneficial impact from a social and hazards and risk perspective. As such, it can be concluded that the modification works are likely to result in ‘very small’ or ‘negligible’ overall environmental impacts.

Following the completion of the modification works, the end result would be substantially the same development as approved under SSD 5147. Therefore a modification to SSD 5147 is being sought under section 4.55(1A) of the EP&A Act.

1.5 Section 4.55 (1A) Modification Process

1.5.1 Scope of this MR

This MR has been prepared to support the modification application. In line with the requirements of section 4.55 (1A) of the EP&A Act, this MR provides the information required by clause 115 of the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation).

Key environmental issues were investigated through targeted assessments by specialists in their fields in line with relevant guidelines and assessment requirements. The outcomes of these assessments have been used to formulate the proposed revised management and mitigation measures and to justify why the revised scope of Conversion Project is required.

1.5.2 Preparation and Exhibition

The objectives of this MR are to:

- Comply with the requirements of the EP&A Act and EP&A Regulation;
- Provide the Minister or the Minister's delegates at the NSW Independent Planning Commission (IPC) with sufficient information to assess the potential environmental impacts, confirm the mitigation measures required and understand the benefits of the modification works; and
- Inform stakeholders and the community about the proposed works. A full account of this process up to lodgement of the modification application is included in **Chapter 6.0 Consultation**.

Clause 115 of the EP&A Regulation outlines the specific information that must be included within the MR. The relevant clauses in Section 115 and where these have been addressed in the MR are shown below in **Table 1-1**.

Table 1-1 Clause 115 Requirements

Clause	Requirement	MR Location
1(a)	The name and address of the applicant.	**Section 1.2**
1(b)	A description of the development to be carried out under the consent (as previously modified).	**Chapter 3.0**
1(c)	The address and formal particulars of title, of the land on which the development is to be carried out.	**Section 1.2** **Section 2.1.1**
1(d)	A description of the proposed modification to the development consent.	**Chapter 4.0**
1(e)	A statement that indicates either: • that the modification is merely intended to correct a minor error, misdescription or miscalculation, or • that the modification is intended to have some other effect, as specified in the statement.	**Section 1.1** **Section 1.4** **Chapter 5.0** **Chapter 16.0**
1(f)	A description of the expected impacts of the modification.	**Chapters 8.0 - 14.0**
1(g)	An undertaking to the effect that the development (as to be modified) will remain substantially the same as the development that was originally approved.	**Section 1.1** **Section 1.4** **Chapter 5.0** **Chapter 15.0**
1(h)	If the applicant is not the owner of the land, a statement signed by the owner of the land to the effect that the owner consents to the making of the application (except where the application for the consent the subject of the modification was made, or could have been made, without the consent of the owner).	Applicant (Viva Energy) is the owner of the land.

Clause	Requirement	MR Location
1(i)	A statement as to whether the application is being made to the Court (under section 4.55) or to the consent authority (under section 4.56), and, if the consent authority so requires, must be in the form approved by that authority.	**Section 1.4** **Section 5.2.1**
2	The notification requirements of clause 49 apply in respect of an application if the consent of the owner of the land would not be required were the application an application for development consent rather than an application for the modification of such consent	Not applicable
3	Additional requirements if an application for the modification of a development consent under section 4.55 (2) or 4.56 (1) of the Act, if it relates to residential flat development.	Not applicable
4	Additional requirements if an application referred to in subclause (3) is also accompanied by a BASIX certificate.	Not applicable
5	The consent authority may refer the proposed modification to the relevant design review panel but not if the application is for modification of a development consent for State significant development.	The Project is classified as State Significant Development
6	Additional requirements if an application for the modification of a development consent under section 4.55 (1A) or (2) of the Act, if it relates to development for which the development application was required to be accompanied by a BASIX certificate or BASIX certificate.	Not applicable
7	Additional requirements relating to the appropriate BASIX certificate.	Not applicable
8	An application for modification of a development consent under section 4.55 (1), (1A) or (2) or 4.56 (1) of the Act relating to land owned by a Local Aboriginal Land Council may be made only with the consent of the New South Wales Aboriginal Land Council.	Land is not owned by Local Aboriginal Land Council
9	The application must be accompanied by the relevant fee prescribed under Part 15.	Noted
10	A development consent may not be modified by the Land and Environment Court under section 4.55 of the Act if an application for modification of the consent has been made to the consent authority under section 4.56 of the Act and has not been withdrawn.	Not applicable

1.5.3 Assessment and Determination

Following lodgement to the NSW Department of Planning and Environment (DPE), DPE will make the following documents publically available:

- The section 4.55 application for modification to development consent SSD 5147, including any accompanying documents or information and any amendments made to the development application; and
- Any assessment report prepared by DPE.

DPE will prepare an assessment report for the modification works that will take into account comments from relevant Government authorities as well as other stakeholders. The assessment report will be provided to the Minister, or their delegate, who will determine whether to recommend section 4.55 approval. The Minister may delegate this determination to the IPC.

If granted, the approval may include a number of recommended conditions of consent to which the proponent would need to adhere during the undertaking modification works.

1.6 Terms and Definitions

Table 1-2 provides a summary of the terms used throughout this MR.

Table 1-2 Summary of Key Terms and Definitions

Terminology used in this MR	Definition
the Conversion Project	The conversion of the Clyde Refinery for use as an efficient finished petroleum products terminal capable of supporting the growth of the NSW economy through the efficient storage and distribution of finished petroleum products. The Conversion Project was consented under SSD 5147.
the conversion works	The previously approved works to convert the Clyde Refinery to the Clyde Terminal. These works were approved as SSD 5147 (the Conversion Project).
the modification works	These works involve the demolition and removal of additional redundant infrastructure including: • State office building; • MTS1 33 kV switch yard; • Tank 106 (slops tank); • two LPG spheres; and • LPG truck loading gantry. The works also include: • the retention of Tanks 40 and 41 in tank farm E1 (previously consented under SSD 5147 for demolition); and • amendments or deletion of several conditions of consent.
the 'Conversion Project Area'.	The Clyde Terminal consisting of parts of the lots located at 9 Devon Street Rosehill: • Lot 100, DP 1168951 • Lot 1, DP 383675 • Lot 101, DP 809340 • Lot 2, DP 224288 Note: Lot 100 of DP 1168951, forming the majority of the Site was formerly Lot 1 of DP 109739 and was subdivided into Lot 100 and Lot 101 of DP 1168951.
the study area	The area in which environmental studies have been undertaken to assist in determining the impacts of the modification works. The parameters of a study area will vary depending on the environmental study being completed.
the proponent	Viva Energy Pty Ltd (Viva Energy)

1.7 Document Structure

Table 1-3 provides a summary of the document structure of this MR.

Table 1-3 Document Structure

Executive Summary	This summarises the key issues and findings detailed in the other parts of the MR.
Introduction	**Chapter 1.0** provides an outline of the approved Conversion Project (SSD 5147), the proposed revised scope of demolition works, the need for the works, briefly outlines the environmental impact assessment process and introduces the various terms used throughout the MR.
Project Location and Existing Environment	**Chapter 2.0** provides a description of the location of the Lots and the Conversion Project Area and describes the existing environment.
Approved Project Description	**Chapter 3.0** provides a description of the approved Conversion Project.
Proposed Modification Details	**Chapter 4.0** provides a detailed description of the proposed modification including a program of activities and how they interact with the approved Conversion Project.
Legislation, Planning Policy and Approvals	**Chapter 5.0** includes the relevant controlling Commonwealth and State legislation and State and local policies. It identifies the licences and approvals required to enable the proposed modification to proceed.
Consultation	**Chapter 6.0** summarises the issues raised during consultation with the relevant stakeholders. The issues raised during the consultation process are addressed in the subsequent specialist chapters of the MR.
Environmental Scoping Assessment	**Chapter 7.0** provides an assessment of the potential environmental impacts of the proposed modification and identifies the key issues for further assessment.
Environmental Assessment	**Chapters 8.0 - 13.0** provide an assessment of the potential impacts of the proposed modification, including potential cumulative impacts, and the identification of appropriate mitigation measures to safeguard the environment.
Cumulative Impacts	**Chapter 14.0** provides an assessment of the cumulative impacts of the proposed modification works.
Revised Management and Mitigation Measures	**Chapter 15.0** details the relevant environmental management and mitigation measures to safeguard against or minimise potential impacts from the proposed modification.
Revised Conditions of Consent	**Chapter 16.0** outlines the existing conditions of consent for the conversion and demolition works that may need to be altered.
Justification	**Chapter 17.0** addresses the principles of Ecologically Sustainable Development (ESD) and the objects of the EP&A Act as well as providing a justification for the proposed modification.
Appendices	**Appendix A, Appendix B, Appendix C**, **Appendix D** and **Appendix E** contain technical appendices for the Final Hazard Analysis, Statement of Heritage Impact Assessment, Species Likelihood of Occurrence and Updated *Biodiversity Conservation Act 2016* (BC Act) and *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Assessments of Significance.

2.0 Project Location and Existing Environment

2.1 The Clyde Terminal

2.1.1 Location

The Clyde Terminal is located on the Camellia peninsula, approximately 16 kilometres (km) west of the Sydney Central Business District, within the Parramatta Local Government Area (LGA). The terminal is surrounded by a mixture of land uses in a primarily industrial setting. The main access to the terminal is located on Durham Street in Rosehill, NSW. The Conversion Project is located on land referred to as the Conversion Project Area within the Clyde Terminal. The modification works are located in the central and eastern portions of the Conversion Project Area. An overview of the Conversion Project Area is shown in **Figure 2-1**. The Conversion Project Area consists of parts of the following lots and deposited plans (DPs):

- Lot 100, DP 1168951;
- Lot 1, DP 383675;
- Lot 101, DP 809340; and
- Lot 2, DP 224288.

Lot 100 of DP 1168951 forms the majority of the Conversion Project Area. This lot was formerly Lot 1 of DP 109739 and was subdivided into Lot 100 and Lot 101 of DP 1168951.

2.1.2 Site History

In 1908 an oil refinery was established on the site and in 1928, Shell took over as owner and operator of the Clyde Refinery. Between 1929 and the mid-1970s, numerous expansions and upgrades of the refinery took place. The expansion of the operations included upgrading and expanding the refinery assets, commissioning a lubricating oil plant, introduction of a chemical and hydrocarbon solvents plant, expansion of the site itself with the purchase of additional land and development of a polypropylene plant.

Following this, only minor additions and modifications were made to the refinery. In the mid-1980s, the butane de-asphalting plant and oil interceptor were demolished. The area that these elements had occupied was redeveloped, with the central control room constructed at that location in 1988. In 1991, a new propylene unit and platformer unit were commissioned, and in 1994, the mounded Liquefied Petroleum Gas (LPG) storage facility was built.

Refinery operations continued until 2011 when Shell publically announced its decision to cease refining prior to mid-2013. In June 2012, Shell confirmed that from late 2012, the Clyde Refinery would cease processing crude oils. Since 2012, the terminal has received, stored and distributed fuel products including diesel, jet fuel and gasoline products.

Following receipt of development consent for the Conversion Project (SSD 5147) in 2015, works to consolidate terminal operations began. This included works to upgrade the terminal, to convert certain tanks to finished product service, to demolish and remove redundant refinery equipment and infrastructure and to operate solely as a finished petroleum products terminal into the future. The Conversion Project is almost complete. The majority of terminal assets have been consolidated into the new terminal footprint and have been upgraded where necessary. The demolition works were split into two phases. The majority of the phase 1 works are now complete. The phase 2 works will be completed in the next six to nine months.

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FIGURE 2-1: THE CONVERSION PROJECT AREA

AECOM

0 100 200 300 m

KEY

Conversion project area boundary

2.1.3 Terminal Operations

The Clyde Terminal continues to receive finished petroleum products from the Gore Bay Terminal via the existing product transfer pipeline, and distributes them by separate pipelines from the Clyde Terminal to the adjacent Parramatta Terminal road gantry, to Sydney Airport, and Newcastle via existing infrastructure. Since refining activities ceased, only the following finished petroleum products are stored at the terminal:

- Gasoline (unleaded 91, 95 and 98);
- Diesel (AGO); and,
- Jet fuel.

Clyde Terminal has consent to store 264 megalitres (ML) of finished petroleum products and 1,550 m^3 of petroleum gases under SSD 5147.

The terminal operates under Environment Protection Licence (EPL) No. 570 issued under the NSW *Protection of Environment Operations Act 1997* (POEO Act). EPL No. 570 authorises and regulates the carrying out of two scheduled activities: waste processing; and chemical storage. It provides discharge and emission limits for a number of potential pollutants and prescribes reporting requirements for Viva Energy.

The terminal is also a Major Hazard Facility (MHF) under the NSW *Work Health and Safety Regulation 2011* and operates 24 hours a day, seven days a week.

2.1.4 Existing Site Environment

The Conversion Project Area is zoned as IN3 Heavy Industrial under the *Parramatta Local Environmental Plan 2011* (LEP). The Conversion Project Area was highly disturbed during the construction and operation of the refinery. However, some areas of ecological significance remain within the terminal boundary and include:

- Riparian vegetation along the banks of Duck River;
- Estuarine wetlands listed under the *State Environmental Planning Policy (SEPP) Coastal Management 2018*, associated vegetation in the north east part of the Conversion Project Area and along Duck River;
- Wetlands at the north east of the Conversion Project Area, which provide potential habitat for the Green and Golden Bell Frog (GGBF) (listed as Endangered under NSW State legislation and Vulnerable under Commonwealth legislation); and
- Whilst there are no formal heritage designations, previous heritage assessments have concluded that the site has State heritage significance given its long industrial history.

These environmentally significant areas are shown in **Figure 2-2**.

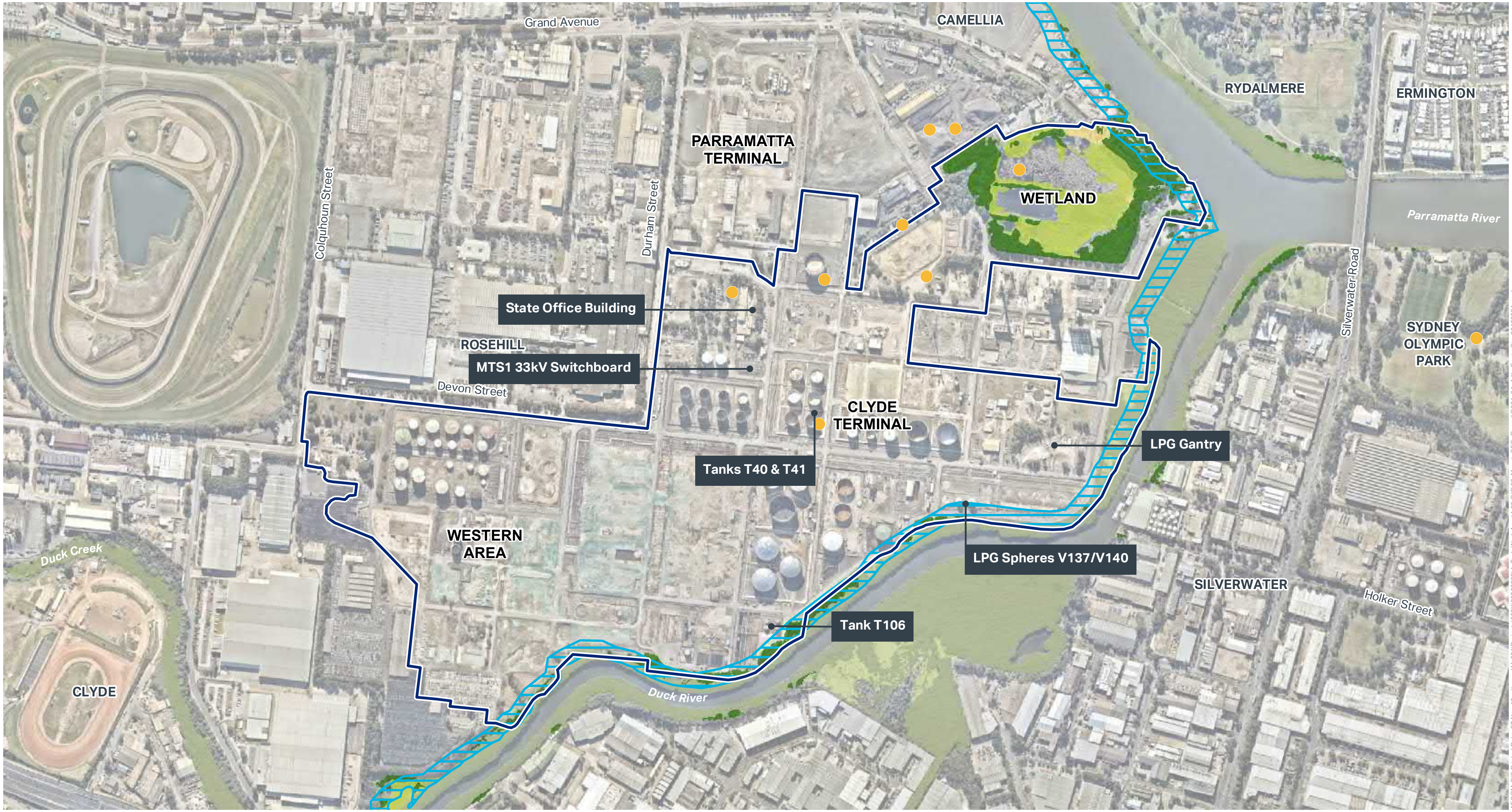

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FIGURE 2-2: AREAS OF ENVIRONMENTAL SIGNIFICANCE

AECOM

0 100 200 300 m

KEY

- Conversion project area boundary
- Riparian vegetation
- Green and Golden Bell Frog record
- Estuarine fringe forest - Swamp Oak floodplain forest (EEC)
- Estuarine mangrove
- Estuarine saltmarsh (EEC)
- Estuarine saltmarsh - Phragmites reedland
- Estuarine saltmarsh - brackish wetland

2.2 The Surrounding Area

2.2.1 Surrounding Land Uses

The Conversion Project Area is surrounded by a mixture of land uses but is primarily located within an industrial setting. Surrounding the Conversion Project Area to the north is the Parramatta Terminal and other Viva Energy owned lands with industrial land uses and to the west is Viva Energy owned land that was formerly leased to AutoNexus, the Rosehill Gardens Racecourse and a mix of industrial and commercial development. To the south is Duck River, beyond which there is the industrial and commercial development of Silverwater. Industrial development within the suburb of Rosehill is adjacent to the north and west of the Conversion Project Area.

Duck River forms the south-east boundary of the Conversion Project Area and eventually joins the Parramatta River (refer to **Figure 2-2**). Eric Primrose Park and Silverwater and Wilson Parks are located across the River to the north-east of the Conversion Project Area.

2.2.2 The Existing Road Network

The local road network surrounding the terminal is centred on the principal collector road Grand Avenue. Durham Street provides access into the Conversion Project Area from Grand Avenue, with Devon Street also running adjacent to the terminal. Grand Avenue feeds onto James Ruse Drive to the west, which provides access to the wider road network. The main access to the Conversion Project Area is via Viva Energy Gate 5, located on Durham Street between Grand Avenue and Devon Street. The local road network and site access is discussed further in **Section 13.2**.

2.2.3 Existing Environment Surrounding the Site

The terminal lies at the confluence of the Parramatta River and the Duck River sub-catchments. The Parramatta River sub-catchment is one of the main tributaries of Sydney Harbour, and is one of the most urbanised catchments in Australia as a result of historical land uses modifying the nature of the Parramatta River estuary. Water pollution is a major environmental issue for Sydney Harbour with polluted sediments and surface water affecting water quality and fauna habitat.

The majority of the area surrounding the terminal comprises industrial properties within the Camellia Industrial Estate. Industries close to the terminal include recycling services, building products, waste services, gas supplies and product transport. The closest residential area to the Conversion Project Area is located around 250 m to the north across Parramatta River in the suburb of Rydalmere.

There are a number of recreational parks within proximity of the Conversion Project Area. Eric Primrose Park is located around 150 m to the north along Parramatta River waterfront and Silverwater Park is located around 250 m to the east along the waterfront at the Duck River and Parramatta River confluence.

Rosehill Gardens Racecourse is located adjacent to the west of the Conversion Project Area and is one of two premier racecourses in Sydney, the other one being Randwick Racecourse. The racecourse holds several major annual events, including the Golden Slipper race.

Areas of environmental significance surrounding the Conversion Project Area include:

- Sections of estuarine wetland within the Duck River sub-catchment, including mangroves, saltmarshes and mudflat vegetation communities (managed under Coastal Management SEPP) along the Parramatta River and Duck River; and
- Surface water, sediment and aquatic flora and fauna within Parramatta River and Duck River.

3.0 Approved Project Description

3.1 Introduction

This Chapter provides an overview of the key components of the approved Conversion Project (SSD 5147). A full project description is available in the Clyde Terminal Conversion Project Environmental Impact Statement (EIS) (AECOM, 2013).

Viva Energy received development consent for the Conversion Project in January 2015 (SSD 5147). The majority of terminal assets have been consolidated into the new terminal footprint and have been upgraded where necessary. The demolition works were split into two phases. The majority of the phase 1 works are now complete. The phase 2 works will be completed in the next six to nine months.

Terminal operations continue to operate in accordance with the development consent for SSD 5147 and the EPL for the Site.

3.2 The Conversion Project (SSD 5147)

3.2.1 Conversion Project Overview

The key components of the approved Conversion Project comprise demolition of redundant infrastructure within the Conversion Project Area and conversion of part of the existing terminal assets to more efficiently receive, undertake product dosing activities, store and distribute solely imported finished petroleum products.

The approved Conversion Project involves three main components

- Demolition of the redundant refinery processing equipment and storage tanks;
- Construction works to improve efficiency and provide capacity to meet future growth in demand for fuel products, including:
  - Conversion of existing storage tanks to store finished fuels;
  - Upgrade of electrical, fire-fighting, wastewater, lighting and safety shutdown systems;
  - Upgrade of bunds and spill management infrastructure; and
- On-going operation as a finished petroleum products terminal to ensure continuity of fuel supply to Viva Energy customers.

Specific activities approved under the approval for SSD 5147 are included in **Table 3-1**.

Table 3-1 Development Components of SSD 5147

Aspect	Description
Demolition	Demolition of redundant refinery infrastructure to ground level including: • Redundant refinery processing units; • 97 storage tanks and tankfarm infrastructure, including bund walls; • Chimney stacks; and • Other redundant infrastructure including the bitumen loading gantry, pipework, columns, vessels, exchanger structures and redundant buildings.
Construction	Conversion of existing storage tanks: • Repair and retention of 17[1] storage tanks in the eastern part of the Conversion Project Area for storage of gasoline, diesel and jet fuel; • Installation of domes on the jet fuel storage tanks; • Retention of two existing butane spheres; • Retention of five existing slops tanks; and • Construction of two new slows tanks.

Aspect	Description
	Electrical: • Replacement of existing substations above the 1 in 100 year flood level; and • Upgrades to electrical and instrumentation systems. Firefighting system: • Construction of new firewater tanks to replace the existing tanks to be demolished; and • Provision of articulated foam deployment and fire response for the converted terminal arrangement. Wastewater system: • Construction of an additional phenol treatment facility for wastewater; and • Upgraded oily water release system for improving wastewater treatment. Bunding and spill management: • Installation of motorised valves to allow quicker closing and remote operation; and • Upgrades to bund walls (as required). Ancillary facilities: • Minor conversion works to lighting, safety shutdown systems, improved product quality segregation, control room facilities and amenities.
Operation	Import, product blending, storage and distribution of finished petroleum products, including operation of: • Tankfarms and associated valving and pipework; • Control rooms, pumping stations, gantries, warehouses and workshops; • Administration facilities; • Electrical substations; • Water supply and treatment facilities, waste handling facilities; and • Firefighting infrastructure.
Product throughput and storage capacity	• 4,400 ML per annum, with expected annual growth of 4%; • Reduction in fuel storage capacity from 638 ML to 264 ML; and • Reduction in gas storage capacity from 10,851 m^3 to 1,550 m^3.
Traffic (vehicles per day)	Demolition, construction and concurrent operation - 169 light and 277 heavy vehicles. Operation - 32 light and 257 heavy vehicles.
Working hours	Demolition and construction: 7am to 6pm (Monday to Friday), 8am to 1pm (Saturday). Operation: 24 hours, 7 days a week.
Employees	Demolition, construction and concurrent operation – 224. Operation - 58.

Note 1: SSD 5147 originally consented works to 17 tanks. Two additional tanks were constructed to replace one existing tank. Construction of these additional two tanks (and demolition of one tank to be replaced) was considered consistent with SSD 5147 by DPE on 22 March 2016. As such the terminal contains 19 tanks for the storage of gasoline, diesel and jet fuel (i.e. the 17 tanks originally approved and the other two tanks proposed to be retained in this application, namely tanks 40 and 41).

Figure 3-1 shows the conversion works as approved by SSD 5147 (based on Figure 6-1 of the Clyde Terminal Conversion Project EIS (AECOM, 2013).

FIGURE 3-1: THE APPROVED PROJECT UNDER SSD 5147

0 100 200 300 m

KEY

Conversion project area boundary	AGO (65ML)	Unleaded 91 (68ML)
Area to be demolished	Jet A1 (65ML)	Unleaded 95 (34ML)
	Slops (1.8ML)	Unleaded 98 (32ML)

3.2.2 Works Programs

Decontamination and decommissioning activities commenced in late 2012. Following the receipt of approval SSD 5147 in 2015, the demolition and conversion works were scheduled to take place in two phases with demolition occurring over 14 months and construction and conversion activities over three years. The first phase of demolition activities, involving the main refinery infrastructure was anticipated to be commenced within one year of approval with phase two demolition involving additional smaller tank farms occurring over one month at a later date, following progression of construction works. Demolition and construction activities were approved to occur concurrently for the first three years of the program in addition to the ongoing operations of the terminal.

Approximately 91 staff and 133 contractors were to be expected during the Conversion Project works. Approximately 30 of these required for demolition works. Changes to access or local roads were not required for the Conversion Project. Approximately 169 light vehicles trips per day were assessed to accommodate the demolition and conversion workforce. Demolition activities estimated 20 heavy vehicles in each direction per day for the transportation of waste materials. Plant and equipment required for the Conversion Project included: blasting equipment, excavator equipped with mechanical shears, trucks, cranes, cutting torch, pneumatic wrench, trucks, cranes, and air compressors.

3.2.3 Approved Management Plans

A number of management plans have been developed for the Conversion Project. These are currently in use and are available on the Viva Energy website. These include:

- Environmental Management Strategy;
- Environmental Management Manual;
- Biodiversity Management Plan;
- Construction and Demolition Air Quality Management Plan;
- Construction and Demolition Noise and Vibration Management Plan;
- Traffic Management Plan;
- Soil and Water Management Plan;
- Waste and Resource Recovery Plan;
- Operational Air Quality Management Plan;
- Demolition Work Plan;
- Environmental Management Plan;
- Work Health and Safety Management Plan; and
- Asbestos Control Plan.

3.3 Continued Works

Continued maintenance and upgrade works are likely to occur over the coming years in order to maintain the viability of the terminal into the future. These upgrade works would be subject of future development applications and/or approvals as required.

4.0 Proposed Modification Details

4.1 Introduction

This Chapter provides an overview of the proposed modification works. It includes a description of the modification and a program for when the works would be undertaken. The modification works are in addition to the works described in **Chapter 3.0 Approved Project Description**.

The proposed modification works would be undertaken within the areas of the Clyde Terminal shown on **Figure 1-1**. The modification works would involve:

- Demolition of the State office building – the main administrative building for the terminal. This building is a three storey brick and concrete office building built in 1986. It is located in the northwest part of the Conversion Project Area;
- Demolition of MTS1 33 kV switch yard – located immediately to the south of the state office building;
- Demolition of Tank 106 (slops tank) – located in the southern part of the Conversion Project Area towards Duck River;
- Demolition of two LPG spheres (V137 and V140) – located in the southeast of the Conversion Project Area towards Duck River;
- Demolition of the LPG truck loading gantry – located in the east of the Conversion Project Area close to the banks of Duck River; and
- Retention of Tanks 40 and 41 and continued use for gasoline storage.

Viva Energy would also like to amend or delete a number of existing conditions of consent. Viva Energy are proposing to modify condition of consent B6 to allow the GGBF habitat restoration works at the Wetland Area to be completed following delays in finalising the design. This involves extending the approved construction period from 4 years to 5 years. Other conditions would be modified or deleted as they have been completed and are no longer required in part or in full. These changes would help simplify compliance requirements at the terminal.

4.2 Demolition Works

The additional demolition works would be undertaken using the same approach as the demolition of other redundant infrastructure under the approved Conversion Project (SSD 5147). The proposed demolition works would be to ground level only. No changes to the existing drainage infrastructure or earthworks are proposed as part of the modification works.

Demolition activities which would be undertaken as part of the modification works would generally comprise of the following activities:

- Disconnect existing services/pipework;
- Demolition to collapse structures using various machinery depending on the composition of the structure;
- Associated civil works to remove structures to grade; and
- Repair of drainage systems (if required).

4.2.1 Office building and switchyard

The State office building, constructed in 1986 is a three storey brick and concrete office building. The building is known to contain small amounts of asbestos in fittings including fire doors and linoleum tiles. The building would be decommissioned and internal fittings and fixtures including asbestos containing components would be removed and disposed of appropriately prior to the structure being demolished.

Demolition of both the office building and switchyard would be undertaken using heavy machinery including excavators. Some vegetation removal of surrounding planted trees and landscaped areas would be required to provide access for demolition equipment. Steel components would be recycled off site while concrete and brick would be processed on the Site at a concrete processing facility consented for the Conversion Project.

4.2.2 Storage and delivery assets

Storage and delivery assets proposed for demolition include the following components as outlined in **Table 4-1** and shown in **Figure 1-1**.

Table 4-1 Storage and delivery assets for demolition

Component	Volume	Location
Slops Tank 106	400 m^3	South of the Site
LPG sphere V137	600 m^3	Southeast of the Site
LPG sphere V140	950 m^3	Southeast of the Site
LPG loading gantry	n/a	East of the Site

The storage and delivery assets have already been decommissioned, cleaned and are currently open to atmosphere. The infrastructure, which predominantly consists of steel, would be cut up using an excavator with either mechanical or hydraulic shears. Steel waste would be being recycled off site while concrete waste would be processed on site at a concrete processing facility consented for the Conversion Project.

The bund associated with slops Tank 106 would remain intact and in place to service the remaining three tanks. The bund drainage would not be affected by the works.

No vegetation removal is required in order to demolish the storage and delivery assets.

4.3 Retention of Tanks

Gasoline Tanks 40 and 41 are located approximately in the centre of the Conversion Project Area to the southeast of the existing State Office Building within tank farm E1 as shown on **Figure 1-1.** Each tank has a volume of 7,650 cubic metres. No physical works are proposed to occur at these tanks as a result of this modification.

4.4 Scheduling

The modification works would commence alongside or just after the consented demolition works and be completed as part of the Conversion Project. The modification works are expected to commence in the first quarter of 2019 and are anticipated to occur over eight weeks.

4.5 Plant and equipment

The plant and equipment required to complete the modification works would be similar to that required for the consented demolition works. Specifically the following equipment would be utilised:

- Excavator with mechanical and hydraulic shears;
- Mobile crane;
- Cutting torches; and
- Trucks.

4.6 Workforce

The development consent for SSD 5147 was approved based on a demolition and construction workforce not exceeding 133 contractors. Required contractors for the proposed modification works would not result in the total number of workers exceeding this limit. The modification works would be undertaken within the boundary of the Clyde Terminal Site. As no additional staff or equipment is required an increase in traffic over the consented movements per day as a result of the modification works is not anticipated.

4.7 Hours of work

The proposed modification works would be completed in line with the condition C22 of the Conditions of Consent for SSD 5147. Condition C22 permits construction and demolition activities during the following hours:

- 7:00am to 6:00pm Monday to Friday
- 8:00am to 5:00pm on Saturday

4.8 Environmental Management

The proposed modification works would be undertaken in accordance with the existing Demolition Work Plan (DWP) and associated sub-plans where applicable, including:

- Asbestos Control Plan;
- Environmental Management Plan;
- Work Health and Safety Management Plan;
- Construction and Demolition Air Quality Management Plan;
- Construction and Demolition Noise and Vibration Management Plan;
- Traffic Management Plan;
- Flood Emergency Response Plan;
- Biodiversity Management Plan; and
- Soil and Water Management Plan.

These plans would be updated as required prior to the modification works commencing.

4.9 Operation

The operation of the Clyde Terminal would remain as described in the Clyde Refinery Conversion EIS (AECOM, 2013) in that it would operate as an efficient and sustainable finished product terminal. It would operate in line with development consent SSD 5147 and other applicable licences and permits.

Consented hours for the operation of the Clyde Terminal are 24 hours a day Monday through Sunday.

5.0 Legislation

5.1 Introduction

This Chapter reviews the key Commonwealth and State legislation as well as the State, regional and local planning policies that apply to the modification works in order to determine the permissibility, regulatory requirements and the approvals required to allow the works to proceed.

5.2 NSW State Legislation

5.2.1 Environmental Planning and Assessment Act 1979

The Conversion Project (SSD 5147) was classified as State Significant Development (SSD) under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) because it involved development with a capital investment value of more than $30 million for a liquid fuel depot meeting the criteria in Clause 10(2) of Schedule 1 in *State Environmental Planning Policy (State and Regional Development) 2011*. On 14 January 2015, SSD 5147 was approved under section 89E (now section 4.38) of the EP&A Act by the Planning Assessment Commission of NSW (now the Independent Planning Commission), as delegate of the Minister for Planning (under delegation executed on 14 September 2011).

The modification works constitutes development as defined by section 1.5 of the EP&A Act and therefore requires consent under Part 4 of the same Act. Modifications to development consents are provided for by section 4.55 of the EP&A Act. Section 4.55 (1A) relates to modifications involving minimal environmental impact. To progress the modification works in accordance within section 4.55 (1A), the proposed works must be substantially the same development as approved under SSD 5147 and must be likely to result in minimal environmental impact.

The modification works are considered to be a minor change to the activities consented under SSD 5147 as the works involve the additional demolition of redundant infrastructure and retention of tanks previously consented for demolition. The modification works share a similar needs case and purposes and are in line with the objectives of the Conversion Project to provide an effective and efficient finished product terminal at the Clyde Terminal. Based on this, the modification works are considered to be ‘substantially the same development’ as consented under SSD 5147.

As demonstrated within this MR, the modification works are likely to result in impacts which are of ‘minimal environmental impact’ (i.e. impacts that are expected to be within the same scale as those that have been previously approved and would result in ‘very small’ or ‘negligible’ overall environmental impacts). The relevant management and mitigation measures that were approved for the Conversion Project (SSD 5147) would continue to apply. While minor and temporary environmental impacts could occur, the additional removal of redundant infrastructure would have a long term beneficial impact from a social and hazards and risk perspective. As such, it can be concluded that the modification works are likely to result in minimal environmental impacts. Therefore a modification to SSD 5147 is being sought under section 4.55 (1A) of the EP&A Act.

A modification through section 4.55 (1A), requires that aspects of the modification works that may have environmental, social or economic impacts that differ from those previously assessed for SSD 5147, undergo assessment in line with section 4.15 of the EP&A Act. In order to comply with the requirements for assessing this type of modification, a MR (this document) must be prepared and submitted alongside the modification application. The application is being made to the consent authority, the Minister for Planning (or delegate).

5.2.2 State Environmental Planning Policies

The relevant SEPPs and their requirements are outlined below.

State Environmental Planning Policy 33 – Hazardous and Offensive Development

State Environmental Planning Policy 33 – Hazardous and Offensive Development (SEPP 33) requires a consent authority to consider whether a development may constitute a hazardous or offensive industry. A Preliminary Hazards Analysis (PHA) completed to accompany the Conversion Project application confirmed that the works comprise potentially hazardous and potentially offensive industry.

A Final Hazards Analysis (FHA) was produced following updates to the PHA in line with the conditions of consent for SSD 5147. The FHA concluded that the Conversion Works would not present a significant risk to surrounding land uses and meets the requirements of SEPP 33 in terms of risk management.

As part of the assessment of the modification works, the FHA was updated to incorporate the retention of Tanks 40 and 41 and the removal of LPG facilities, Tank 106 and the gantry (refer to **Chapter 8.0 Hazards and Risk**).. The revised FHA (refer to **Appendix A**) concluded that the modification works would be acceptable under the provisions of SEPP 33. The controls identified in the FHA would be implemented for the modification works.

Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005

The Conversion Project Area falls within the boundary of the 'Foreshore and Waterways area' and is therefore subject to the *Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005* (Sydney Harbour SREP), which is a deemed SEPP.

Under the Sydney Harbour SREP, the Conversion Project Area is located on land adjacent to the Parramatta River, which is zoned as W1 Maritime Waters and W2 Environment Protection. The Conversion Project Area is also located on land adjacent to the Duck River, which is zoned as W2 Environmental Protection.

The objectives of the W1 Maritime Waters zone are:

- *a. "to give preference to and protect waters required for the effective and efficient movement of commercial shipping, public water transport and maritime industrial operations generally*
- *b. to allow development only where it is demonstrated that it is compatible with, and will not adversely affect the effective and efficient movement of, commercial shipping, public water transport and maritime industry operations,*
- *c. to promote equitable use of the waterway, including use by passive recreation craft".*

The objectives of the W2 Environment Protection zone are:

- *a. "to protect the natural and cultural values of waters in this zone,*
- *b. to prevent damage or the possibility of longer term detrimental impacts to the natural and cultural values of waters in this zone and adjoining foreshores,*
- *c. to give preference to enhancing and rehabilitating the natural and cultural values of waters in this zone and adjoining foreshores,*
- *d. to provide for the long-term management of the natural and cultural values of waters in this zone and adjoining foreshores."*

The modification works are consistent with the objectives of the W1 Maritime Waters zone. The modification works are considered compatible with the objectives of the W2 Environment Protection Zone and would not detrimentally affect the natural and cultural values of water in this zone.

The Sydney Harbour SREP also lists certain heritage items. Whilst there are no items listed within the Conversion Project Area, there are two items in close proximity, namely No. 35 Shell Oil Refinery Wharf on the Duck River and No. 36 Industrial Wharves at 33 Grand Avenue, Camellia. These heritage items would not be impacted by the modification works.

In addition, the Sydney Harbour SREP designates areas adjacent to the Duck River as a 'Wetlands Protection Area'. This designation requires that development in this area is only carried out with development consent and that a number of 'matters' are taken into consideration by consent authorities before granting consent to development under Part 4 of the EP&A Act. Mapping shows this to include the vegetated riparian zone along the south-eastern boundary of the Conversion Project Area. This wetlands protected area would not be impacted by the modification works.

State Environmental Planning Policy (Coastal Management) 2018

State Environmental Planning Policy (Coastal Management) 2018 (Coastal Management SEPP) gives effect to the objects of the *Coastal Management Act 2016* by specifying how development proposals are to be assessed if they fall within the coastal zone. The SEPP presents four coastal management areas defined in the Act through detailed mapping and specifies assessment criteria that are specific for each coastal management area. Consent authorities are required to consider these criteria when assessing proposals for development that falls within one or more of the management areas.

The four coastal management areas include:

- Coastal wetlands and littoral rainforests area (including land within and in proximity to coastal wetlands or littoral rainforests);
- Coastal vulnerability area;
- Coastal environment area; and
- Coastal use area.

Review of the Coastal Management SEPP maps has identified that three of the four coastal management areas fall within all or parts of the Conversion Project Area (refer to **Figure 5-1**). In particular, the wetland located in the north east of the Conversion Project Area is classified by the SEPP as a coastal wetland. The riparian zone along Duck Creek is also classified by the SEPP as a coastal wetland.

With respect to the modification works, Tank 106, the two LPG spheres and the LPG truck loading gantry are located within the proximity area for coastal wetlands. All of the proposed modification works are located within both the coastal environment and coastal use management areas.

For works within the proximity area for coastal wetlands, clause 11(1) provides that development consent must not be granted unless the consent authority is satisfied that the proposed development will not significantly impact on:

a. *the biophysical, hydrological or ecological integrity of the adjacent coastal wetland or littoral rainforest, or*

b. *the quantity and quality of surface and ground water flows to and from the adjacent coastal wetland or littoral rainforest.*

An assessment of the potential impacts of the modification works on ecology, surface water and ground water is provided in **Chapter 11.0 Ecology** and **Chapter 13.1 Soil, Water and Contamination**. The modification works are located within the SSD 5147 boundary and would be managed in accordance with the approved environmental management plans for the Conversion Project. The works are unlikely to significantly impact on the matters listed in clause 11(1).

Although the Conversion Project Area is located on land within the Coastal environment and Coastal use areas, the considerations for these areas do not apply as the land is also within the Foreshores and Waterways Area as defined by the Sydney Harbour SREP (refer to clauses 13(3) and 14(2) of the Coastal Management SEPP).

Division 5 of the Coastal Management SEPP outlines general considerations for land within the coastal zone. Development consent must not be granted to development on land within the coastal zone unless the consent authority:

- *"is satisfied that the proposed development is not likely to cause increased risk of coastal hazards on that land or other land"; and*
- *"has taken into consideration the relevant provisions of any certified coastal management program that applies to the land".*

The Conversion Project Area lies within the Parramatta River Estuary and therefore is subject to the Parramatta River Estuary Coastal Zone Management Plan (Cardno, 2013). The Parramatta River Estuary Coastal Zone Management Plan does not include any actions for the land where the modification works are proposed.

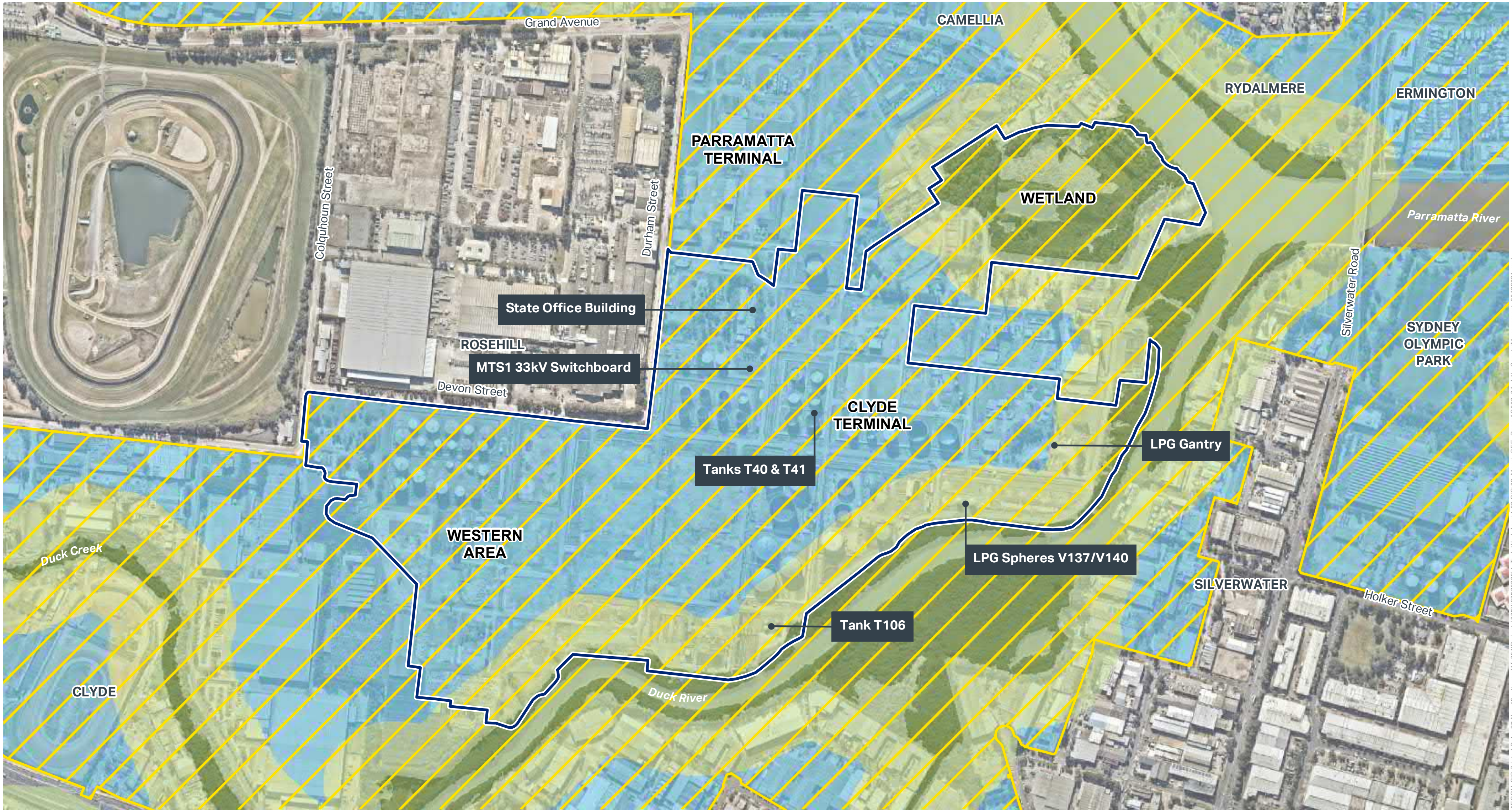

FIGURE 5-1: COASTAL MANAGEMENT SEPP COASTAL MANAGEMENT AREAS

KEY

- Conversion project area boundary
- Coastal Environment Area
- Coastal Use Area
- Coastal Wetlands
- Proximity Area: Coastal Wetlands

AECOM

0 100 200 300 m

State Environmental Planning Policy 55 – Remediation of Land

State Environmental Planning Policy 55 – Remediation of Land (SEPP 55) provides that a consent authority may not consent to a development unless it has considered whether the land is contaminated, and if so, whether remediation is required to make the land suitable for the purposes of the development. If remediation is so required, the consent authority must be satisfied that the land would be remediated before that land is used for the identified purpose.

Contamination issues are discussed within **Chapter 13.1 Soil, Water and Contamination**. The modification works do not require excavation of soil with all demolition works occurring to grade. It is unlikely that contamination would be encountered. If contamination is encountered during the modification works, it would be managed in line with the measures outlined within the approved Management Plans for the Conversion Project. No change of land use is proposed as part of the modification works and the land would continue to be suitable for its consented use as a liquid fuel depot and therefore the provisions of SEPP 55 do not prevent consent being granted for the works.

5.2.3 Local Environmental Planning Policies

Parramatta Local Environment Plan 2011

Land use within the terminal is controlled by the *Parramatta Local Environmental Plan 2011* (LEP). The LEP provides that a consent authority must have regard to the relevant land use objectives when determining a development within the IN3 Heavy Industrial zone. An analysis of how the Conversion Project is compatible with the planning objectives was provided in the EIS. Given the similar nature of the proposed modification works and their location within the Conversion Project Area, it is considered that there is no change to the assessment in the EIS. The modification works are also located outside of the Riparian Land and Waterways Zoning and Heritage Zoning protected under the LEP.

5.2.4 Other NSW State Legislation

Protection of the Environment Operations Act 1997

Section 48 of the *Protection of the Environment Operations Act 1997* (POEO Act) provides for the issue of an Environment Protection Licence (EPL) for scheduled activities related to pollution and waste disposal caused by development or operation of developments. Activities requiring an EPL are listed in Schedule 1 of the Act. Activities relating to chemical storage are listed in clause 9 of Schedule 1 of the POEO Act. These include Petroleum Products Storage with a capacity to store more than 200 tonnes (liquefied gases) or 2,000 tonnes (chemicals in any other form).

EPL 570 licences a number of activities at the terminal, including Petroleum Products Storage. The EPL is frequently amended, in consultation with the NSW Environment Protection Authority (EPA), to ensure that the activities at the terminal are appropriately managed. The modification works would not alone be defined as a Scheduled Activity under the POEO Act and no licenced emission source specific to these works has been identified. No updates to the EPL for the terminal are likely to be required as a result of the modification works.

Work Health and Safety Act 2011

The *Work Health and Safety Act 2011* (WH&S Act) and its supporting *Work Health and Safety Regulation 2011* defines major hazard facilities (MHFs), regulates their operation and includes measures to prevent accidents occurring at MHFs.

The terminal is classified as a MHF. Works to or modifications of a MHF need to be discussed with SafeWork NSW as the administrators of the WH&S Act. Viva Energy undertakes regular consultation with SafeWork NSW and will continue to do so moving forward. However as the modification works would not substantially modify the MHF, consent and approval of SafeWork NSW is not required.

Heritage Act 1977

The *Heritage Act 1977* (Heritage Act) aims to promote an understanding, encourage conservation and provide for protection of NSW State Heritage. State and/or local heritage significance can relate to historical, scientific, cultural, social, archaeological, architectural, natural or aesthetic values of a place, building, work, relic, moveable object or precinct. The Heritage Act provides for the listing of heritage structures on the State Heritage Register and Orders can be made under the Heritage Act to protect relics from removal or alteration.

The Clyde Terminal does not contain any heritage designations. The heritage assessment in the EIS for the Conversion Project concluded that the site had State significance on historical, associative, rarity and representative grounds and of local significance holding social, technical, and research values. Previous assessments of archaeological potential at the Conversion Project Area have been undertaken by AECOM (AECOM, 2013) and Australian Museum Consulting (Australian Museum Consulting, 2015). These assessments identified that although two areas having the potential to contain archaeological significance, the areas are unlikely to yield archaeological information that is not readily available from other sources.

An assessment of the potential impacts of the modification works on heritage significance is provided in **Chapter 11.0 Non-Aboriginal Heritage**. That assessment concluded that the demolition of additional structures as part of the modification works would not significantly affect the heritage significance of the site.

National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* provides for the conservation of objects, places or features of significance to Aboriginal people. Desktop searches and previous investigations have indicated that there are no known Aboriginal sites or objects located on Conversion Project Area. Investigations undertaken during the EIS confirmed that the Conversion Project Area is located on disturbed land and it is unlikely that any Aboriginal items remain in-situ. The modification works involve demolition to grade and no impacts to Aboriginal heritage values are therefore anticipated during the works.

Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BC Act) is a new Act that repeals the *Threatened Species Conservation Act 1995 (NSW)* and parts of the EP&A Act. The purpose of this Act is to maintain a healthy, productive and resilient environment for the greatest wellbeing of the community consistent with the principles of the ecological sustainable development in NSW.

Assessment of potential impacts to matters protected under the BC Act is detailed in **Chapter 12.0 Ecology**.

Noxious Weeds Act 1993

The *Noxious Weeds Act 1993* (NW Act) provides for the identification and control of noxious weeds, including the duties of public and private landholders on this regard. The NW Act stipulates that an occupier of land must take steps to control noxious weeds on their land.

The NW Act also provides for the monitoring of and reporting on the effectiveness of the management of weeds in NSW. Appropriate methods for controlling noxious weed species are defined under the control category or categories for particular species of weeds. Management of noxious weeds within the Site as part of the modification works would continue to be subject to Viva Energy's existing Biodiversity Management Plan.

5.3 Commonwealth Legislation

5.3.1 Environmental Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) requires approval from the Commonwealth Minister for Environment and Energy to carry out an action that has, will have or is likely to have a significant impact on a matters of national environmental significance (MNES).

During preparation of the EIS for SSD 5147, a referral (2013/6878) was submitted to the Commonwealth Department of the Environment (now, Department of Environment and Energy (DoEE)) in relation to the potential impacts on the Green and Golden Bell Frog (GGBF), which is listed as vulnerable under the EPBC Act. SSD 5147 was deemed to be a controlled action on listed threatened species and communities (sections 18 and 18A) and an EPBC Approval (EPBC 2013/6867) was issued on 17 April 2014 (with conditions).

Condition of Approval 1 (CoA 1) states that the approval holder must not demolish redundant infrastructure or modify existing assets other than as described in EPBC referral 2013/6878 received by the Department on 23 May 2013. The modification works involve the demolition of additional redundant infrastructure outside of that described in the EPBC referral. The works would not impact on MNES. DoEE has been contacted to discuss this condition. Viva Energy is preparing a summary of the relevant parts of this Modification Report to provide to DoEE in support of a potential modification to this condition (if required).

A search of the EPBC Protected Matters database was conducted on 30 August 2018. The search covered the modification works and a 10 km zone surrounding the area in order to identify any potential MNES that have been listed since the EIS was completed. The results of the database search and a summary of the findings of the EIS are included in **Table 5-1**.

Table 5-1 Matters of National Environmental Significance

MNES	Matters Within the Vicinity of the Site
World Heritage Properties	There are no World Heritage Properties within the Conversion Project Area. There are two World Heritage Properties approximately 3 km west of the modification works, namely the Parramatta Park and the Old Government House and Domain. The modification works would not impact on World Heritage Properties.
National Heritage Places	The Old Government House and Domain World Heritage Property are also listed as a National Heritage Property. The Parramatta Female Factory Precinct is also located approximately 4 km north west of the modification works. The modification works would not impact on National Heritage Places.
Wetlands of International Importance	There are no wetlands of International Importance located within 10 km of the modification works. The modification works would not impact on wetlands of International Importance.
Commonwealth Listed Threatened Species and Ecological Communities	**Threatened Ecological Communities** Ten Commonwealth listed threatened ecological communities were identified within 10 km of the modification works. **Threatened Flora** Twenty-seven flora species listed as threatened under the EPBC Act are recorded as being known or likely to occur within 10 km of the modification works. **Threatened Terrestrial Fauna** Forty-six 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 modification works. **Threatened Marine Fauna** Three marine fauna species that have been listed as threatened under the EPBC Act and are known or likely to occur within 10 km of the modification works. Ecology is assessed further in **Chapter 12.0 Ecology**
Commonwealth Listed Migratory Species	A total of 58 listed threatened migratory species have either been recorded, or their potential habitat has been recorded, in the vicinity of the modification works. The modification works would not result in a significant impact to Commonwealth listed migratory species.
Nuclear Action	The modification works would not result in any nuclear action, nor would any nuclear activity need to be undertaken as defined in the EPBC Act.
Commonwealth Marine Areas	There are no Commonwealth Marine Areas in the vicinity of the Conversion Project Area. The modification works would not impact on

MNES	Matters Within the Vicinity of the Site
	Commonwealth Marine Areas.
Water Resource (Coal Seam Gas / Coal Mining)	The modification works are not related to coal seam gas or coal mining development works.
Environment of Commonwealth Land	The modification works are not located on Commonwealth Land or would affect the environment of Commonwealth Land.

6.0 Consultation

As part of the Conversion Project, Viva Energy undertakes various levels of consultation with range of stakeholders. In the lead up to this application a number of relevant stakeholders have been contacted. This chapter documents consultation undertaken specific to the modification works.

6.1 Objectives of Consultation

The main objectives of the consultation are to:

- Identify the relevant stakeholders and advise them of the modification works;
- Determine key issues and concerns held by relevant stakeholders; and
- Ensure communication with government agencies and the community is implemented with regards to the modification works.

6.2 Stakeholder Identification

The Conversion Project is currently being undertaken and is nearing completion. The proposed modification works are of a similar nature to the works approved by SSD 5147 and are located within the Conversion Project Area. As such, the stakeholders relevant to these works are similar to those identified within the Conversion Project EIS. For this modification, key stakeholders were identified as:

- DPE;
- EPA;
- Parramatta City Council (PCC); and
- DoEE.

6.3 Government Agency Consultation

Viva Energy has consulted with a number of stakeholders regarding the modification works. A letter was provided to DPE and contact was made with the other stakeholders listed in **Table 6-1** below.

All agencies were advised that further opportunities for comment would be available at the time of public exhibition of the Modification Application and at that time an environmental assessment of the modification works would be available.

The outcomes of consultations with these stakeholders (including how any issues raised have been addressed) are summarised in **Table 6-1**.

Table 6-1 Stakeholder Consultation

Stakeholder	Consultation Method and Timing	Issue Raised by Agency	Response
DPE	Notification was provided by issue of a letter outlining the planning justification and scope for the proposed modification on 23 August 2018 prior to preparation of the MR.	Email response received 14 September 2018 confirming the works as a modification.	N/A
NSW EPA	Phone call undertaken on 14 September 2018	No specific questions asked following a discussion regarding the proposed modification. EPA confirmed they would review the application following lodgement.	N/A

Stakeholder	Consultation Method and Timing	Issue Raised by Agency	Response
PCC	Phone call undertaken on 5 September 2018	PCC requested background information on the Project, planning approval pathway and consultation activities. PCC noted that formal comment would follow submission of the modification application.	PCC was made aware of the Project and its relationship with SSD 5147 and the Clyde Western Area Remediation Project SSD 18_9302. Noted that Viva Energy intend to complete works in line with existing environmental management plans and measures from SSD 5147 PCC made aware that modification application would be provided to all agencies that previously commented on EIS for SSD 5147.
DoEE	Phone call to previous DoEE contact on 12 October 2018	Phone call went to new part of the Department. Not relevant person. Department yet to confirm correct contact.	Viva Energy is summarising relevant parts of the Modification Report for submission to DoEE (refer to **Section 5.3.1**).

6.4 Ongoing or future Consultation

6.4.1 Approvals

The modification application and accompanying MR will be placed on public exhibition by DPE for a period of 14 days. During the exhibition period any person may make a submission regarding the modification works, and these submissions will be considered in the assessment of the modification application. Submissions can be made online at http://majorprojects.planning.nsw.gov.au/ or in writing and addressed to the planning officer below:

Department of Planning and Infrastructure
Attention: Kane Winwood
GPO Box 39
Sydney NSW 2001

6.4.2 During the modification works

Prior to the commencement of the modification works, Viva Energy would provide a Conversion Project Community Update on the Viva Energy website, Clyde and Parramatta Terminal Community page. Neighbouring properties would also be consulted via letterbox drop prior to works commencing.

Prior to and during the works Viva Energy would welcome direct feedback and concerns via the following methods:

- Clyde & Parramatta Terminals 24 Hour Line (including complaints line): 02 9897 8704
- Email contacts featured on the Viva Energy website

Comments and concerns received would be managed under the Viva Energy Complaints Management Procedure established for the Conversion Project. A complaints register is maintained on the Viva Energy website.

7.0 Environmental Scoping Assessment

7.1 Environmental Scoping for Modification Application

This MR documents a number of environmental assessments that have been carried out to identify additional potential environmental impacts resulting from the modification works, and to identify appropriate measures to manage or mitigate these impacts.

The identification of potential impacts, and confirmation of appropriate assessment methodologies, is determined through a scoping process. The scoping process for this MR was based on:

- review of available information and documents relating to the existing environment at the Site;
- site visits and appraisals;
- identifying the sensitivity of the surrounding environment (refer to **Chapter 2.0 Project Location and Existing Environment**);
- understanding the characteristics of the modification and how they relate to the approved Conversion Project and the assessments which have been completed previously, in particular the demolition works (refer to **Chapter 4.0 Proposed Modification Details**);
- review of relevant legislation and planning policy (refer to **Chapter 5.0 Legislation**);
- consultation with stakeholders (refer to **Chapter 6.0 Consultation**); and
- identification of other projects or actions that may cumulatively add to any perceived impact from the modification works.

7.2 Summary of Potential Issues Identified

Following the scoping process, the following environmental aspects were considered relevant to the modification:

- Hazards and Risk;
- Ecology;
- Non-Aboriginal heritage;
- Air Quality;
- Noise and Vibration;
- Soil, Water and Contamination;
- Transport and Access; and
- Waste Management.

The following environmental aspects were considered unlikely to be impacted by the revised demolition works and are therefore not discussed further in this MR:

- Aboriginal Heritage – the site is considered to retain no potential for Aboriginal archaeological materials given the extensive level of previous ground disturbance associated with development and operation of the terminal. A search of the OEH Aboriginal Heritage Information Management System was undertaken for the Conversion Project Area on 30 August 2018 with a 200 metre buffer. No Aboriginal sites or places were identified within the terminal or surrounding areas.
- Social and Economic – the closest residential area and community facilities are located around 250 m north of the modification works and are separated from the Conversion Project Area by Parramatta River. Given that all works would be contained to within the Conversion Project Area, the social and/or economic environment would not be affected.
- Land use – all activities would be carried out within the Conversion Project Area and would not change the land use, or affect surrounding land.

- Landscape and visual amenity – the modification works would occur within the Conversion Project Area and be visually consistent with other demolition activities that are occurring as part of the Conversion Project.

7.3 Prioritisation of Potential Issues

A review was undertaken to determine the key issues and prioritise the scope of work for each environmental aspect. This risk assessment considered the issues mentioned during consultation with relevant stakeholders and the Clyde Terminal Conversion Project EIS (AECOM, 2013).

Table 7-1 outlines the key environmental aspects in relation to the modification works.

Table 7-1 Prioritisation of Environmental Aspects

High Priority Issues	Medium Priority Issues	Low Priority Issues
• Hazards and Risk (**Chapter 8.0**) • Air Quality and Odour (**Chapter 9.0**) • Noise and Vibration (**Chapter 10.0**) • Non-Aboriginal heritage (**Chapter11.0**)	• Ecology (**Chapter 12.0**)	• Soil, Water and Contamination (**Section 13.1**) • Transport and Access (**Section 13.2**) • Waste Management (**Section 13.3**)

7.4 Format of the Assessment Chapters

A general impact assessment format has been adopted for reporting each of the assessment chapters of the MR. This is outlined below.

Introduction

This section provides an overview of the environmental aspect under consideration. It also provides cross-reference to other technical assessments or relevant appendices that have been used to inform the assessment chapter.

Method of Assessment

This section summarises the methodology for:

- Determining the existing environment relevant to the particular environmental aspect;
- Conducting an assessment of the potential environmental impacts of the modification in relation to the particular environmental aspect;
- Determining whether these potential impacts are significant; and
- Recommending mitigation measures that will minimise and manage these impacts.

For each environmental assessment there is an explanation of the approach to identifying impacts and assessing whether a potential impact is likely to be considered significant. Assessments can either be quantitative (relying on criteria, standards and thresholds) or qualitative (using certain scientific material, but ultimately making decisions based on professional judgement).

Existing Environment

The section describes the key components, characteristics and the status of the existing environment relevant to the environmental aspect. It also considers changes to the existing environment over the period of time that the modification works would be carried out.

As the proposed works are a modification to an approved Project, the existing environment takes into consideration the influence the conversion works and demolition works (i.e. the Conversion Project) has had and would continue to have on the existing environment.

The key receptors for each assessment will be identified and described in this section.

Impact Assessment

This section identifies potential impacts of the modification works on the sensitive receptors for the particular environmental aspect and evaluates the significance of the impact in accordance with the criteria detailed in the Method of Assessment. Impacts may be referred to either prior to (potential impact) or following mitigation (residual impact). In the 'Impact Assessment' section all impacts are potential impacts.

Impacts can be considered:

- Direct or indirect;
- Adverse or beneficial; or
- Significant, non-significant (negligible) or neutral.

Where existing criteria, guidance, environmental standards or assessment methodologies exist, the significance of an impact will be based on that information. Where possible and/or necessary, quantitative judgements about the significance of an impact will be made using this information. Where no explicit guidance or information exists, qualitative judgements on the significance of an impact will be made. Where qualitative judgements are required, some or all of the following impact characteristics will be considered to understand its potential magnitude:

- Extent – the area potentially affected by the impact;
- Magnitude – the size or amount of the impact;
- Duration – how long the impact is likely to last;
- Frequency – whether the impact is continuous, brief or intermittent;
- Timing – if the impact occurs at a particularly sensitive time; and
- Permanence – whether the impact is permanent or temporary.

The judgement as to whether an impact is significant will depend on the importance or sensitivity of the receptor (e.g. as defined by legislation, policy, standards or guidance) and the magnitude of the impact affecting it (as decided by quantitative or qualitative means). For the purposes of the 'Impact Assessment' section of each technical chapter all impacts are considered 'alone' and not cumulatively.

Mitigation

This section describes the management and mitigation measures that have been identified to avoid, reduce or compensate for the effects of significant impacts on the environment. The mitigation hierarchy has been used to help identify management and mitigation measures for each of the technical assessments. Wherever possible, impacts have been firstly avoided where possible, then either reduced at source or at receptor where avoidance cannot be achieved, and finally either compensated or offset where avoidance or reduction is not possible or would not achieve practicable or acceptable levels of mitigation. If management and mitigation measures are to be implemented through particular environmental management plans, then these will also be discussed.

Once all of the mitigation measures are identified and described, this section will also consider residual impacts that would remain following the application of the management and mitigation measures.

Summary of measures

The MR will provide a table summarising the additional management and mitigation measures required to manage the potential impacts of the modification works (in addition to those recommended for the Conversion Project). These may include unaltered or amended measures from SSD 5147 or new measures.

The management and mitigation tables from all of the technical assessments are collated into a single table (**Table 15-1**) within **Chapter 15.0 Revised Management and Mitigation Measures**. **Table 15-1** includes an updated, consolidated schedule of mitigation and management measures, and differentiates between the measures established for the Conversion Project and those proposed for the modification works.

8.0 Hazards and Risk

8.1 Introduction

Sherpa Consulting Pty Ltd (Sherpa) updated the Final Hazard Analysis (FHA) Report (revision 4) for the Conversion Project to incorporate the modification works (Sherpa, 2018). The updated FHA is provided in **Appendix A** and the outcomes are summarised within this chapter.

8.2 Method of Assessment

Sherpa prepared a Preliminary Hazard Analysis (PHA, revision 1) for the Conversion Project as part of the Conversion Project EIS. The PHA was undertaken to determine if the Site would meet the definition of 'hazardous' and/or 'offensive' in the context of SEPP 33, and would thereby require further risk reduction measures.

The PHA included a Level 3 Quantitative Risk Analysis in accordance with the NSW Department of Planning's *Hazardous Industry Planning and Advisory Paper No 6 - Guidelines for Hazard Analysis* (DPE, 2011a). The PHA methodology is detailed further in Chapter 19 of the Conversion Project EIS.

Sherpa updated the PHA in the form of a FHA (rev 0) in line with condition C2(d) of SSD 5147. Sherpa has updated the FHA (revision 4) to incorporate the proposed modification works including the removal of LPG (butane) facilities and Tank 106. Given that the Clyde Terminal operates alongside Viva Energy's adjacent Parramatta Terminal, the FHA report includes a cumulative assessment of the hazards and risks of these two terminals operating together.

8.3 Existing Environment

8.3.1 Site Operations

The Site is situated within the Camellia Industrial Estate and operates 24 hours a day seven days a week receiving, storing and distributing bulk fuel products, including Gasoline, Diesel and Jet Fuel. Smaller quantities of chemicals are also stored as packaged goods, including cleaning products, lubricants and acetylene for site maintenance activities.

SSD 5147 for the Conversion Project approved the following changes with respect to bulk fuel product storage volumes:

- Reduction in fuel storage capacity from 638 ML to 264 ML; and
- Reduction in gas storage capacity from 10,851 m^3 to 1,550 m^3.

It is proposed to remove the physical infrastructure to store and distribute butane at the Site through the demolition of two LPG (butane) spheres (i.e. V137 and V140 with a combined storage capacity of 1,550 m^3) and the LPG truck loading gantry. In addition, the retention of Tanks 40 and 41 for the storage of gasoline would retain a fuel storage capacity of 15.3 ML at the Site, however the purpose of retaining these tanks is in order to improve operational flexibility, as such no change is proposed to the previously approved fuel storage capacity of 264 ML.

8.3.2 Surrounding land use

The land use context of the areas surrounding the Clyde Terminal comprises industrial and transport related facilities, parks and recreational areas and Rosehill Gardens Racecourse. The Clyde Terminal is bordered by Durham Street, Devon Street and Grand Avenue. The Parramatta Terminal is located immediately north of the Clyde Terminal and is bounded by Durham Street to the west and Grand Avenue to the north.

8.4 Impact Assessment

The FHA provides a detailed risk analysis for potential hazards related to the Conversion Project and modification works. It identifies possible causes of potential incident scenarios and their consequences to public safety and the biophysical environment.

The FHA uses risk criteria established by the *Hazardous Industry Planning Advisory Papers (HIPAP) No. 4 – Risk Criteria for Land Use Safety Planning* (DPE, 2011b). Revised contour figures for the risk assessment are presented in Chapter 9 of **Appendix A**.

The FHA concludes:

- The main contributors to off-site fatality risk were found to be Unleaded Petrol pump pit fire and the Tank Farm K bund fire, located in the northern portion of the Conversion Project Area (refer to Figure 9.5 of **Appendix A**).
- The terminal would comply with all relevant HIPAP criteria as outlined below:
  - Individual fatality risk: The 50 x 10^{-6} per year contour (target is to be retained on site) marginally extends beyond the Conversion Project Area boundary into the Parramatta Terminal as the risk contour goes offsite by approximately 10 metres. However Parramatta Terminal is operated by Viva Energy and hence the sites are under a single ownership. The part of the site that is impacted would only have an occasional presence of people and the contour does not reach buildings, muster points or populated areas. There is a joint Emergency Response Plan (ERP) in place and Parramatta Terminal would be notified of emergencies at Clyde;
  - Individual injury risk: The injury risk level does not impact residential development at frequencies of more than 50 x 10^{-6} per year; and
  - Accident propagation/escalation risk: The 50 x 10^{-6} per year contour remains within the site boundary.
- In the context of SEPP 33, the facility continues to be considered 'potentially hazardous' (rather than hazardous) and 'potentially offensive' (rather than offensive).

The removal of the LPG infrastructure has resulted in a reduction in the risk profile for the Site compared to the Conversion Project SSD 5147. The LPG Boiling Liquid Expanding Vapour Explosion (BLEVE) hazard from operation of LPG infrastructure was previously identified as one of the main contributors to offsite fatality risk. The other main contributor to offsite fatality risk was flash fire (vapour cloud explosion) following overfill of gasoline storage tanks. However as demonstrated in the revised FHA the retention of these tanks has not increased the risk profile of the terminal.

The modification works are generally consistent with the demolition works that were assessed in the Conversion Project EIS. As such, the hazards that could occur as a result of the works during demolition have been previously consented and remain acceptable under the provisions of SEPP 33.

8.5 Mitigation

A number of risk reduction measures would be implemented to help ensure that appropriate controls are in place during the modification works. A Demolition Management Plan (DMP) was prepared for the Conversion Project. When relevant the modification works would be managed in accordance with the controls outlined in the existing DMP.

Viva Energy has a commitment to meet the intent and specific requirements of the WH&S Act and the *Work Health and Safety Regulation 2011* (WH&S Regulations). Viva Energy has numerous policies, procedures and controls to create and maintain a safe workplace at the Site. This includes an established incident reporting and response process. These are regularly reviewed and modified as necessary in order to maintain compliance with the WH&S Act and WH&S Regulations. The modification works would comply with these policies, procedures and controls.

The modification works would also comply with other current and relevant safety codes and statutory requirements with respect to safe working conditions. In particular, this would include standards and requirements relating to the handling and management of hazardous, flammable and/or contaminated materials. Personnel required to work with these substances would be trained in their safe use and handling and would be provided with all the relevant safety equipment and appropriate personal protective equipment.

Emergency procedures have been developed for the Clyde Terminal. The terminal has an Operations Manager with overall responsibility for safety, who is supported by experienced personnel trained in the operation and support of the plant and associated facilities. The modification works would be undertaken under the supervision of a Demolition Manager and in close coordination with the Site Operations Manager and in accordance with the existing Conversion Project management plans, where applicable.

Viva Energy would also continue to manage the terminal in accordance with existing requirements as a major hazard facility.

As the modification works result in a decrease in the overall risk profile of the terminal and as the works and identified hazards are consistent with those assessed in the Conversion Project EIS, no further measures or controls are required above those agreed for the Conversion Project.

9.0 Air Quality

9.1 Introduction

An Air Quality Impact Assessment was prepared by AECOM for the Conversion Project EIS (AECOM, 2013). This chapter presents the results of an additional air quality assessment that has been undertaken for the modification works and is based on background information and criteria presented in the EIS. This assessment comprised a review of the proposed modification works and applicable criteria to evaluate the likely air quality impacts and confirm if any additional mitigation measures are required.

9.2 Assessment Methodology

9.2.1 Retention of Tanks 40 and 41

SSD 5147 provided for the demolition of Tanks 40 and 41 in the central part of the Conversion Project Area. It is now proposed to retain these tanks for their existing use for unleaded fuel storage. There would not be a change in the consented throughput and consented storage volumes resulting from the retention of these two tanks. Total volatile organic compound (VOC) and benzene fugitive emissions associated with the retention of Tanks 40 and 41 for the storage of premium unleaded petrol has be assessed using the TANKS emissions estimation model.

9.2.2 Demolition Activities

The 2014 United Kingdom (UK) Institute of Air Quality Management (IAQM) *Guidance on the assessment of dust from demolition and construction* document provides a qualitative risk assessment process for the potential impact of dust generated from demolition, earthmoving and construction activities. As the remaining modification works are limited to demolition of structures, only the demolition section of the IAQM methodology is relevant and included in assessment process set out in **Section 9.4** below.

9.3 Existing Environment

The NSW Office of Environment and Heritage (OEH) operate several ambient air quality monitoring sites across the Sydney region. The locations nearest to the Conversion Project Area are at Chullora (8 km to the southeast) and Prospect (10 km to the west).

Given that particulates are the primary pollutant of concern for the modification works from an air quality perspective, the focus of the existing environment analysis has been on particulate concentration, and in particular the PM_{10} concentration, which represents the fraction whereby health effects may result from emissions. **Table 9-1** presents the PM_{10} data for the two monitoring locations for the years 2014 to 2017.

Table 9-1 Chullora and Prospect OEH Monitoring Location Ambient PM_{10} Concentrations; 2014-2017

Statistic	Annual average PM_{10} Concentration - µg/m^3			
	2014	2015	2016	2017
Chullora Annual Average	18.1	17.5	18.1	20.1
Prospect Annual Average	17.6	17.6	18.9	18.9

The nearby Parramatta North weather station provides over 50 years of meteorological data between 1965 and 2018. The warmest temperatures at Parramatta North occur in summer, with the average maximum temperature recorded in January (28.5^{o}C). July is the coldest month with an average minimum temperature of 6.2^{o}C. Rainfall is highest in February (mean rainfall of 121.3 mm) and lowest in July (mean rainfall of 45.3 mm). Annual average rainfall is 972.0 mm.

Wind data is shown in **Figure 9-1** and **Figure 9-2** and shows the following patterns:

- January to March - morning winds are variable with moderate calm conditions (7 to 9%). Afternoon winds increase in strength changing to predominantly from the eastern quadrant with low (1 to 2%) calm conditions.
- April to June - morning winds are light and predominantly from the west and northwest with calm conditions from 6 to 9%. Afternoon winds increase in strength changing to predominantly from the eastern quadrant in April and variable in May and June with moderate (4 to 6%) calm conditions.
- July to September, morning winds are light and predominantly from the west and northwest with calm conditions of 6%. Afternoon winds increase in strength becoming variable with moderate (2 to 6%) calm conditions.
- October to December, morning winds are light and variable with calm conditions from 5 to 6%. Afternoon winds increase in strength changing to predominantly from the eastern quadrant with very low (1%) calm conditions.

The meteorological data indicates variable wind patterns throughout the year with a summer easterly/winter westerly wind pattern. Given the predominant winds and the surrounding landuse, there are no indications of potential air quality impacts due to prevailing meteorology.

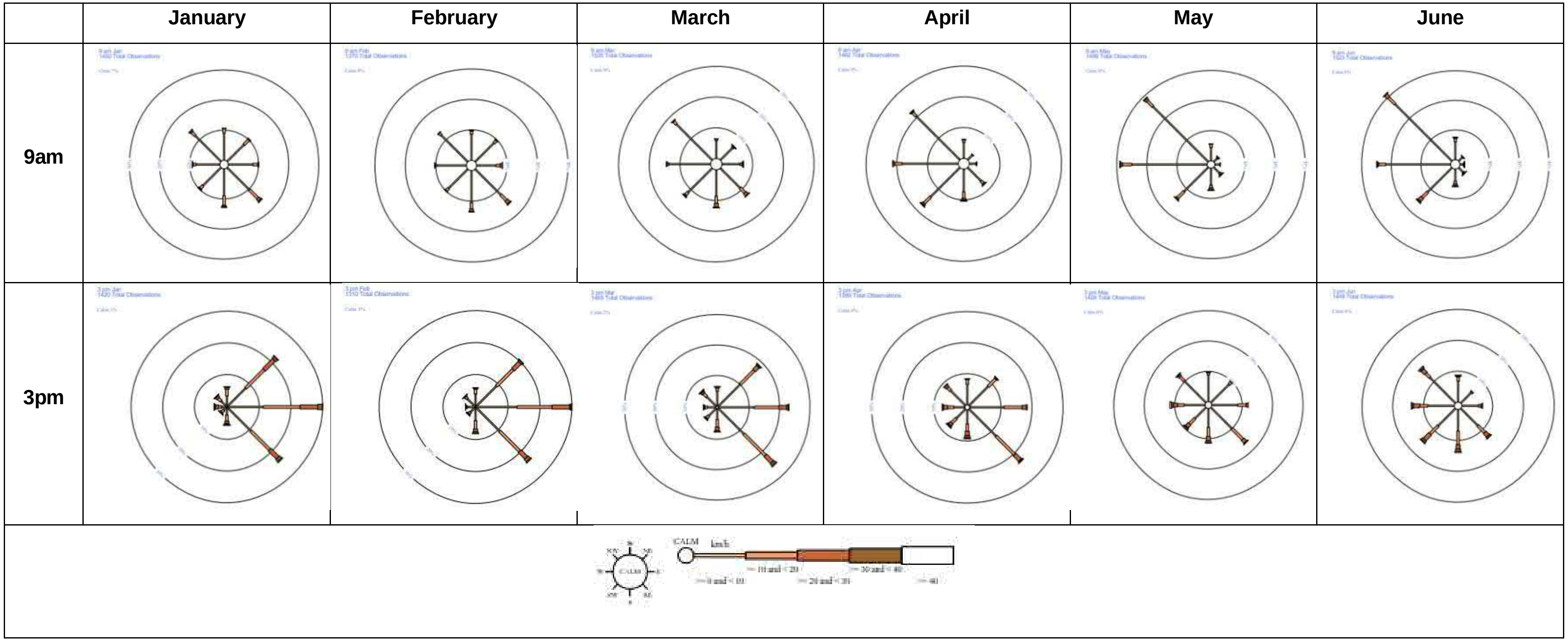

Figure 9-1 9 am and 3 pm Wind Roses; Parramatta North; January to June; 1967–2018

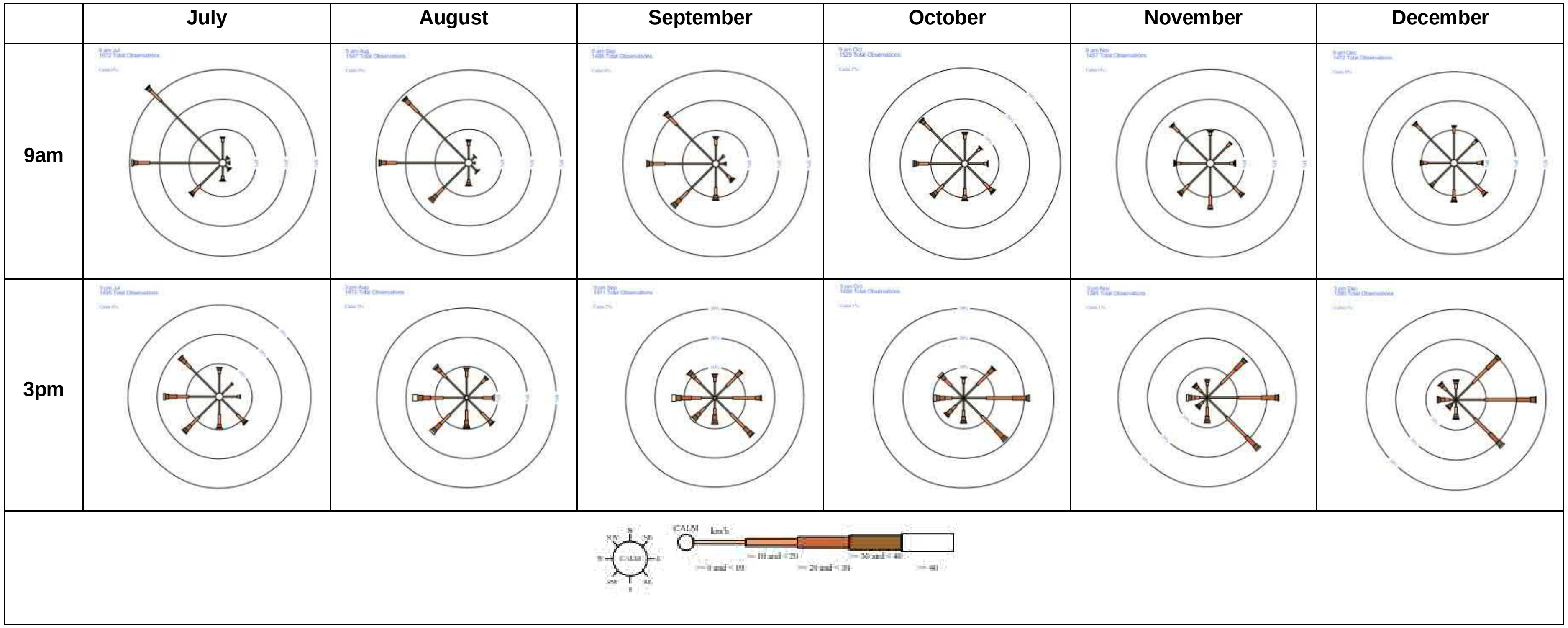

Figure 9-2 9 am and 3 pm Wind Roses; Parramatta North; July to December; 1968–2018

9.4 Impact Assessment

9.4.1 Retention of Tanks 40 and 41

The TANKS emissions estimation model identifies that the retention of Tanks 40 and 41 would increase the predicted total VOC emission rate of the Site from 40,688 kg/year to 49,123 kg/year. Whilst this total VOC emission rate would be a small increase on what was previously consented it would still represent an 81% reduction from the maximum annual total VOC emission rate of 263,470 kg/year calculated for the operation of the Clyde Refinery in 2009 - 2010. The predicted benzene emission rate of 148 kg/year is predicted to increase to 198 kg/year which represents a reduction of 99% when compared to the previous maximum annual total emission rate of benzene of 20,870 kg/year for 2011 - 2012. As such, the predicted annual emission rates of total VOCs and benzene associated with the modification works would still represent a significant reduction in emissions compared to historical emissions from the previous operational Clyde Refinery.

The Clyde facility has a current total VOC load limit of 1,250,000 kg/year and a benzene load limit of 26,000 kg/year stipulated in EPL 570. The reported load values for the modified project represent 4% of the allowable load limit for total VOC and <1% of the allowable load limit for benzene.

9.4.2 Demolition activities

The main potential impacts resulting from the additional demolition works relate to particulate matter. Therefore the IAQM guidance presented in **Section 9.2** has been used to assess the potential impacts. This guidance involves working through a four step process. This stepped assessment is presented below.

Step 1 - Screening Assessment

An assessment will normally be required where a “human receptor” could be within:

- 350 m from the boundary of a site; or
- 50 m from the route used by construction vehicles on public roads up to 500 m from a site entrance.

As the modification works would involve demolition activities within 350 m of the boundary of the Conversion Project Area, there is the potential for human receptors, consisting of workers in surrounding industrial facilities or public road users, to be impacted by the modification works.

Step 2 - Dust Impact Assessment

Step 2 involves using a risk assessment tool to appraise the potential for dust impacts due to unmitigated dust emissions from a construction project. The key components of the risk assessment are defining the dust emission magnitudes (Step 2A), the surrounding area sensitivity (Step 2B), and then combining these in a risk matrix (Step 2C) to determine an overall risk of dust impacts.

Step 2A - Dust Emission Magnitude

Dust emission magnitudes are estimated according to the scale of works being undertaken classified as Small, Medium or Large. The IAQM guidance provides examples of demolition to aid classification, which have been reproduced in **Table 9-2** below.

Table 9-2 Examples of Small, Medium and Large demolition and construction activities

Activity		Small	Medium	Large
Demolition	Total building volume (m^3)	<20,000	20,000–50,000	>50,000

The total demolition volume for the modification works is estimated to be approximately 14,000 m^3. Inclusive of the Phase 2 demolition works this volume would remain less than 20,000 m^3 for the purposes of this assessment. Therefore the dust emission magnitudes for the additional works, based on the IAQM guidance, have been determined to be ‘Small’ with the relevant cell in **Table 9-2** highlighted.

Step 2B – Surrounding Area Sensitivity

The IAQM methodology classifies the surrounding area sensitivity to dust soiling and human health impacts due to particulate matter effects to be classified as high, medium, or low. The classifications are determined according to matrix tables for both dust soiling and human health impacts, which are reproduced in **Table 9-3** and **Table 9-4** respectively below. Factors used in the matrix tables to determine the surrounding area sensitivity are described as follows:

- Offsite receptor sensitivity (for individual receptors in the area):
  - *High sensitivity – locations where members of the public are likely to be exposed for eight hours or more in a day. (e.g. private residences, hospitals, schools, or aged care homes).*
  - *Medium sensitivity - places of work where exposure is likely to be eight hours or more in a day.*
  - *Low sensitivity – locations where exposure is transient – e.g. one or two hours maximum. For example parks, footpaths, shopping streets, playing fields.*
- Number of receptors of each sensitivity type in the area
- Distance from source
- Annual mean PM_{10} concentration (only applicable to the human health impact matrix).

Table 9-3 provides the IAQM guidance sensitivity levels from dust soiling effects on people and property.

Table 9-3 Surrounding Area Sensitivity to Dust Soiling Effects on People and Property

Receptor Sensitivity	Number of Receptors	Distance from the source (m)			
		<20	<50	<100	<350
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

As the surrounding receptors would predominantly be people in their place of work at surrounding industrial premises, potential exposure would likely exceed eight hours. Receptor sensitivity has therefore been assessed as 'medium'. Receptors would be located between 100 and 350 m from the modification works and the surrounding area sensitivity for dust soiling effects on people and property from the proposed modification works has therefore been assessed as low.

Annual average PM_{10} concentrations for the Chullora and Prospect OEH monitoring locations (**Table** 9-1 above) range from 17.5 to 20.1 µg/m^3. The IAQM guidance provides sensitivities for the following annual average PM_{10} ranges: >32, 28-32, 24-28 and <24 µg/m^3.

Table 9-4 below provides the IAQM guidance sensitivity levels for human health impacts for an annual average PM_{10} concentration of <24 µg/m^3.

Table 9-4 Surrounding Area Sensitivity to Human Health Impacts for Annual Average PM_{10} concentration <24 $\mu g/m^3$

Receptor Sensitivity	Number of Receptors	Distance from the source (m)				
		<20	<50	<100	<200	<350
High	>100	Medium	Low	Low	Low	Low
	10-100	Low	Low	Low	Low	Low
	1-10	Low	Low	Low	Low	Low
Medium	>10	Low	Low	Low	Low	Low
	1-10	Low	Low	Low	Low	Low
Low	>1	Low	Low	Low	Low	Low

There are no residential areas, schools, hospitals or aged care homes within 350 m of the Site with the predominant landuse light and heavy industrial where workers would be exposed for up to eight hours during the working day. The resulting classification of receptor sensitivity has therefore been determined as medium with the likely number of receptors being >10.

As the modification works would result in demolition activities occurring, at its closest, approximately 130 m from the nearest offsite industrial receptor, the surrounding area sensitivity derived for human health impacts from the proposed demolition works is low.

Step 2C - Unmitigated Risks of Impacts

The dust emission magnitude as determined in Step2A is combined with the sensitivity as determined in Step 2B to determine the risk of impacts with no mitigation applied.

Table 9-5, reproduced from the IAQM guidance, provides the risk of dust impacts from the scale of proposed demolition as listed in **Table 9-2**.

Table 9-5 Risk of Dust Impacts from Demolition

Surrounding Area Sensitivity	Dust Emission Magnitude		
	Large	Medium	Small
High	High	Medium	Medium
Medium	High	Medium	Low
Low	Medium	Low	Negligible

The unmitigated risk of dust impacts from demolition activities for both dust soiling and human health determined from **Table 9-5** for the scale of activity as determined in **Table 9-2** is negligible.

Step 3 – Management Strategies

The outcome of Step 2C is used to determine the level of management that is required to ensure that dust impacts on surrounding sensitive receptors are maintained at an acceptable level. A high or medium-level risk rating means that suitable management measures must be implemented.

Recommended site-specific and in-principle management measures are described in **Section 9.5** below. The implementation of these measures would result in minimal risk of dust impacts on surrounding receptors.

Step 4 – Reassessment

The final step of the IAQM methodology is to determine whether there are significant residual impacts, post mitigation, arising from a proposed development. The guidance states:

> *For almost all construction activity, the aim should be to prevent significant effects on receptors through the use of effective mitigation. Experience shows that this is normally possible. Hence the residual effect will normally be "not significant".*

It is anticipated that the additional demolition works would not constitute an atypical case and that with implementation of the proposed mitigation measures described in **Section 9.5** below, the residual effect (impacts) would be “not significant” in regard to dust soiling and human health impacts.

9.5 Mitigation

The unmitigated risk of air quality impacts during the additional demolition works has been predicted to be negligible for dust soiling on people and property and human health. With the implementation of the relevant mitigation measures listed in **Chapter 15.0 Revised Management and Mitigation Measures** negligible offsite impacts from the modification works are likely to occur.

10.0 Noise and Vibration

10.1 Introduction

A Noise Impact Assessment was prepared by AECOM for the Conversion Project EIS (AECOM, 2013). This chapter presents the results of the additional noise assessment that has been undertaken for the modification works and is based on background information and criteria presented in the EIS. This assessment comprised a review of the modification works and applicable criteria to evaluate the likely noise and vibration impacts and confirm if any additional mitigation measures are required.

10.2 Method of Assessment

10.2.1 Demolition Noise

The noise assessment has been carried out using the following methodology:

- Identification of nearby noise sensitive receivers potentially affected by the modification works in comparison to the previous noise assessment undertaken for the Conversion Project;
- Prediction of demolition noise levels at the sensitive locations;
- Comparison and assessment of predicted demolition noise levels against the project noise management levels; and
- Review of the noise measures stipulated in the EIS and SSD 5147 conditions of consent and identification of additional noise mitigation, monitoring and management measures, where required.

10.2.2 Operational Noise

Operation of the Clyde Terminal following the modification works would be consistent with its existing operation under the development consent for SSD 5147. As such, an operational noise assessment is not required.

10.2.3 Vibration

Due to the large distances between the Site and receivers, as well as the absence of any demolition plant which produce significant levels of vibration, adverse effects of demolition vibration are extremely unlikely, with respect to either human comfort or structural damage. Therefore, demolition vibration is not considered a significant issue for the modification works and has not been assessed. No specific additional mitigation measures above those consented under SSD 5147 are considered necessary.

10.3 Existing Environment

The existing physical environment on the terminal is outlined in **Chapter 2.0 Project Location and Existing Environment**. Background noise levels at the most affected sensitive receiver locations surrounding the Conversion Project Area are generally controlled by transport infrastructure with industry also contributing at some receiver locations.

Potentially affected noise sensitive receptors for the modification works are consistent with those identified for the Conversion Project. These industrial and residential premises and have been identified below in **Table 10-1** and are shown on **Figure 10-1**.

Table 10-1 Identified Potentially Noise Affected Receivers

Catchment Area	Receiver Number	Location	Approximate Distance and Direction from nearest component of modification works	Approximate Distance and Direction from Conversion Project Area Boundary
Residential Receivers				
Rosehill	R1	128 James Ruse Drive, Rosehill	1.6 km north west	1 km north west
	R2	82-100 James Ruse Drive, Rosehill	1.6 km west	850 m west
	R3	71 James Ruse Drive, Rosehill	1.7 km west	850 m west
Silverwater	R4	92 Asquith Street, Silverwater	600 m south west	600 m south
Newington	R5	1-9 Mockridge Avenue, Newington	1.1 km south east	1.1 km south east
Rydalmere	R6	529 John Street, Rydalmere	700 m north east	400 m north east
	R7	35 John Street, Rydalmere	900 m north	400 m north east
Non-residential Receivers				
	N1	Our Lady of Lebanon Maronite Church	2.1 km north west	1.6 km north west
	N2	C3 Church, Silverwater	700 m south east	830 m south east
	N3	Sydney Korean Catholic Community Church	950 m south	880 m south
	N4	Sydney Baha'I Centre	700 m south	670 m south east
	N5	Our Lady of Lebanon Aged Care Hostel	1.9 km north west	1.4 km north west
	N6	Rosehill Child Care Centre	1.8 km west	1.3 km north west
	N7	Rosehill Public School	1.7 km west	1.1 km west
	N8	Bordering industrial premises	Adjacent in all directions	Adjacent in all directions

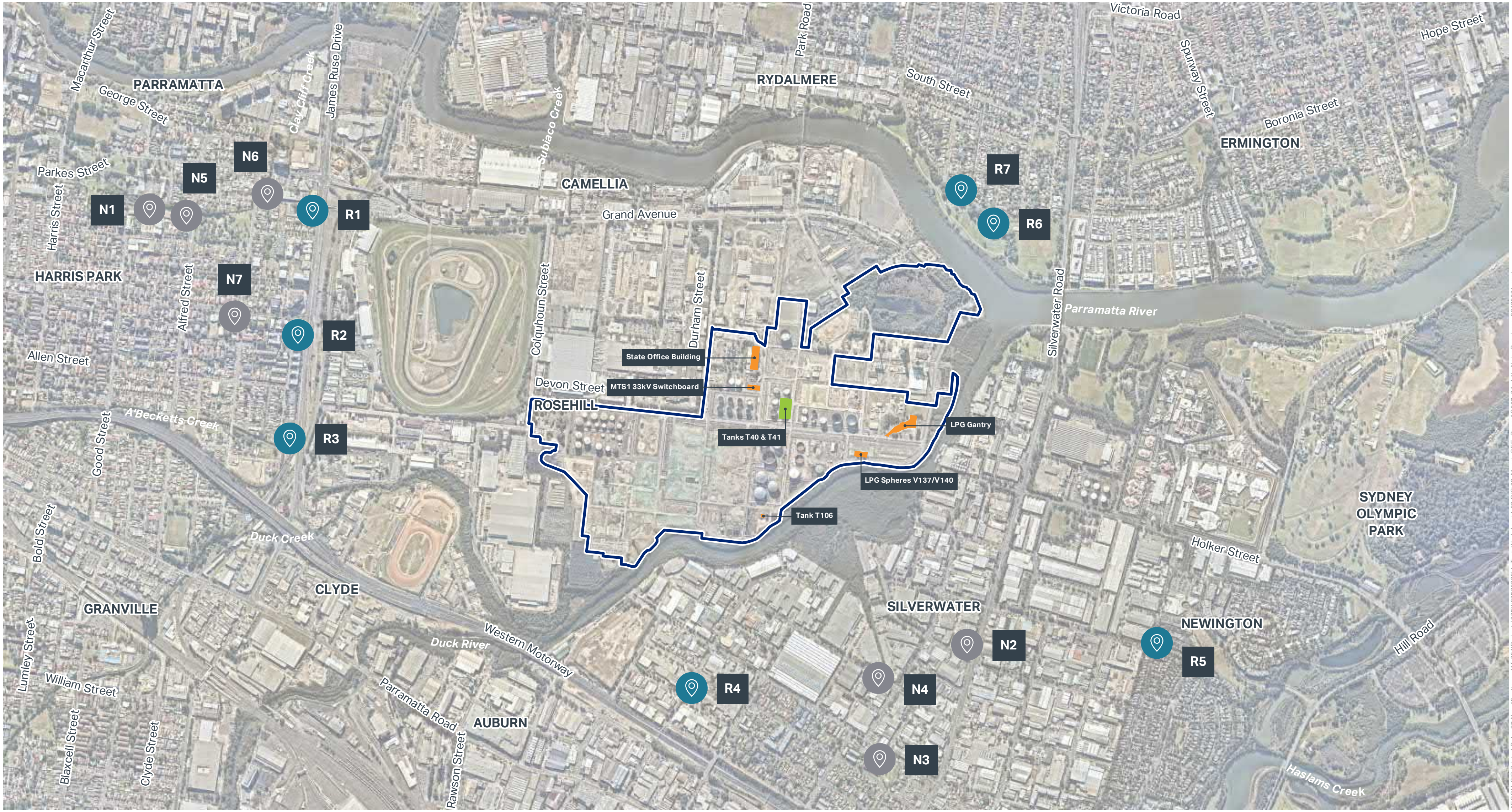

FIGURE 10-1: LOCATION OF NOISE RECEIVERS

KEY

Conversion project area boundary

Non-residential Receiver

Residential Receiver

Site Modifications

Retain

Demolish

AECOM

0 200 400 600 m

10.3.1 Noise Criteria

Noise Management Levels (NMLs) for the Conversion Project were derived in accordance with the *NSW EPA Interim Construction Noise Guidelines* (ICNG) and are presented in **Table 10-2**. Background noise levels at nearby sensitive receivers are predominantly generated by surrounding transport infrastructure. Therefore, despite the conversion of the refinery to the Clyde Terminal and subsequent reduction in noise generated from the site, significant infrastructure development that has occurred in the last six years including changes to the M4 Motorway has resulted in an overall increase in background noise levels at nearby sensitive receivers. The previously identified noise management levels would therefore provide a conservative set of criteria for this assessment.

Table 10-2 Construction Noise Management Levels

Receivers	Receiver number	Period[1]	Rating Background Level L_{A90} dB(A)	Noise management levels, L_{Aeq} dB(A)
Residents East of James Ruse Drive (Rydalmere, Silverwater and Newington)	R4, R5, R6, R7	Daytime	36	46
Residents West of James Ruse Drive (Rosehill)	R1, R2, R3	Daytime	37	47
Classrooms at schools	N7	Daytime	-	45
Places of worship	N1, N2, N3, N4	Daytime	-	45
Industrial premises	N8	Daytime	-	75
Aged Care/Child Care[2]	N5, N6	Daytime	-	47

Notes: 1. Daytime is 7:00 am to 6:00 pm

2. In the absence of a noise management levels for aged care facilities or child care facilities, the Our Lady of Lebanon Aged Care Hostel and Rosehill Child Care Centre have been assessed against the residential noise management levels.

The noise criteria for the assessment of traffic noise are provided in NSW Government's *NSW Road Noise Policy*. However, the modification works would be completed within the consented number of contractors. Therefore no incremental traffic movements would be generated, beyond the volumes previously assessed for the Conversion Project. Additional off-site noise impacts generated by truck movements are therefore not expected and have not been assessed further.

10.4 Impact Assessment

10.4.1 Overview

As outlined in **Chapter 4.0 Proposed Modification Details**, the modification works are anticipated to occur over an eight week period within the wider program for the Conversion Project. The proposed demolition hours are daytime 7:00am to 6:00pm in accordance with the consent for SSD 5147.

Provided in **Table 10-3** is a summary of the equipment that has been considered in the demolition noise assessment. This equipment is consistent with the proposed equipment to be used for the remainder of the consented demolition works (i.e. the Phase 2 demolition works). Additional equipment would not be required.

Table 10-3 Demolition Equipment and Sound Power Levels

Machinery	L_{Aeq} Sound Power Level, dB(A)	Number of plant
Excavator equipped with mechanical shears	107	2
Excavator equipped with hydraulic shears	107	2
Trucks	108	4
Cranes	105	2
Cutting torches	110	3

10.4.2 Demolition Noise

The results of the noise assessment are presented in **Table 10-4**.

Table 10-4 Predicted Demolition Noise Impacts

Address	Floor	Predicted Noise impacts		
		NML	Predicted $L_{Aeq(15min)}$	Exceedance
Residential receivers				
128 James Ruse Dr, Rosehill	1	47	41	-
82-11 James Rise Dr, Rosehill	1	47	41	-
	2	47	41	-
	3	47	41	-
	4	47	41	-
	5	47	41	-
	6	47	41	-
71 James Ruse Dr, Rosehill	1	47	41	-
	2	47	41	-
92 Asquith St, Silverwater	1	46	47	1
1-9 Mockridge Ave, Newington	1	46	42	-
	2	46	42	-
	3	46	42	-
	4	46	42	-
529 John Street, Rydalmere	1	46	49	3
35 John Street, Rydalmere	1	46	48	2
Non-residential receivers				
Our Lady of Lebanon Maronite Church[1]	1	45	27	-
C3 Church, Silverwater[1]	1	45	36	-
Sydney Korean Catholic Community Church[1]	1	45	34	-
Sydney Baha'l Centre[1]	1	45	36	-
	2	45	36	-
	3	45	36	-

Address	Floor	Predicted Noise impacts		
		NML	Predicted $L_{Aeq(15min)}$	Exceedance
Our Lady of Lebanon Aged Care Hostel	1	47	35	-
Rosehill Child Care Centre	1	47	39	-
Rosehill Public School[1]	1	45	39	-
Bordering Industrial Premises - East[1]	1	75	65	-
Bordering Industrial Premises – North[1]	1	75	61	-
Bordering Industrial Premises – North East[1]	1	75	61	-
Bordering Industrial Premises – North West[1]	1	75	60	-
Bordering Industrial Premises – South[1]	1	75	49	-
Bordering Industrial Premises – South East[1]	1	75	55	-
Bordering Industrial Premises – South West[1]	1	75	50	-
Bordering Industrial Premises - West[1]	1	75	54	-

Notes:

1 *Internal criteria and predicted noise level. Conservatively an industry standard correction of 10 dB has been applied to account for an external to internal transmission loss with windows open*

The results in **Table 10-4** indicate that noise levels may exceed the applicable NMLs by up to 3 dBA under a conservative assessment approach, with all construction plant operating simultaneously at the nearest Conversion Project Area boundary and without shielding. In practice exceedances of these magnitudes are unlikely to occur given that none of the potentially affected receptors are located near the proposed modification works (indeed the boundary includes the Wetland Area to the northeast of the terminal where no modification works are proposed). Equally noise levels up to two decibels are typically considered inaudible. However considering there is the potential for exceedances of the NMLs; reasonable and feasible noise mitigation measures in line with the existing DWP for the conversion works would be implemented.

10.4.3 Conclusion

The activities and equipment proposed for the additional demolition works are consistent with those assessed for the Conversion Project. The works would be undertaken within the program of the approved Conversion Project. While the specific works locations are not the same, the modification works are located within the Conversion Project Area boundary. The noise impacts of the modification works are not expected to be significantly different to those reported in the original assessment.

In addition, the modification works would be undertaken over a limited duration of up to eight weeks and as such, potential impacts would be of a relatively short duration. Whilst the works are predicted to at times exceed the demolition noise management levels at the closest residential receivers, the predicted noise levels do not exceed the highly noise affected 75 dBA noise criterion from the ICNG.

10.5 Mitigation

The management and mitigation measures relating to the modification works are identified in **Chapter 15.0 Revised Management and Mitigation Measures**, and would largely be consistent, as relevant, with the approved Conversion Project (SSD 5147).

The Conversion Project Noise and Vibration Management Plan has been reviewed and the measures outlined in the plan would be implemented during the proposed modification works. These measures would be sufficient to manage noise generated by the works.

11.0 Non-Aboriginal Heritage

11.1 Introduction

A Statement of Heritage Impact (SoHI) was undertaken to address the potential historic heritage impacts that may result from the modification works. This chapter provides a summary of the findings of the SoHI and includes relevant information from the previous Historical Archaeological Assessment for the Conversion Works EIS (AECOM, 2013). The SoHI for the modification works is provided in full in **Appendix B**. No Aboriginal archaeological assessment has been undertaken as part of this SoHI.

11.2 Method of Assessment

This heritage assessment has been undertaken in accordance with the NSW Heritage Division guidelines *Assessing Heritage Significance* (NSW Heritage Office, 2001) and *Statements of Heritage Impact* (NSW Heritage Office, 2002) and includes:

- Desktop searches of relevant heritage registers.
- Review of the following key documents:
  - Clyde Terminal Conversion Project, Appendix E – Clyde Terminal Historical Archaeological Assessment (AECOM, 2013);
  - Clyde Terminal Conversion Project: Documentary Recording (Australian Museum Consulting, 2015)
  - SSD 5147 Shell Oil Refinery, Clyde Archival Recording, Alexander Mayes Photography, 2014 (Mayes, 2014)
  - Clyde Terminal Conversion Project: Historic Archaeological Assessment (Australian Museum Consulting, 2015)
- A site inspection carried out on 16 August 2018 to assess the structures proposed for demolition.

A re-assessment of the heritage significance of the site was undertaken. The assessment was undertaken in light of the conservation processes and principles found in *The Australian ICOMOS Charter for Places of Cultural Significance* (2013) (Burra Charter). The Burra Charter is considered to be the pre-eminent guidance document for the management of change for places of heritage significance within Australia.

The process of linking this assessment with an item's historical context has been developed through the NSW Heritage Management System and is outlined in the guideline *Assessing Heritage Significance*, part of the NSW Heritage Manual (Heritage Branch, Department of Planning). The *Assessing Heritage Significance* guidelines establish seven evaluation criteria (which reflect four categories of significance and whether a place is rare or representative) under which a place can be evaluated in the context of State or local historical themes. Similarly, a heritage item can be significant at a local level (i.e. to the people living in the vicinity of the site), at a State level (i.e. to all people living within NSW) or be significant to the country as a whole and be of National or Commonwealth significance.

11.3 Existing Environment

The terminal has four historical phases as follows:

1. Aboriginal occupation pre 1804 colonial occupation of the area;
2. Early land grants and Elizabeth Farm between 1816 and 1918;
3. John Fells & Co between 1918 and 1927; and
4. British Imperial Oil / Shell / Viva Energy since 1928 until the present day.

A detailed outline of the historical operations of the Clyde Refinery, before refining operations ceased and it became the Clyde Terminal, is provided in **Appendix B**. The historical context of the components of the site subject to this modification is presented below.

State Office Building

The State Office Building was constructed in 1986 as an administrative centre for Clyde Terminal. The three story building is predominantly constructed with brick and contains a number of plantings on the perimeter. The building is designed in a contemporary style typical of the era. Stylistic characters include; circular forms, tensioned membrane structures, internal conservatories, skillion roofs and clerestory windows. Online searches did not reveal whether the building was designed by a significant person. Considering the building's stylistic features it is likely to have been designed by an architect or designer.

The State Office Building is not linked to a key historical phase and has an incidental association with the historically significant activity of the site. It is however, a fine example of 1980s Australian architecture.

MTS1 33kV Switchyard

The MTS1 33 kV switchyard is located north of the Conversion Project Area, immediately south of the State Office Building and is located behind a gated, anti-climb, chain wire fence with high voltage warning signs. The switchyard is likely to have been constructed between 1970 and 1978. The switchyard has only a contributory significance to the historical significance of the Clyde Terminal.

Tank 106

Tank 106 is located south of the Site adjacent to Duck River within the No. 7 Water Treatment facility. There are four green painted tanks in this area which are contained by a drainage bund and are screened to the south by plantings along Duck River. Tank 106 shows signs of corrosion to the tank surface and to the external access stair and balustrade. Tank 106 is likely to have been constructed between 1956 and 1970. Tank 106 has only a contributory significance to the historical significance of the Clyde Terminal.

LPG Spheres V137 and V140 and LPG Truck Loading Gantry

LPG spheres V137 and V140 are located on the south eastern portion of the Conversion Project Area adjacent to Duck River. The area is surrounded by a combination of brick retaining walls and concrete and asphalted plinths. The spheres are elevated on columns and are connected by a steel framed access stair and walkway. Corrosion was noted on the sphere surface.

The LPG Truck Loading Gantry, also located on the south eastern portion of the Conversion Project Area, is steel framed and has four bays with steel portal structures. A permanent storage shed on a concrete base is located east of the structure and a portable building is located to the north east.

LPG above ground storage was added to the Clyde Refinery in 1977. The LPG truck loading gantry is inherently linked to the LPG spheres as the gantry facilitates the export of LPG by road tankers. To facilitate the inclusion of LPG at the terminal, spheres V137 and V140 and the LPG Truck Loading Gantry are likely to have been constructed between 1970 and 1978.

The LPG spheres and truck loading gantry have only a contributory significance to the historical significance of the Clyde Terminal.

Tanks 40 and 41

Tanks 40 and 41 are located at the centre of the Conversion Project Area. The tanks are part of a group comprising six tanks aligned in two rows north-south. Tanks 40 and 41 are both concrete tanks with external access stairs. Tank 40 appears to be older than Tank 41 and shows signs of weathering.

11.3.1 Local Heritage

The wetlands adjacent to Duck River are listed as a local heritage item under the LEP (I1). Potential impacts to the riparian corridor associated with this wetland area are not anticipated and discussed in **Chapter 12 Ecology**.

11.4 Impact Assessment

The State Office Building is not linked to a key historical phase and has an incidental association with the historically significant activity of the site. It is however a fine example of 1980s Australian architecture. The demolition of the building would have a minor negative impact as a loss of a fine contemporary building which contributes to the aesthetic character as well as conveying the terminal's administrative activity.

MTS1 33 kV switch yard, Tank 106, LPG spheres and the LPG truck loading gantry have historical significance as contributory elements within the key phase, Phase 4: British Imperial Oil / Shell / Viva Energy. The structures have been constructed in the very last stages of this key phase. The loss of these items is considered a minor negative impact to the heritage significance of Clyde Terminal.

The loss of the LPG spheres would have a minor visual impact to the site's heritage value. The spheres' distinct shape and size are visible from principal vistas within the site and the items are considered one of the largest equipment remaining from a key phase of development that is reminiscent of the refinery activities.

The retention of storage Tanks 40 and 41 are considered to be a minor but positive impact as it reinstates the scientific and aesthetic value of the site.

Previous archaeological assessments have confirmed that there is no potential for archaeology that relates to the early refinery site. The proposed works are not located in the vicinity of the early refinery works and involve demolition only to grade. The modification works would therefore have no impact on any archaeological deposits.

The modification works are well contained within the Clyde Terminal and would have no impact to adjacent heritage items including the locally listed wetland (I1).

The adaptation and conservation of these structures is not considered viable due to economic and practical reasons relating to maintenance and potential hazards associated with the terminal. The demolition works associated with SSD 5147 was previously assessed as a negative impact on the heritage significance of the site. Considering the scale of these modifications and their impact, the proposed works are considered minor in comparison.

11.5 Mitigation

The previous heritage assessment recommended that a photographic archival recording be undertaken for the terminal. A photographic archival recording was completed by Alexander Mayes Photography in 2014 and a documentary recording of the refinery process at Clyde Terminal was also completed by Australian Museum Consulting in 2015. Whilst the recording focussed on the items specific to the Conversion Project, it did not include the following items:

- State Office Building;
- MTS1 33kV switch yard;
- Tank 106 (slops tank);
- LPG spheres (V137 and V140); and
- LPG truck loading gantry.

A photographic archival recording should therefore be undertaken for the above items to mitigate potential impacts to heritage significance.

12.0 Ecology

12.1 Introduction

This chapter provides an overview of the ecological considerations associated with the proposed modification works. This overview is based on a desktop review of available information along with a site walkover undertaken on 16 August 2018.

Where practical, measures are provided to prevent, avoid, reduce or mitigate impacts upon ecological values arising from the modification works.

12.2 Method of Assessment

The Site has previously been investigated for ecological values as part of the original development application for the conversion works (SSD 5147) (AECOM, 2013). This original study has been utilised as the basis of this assessment.

This assessment was undertaken in two primary parts:

- Desktop review of relevant literature and databases to establish the likely ecological conditions at the Conversion Project Area. This review was undertaken prior to field survey to inform searches to be undertaken at the Conversion Project Area. This included an assessment of likelihood of threatened biota with the potential to occur at the Conversion Project Area, as informed by searches of the NSW Bionet Atlas and the Commonwealth Protected Matters Search Tool. Species with a medium or high likelihood of occurrence were taken forward for targeted field survey.
- Field assessment of the relevant parts of the Conversion Project Area was undertaken in the form of a site walkover inspection. During this assessment targeted searches were undertaken for threatened species and their habitat. The field assessment was undertaken on 16 August 2018 by Jamie McMahon, a qualified and experienced ecologist from AECOM.

A particular focus of the ecological inspection was to assess the potential for the presence and usage of the Conversion Project Area by Green and Golden Bell Frogs (GGBF). The *Plan of Management - Restoration of Green and Golden Bell Frog Habitat Clyde* (Biosphere, 2013) prepared for the original conversion works SSDA was reviewed to better understand context of the population at the site and the potential for the modification works to affect any nearby extant population.

12.3 Existing Environment

12.3.1 Flora

The vast majority of the terminal is devoid of vegetation, being primarily occupied by buildings, operational equipment, open hard stand areas or roadways including managed verges. Where non-ephemeral (weedy) groundcover is present it is generally comprised of planted and self-sewn native and exotic groundcovers, shrubs and trees.

As shown in **Figure 12-1**, the riparian area adjacent to Duck River and in the vicinity of Tank 106, LPG gantry and LPG spheres V137 and V140 contains areas identified as the following communities:

- Estuarine fringe forest;
- Estuarine mangrove; and
- Estuarine saltmarsh.

Two endangered ecological communities (EEC) listed under BC Act have been previously reported in this riparian corridor:

- 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 Conversion Project Area and as intermittent stands along the foreshore of both Duck and Parramatta Rivers; 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 Conversion Project Area.

Additionally the vulnerable Narrow-leafed Wilsonia (*Wilsonia backhousei*) has been recorded at six locations including within the areas of coastal saltmarsh within the riparian corridor of Duck River.

Vegetation in and around the elements of the proposed modification works was limited to a small stand of Swamp Oak (*Casuarina glauca*) around the redundant LPG gantries and a variety of native and exotic planted landscaping vegetation around the State Office Building. Vegetation in this latter location included the following:

- *Eucalyptus botryoides;*
- *Agapanthus sp.;*
- *Lomandra longifolia;*
- *Banksia integrifolia;*
- *Eucalyptus fibrosa;*
- *Dianella revoluta;*
- London plane tree (*Platanus x acerifolia);*
- *Acacia parramattensis; and*
- Bottlebrush species (*Callistemon sp*).

The area around the State Office Building is highly landscaped and maintained, including mowing of all grass areas. Based on the nature of the area, including the highly diverse nature of native and exotic vegetation, it does not contain any recognised plant community type (PCT).

12.3.2 Fauna

Two listed threatened species are considered to have a medium likelihood of occurring within the Conversion Project Area including:

- The endangered GGBF (*Litoria aurea*); and
- The endangered Grey-headed Flying-fox (*Petaurus poliocephalus*).

Parts of the Conversion Project Area, including remnant wetland in the northeast corner, are likely to provide habitat for a range of fauna including native wetland birds and frogs. No modification works would however be undertaken in the vicinity of any of these wetland areas.

The majority of the terminal is highly modified with generally very low habitat value for native fauna. Despite this, some modified areas have been observed during previous surveys to contain some habitat for GGBF (Biosphere, 2013). Further to this native birds have been observed during this assessment and previous surveys to perch on existing infrastructure at the Clyde Terminal whilst moving between habitat sites.

Green and Golden Bell Frog

The Conversion Project Area is known to contain habitat for the Clyde/Rosehill subpopulation of the GGBF (DECC, 2008). As per the *Significant Impact Guidelines for the vulnerable Green and Golden Bell Frog (Litoria aurea): EPBC Act Policy Statement 3.19* (DEWHA, 2009), a current population of GGBF is considered to be present on a site where one of more GGBF individuals have been detected on at least one occasion since 1995, even if they have not been recently discovered at the terminal.

BioNet records identify that GGBF has been recorded in the vicinity of the modification works within the tank bund of tankfarm E1 and adjacent to the State Office Building. Details of relevant BioNet records are provided in **Table 12-1.**

Table 12-1 GGBF BioNet Records

Area	Observation Date	Accuracy	Sighting Notes
Tankfarm E1	1/1/2000	1000	Occasional frog turns up in water in this tankfarm
State Office Building	1/1/2000	1000	Occasional frog appears in gardens

Based on the metadata and sighting notes provided for the above records, it is clear that these records are highly questionable. None of the records appear to reference an actual sighting, but reference anecdotal evidence of the presence. The sighting notes associated with the records make no specific reference to GGBF, accuracy of the locations is one kilometre and the date of the first two records indicate that these have been given a nominal date in absence of any specific sighting. As such these records are not deemed to be valid and therefore additional site-specific habitat assessment was undertaken.

It was apparent from the site inspection that the LPG Gantries, LPG spheres and substation areas all contain little to no vegetation. As such these areas do not constitute any habitat for GGBF or any other threatened species.

The State Office Building was assessed for habitat value for GGBF in particular. Whilst this area does contain a variety of vegetation, the habitat value of the area is deemed to be low based on the absence of relevant habitat features such as leaf litter, coarse woody debris, permanent or ephemeral standing water, tree hollows or fallen timber (logs). Whilst it is recognised that GGBF do occasionally inhabit disturbed areas, the general lack of water-based habitat features suggest that this area is unlikely to constitute viable GGBF breeding habitat. Further to this, the State Office Building area is also considered unlikely to constitute foraging habitat based on the substantial distance and terminal activity (active roadways and equipment) between this area and the location of the main population in the wetland area to the northeast.

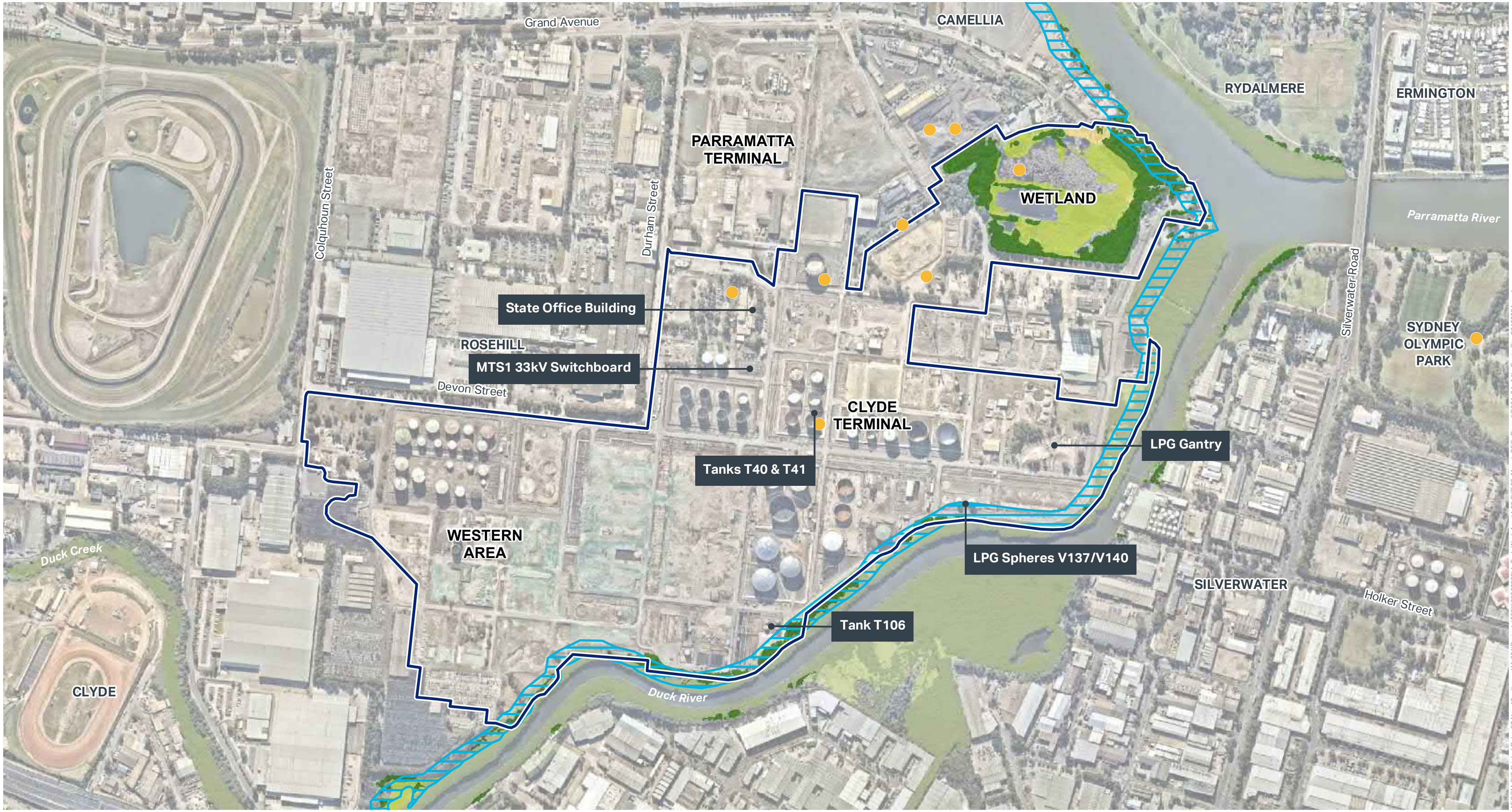

FIGURE 12-1: AREAS OF ENVIRONMENTAL SIGNIFICANCE

KEY

- Conversion project area boundary
- Riparian vegetation
- Green and Golden Bell Frog record
- Estuarine fringe forest - Swamp Oak floodplain forest (EEC)
- Estuarine mangrove
- Estuarine saltmarsh (EEC)
- Estuarine saltmarsh - Phragmites reedland
- Estuarine saltmarsh - brackish wetland

0 100 200 300 m

12.4 Impact Assessment

12.4.1 Flora

The proposed modification works would not require substantial vegetation clearing, however, clearing of exotic and planted native vegetation would be required to facilitate the demolition of the State Office Building. Vegetation clearing would be minimised as far as practical as part of the design and demolition activities.

While it is recognised that vegetation around the State office building is likely to provide a minor degree of connectivity for highly mobile and urban adapted species within the context of the Clyde area, this is likely to be minimal in the context of the Conversion Project Area's long history of disturbance related to industrial activities. As such the loss of this vegetation is not expected to result in any fragmentation of vegetation communities within the locality.

Staff and contractors would continue to access the Conversion Project Area using existing access at Gates 4 and 5. With the exception of the transport of waste materials, the modification works would be wholly contained within the Conversion Project Area and is not anticipated to result in any significant offsite impacts.

Construction of the modification works is likely to generate dust and sediment, which may affect surface water quality within the terminal. Provided relevant surface water management measures are implemented the potential for offsite ecology impacts is considered to be low.

Existing tank bunds and site drainage would not be affected by the modification works. As such there is not anticipated to be any operational impact upon offsite water quality in the Duck and Parramatta River catchments.

Species: Narrow-leafed Wilsonia (*Willsonia backhousei*)

This species occurs within the intermittent areas of saltmarsh along the riparian area bounding the Conversion Project Area. Although modification works involving the demolition of Tank 106, LPG gantry and LPG spheres V137 and V140 would involve works in the vicinity of these areas, no direct impacts upon this species are anticipated.

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

This EEC, including remnant Swamp Oak Trees, occurs intermittently along the riparian areas bounding the Conversion Project Area. No areas of this EEC would require removal as part of the modification works and as such no direct impacts are anticipated.

Community: Themeda Grassland on Seacliffs and Coastal Headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions

This saltmarsh occurs intermittently along the riparian areas bounding the Conversion Project Area. No areas of this EEC would require removal as part of the modification works and as such no direct impacts are anticipated.

12.4.2 Fauna

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

The Grey-headed Flying-fox utilises a range of habitats throughout the Sydney basin and along the east coast generally. This includes marine and riparian areas along major waterways. Although the EIS for the Conversion Project (AECOM, 2013) states that records of this species have been observed overflying the terminal, habitat opportunities within the Conversion Project Area are limited by the general lack of canopy vegetation. The vegetation around the State Office Building presents the only area of substantial potential roosting or habitat for this species, though it is noted that much of this vegetation is introduced or not native to the Sydney region. Despite this some species, such as eucalypts, produce nectar which may support foraging at certain times of the year.

The loss of vegetation around the State Office Building is unlikely to result in a significant impact upon this species in the context of the abundant landscape plantings in nearby areas, particularly parks and residential properties. Despite this, the degree of vegetation removal will be minimised during design and demolition activities to reduce the potential for impact upon this species.

Assessments of significance were undertaken for this species in accordance with Section 7.3 of the BC Act (refer to **Appendix D**) and in accordance with *Matters of National Environmental Significance Significant impact guidelines 1.1* (DoEE, 2013) (refer to **Appendix E**). These assessments indicated that there would be no significant impact upon this species as a result of the modification works.

Green and Golden Bell Frog (*Litoria aurea*)

The broader terminal site is known to contain a key population of the GGBF. This population appears to centre on the north-eastern corner of the Conversion Project Area, though scattered records are known within the main terminal area.

The modification works involve the retention of Tanks 40 and 41 within tankfarm E1. The EIS for the Conversion Project (AECOM, 2013), identified that although previous records of the GGBF exist in tankfarm E1, the area is currently considered unsuitable habitat for GGBF. Notwithstanding this any potential impact on residual habitat associated with the removal of Tanks 40 and 41 would be removed through the retention of these tanks as no conversion works are now proposed in this area.

Anecdotal records exist indicating that the grounds of the State Office Building provide habitat for GGBF. While these records provide important context to the wetland GGBF population they are not considered reliable. Despite this the grounds of the State Office Building were inspected for potential habitat value. As outlined above, the area around the State Office Building is not considered to provide suitable habitat for this species given the lack of habitat features and the substantial separation from the presumed source population in the wetland area. Given there will be no impact upon the wetland area as a result of the modification works the potential for impacts upon GGBF arising from these works is considered to be negligible.

Assessments of significance were undertaken for this species in accordance with Section 7.3 of the BC Act (refer to **Appendix D**) and in accordance with *Matters of National Environmental Significance Significant impact guidelines 1.1* (DoEE, 2013) (refer to **Appendix E**). These assessments indicated that there would be no significant impact upon this species as a result of the modification works.

12.5 Mitigation

Impacts to ecology would be managed through the implementation of the relevant measures contained within the existing Demolition Work Plan (DWP), associated Biodiversity Management Plan (BMP) and GGBF Plan of Management for the approved Conversion Project. Relevant measures from these plans and the original EIS are reproduced below.

12.5.1 Flora

The modification works would require minor clearing of vegetation to facilitate the demolition of the State Office Building. Existing management measures outlined in the EIS for the Conversion Works (AECOM, 2013) and included in the DWP and BMP would continue to apply for the modification works. Specific measures would include:

- The final demolition plan would minimise the construction footprint and the requirement for clearing of native vegetation wherever possible and within reason given the need to minimise fire hazard risks onsite;
- 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 would be adopted to reduce the impact of incursions into the root zone of trees to be retained;

- Viva Energy would continue to undertake ongoing bush regeneration in and around the vicinity of the terminal;
- If any damage occurs to vegetation beyond the nominated work area the Project Manager would be notified so that appropriate remediation strategies can be developed and implemented;
- Should the proposed demolition footprint be changed such that works would encroach into more densely vegetated areas, then a suitably qualified ecologist is to be engaged to:
  - Conduct pre-clearance surveys of the final footprint immediately prior to demolition commencing, and
  - Undertake additional impact assessment if required.
- The riparian vegetation along the southern and eastern borders of the Conversion Project Area would continue to be preserved.

12.5.2 Fauna

Pre clearance surveys would be undertaken prior to clearing of vegetation surrounding the State Office Building to identify the presence of protected fauna species. Specific management measures for the GGBF are identified below. Should other protected fauna species be identified, works would cease and fauna given the opportunity to disperse prior to works resuming.

Green and Golden Bell Frog

Potential impacts on the GGBF would continue to be managed with the specific measures outlined in the Green and Golden Bell Frog Plan of Management (Biosphere, 2013) (PoM). The PoM applies the three principles of mitigation outlined 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* (DEWHA, 2009) including:

- Avoid
- Minimise
- Manage

As described in **Section 12.3.2**, modification works would be undertaken in areas not considered to be viable GGBF habitat. Nonetheless, should any frogs be identified during the modification works, works would cease in the immediate area and OEH contacted to determine the appropriate action. Frogs would not be relocated without an appropriate licence issued under the NSW BC Act.

13.0 Other Issues

13.1 Soil, Water and Contamination

13.1.1 Introduction

This section presents a description of the soil, water and contamination status of the areas of the Conversion Project Area where the modification works would occur. This description and assessment is based on a desktop review of existing information and identified the potential impacts of the modification works. Where impacts have been identified, mitigation measures are provided with a view to avoiding or minimising the potential impacts in relation to soils, water and contamination.

13.1.2 Method of Assessment

The desktop review for this assessment include examining previous investigations, historic site information, records of contamination and details of past contamination management activities.

The information presented in this section is primarily drawn from a review of the following reports:

- Clyde Terminal Conversion Project Environmental Impact Statement (AECOM, 2013);
- Shell Clyde Terminal Conversion SSD 5147 Flood Assessment Report (WMA Water, 2016);
- Quarter 2 (2018) Groundwater Monitoring Event - Clyde and Parramatta Terminal (ERM, 2018); and
- Environmental Conditions Summary Report - Shell Clyde Refinery (ERM, 2012).

13.1.3 Existing Environment

Regional Topography and Geology

The terminal and the surrounding general industrial area are located on the Camellia Peninsula bounded by the Parramatta River to the north and by the Duck River to the south and east. The Conversion Project Area is generally flat and ranges from two to five metres Australian Height Datum (AHD) in elevation.

The Conversion Project Area is located within the Central Lowlands topographic zone within the Sydney Basin geological province. The majority of the Conversion Project Area, including the areas subject to this modification are characterised by the Disturbed Terrain soil landscape (soil code: XX) which reflects the significant historical disturbance on the site. Fill material is present across the terminal to a depth of approximately1.0 to 1.5 metres below ground level (mbgl) and underlain by low permeability clay which has been observed at up to 8 mbgl.

Acid sulfate soils

A search of the Acid Sulfate Soils Mapping from the LEP was undertaken and confirms that the terminal predominantly contains Class 3 acid sulfate soils (ASS). The majority of the modification works would be undertaken in areas identified as Class 3 ASS, while works to demolish the State Office Building and Switchyard in the northwest of the modification area would be undertaken in areas identified as Class 4 ASS. ASS in Class 3 areas are likely to be found beyond 1 mbgl, while ASS in Class 4 areas are likely to be found beyond 2 mbgl. Any works that would extend below, or lower the water table below these depths would require specific assessment and management. The ASS environment for the Conversion Project Areais shown in **Figure 13-1**.

As the modification works would involve demolition activities to ground level only, it is considered unlikely that ASS would be encountered.

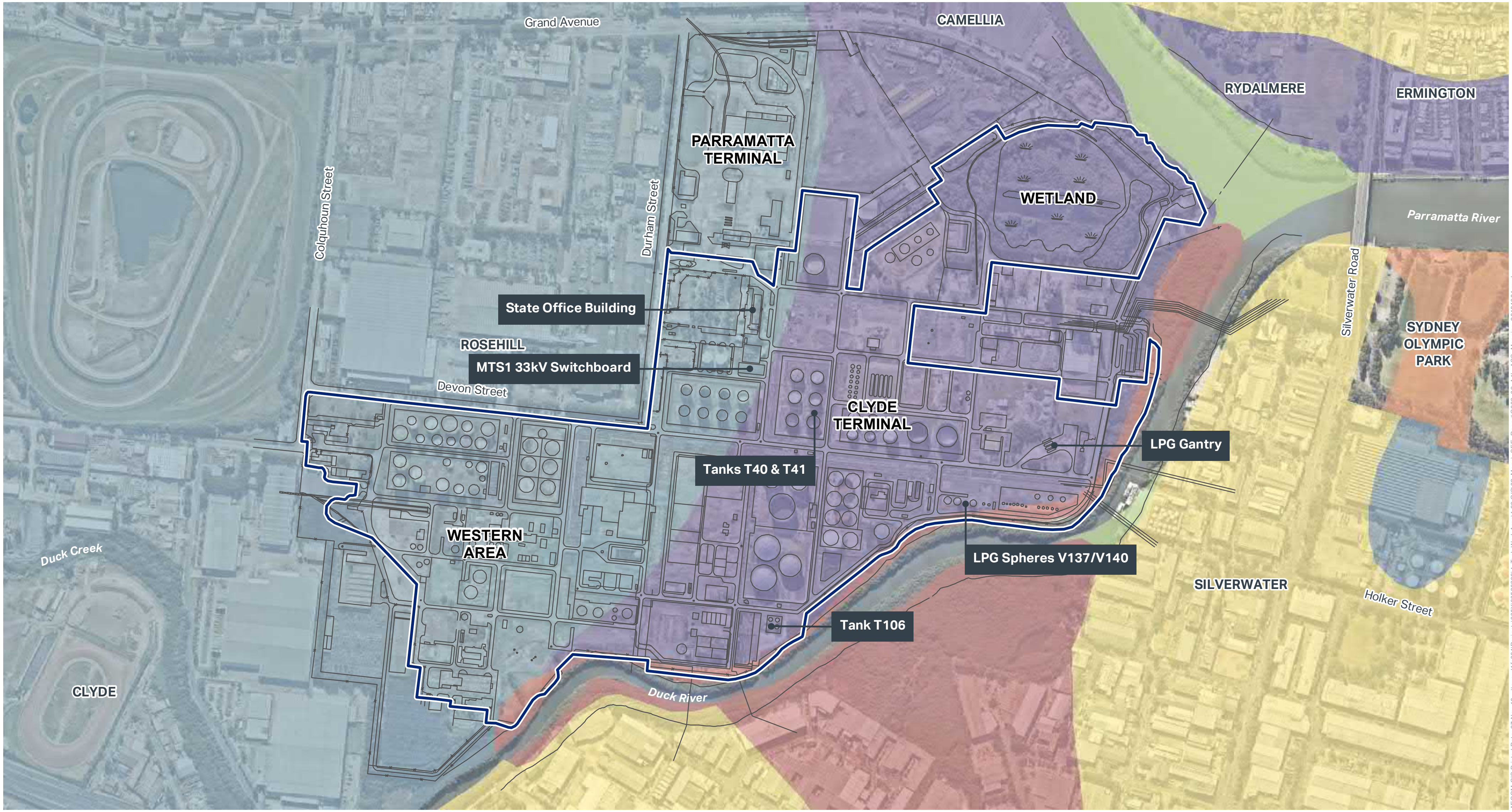

FIGURE 13-1: ACID SULFATE SOIL MAPPING

KEY

Conversion project area boundary

Acid Sulfate Soils Risk

- Class 1
- Class 2
- Class 3
- Class 4
- Class 5
- Disturbed terrain

AECOM

0 100 200 300 m

Hydrogeology

Groundwater conditions within the terminal are monitored through an established groundwater monitoring well network. A quarterly groundwater monitoring program is implemented.

Groundwater is represented as a shallow unconfined water zone within the fill material and estuarine-alluvial sediments at depths between 0.5 and 3 mgbl. Groundwater depths are limited by the low-permeability clay layer underlying the fill material. Groundwater flow is subject to localised groundwater mounding at the centre of the terminal but generally flows to the northeast, east and southeast towards the bounding Duck and Parramatta Rivers. Flow rates are low and appear to be locally influenced by anthropogenic subsurface features such as tank bunds and the butyl membrane barrier west of the remnant wetland area.

Petroleum hydrocarbons and metals are present in groundwater. However, groundwater monitoring results do not indicate the presence of a widespread plume of contaminants of concern (COCs). The spatial extent and thickness of light non aqueous phase liquids (LNAPL) observed in the monitoring well network is considered to be stable to decreasing slowly over time.

Surface water

The terminal is located at the confluence of the Duck and Parramatta Rivers, within the Parramatta River sub-catchment, one of eight sub-catchments in the Sydney catchment. The Parramatta River is a third order stream and the main tributary of Sydney Harbour, extending from Blacktown Creek in the west to the confluence of Lane Cove River in the east. Duck River is a first order perennial stream and southern tributary of the Parramatta River.

The Parramatta River is one of the most urbanised catchments in Australia. Historical land uses have highly modified the river and its banks, with a range of sediments and pollutants entering the watercourse which have impacted on water quality and habitat values.

The terminal is divided into seven catchment areas based on the need for various water capture and processing infrastructure. Clean runoff catchments are also located within the Conversion Project Area. Relevant catchment areas are detailed in **Table 13-1**.

Table 13-1 Site catchment areas

Area No.	Description	Modification works component
3	In the south-eastern section of the Site, adjacent to Duck River. It contains the majority of the Clyde Terminal infrastructure	• LPG Spheres V137 and V140 • LPG Truck Loading Gantry • Tanks 40 and 41
4	Two select areas in the mid-section of the Western Area.	• Slops tank 106
7	A narrow north south catchment in the centre of the Conversion Project Area.	• MTS1 33kV Switchyard
Clean Runoff Catchments	Various parts of the Conversion Project Area which are open to the public or have no operational use for the terminal.	• State Office Building

The majority of the Conversion Project Area is sealed and an extensive surface water drainage network is present. Accidentally oil contaminated and continually oil contaminated drainage systems direct water from the seven catchments at the terminal to the onsite wastewater treatment plant for treatment before release at discharge points into Duck River in accordance with EPL 570. Clean catchment areas (around the State Office Building and close to the MTS1 33kV Switchyard) drain into an underground clean water drainage line which discharges through the remnant wetland to the Parramatta River.

Flood risk

The Site is located to the immediate west of Duck River and immediately prior to the confluence of Duck River with the Parramatta River. Prior to development, the land would probably have been low lying mangrove inhabited wetlands. With the exception of works areas associated with existing conversion and demolition works; the Conversion Project Area predominantly consists of impervious ground coverage with minimal infiltration levels. There are several low lying and bunded areas which may temporarily store rain water runoff prior to being drained with the existing bund drainage system.

The *Shell Clyde Terminal Conversion SSD-5147 Flood Assessment Report 2016* prepared by WMA Water, outlined that LPG spheres V137 and V140, the LPG gantry, MTS1 switchyard and Tank 106 would likely be overtopped to a depth not exceeding 0.5 m during the 1% Annual Exceedance Probability (AEP) (also known as a 1 in 100 year) flood. Similarly these areas were assessed as having a low hydraulic hazard during a 1% AEP flood event with the Tank 106 bund area assessed as having a high hydraulic hazard.

Contamination

To assist in classifying and managing contamination across the Clyde Terminal, the terminal has been divided into four conceptual site model (CSM) zones. The proposed modification works would occur within CSM2. Groundwater contamination known to be present in the CSM2 zone includes:

- LNAPL;
- BTEX;
- PAH; and
- PCBs.

Soils within the CSM2 zone primarily consist of imported fill and are also known to contain contamination, including lead, chromium and asbestos. Concentrations of contaminants of concern exceeding the commercial screening criteria are generally contained to the top 1 metre of the soil profile.

13.1.4 Impact Assessment

Demolition

The additional demolition works would extend only to grade and would not require excavations below ground level. As such impacts to soils and the likelihood of encountering contamination is considered low. As excavation works would be only to grade, demolition works are not anticipated to intercept with any groundwater.

Potential stormwater impacts associated with the modification works include those arising from demolition and ground disturbance works (i.e. potential impacts to stormwater run-off quality), as well as potential changes to the operation of stormwater catchments in the short and longer term (i.e. catchment hydraulics).

Drainage on the Conversion Project Area already has controls in place to remove suspended solids from stormwater via sedimentation and to remove oil via gravity separation. Additional controls were also agreed for the Conversion Project (refer to **Table 15-1**). These controls would remain in place during the duration of the modification works and would mitigate potential impacts for stormwater quality. Given that the demolition of asset delivery infrastructure is proposed to occur following the emptying and cleaning of the infrastructure, it is expected that no hydrocarbon residues would be present prior to the demolition works occurring.

The risk profile of the terminal with respect to the ability to accommodate high rainfall events and/or broader flooding events would not change from that which currently exists during and following the modification works. The existing bunds associated with Tank 106 and Tanks 40 and 41 would be left intact. Additionally, while redundant infrastructure would be removed, the existing ground level would remain the same and as such there would be no notable change in the flooding risk profile.

As the modification works would involve only demolition activities to grade, potential soil impacts are considered isolated and limited in extent. Contamination impacts related to the proposed modifications would be generally restricted to petroleum hydrocarbons and limited to fill material and shallow soils. Based on the understanding of geology and hydrogeology, the migration potential of COCs in groundwater is limited by the low permeability of the lithology, relatively flat hydraulic gradient and low average groundwater velocity.

Potential soil and groundwater impacts from the modification works may include:

- Demolition workers encountering contaminated soil during demolition of redundant structures, including the removal of footings, and mobilising or dispersing it across the Site and local environment;
- Encountering of asbestos during the demolition of redundant structures, particularly the State office building;
- Newly disturbed areas subject to erosion and sediment control issues;
- Spills and leaks from demolition equipment potentially contaminating soil and groundwater; and
- Vehicles dispersing contaminated materials across the Site and off-site.

As outlined in **Section 13.1.3**, soils in the modification works area have levels of contamination that require management, including elevated concentrations of lead and chromium. As soils and groundwater is not anticipated to be disturbed, encountering contaminated soils and/or groundwater is considered unlikely.

Post-demolition

Ongoing investigations and monitoring in relation to groundwater and contamination would continue in accordance with the existing environmental management system for the terminal and in line with EPL 570.

The existing stormwater management system at the terminal would remain intact once the modification works are complete. In addition, the terminal's stormwater receiving environments would not change. The change in volume and quality of stormwater discharged from the terminal, arising from modification works is expected to be negligible.

13.1.5 Mitigation

The management and mitigation measures relating to modification works are identified in **Chapter 15.0 Revised Management and Mitigation Measures**, and would largely be consistent with the Soil and Water Management Plan for the Conversion Project (SSD 5147). Measures to manage potential impacts to stormwater runoff quality during the modification works would be consistent, as relevant, with those currently documented within the DWP and associated sub-plans including:

- Soil and Water Management Plan; and
- Flood Emergency Management Plan.

As the proposed modification works would not involve excavations or significant earthworks, the minor disturbance of soils that may occur as a result of the works would be readily manageable though existing management measures, including erosion and sediment controls on the Conversion Project Area.

Viva Energy would maintain their existing risk reduction measures in place across the terminal. Viva Energy requires all contractors and employees to obtain a work permit for all work in areas where potential soil and groundwater contamination exists (such as within tank bunds or for any works that can potentially expose groundwater). The work permit includes a hazard analysis, outlines controls (such as monitoring) and required personal protective equipment. Worker exposure is also reduced by restricting access to areas requiring work permits to only authorised personnel.

13.2 Transport and Access

13.2.1 Introduction

This section provides an overview of the traffic, transport and access considerations for the modification works.

13.2.2 Method of Assessment

The scope of this assessment is to provide a qualitative assessment of the potential transport and access impacts that could arise from the modification works.

Potential impacts have been discussed in the context of the existing environment and other approved activities that have taken place and are taking place at the Conversion Project Area. This assessment has relied on previous assessments undertaken for the Conversion Project.

13.2.3 Existing Environment

Local Road Network

The terminal is located in the suburb of Rosehill in the Camellia Industrial estate. The main access point for the Conversion Project Area is from Durham Street, of which Gate 4 provides heavy vehicle access to the terminal, while Gate 5 provides light vehicle access and parking facilities.

The principal collector road for the Conversion Project Area is Grand Avenue, which also provides access onto Hassall Street, and onward to Parkes Street heading west to the Parramatta Central Business District. Hassall Street also provides access onto James Ruse Drive, the main arterial road in the surrounding area which provides connectivity south to the M4 Western Motorway and Parramatta Road, and north over the Parramatta River to Victoria Road and onward to the Cumberland Highway. Alternative access to the Conversion Project Area is via Parramatta Road via Wentworth Street, Kay Street and Unwin Street.

Table 13-2 provides a description of the road network surrounding the terminal.

Table 13-2 Surrounding Road Network

Road name	Description
Devon Street	A local road running east-west adjacent to the northern boundary of the Conversion Project Area, connecting to both Colquhoun Street and Durham Street. It is a two-lane road with a posted speed limit of 50 km/h.
Durham Street	Provides the main access to the Conversion Project Area. It is located approximately halfway between Grand Avenue and Devon Street, and is two-lane local road with a posted speed limit of 50 km/h.
Colquhoun Street	Provides access to the southern end of the Conversion Project Area and connects to Grand Avenue to the north, providing connectivity from the Conversion Project Area to the surrounding road network. Colquhoun Street is a two-lane local road with a speed limit of 50 km/h
Unwin Street / Kay Street	Provides access from Colquhoun Street to Wentworth Street, which is part of the route which allows secondary access to Parramatta Road from the Conversion Project Area. They are two-lane roads with a posted speed limit of 50 km/h.
Wentworth Street	Links Kay Street to Parramatta Road. It is a two-lane road with a posted speed limit of 50 km/h.
Grand Avenue	The collector road serving local roads which access the Conversion Project Area. It is a two-lane divided road with a large central median, and has a posted speed limit of 60 km/h
Hassall Street	Grand Avenue continues as Hassall Street to the west of James Ruse Drive, and provides a connection west to Parkes Street and onward to the Parramatta Central Business District. It is a four-lane collector road with a posted speed limit of 60 km/h.
James Ruse Drive	The major arterial road providing access from Grand Avenue to important arterial routes and the motorway network. It provides connectivity south to the M4 Western Motorway and Parramatta Road, and north to Victoria Road and the Cumberland Highway. It is a six-lane road with a posted speed limit of 70 km/h.
Parramatta Road	An arterial road which acts as a secondary east-west route to the M4 Western Motorway. It is a four-lane road with a posted speed limit of 60 km/h.
M4 Western Motorway	The major highway route providing an east-west link between the foothills of the Blue Mountains and Strathfield. It can be accessed via an interchange with James Ruse Drive and is a six-lane motorway with a variable speed limit system in place, which would normally operate at 100 km/h.

Road name	Description
Victoria Road	Provides a major connection east toward Ryde and other arterial roads such as Lane Cove Road, connecting to other parts of Sydney. It is a four-lane road with a posted speed limit of 60 km/h.
Cumberland Highway	Provides an important connection to Sydney's North West and upper North Shore toward the F3. It a four-lane road with a posted speed limit of 60 km/h

Public Transport

The Conversion Project Area is not readily serviced by public transport connections. The nearest public transport stops, including buses on Victoria Road, Camellia Station and Rydalmere Wharf, are located approximately 2 km away from the Conversion Project Area access point on Durham Street.

As significant distance exists between the Conversion Project Area and public transport connections, public transportation use by staff and contractors is anticipated to be low.

Stage one of the Parramatta Light Rail Project provides a connection to the light rail network at the Camellia Station. While this may present an opportunity for an increase in the uptake of public transport, the timing of the operation of the light rail project would be significantly beyond the timing of the modification works and therefore no impacts are anticipated.

13.2.4 Impact Assessment

The Conversion Project Area has been progressively converted from an active refinery to a storage and distribution facility (terminal). As a result of this change the number of employees on-site has reduced significantly. In turn, traffic generation from the site has also significantly reduced in recent years (refer to the EIS for SSD 5147).

The development consent for SSD 5147 was approved based on a demolition and construction workforce not exceeding 133 contractors on site. Required contractors for the proposed modification works would not result in the total number of workers exceeding this limit.

The modification works would be undertaken within the boundary of the Conversion Project Area. As no additional staff or equipment is required an increase in traffic over the consented movements per day as a result of the modification works is not anticipated.

The heavy vehicle movements for the modification works, should they be required, can be accommodated within the maximum heavy vehicle movements for the approved demolition works (20 per day). It is therefore considered unlikely that these works would have any additional adverse impact on the local road network.

Access provisions would remain unchanged for the modification works as site access at Gate 4 is already designed to accommodate heavy articulated vehicle movements. There would not be a need for additional parking allocations, as existing car parking arrangements at the terminal would be adequate to service the parking for construction workforce.

In general, impacts to transport and access would not be greater than those already identified and approved as part of the Conversion Project (SSD 5147).

13.2.5 Mitigation

Measures to manage potential transport and access impacts during the modification works are identified in **Chapter 15.0 Revised Management and Mitigation Measures**. These are largely consistent with the approved Conversion Project (SSD 5147). Works would be undertaken, as relevant, in accordance with the measures outlined in the existing Traffic Management Plan developed for the Conversion Project.

13.3 Waste Management

13.3.1 Introduction

This section provides an assessment of the waste management issues relating to the modification works. It identifies and classifies the various waste streams generated from the modification works and proposes relevant management strategies for effective storage, reuse/recovery, treatment and/or disposal in accordance with applicable standards and regulatory requirements.

13.3.2 Method of Assessment

The waste management assessment involved an analysis of the proposed modification works to identify potential or likely waste streams arising from the works. The assessment has been completed using information provided by Viva Energy.

13.3.3 Existing Environment

The Clyde Terminal currently operates under EPL No 570 which provides for, amongst other things, the scheduled activity of waste processing by non-thermal treatment. In particular, condition L5 of the EPL provides for the receipt, storage, processing and disposal of certain wastes scheduled under the *Protection of the Environment Operations (Waste) Regulation 2014*. The adjacent Parramatta Terminal operates under a separate EPL (No 660).

Operational waste is generally managed in accordance with the Environmental Management Manual with waste associated with existing demolition works covered by the DWP and Soil and Water Management Plans. Waste management on the terminal supports the goal of the *Waste Avoidance and Resource Recovery Strategy 2014* - 2021 (EPA, 2014) of improving quality of life for current and future generations through providing a hierarchy to achieve efficient resource use. The waste hierarchy implemented on the terminal is as follows: prevention; minimisation; reuse; recycle; recovery measures; or disposal of waste.

Table 13-3 summarises current waste management practices for the main waste streams anticipated as a result of the modification works. Potentially contaminated waste is classified in-situ by thorough sampling of wastes and sending for analysis to a third party laboratory. Based on laboratory results, wastes are classified as restricted, hazardous or general solid (consistent with EPA Waste Classification Guidelines).

Table 13-3 Current Waste Management at the Clyde Terminal

Waste Stream	Segregation	Temporary Storage	Onsite Treatment	Transportation	Reuse / Recycle	Disposal
General waste, including, e-wastes, green wastes, tyres, timber, untreated timber, and mercury contaminate wastes, rubber, fabric and waxes	Collection bins located in plot areas for rubbish, paper and green waste.	Varies according to waste stream.	Varies according to waste stream.	Offsite transportation on covered skips by a licensed contractor.	Offsite recycling of paper, green waste and e-waste.	Currently disposed under contract with SUEZ. The majority of this waste currently goes to Elizabeth Drive Kemps Creek Landfill, in consideration of the Waste Classification Guideline.
Asbestos	Asbestos as per Chapter 8 of the WH&S Regulation.	Bonded asbestos material to be securely packaged. Friable asbestos material must be kept in a sealed container. Asbestos-contaminated soil must be wetted down.	No on-site treatment.	Transported in a covered, leak-proof vehicle.	It is illegal to re-use or recycle asbestos waste.	At a landfill site that can lawfully receive asbestos.
Scrap metal	Contaminated / not contaminated scrap metal bins located onsite.	-	Hydroblasting in a bunded area.	Contaminated scrap metal - offsite transportation on covered skips by licensed contractor.	Offsite recycling.	Currently disposed under contract with Shell & Parker. The majority of this waste currently goes to the Yard & Shredder, 45 Tattersall Road, Blacktown.
Contaminated soil	-	Weathering in landfarm.			-	Stored for reuse or disposal alongside material from the Western Area Remediation Project.

Waste Stream	Segregation	Temporary Storage	Onsite Treatment	Transportation	Reuse / Recycle	Disposal
Concrete and brick	-	-	Processed on site at the concrete processing facility.	-	-	Disposed of alongside other general solid waste following processing.

13.3.4 Impact Assessment

Environmental values and potential impacts

Waste has the potential to affect ecological functions, air quality, water quality, visual amenity, social values and human health. However, if re-use options are available and utilised, waste can be considered a resource.

Environmental values that have the potential to be affected by waste include:

- Life, health and wellbeing of people;
- Diversity of ecological processes and associated ecosystems;
- Land use capability, having regard to economic considerations; and
- The management of finite natural resources.

The appropriate management of waste would protect these values through the duration of the modification works.

If not managed appropriately, waste generated by the modification works has the potential to cause the following impacts:

- Land and water (surface and groundwater) contamination as a result of spills or inappropriate storage, handling, transportation and disposal of solid and liquid wastes;
- Increased vermin and spread of disease from inappropriate storage and handling of wastes;
- Visual amenity impacts caused by poorly executed demolition activities and inappropriate storage of waste;
- Air quality impacts such as dust and odour generated from the inadequate storage, handling, transportation and disposal of solid wastes;
- Social impacts to surrounding community as a result of air quality and visual amenity impacts; and
- Inefficient and careless use of resources.

Management strategies developed for each waste stream have been designed to be consistent with the waste management hierarchy, meet relevant legislation and policy, and to achieve the environmental objectives of the modification works. These strategies have been developed with view to minimising impacts with respect to the above factors.

Waste generation

During the modification works the key activities expected to generate waste is the demolition of redundant infrastructure including the State Office Building, MTS1 switch yard, Tank 106, LPG spheres V137 and V140 and the LPG loading gantry. On the contrary, the retention of Tanks 40 and 41 would result in decrease in total waste generated over what was assessed and consented as part of SSD 5147.

Redundant infrastructure would be progressively cut up and collapsed to allow for transportation by excavator and truck. Waste types would generally include waste classified as general solid (non-putrescible) wastes and consist of steel and steel alloys and concrete. Other waste streams that would be generated in relatively minor quantities include:

- General Solid Waste (Non-putrescible) including packaging waste, and asphalt waste; and
- General Solid Waste (Putrescible) food waste from demolition workers.

13.3.5 Mitigation

Measures to ensure appropriate waste management during the modification works would be consistent, as relevant, with those documented within the existing Demolition Work Plan and the Waste and Resource Recovery Management Plan as required under the DC (SSD 5147).

14.0 Cumulative Impacts

For a cumulative effect to occur, impacts from two or more distinct projects need to affect the same receptor. As outlined above, the modification works have the potential to result in a number of minor environmental impacts. For all of these aspects, there are expected to be no significant residual impacts as a result of the modification works on any sensitive receptors.

Consistent with a number of strategic plans, including the *Greater Parramatta - Interim Land Use and Infrastructure Implementation Plan 2017* (DPE, 2017), the Parramatta LGA is currently experiencing strong growth with a large number of infrastructure and development projects in various stages of planning and implementation. The Camellia Industrial Precinct is itself a strategic industrial area that continues to support a wide range of processing and industrial service based industries.

Impacts of existing developments in the vicinity of the Conversion Project Area on the modification works have been inherently covered as part of this MR through the consideration of background data and the existing environments, to which the predicted impacts of the modification works have been added. Given that the proposed modification would not result in an increase in the total number of personnel, truck and vehicle movements or equipment previously consented for the Site, cumulative impacts with external projects are not anticipated to be significant as a result of this modification and would be substantially the same extent as approved under SSD 5147.

Notwithstanding this, a search of the DPE Major Project Assessments Register was undertaken on 31 August 2018 to determine the presence of major projects in the vicinity of the Conversion Project Area. One major project, the Veolia Environmental Services Camellia Resource Recovery Facility (SSD 4964), was identified on the Camellia Peninsula following approval of the Conversion Project in January 2015. SSD 4964 permits the establishment of a general solid waste (non-putrescible) material recycling facility and associated infrastructure and was approved in July 2016. Given the minor scale and no additional requirements for workers, trucks and/or equipment, potential cumulative impacts of the proposed modification works and the construction of SSD 4964 are considered to be negligible.

Viva Energy is currently planning for the Viva Energy Clyde Western Area Remediation Project at the Site. The Western Area Remediation Project proposes the remediation of contaminated soils and groundwater in the Western Area of the Clyde Terminal to a commercial/industrial standard inclusive of necessary infrastructure removal, waste management, soil management, land forming and stormwater management activities. The proposed modification works would be undertaken prior to the Western Area Remediation works commencing, and as such cumulative impacts with this project are not anticipated.

The proposed modification works would be undertaken concurrently with the approved Phase 2 demolition works associated with the conversion project. Phase 2 demolition works are proposed to commence in Q1 2019 and would involve the demolition of the following components:

- Tank 52;
- Tankfarm A2;
- Tankfarm A3;
- Tankfarm C; and
- Substation 17.

The Phase 2 demolition works are consented under SSD 5147 and would be undertaken utilising the same personnel and equipment as proposed for the modification works.

For most assessments, no cumulative impacts with the Phase 2 demolition works are likely. In most cases this is because the modification works are integrated with the Phase 2 demolition works and require no additional equipment, vehicle movements or workforce.

If the modification works took place concurrently with the Phase 2 demolition works there is the potential that air quality or noise impacts could increase.

The air quality assessment presented in **Chapter 9** identified that the modification works could produce dust impacts. The assessment that was undertaken included a consideration of the modification works and the Phase 2 demolition works occurring at the same time. This potential increase was considered as part of the air quality assessment (refer to Step 2A under **Section 9.4.2**). As concluded within **Section 9.5** "*the unmitigated risk of air quality impacts during the additional demolition works has been predicted to be negligible for dust soiling on people and property and human health.*" This conclusion was made inclusive of potential cumulative impacts from the Phase 2 demolition works.

A consideration of cumulative noise impacts from the modification works operating concurrently with the Phase 2 demolition works was also completed. This assessment predicted potential exceedances of the applicable noise management levels for the residential receivers at:

- 92 Asquith St, Silverwater (NML: 46 dB A, exceedance: 4 dB A);
- 529 John Street, Rydalmere (NML: 46 dB A, exceedance: 6 dB A); and
- 35 John Street, Rydalmere (NML: 46 dB A, exceedance: 5 dB A).

Whilst noise exceedences are predicted, these results are highly conservative and any impact would be temporary and would not exceed the highly noise affected 75 dBA noise criterion from the ICNG. The mitigation approach to these potential cumulative impacts would be the same as for the modification works alone as the predicted noise levels are not significantly different to those reported in the original assessment. As such the mitigation and management measures presented within the Conversion Project Noise and Vibration Management Plan would be implemented during the proposed modification works and the Phase 2 works. These measures would be sufficient to manage potential noise impacts.

Given the relative scale of the proposed modification works and application of management and mitigation measures outlined in **Chapter 15.0 Revised Management and Mitigation Measures**, cumulative impacts with the Phase 2 demolition works are considered negligible.

Provided the appropriate management and mitigation measures are implemented, it is considered unlikely that the proposed modification works would result in significant adverse cumulative effects on nearby sensitive receptors (e.g. surrounding community, ecological values, heritage values, local roads etc.).

15.0 Revised Management and Mitigation Measures

The preceding chapters of this MR describe the potential impacts of the proposed modification works and identify a suite of measures and controls for managing risk to avoid, mitigate or offset potential impacts. This chapter provides a summary of all proposed management and mitigation measures. These measures are expected to provide a basis for conditions of consent to be issued should the modification works be approved.

Broadly, mitigation and management measures relevant to the modification works would be implemented and monitored through the existing Environmental Management Strategy and associated sub-plans.

Management and mitigation measures for the ongoing operation of the Clyde Terminal would continue to be implemented in accordance with the existing Environmental Management Manual for the terminal.

15.1 Draft Management and Mitigation Measures

The adoption of the mitigation and management measures discussed in **Chapters 8.0 - 13.0** is an important component of the modification works and reinforces Viva Energy's commitment to controlling its potential impact on the environment and community. **Table 15-1** below contains a consolidated set of mitigation and management measures for the whole Project (i.e. the Conversion Project and the modification works), and confirms the stage at which each measure would be implemented.

Additional measures have been proposed for the modification works. These include updated requirements for the relocation of GGBFs and archival recording of components proposed for demolition. Updates or additions to the approved management and mitigation measures for the conversion works have been shown in **bold**.

If required, these measures may be modified as a result of subsequent discussions with DPE and other stakeholders.

In **Table 15-1** the following acronyms have been used to describe each stage:

- C - Construction
- D - Demolition
- O - Operation

Where management plans were identified as being required for the approved Conversion Project (SSD 5147), they would be implemented and updated, as relevant, to include the modification works. As such, the measures requiring the development of plans for the approved demolition works have not been identified as being relevant in the table.

Table 15-1 Consented Management and Mitigation Measures

<table>
<tr><th rowspan="2">Summary of Mitigation Measures</th><th colspan="3">Conversion and Modification Works (SSD 5147 and SSD 5147 MOD1)</th></tr>
<tr><th>C</th><th>D</th><th>O</th></tr>
<tr><td colspan="4">Commitment</td></tr>
<tr><td>The Project is to be undertaken in accordance with the commitments provided within the EIS, the EIS Response to Submissions, this MR and the approval conditions.</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td colspan="4">Transport</td></tr>
<tr><td>The TIA prepared by AECOM has concluded that the Project would not create significant impacts for the surrounding road network. However, it is nevertheless proposed that:
• Vehicular traffic would be minimised during peak hour traffic periods where practical do to so;
• A Construction Traffic Management Plan be prepared prior to the works commencing;
• Demolition and construction generated traffic would be parked at the Project Area to limit the numbers of vehicles situated in the streets surrounding the Clyde Terminal.
• Movement of construction and demolition equipment at the terminal but outside the ‘areas of control’ for construction and demolition works will be co-ordinated with the <s>Clyde Project Manager</s> Parramatta and Clyde Coordinator. If traffic control is identified as being required in the SimOps meeting for the movement, a detailed Traffic Control Plan will be produced; and
• Transportation of oversized or overmass vehicles or loads will require appropriate permits from the relevant authority (Roads and Maritime Services or Parramatta City Council) prior to movement.</td><td>✓</td><td>✓</td><td></td></tr>
<tr><td colspan="4">Social and Economic Effects</td></tr>
<tr><td>Mitigation measures proposed to minimise potential social and economic impacts of the Project on the surrounding Parramatta LGA during the demolition, <s>and </s>construction and modification works, and during the continued operation of the converted Clyde Terminal include:
• Viva Energy would continue to undertake stakeholder engagement and consultation regarding the Project;
• Environmental reporting procedures would continue to be implemented, including a complaints register;
• A Construction Traffic Management Plan would be prepared to avoid and minimise potential impacts associated with access routes and major intersections;
• An Environmental Management Strategy (EMS) and Demolition Work Plan (DWP) (including relevant subplans</td><td>✓</td><td>✓</td><td>✓</td></tr>
</table>

Summary of Mitigation Measures	Conversion and Modification Works (SSD 5147 and SSD 5147 MOD1)		
	C	D	O
~~CEMP~~ would be prepared to minimise potential environmental, heritage and social impacts during the demolition**,** ~~and~~ construction **and modification** works; and • An **Environmental Management Manual (EMM)**~~OEMP~~ would be prepared to minimise potential environmental and social impacts during operation of the converted Clyde Terminal. **Viva Energy** would continue to communicate and consult with staff regarding possible alternative redeployment opportunities for those that would no longer be required at the Clyde Terminal once the conversion works have been completed, where this is reasonable and feasible. Further, mechanical trade and instrument electrical trade apprenticeship roles would be retained where possible to enable completion of those apprenticeships. **Viva Energy** would also continue to support its Employee Assistance Program.			
Surface Water, Industrial Water and Flooding			
In managing surface water, industrial water and flooding at the Project Area, **Viva Energy** would implement the following mitigation measures:			
• A detailed ESCP is to be compiled and included in the CEMP; • Demolition and construction waste would be stored 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 works 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 prevent leachate and erosion, be no more than 5 m tall, and allow	✓	✓	

Summary of Mitigation Measures	Conversion and Modification Works (SSD 5147 and SSD 5147 MOD1)		
	C	D	O
adequate room for transport around and management of each stockpile. • Wastewater that has been potentially contaminated during the demolition**,** ~~and~~ construction **and modification** works would be directed via CPIs to allow for sediment and oil to be removed; • Temporary stormwater management measures (such as sandbags, sediment fences and berms) would be used to minimise the risks of sediment-laden runoff and other construction pollutants entering downstream systems; • During demolition works, potential chemical pollutants (e.g. fuels, oils, lubricants, paints, herbicides, etc.) would 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; and • Water saving devices would be installed wherever possible during the conversion works to reduce wastage.			
• 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 No. 570, or any replacement/ amended EPL as provided under the POEO Act; • 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; • The Project would not involve the construction of extensive new infrastructure on land lying within the 1:100 year flood event; • Any new development or infrastructure at the Project Area would be constructed with regard to the design principles and standards outlined in the Floodplain Matrix of Planning and Development Controls identified in the Floodplain Risk Management Policy; • **Viva Energy** would consult with Parramatta City Council and WMA concerning the results of *Duck River and Duck Creek Flood Study Review: Final Draft Report* (WMA, 2011) whilst this report is still in draft format; • In consultation with Parramatta City Council as the WMA Final Draft Report is finalised and is officially adopted by Council, Shell would develop a site specific Emergency Response Flood Plan demonstrating **Viva Energy's** ability to secure or move plant, goods and substances above the one percent AEP flood level within the flood warning time that is likely to be available. This Emergency Response Flood Plan would also include requirements for personnel evacuation drills and procedures for equipment and product protection; • Infrastructure at the Project Area would continue to be located outside of the riparian buffer zone along the southern and eastern borders of the Project Area; and • The Project would not result in a reduction of wetland or riparian vegetation.	✓	✓	✓

Summary of Mitigation Measures	Conversion and Modification Works (SSD 5147 and SSD 5147 MOD1)		
	C	D	O
• The *Clyde Terminal Conversion Project: Clyde Waste Water Management System* (Shell, 2012a) would be revised once the demolition**,** ~~and~~ construction **and modification** activities are complete, so that it is up to date for operation of the converted Clyde Terminal; • Once operation of the converted Clyde Terminal commences, **Viva Energy** would undertake an internal audit of the Project Area to take stock of how reduced operations have reduced water consumption and improved water efficiency. Further recommendations of the audit would then be taken into consideration if further potential water resource savings or opportunities for reuse are identified; and • Following testing, contaminated soil that is unsuitable for reuse would be managed in accordance with the Waste and Resource Recovery Plan.			✓
Land Use			
It is considered that the Project would not have any significant impacts on land use as it would involve the continued use of the Project Area for purposes similar to its current use. **Viva Energy** would continue its dialogue with land users who are currently leasing land adjacent to the Project Area from **Viva Energy**. In considering a future use of the surplus land in the western and north-eastern sections of the Project Area, **Viva Energy** would take into account: • The extent of any contamination that is discovered in the western and north-eastern sections of the Project Area; • The extent of any remediation that is required subsequent to those contamination investigations; and • Consultation with relevant Government departments and agencies such as the EPA, **DPE** and Parramatta City Council, and Council's desired strategic planning outcomes for the Camellia Industrial Estate.	✓	✓	✓
Air Quality and Odour			
Potential fugitive dust and odour impacts resulting from demolition**,** ~~and~~ construction **and modification** works would be managed by the CEMP which would include the following measures: • Loads would be covered during transportation; • Exposed surfaces and roads would be watered as required; • Measures would be implemented to modify or suspend dust-generating activities during periods of high wind speeds or whenever dust plumes from the works are visible. A high wind value should be decided though discussions with regulators, however a typical value is 8 m/s averaged over a 1-hour period;	✓	✓	

Summary of Mitigation Measures	Conversion and Modification Works (SSD 5147 and SSD 5147 MOD1)		
	C	D	O
• Regularly trafficked surfaces would be sealed as soon as possible after construction; • Roadway use would be controlled i.e. through defined road access to minimise dust; • Complaints management system would be in place; and • Accidental spills would be immediately cleaned up. Potential fuel combustion emissions resulting from vehicles and equipment associated with the demolition**,** ~~and~~ construction **and modification** works would be managed with the following measures: • Engines would be turned off while parked onsite; • Vehicular access would be confined to designated, sealed access roads; • Equipment, plant and machinery would be regularly tuned, modified or maintained to minimise visible smoke and emissions; • Project Area speed limits would be implemented; and • Haul road lengths would be minimised.			
The demolition and conversion works would be undertaken with standard construction equipment and the emissions would be managed using best practice construction management and mitigation. The following additional mitigation measures would be implemented to minimise potential impacts from the demolition activities and would be detailed in the final management plans: • All processing assets have already been cleaned, purged and gas-freed before the units were airgaped by cutting sections of pipework from them; • Catalysts are removed and packaged into drums to be shipped overseas for remediation and reclamation; • Pipework and tanks are water washed, the oily water consolidated and the hydrocarbon removed before wastewater is treated and either disposed of as prescribed waste or treated through the Clyde waste water equipment; and • Other processing equipment is purged either using water or gas to reclaim the hydrocarbons so value could be extracted from these products and are purged with nitrogen awaiting demolition. The Demolition Management Plan would be prepared by the Demolition Contractor.	✓	✓	

Summary of Mitigation Measures	Conversion and Modification Works (SSD 5147 and SSD 5147 MOD1)		
	C	D	O
Ecology			
It is considered that the Project would not have a significant effect on the GGBF, Microbats, Grey-headed Flying-fox or any other flora and fauna in the vicinity of the Project Area. Any impacts to species can be adequately managed through development of the following mitigation measures. For the conversion **and modification** works, measures shall be incorporated into a CEMP.			
Green and Golden Bell Frog A GGBF specific mitigation strategy is to be prepared and included as a sub-plan to the CEMP for the proposed Project, in consultation with the NSW 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 within the footprint of the actual conversion works; and • ~~Any frogs found would be relocated to the remnant wetland (within the Project Area boundary), by appropriately trained personnel adopting the *Frog Hygiene Protocol* (Department of Environment and Climate Change, 2008d). This would not require licensing for translocation of threatened species under the NSW TSC Act.~~ • **Should Green and Golden Bell Frogs be encountered during the conversion project works, construction and/or demolition activities would cease in the immediate area. Green and Golden Bell Frogs would be relocated according to the relevant provisions of the NSW *Biodiversity Conservation Act 2016*.** 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 to provide additional habitat during breeding season; • Design and implementation of a systematic monitoring, reporting and feedback program to assess GGBF relocation, mitigation measures undertaken, and population dynamics for this site; and	✓	✓	✓

Summary of Mitigation Measures	Conversion and Modification Works (SSD 5147 and SSD 5147 MOD1)		
	C	D	O
• A small temporary refuge area will be established, surrounded by frog proof fencing while works are undertaken and the wetland area is reconstructed. ***Management of Impacts*** A suitably qualified ecologist is to be engaged prior to the issue of plans for demolition**,** ~~and~~ construction **and modification** works to improve tankfarm drainage to advise on the following: • Proposed works to reduce the risk of potential impacts to GGBF, and • Proposed specific mitigation strategies contained within the CEMP. The CEMP GGBF sub-plan is also to include: • Management of site demolition**,** ~~and~~ construction **and modification** 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.			
Grey-headed Flying Fox and Microbat Species Prior to demolition works, inspection of exterior casings and insulations on towers (i.e. potential habitat where microbats have historically been observed) is to be undertaken regularly for signs of microbat occurrence. Regular inspections would also be undertaken of buildings scheduled for demolition.	✓	✓	
Protection of Flora While it is recognised that the proposed Project would require negligible vegetation clearing, the following measures are proposed to ensure that minimal potential impacts occur to vegetation in and adjacent to the proposed works areas: • The final demolition plan should minimise the construction footprint and the requirement for clearing of native vegetation wherever possible and within reason given the need to minimise fire hazard risks onsite; • There would 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 would include signage, barrier fencing and tree guards, wherever they would be appropriate. There would be no storage of soil, building materials, tools, paints, fuel or contaminants, etc. within the no-go areas;	✓	✓	

Summary of Mitigation Measures	Conversion and Modification Works (SSD 5147 and SSD 5147 MOD1)		
	C	D	O
• 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; • **Viva Energy** 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; • Should the proposed demolition footprint be changed such that works would encroach into more densely vegetated areas, then it is recommended that a suitably qualified ecologist is to be engaged to: - Conduct pre-clearance surveys of the final footprint immediately prior to demolition commencing, and - Undertake additional impact assessment if required. • The riparian vegetation along the southern and eastern borders of the Project Area would continue to be preserved.			
Weed Management The following measures would be put in place to manage weeds: • 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; • Soil and vegetation removed would be covered during transport and taken to an 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*).	✓	✓	✓
Plant Pathogen Hygiene *Phytophthora cinnamomi* is not known to be present in the Project Area and there is little likelihood that the proposed Project	✓	✓	

Summary of Mitigation Measures	Conversion and Modification Works (SSD 5147 and SSD 5147 MOD1)		
	C	D	O
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.			

Protection of Aquatic Environments
The following additional 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.
• A detailed ESCP is to be compiled and included in the CEMP;
• Demolition and construction waste would be stored 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 **and modification** works;
• Wastewater that has been potentially contaminated during the demolition**,** ~~and~~ construction **and modification** works would be properly treated via the Clyde Terminal wastewater treatment facilities to ensure compliance with the conditions of **Viva Energy's** EPL No. 570;
• 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, 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;
• 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;
• Manage ASS in accordance with the mitigation measures detailed in Section 17.3 **of the EIS** and the Soil and Groundwater Contamination section below.
• 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
	✓	✓	✓

Summary of Mitigation Measures	Conversion and Modification Works (SSD 5147 and SSD 5147 MOD1)		
	C	D	O
- The Project would not result in a reduction of wetland or riparian vegetation.			
Viva Energy will contact Parramatta City Council before any removal is undertaken for any native trees over 5 m high that are required to be removed. It is not **Viva Energy's** intention to remove any of the native trees in this area. This will be subject to review with the demolition contractor and if it is considered necessary to remove any trees, then this matter has been identified in the EIS and will involve discussions with Parramatta City Council before such action is taken to determine the most suitable course of action.	✓	✓	
Soil and Groundwater Contamination			
Currently, soil and groundwater conditions at the Clyde Terminal site are regulated by Condition U1 of EPL No. 570 which references the need for the SGMP ~~2010~~ and an associated annual report. The ongoing operations at the Project Area would also continue to be regulated by the requirements of the POEO Act and CLM Act.			
Demolition and Construction Mitigation Measures • Prior to demolition**,** ~~and~~ construction **and modification** activities taking place, **Viva Energy** would develop an ESCP to manage those risks at the Project Area. The ESCP would be incorporated as part of the CEMP and would be developed in accordance with *Managing Urban Stormwater: Soils and Construction* (Landcom, 2004); • The SGMP ~~2010~~ would be revised as part of the conversion activities where necessary to take account of demolition and construction activities; • **Viva Energy** would undertake the following actions in accordance with the CEMP for the Project. During the limited excavation activities that are planned for the conversion works, the following management measures would be applied: - Reference would be made to the identification of certain Contaminants of Concern in specific areas of the Project Area as per Conceptual Site Model 2012; - With reference to the Conceptual Site Model 2012, soil and groundwater conditions at the Project Area would continue to be managed through a series of triggers and appropriately designed response mechanisms; - Identify any required occupational hygiene monitoring for demolition and construction personnel in relation to VOCs; - Any subsurface works would be designed to control and protect the health and safety of people onsite; - The use of geotextile liners or temporary capping would be used to reduce infiltration of surface water runoff where soil is to be excavated during demolition and construction; - Groundwater routine reporting would continue to be undertaken as per **Viva Energy's** GWSAP, which would be revised as part of the Project; and	✓	✓	

Summary of Mitigation Measures	Conversion and Modification Works (SSD 5147 and SSD 5147 MOD1)		
	C	D	O
- If trigger values are exceeded at the Project Area for soil and groundwater quality as outlined in the Environmental Conditions Summary Report (ERM, 2012), the Conceptual Site Model 2012 would be used to guide appropriate clarification or mitigation measures. • If contaminated soils are discovered during excavations, they would be separated and managed in accordance with **Viva Energy's** existing waste management system for the Project Area, which would be incorporated as part of the Project CEMP; • Further investigations would be undertaken in areas that are currently unable to be accessed due to plant and equipment on these areas, once the aboveground infrastructure is removed and access to the relevant areas is available; • Throughout the Project, **Viva Energy** would continue to undertake the following management measures as part of the SGMP ~~2010~~: - Contaminants of Concern would continue to be monitored as part of the ongoing SGMP ~~2010~~. A data gap would be identified in the event that one or more of these Contaminants of Concern are detected at concentrations exceeding their applicable groundwater screening criteria and may have the potential to pose a risk to identified receivers. Additional evaluation would then be completed to fill in those data gaps to confirm whether there is a risk that warrants further action; and - In the event that remedial actions are required to mitigate the risk of pathway exposure to contamination, the Conceptual Site Model 2012 would serve as a design basis for that remedial action. • In general, **Viva Energy** would continue to use a hierarchy of controls, including engineering controls, to mitigate risks and prevent loss of containment during both the conversion works and operation of the converted Clyde Terminal. **Viva Energy** would continue to focus its incident prevention at the Project Area on strengthening preventative barriers against spills. The infrastructure upgrades undertaken as part of the conversion works would assist in preventing loss of containment by: - Upgrading safeguards to prevent tank overfills; and - Ensuring pipelines continue to be designed to withstand greater pressures than the maximum pump discharge pressures. • Existing bund walls at the Clyde Terminal would be inspected prior to the conversion works commencing to identify any necessary improvements. These improvements would include either: - The demolition of the existing bund walls; or - Injection of concrete into the existing bund walls to strengthen the structure or repair any faults. • ASS would be managed according to an ASSMP which would be incorporated into the existing *Soil and Groundwater*			

Summary of Mitigation Measures	Conversion and Modification Works (SSD 5147 and SSD 5147 MOD1)		
	C	D	O
Management Plan Shell Clyde Refinery and Parramatta Terminal, Durham Street, Rosehill, NSW (Shell, 2010), the WMP 2013 and the CEMP to be prepared for the conversion works; • Identify any ASS impacted soils within the Project Area before excavation activities are undertaken; • Any ASS impacted soils excavated from the Project Area would be kept wet at all times until it is disposed of and managed in accordance with the *Waste Classification Guidelines Part 4: Acid Sulphate Soils* (Department of Environment and Climate Change, 2008e); and • 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.			
Ongoing Operational Mitigation Measures • The SGMP ~~2010~~ would be revised as part of the operation of the converted Clyde Terminal to take account of the upgraded operations; • **Viva Energy** would determine if the surplus land in the western and north-eastern portion of the Project Area is to be made available for an alternative use and a separate development application would need to be submitted so that any necessary remediation and also redevelopment of this land can take place (the Clyde Remediation and Redevelopment Application); • Following the conversion works and when unimpeded site access is re-established in certain areas, additional investigation and remediation can be completed as required; • The three key barriers to receivers' exposure would be maintained: primary source management; operational area (internal) monitoring; and boundary containment monitoring. These three key barriers would continue monitoring to evaluate barrier effectiveness on a quarterly basis and when otherwise triggered; • **Viva Energy's** risk management systems would continue to be reviewed and amended before critical changes throughout the conversion works to identify and assess the risks that these changes pose both onsite and offsite, and to ensure multiple layers of controls exist to minimise the opportunity for incidents to occur; • **Viva Energy** would notify WorkCover of any changes to the levels of risk before critical changes occur throughout the conversion works and would submit safety reports to WorkCover as required, ensuring WorkCover's oversight of the risks and controls at the Clyde Terminal; • **Viva Energy** would continually review and amend the Emergency Procedure Plans to account for the changes in risks	✓	✓	✓

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<tr><th rowspan="2">Summary of Mitigation Measures</th><th colspan="3">Conversion and Modification Works (SSD 5147 and SSD 5147 MOD1)</th></tr>
<tr><th>C</th><th>D</th><th>O</th></tr>
<tr><td>and the changes in fire fighting equipment at the Clyde Terminal throughout the conversion activities, and consult with Fire and Rescue NSW during this process;
• The following management measures would be incorporated as part of the OEMP and undertaken to prevent and manage the implications of any loss of containment scenarios:
- Current systems in place at the Project Area that would continue to prevent loss of primary containment and spill incidents include:
▪ Log checklists carried out every shift by operators to ensure that equipment such as valves are in the correct position;
▪ Water drain tanks through quick flush tanks to separate water from fuels, returning fuel to tanks and draining water to wastewater treatment facility, thus minimising the opportunity for fuel to enter the interceptor system;
▪ Decontaminate the tankfarms, drainage and wastewater systems across the Clyde Terminal area to ensure minimal opportunity for stormwater to be impacted by remnant hydrocarbon contact;
▪ Re-profile tankfarm floors to ensure adequate and effective stormwater draining and bund capacity is preserved to serve its primary purpose of protection of the environment from hydrocarbon spillage; and
▪ Review and repair tankfarm bund walls where required to ensure integrity in the event of a spill incident.
- Tank overfill would continue to be prevented through a combination of:
▪ An automatic tank level gauging system with multiple level alarms including: target fill level; high level alarm with time for appropriate operator action at each point and before the next level; an alarm point; and manual dips to provide accuracy of the tank level gauging system;
▪ A final independent high-high level alarm system that provides an alarm independently from the other alarms and tank level gauging system. This system provides for sufficient response time before overfill is anticipated to occur and would trip inflow facility pumps shutting down product inflow to tanks;
▪ The movement management system that provides for the analysis of data and tank movement management; and
▪ Operational readiness planning with procedural support.
- A series of facility integrity checklists would be developed consistent with other Viva Energy terminal facilities to ensure inspections and maintenance of safety and environmentally critical equipment and repairs are undertaken in a timely manner;
- Viva Energy's existing Permit to Work system would be changed to be appropriate for converted Clyde Terminal operations and would be introduced with appropriate training and mentoring to ensure controls are in place across the Clyde Terminal to control all works, and to integrate these with non-routine activities during operation of the</td><td></td><td></td><td></td></tr>
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Summary of Mitigation Measures	Conversion and Modification Works (SSD 5147 and SSD 5147 MOD1)		
	C	D	O
converted Clyde Terminal; - Operators would continue to be trained to look for spills and leaks in the course of their shift rounds; - Operators would be trained in the new environmental controls appropriate for the converted Clyde Terminal operations and specifically in the use of newly installed environmental control equipment; - Existing interceptors within the Project Area would continue to be maintained as a means of tertiary containment; and - Spill incidents would be reported within the **Viva Energy** incident reporting system and, where required, to the EPA and WorkCover. • If a release event is known or suspected to have occurred, additional assessment may be justified to determine if there have been any soil and groundwater impacts under the SGMP ~~2010~~ as follows: - A program of works would be developed to cover any data gaps and determine whether any associated risks are within acceptable levels; - Investigation techniques to be employed would include, where relevant: ▪ Trial pit excavations; ▪ Advancement of soil bores; ▪ Monitoring well installations; and ▪ Analytical sampling of soil and groundwater quality. - If investigation shows that risks are greater than acceptable levels identified in the SGMP ~~2010~~, some form of remedial action would be warranted in order to eliminate or reduce potential exposure pathways. This would be likely to involve one or more of the following: ▪ Excavation of surface soil and removal or treatment before reinstatement; ▪ Excavation of interception trenches and associated pumps as needed to remove and prevent further spread of shallow groundwater contamination; ▪ Installation of pumps in groundwater wells to remove or control the spread of contamination; and ▪ Emplacement of impermeable materials in soil trenches to contain the spread of contaminated groundwater.			
European Heritage			
It is anticipated that the impacts to the historical and technical significance of the Refinery can be managed through a full photographic and documentary archival recording of the facility. Specifically, the following mitigation measures are recommended for the Project to minimise impacts on heritage significance.			

Summary of Mitigation Measures	Conversion and Modification Works (SSD 5147 and SSD 5147 MOD1)		
	C	D	O
• Parramatta Council requires consideration be given to provision of an Arts Plan. As such, oral histories are to be recorded from past and present staff regarding the operations of the former Clyde Refinery, and a full photographic and documentary archival recording of the Project Area would be used to manage the impact to the historical and technical significance of the former Clyde Refinery; • Photographic recording would be undertaken in accordance with the NSW Heritage Branch guidelines *How to prepare archival records of heritage items* (NSW Heritage Office, 1998) and *Photographic recording of heritage items using film or digital capture* (NSW Heritage Office, 2006); • Archival recordings would be undertaken to capture, prior to demolition works taking place, and for infrastructure that would be demolished; • Documentary recording would contain a detailed timeline of each piece of equipment and tankfarm, together with copies of plans and schematics; • A photographic archival recording would be undertaken prior to the demolition of the stacks. The recording would include broad views of the larger Clyde Refinery area; • ~~Subsurface impacts to the area of archaeological potential identified around the bitumen gantry through the removal of foundations or other invasive works, are to be managed through the preparation and implementation of an Archaeological Research Design and Methodology;~~ • The memorial to John Simpsom Fell, Horace Liddon Spencer and Albert Edward Ward, located near the bitumen gantry, is to be relocated to a publicly accessible area (e.g. visitor car park or Project Area). Shell would investigate the feasibility of undertaking a memorial relocation ceremony involving family and descendants of the three men and use of the plaque as a teaching aid for the importance of workplace safety; and • A brief management section is to be prepared within the Project Area's OEMP to guide the management of archaeological potential at the historical residential area along Devon Street and at the second bitumen gantry. • **Archival recording will be updated to include the State Office Building, MTS1 33 kV switch yard, Tank 106, LPG spheres V137 and V140 and LPG truck loading gantry.**	✓	✓	

Summary of Mitigation Measures	Conversion and Modification Works (SSD 5147 and SSD 5147 MOD1)		
	C	D	O
Hazard and Risk			
Risk Management in Design All tanks converted as part of the Project would be constructed to recognised Australian and International Standards, in line with the existing tanks at the Clyde Terminal. The design would be subject to the **Viva Energy's** risk management process. Risk management activities that directly relate to the NSW Seven Stage Planning Process are outlined below: • Preliminary Hazard Analysis; • **Viva Energy's** Hazard and Effects Management Process; • Hazard and Operability Study; • Fire Safety Study; • Final Hazard Analysis; • Emergency Response Plan Review annually or prior to each critical modification; • Construction Safety Study; • Commissioning review; and • Safety Management System Update.	✓		
Terminal Safety Systems Safety Systems proposed for the Project are as follows: • Process Control: The process control system (i.e. tank level gauging) is integrated with the existing Clyde Terminal process Distributed Control System; • Process Shutdown Systems: Existing pump interlocks would be retained and new tank high level trips would be provided as required to demonstrate as low as reasonably practicable risk; • Bund Walls and Drains: The existing bunds and drains would be retained; • Articulated and remotely operated foam application system would be installed; • Fire Water: The existing firewater main, monitors and hydrants would be modified for the converted Clyde Terminal operations; • Tank Rim Seam Foam Pourers: Rim seal foam pourers would be modified or installed to meet the revised tank configuration; and • Hazardous Area Classification: Ignition sources would be controlled by the application of suitable hazardous area	✓	✓	✓

Summary of Mitigation Measures	Conversion and Modification Works (SSD 5147 and SSD 5147 MOD1)		
	C	D	O
classification standards.			
Safety in Operation The existing Clyde Terminal and Gore Bay Terminal Management System would be updated to align with operation of the modified Gore Bay Terminal and converted Clyde Terminal. The ERP 2012 would also be updated again as required before operation of the converted Clyde Terminal commences, and in particular the Final Hazard Analysis would be prepared at this time. The implementation of the ERP would include the activation of external emergency services if required.			✓
Proposed Automation and Safeguarding Operation The following safeguards and automation upgrades are proposed: • Yokogawa Prosafe SGS would be installed to replace the functionality of the existing relay logic; • Permissives (interlocks) would be improved to prevent the incorrect valves being opened; • Motorised valves would be installed inside tank bunds to allow quicker acting valves and remote operation; • The reliability of telemetry between Clyde/Gore Bay would be improved; • The Independent High Level Alarm and tank gauging systems would be improved; • Pump trip systems would be improved; • The site fire system and dump valve logic would be improved; and • Non-safeguarding controls would also be upgraded.	✓		
Emergency Response Plans would include the actions to cease all product transfers and shut all valves and “lock the product inside the tanks”.			✓
Ausgrid must be contacted before planning any work near Ausgrid’s underground power and control cables that run though the Clyde facility. It is imperative that any hand excavation or hand boring works within 2m of either side of these cables be classified as "Work Near Underground Assets" according to Work Cover Guidelines an must comply with Ausgrid's standard: NS156 Working Near or around Underground Cables. Mechanical excavation or boring works within 2m of these cables is not permitted. **Viva Energy’s** own internal standards require cable location to be determined using plans then locating equipment before undertaking hand digging and auguring around cable locations. **Viva Energy** will comply with Ausgrid’s requirements.	✓	✓	
Emergency response will involve using a semi-automatic fire suppression system; a SIL-rated fire detection system or melt-tube technology that would alarm back to the Control Room for Operator verification of an incident before deployment of fire-	✓	✓	✓

Summary of Mitigation Measures	Conversion and Modification Works (SSD 5147 and SSD 5147 MOD1)		
	C	D	O
fighting foam and/or water deluge systems. Activation of the fire system would shut all valves, shutdown pumps and transfer operations and activate fire systems as the first stage of the response with support provided by Fire & Rescue NSW. This fixed fire system will replace the mobile fire response that is currently in place.			
Waste Management			
Demolition and Construction Waste Mitigation Measures Demolition, construction and operational waste would be managed and disposed of in accordance with relevant State legislation and Government requirements. The existing WMP 2013 would be **updated** for demolition**,** ~~and~~ construction **and modification** works, and this would be incorporated into the CEMP. The following waste management mitigation measures would be incorporated as part of the CEMP for the Project to eliminate or reduce the risk of environmental impacts: • Demolition and construction contractors would be required to provide a detailed waste management plan and tracking system that incorporates available recycling options; • Before transfer to the designated locations as per the waste permit system, wastes may require stockpiling. Wastes would be: - Clearly labelled, to ensure that all such waste is clearly identified and stored separately from other types of materials and wastes, and particular to ensure that contaminated and non-contaminated wastes are stockpiled separately; - Located away from trafficked areas and other potential disturbances; - Placed on geo-fabric lining and covered to prevent leachate and erosion; and - Be no more than 3 to 5 m tall depending in the type of wastes stockpiled, and allow adequate room for transport around and management of each stockpile. • Demolition and construction waste would be stored on a sealed and bunded surface whilst awaiting transfer or processing; • Radioactive substances waste would be disposed of as per the requirements of the *Radiation Control Regulation 2003* and the *Waste Classification Guidelines Part 3: Waste Containing Radioactive Material* (Department of Environment and Climate Change, 2008e); • A small amount of asbestos is present on the Project Area and would require removal during demolition activities. As such, **Viva Energy** and its contractors would comply with the following obligations set out in Chapter 8 of the WH&S Regulation: - Ensure that exposure to asbestos at the Project Area is eliminated as far as reasonably practicable; - Ensure an asbestos register is maintained;	✓	✓	

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<tr><td>- Ensure an asbestos management plan is in place for the Project Area;
- Engage a licensed asbestos contractor to carry out the removal of asbestos from the Clyde Terminal;
- Ensure that health monitoring is provided to those personnel undertaking asbestos works as part of the Project;
- Ensure access to the asbestos removal area is limited to those who are actually involved in the removal of the asbestos, including the placement of relevant signage and barriers;
- If there is uncertainty as to whether the exposure standard is likely to be exceeded, Viva Energy would engage a competent contractor to perform air quality monitoring in the area;
- Decontamination facilities would be provided at all times at the Project Area; and
- Ensure that asbestos waste, and asbestos contaminated plant or clothing is decontaminated, sealed and labelled before it is removed from the Project Area to a site that is authorised to receive asbestos waste.
• As per the requirements of clause 42 the POEO Waste Regulation, asbestos waste would be securely packaged, be in a sealed container, be wetted down, or be contained in a covered, leak-proof vehicle.</td><td></td><td></td><td></td></tr>
<tr><td>Operational Waste Mitigation Measures
Waste management mitigation measures for operation of the Clyde Terminal would be incorporated into an updated version of the WMP 2013. Operational waste management mitigation measures include:
• Waste management would continue to be undertaken in accordance with the Waste Avoidance and Resource Recovery Act 2001 and the Waste Avoidance and Resource Recovery Strategy 2007 (Department of Environment and Conservation, 2007), in that resources would be used efficiently, and the hierarchy of waste avoidance, recovery and disposal would be followed;
• Waste would continue to be identified, characterised, classified and separated in accordance with the Waste Classification Guidelines (Department of Environment and Climate Change, 2008e), and records of these procedures would be maintained for the life of the conversion works, and beyond that, for the required statutory period;
• The waste permit system for the onsite and offsite transfer and disposal of waste would continue to be followed;
• EPL No. 570 would continue to provide the key guidelines for waste management at the Project Area. In particular:
- Waste designated for recycling would be stored separately from other wastes;
- All above ground tanks containing material with the potential to cause environmental harm would be bunded or have an alternative spill containment system in place; and
- Dewatered oily sludge would be treated in an onsite landfarm or disposed of offsite to a place that can lawfully accept that class of wastes.
• Waste materials would be stored in the designated locations as per EPL No. 570 and the WMP 2013;</td><td></td><td></td><td>✓</td></tr>
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Summary of Mitigation Measures	Conversion and Modification Works (SSD 5147 and SSD 5147 MOD1)		
	C	D	O
• Wastes scheduled under the POEO Waste Regulation would continue to be subject to waste tracking requirements, except where an exemption exists under EPL No. 570. A record of these waste movements would nevertheless be maintained by **Viva Energy**; • Leachate or residual water from waste dewatering activities would be directed to the interceptors for treatment before being released as licensed discharge. Waste materials separated out at the interceptors would be disposed at an offsite licensed facility; • In the unlikely event that waste or its leachate is released to the environment, the investigation and remediation measures outlined in the SGMP ~~2010~~ would be adhered to; and • PCB wastes would be managed and disposed of according to the CCO issued by the EPA for the handling of PCB wastes.			
Hazardous Waste Mitigation Measures Hazardous wastes generated during demolition and construction activities, and/or operation of the converted Clyde Terminal would be treated or immobilised in the following manner before being transported offsite by a licensed waste contractor: • Asbestos wastes according to the requirements of the POEO Waste Regulation, that it be securely packaged in a sealed container and wetted down or contained in a covered, leak-proof vehicle; • PCB wastes according to the CCO issued by the EPA for the handling of PCB wastes; • Oil filters and packing and used oily rags would be managed as prescribed waste. Any powdery used oil-absorbent materials would be bagged or drummed or otherwise contained to facilitate their safe handling and disposal; • Oily sludges (for example, from tank cleaning during the ongoing operation of the Clyde Terminal) would continue to be treated in the sludge dewatering facility and/or the landfarm area, as per EPL No. 570; • Redundant equipment containing any radioactive isotopes would be disposed of as per the requirements of the *Radiation Control Regulation 2003* and the *Waste Classification Guidelines Part 3: Waste Containing Radioactive Material* (Department of Environment and Climate Change, 2008e); and • Organic solvents, contaminated blue metal and empty drums would be managed by chemical fixation to convert the hazardous contaminants to a chemically stable form. Where this is not possible, macroencapsulation would be used to place a physical barrier between those contaminated wastes and the surrounding environment.	✓	✓	✓

<table>
<tr><th rowspan="2">Summary of Mitigation Measures</th><th colspan="3">Conversion and Modification Works (SSD 5147 and SSD 5147 MOD1)</th></tr>
<tr><th>C</th><th>D</th><th>O</th></tr>
<tr><td colspan="4">Aboriginal Heritage</td></tr>
<tr><td colspan="4">Whilst the ACHA predicts that the Project would not impact on the Aboriginal heritage values of the area, the following management measures would nevertheless be implemented if any potential Aboriginal objects or human remains are discovered at the Project Area.</td></tr>
<tr><td>• Should any suspected Aboriginal objects be uncovered during demolition or construction works, all works in the vicinity should cease immediately to prevent any further impacts and a qualified archaeologist be brought onsite to make an assessment. If the object is found to be an Aboriginal object, it would be notified under the National Parks and Wildlife Act as soon as possible;
• If suspected human remains are exposed, all construction work is to cease immediately in the near vicinity of the find location and the Project Manager is to be immediately notified to allow assessment and management:
- An area of 20 m radius is to be cordoned off by temporary fencing around the exposed human remains site - construction work can continue outside of this area as long as there is no risk of interference to the human remains or the assessment of human remains;
- The Police and the OEH are to be contacted immediately; and
- A physical or forensic anthropologist would be commissioned by the Police to inspect the remains in situ (organised by the Police unless otherwise directed), and make a determination of ancestry (Aboriginal or non-Aboriginal) and antiquity (pre-contact, historic or modern).
• Subsequent management actions would be dependent on the findings of the forensic anthropologist:
- If the remains are identified as modern and human, the area would become a crime scene under the jurisdiction of the NSW Police;
- If the remains are identified as pre-contact or historic Aboriginal, the site would be secured and OEH and all Registered Aboriginal Parties notified in writing. Where impacts to exposed Aboriginal skeletal remains cannot be avoided, remains would be retrieved via controlled archaeological excavation and reburied outside of the Disturbance Boundary in a manner and location determined by Registered Aboriginal Parties;
- If the remains are identified as historic non-Aboriginal, the site is to be secured and the NSW Heritage Branch contacted; and
- If the remains are identified as non-human, work can recommence immediately.
• The above process functions only to appropriately identify the remains and secure the site. From this time, the management of the area and remains is to be determined through one of the following means:
- If the remains are identified as a modern matter liaise with the Police;</td><td>✓</td><td>✓</td><td></td></tr>
</table>

Summary of Mitigation Measures	Conversion and Modification Works (SSD 5147 and SSD 5147 MOD1)		
	C	D	O
- If the remains are identified as Aboriginal liaise with the proponent, OEH and Aboriginal stakeholders; - If the remains are identified as non-Aboriginal (historical) liaise with the **DPE** and the Heritage Office; and - If the remains are identified as not being human then work can recommence immediately.			
Noise and Vibration			
Demolition and Construction Waste Contractors would demonstrate best practicable means and include noise mitigation measures in the CEMP plan, which could include: • Construction activities to be limited to between 7am and 6pm Monday to Friday and 8am to 1pm Saturday; • Where work is undertaken outside of the standard working hours it would be in accordance with the *Interim Construction Noise Guideline* (EPA, 2009); • Construction of noise bunds or barriers, where feasible and effective for noise suppression, at the early demolition and construction stage; • Use of temporary barriers for stationary noisy equipment; • Possible restrictions to construction hours (beyond the above hours) where noise impacts are significant; • All plant items **would** be properly maintained and operated according to manufacturers' recommendations in such a manner as to avoid causing excessive noise; • All pneumatic tools would be fitted with silencers or mufflers; • Any compressors brought on to site should be silenced or sound reduced models fitted with acoustic enclosures; • Consultation with property owners likely to be affected prior to works being carried out; and • Noise monitoring at sensitive locations as agreed with EPA for any excessive noise or noise complaints being assessed with appropriate action taken.	✓	✓	
Traffic Noise The existing OEMP includes provisions for vehicle protocols in and around the Clyde Terminal and the Parramatta Terminal. This would be revised for operations once the demolition**,** ~~and~~ construction **and modification** works have been completed.			✓
~~***Blasting***~~ ~~The CEMP would include a blast plan and control measures to minimize the impact of ground vibration and noise as a result of blasting at a particular site. Items to be considered in the development of this part of the CEMP are:~~		✓	

Summary of Mitigation Measures	Conversion and Modification Works (SSD 5147 and SSD 5147 MOD1)		
	C	D	O
• ~~Reducing maximum instantaneous charge, for example by reducing blasthole diameter or deck loading;~~ • ~~Using a combination of appropriate delays;~~ • ~~Allowing for excessive humps or toe in the blast design;~~ • ~~Optimising blast design by altering drilling patterns, delaying layout or altering blasthole inclination from the vertical;~~ • ~~Exercising strict control over the location, spacing and orientation of all blastholes and using the minimum practicable sub-drilling that gives satisfactory to conditions; and~~ • ~~Establishing times of blasting to suit the situation;~~ • ~~Using experienced blast contractor to be used;~~ • ~~Using a series of test blasts to be used to determine site specific conditions. As a result of these tests the maximum instantaneous charge should be determined;~~ • ~~Restricting blasting or ceasing blasting if the predictions indicate that air blast overpressure levels are likely to be exceeded at neighbouring dwellings unless agreed with the owner(s);~~ • ~~Ensuring all reasonable attempts are made to contact sensitive receivers located within 500 m of a blast location;~~ • ~~Using linear enclosures or shielding would be used to assist in airblast attenuation if required;~~ • ~~Ensuring stemming type and length is adequate;~~ • ~~Eliminating exposed detonating cord and investigating alternative initiation method;~~ • ~~Making extra efforts to eliminate the need for two shots (e.g. better control of drill patterns);~~ • ~~Using survey methods, as appropriate, to ensure burden is adequate;~~ • ~~Considering delaying or cancelling the blast by not loading if the weather forecast is unfavourable;~~ • ~~Allowing for the effects of temperature inversion and wind speed and direction on the propagation of airblast to surrounding areas;~~ • ~~Orientating faces where possible so that they do not directly face residences;~~ • ~~Varying the direction of initiation;~~ • ~~Exercising strict control over the burden, spacing and orientation of all blastholes;~~ • ~~Taking particular care where the face is already broken or where it is strongly jointed, sheared or faulted;~~ • ~~Considering deck loading where appropriate to avoid broken ground or cavities in the face (e.g. from back break);~~ • ~~Adequately monitoring the blasts to help minimise complaints and also to provide documentation in the event of any claims for damages arising from blasting; and~~ • ~~Recording of complaints associated with blasting, identifying the nature of the complaint, the particular operation that initiated the complaint, and documenting action taken.~~			

Summary of Mitigation Measures	Conversion and Modification Works (SSD 5147 and SSD 5147 MOD1)		
	C	D	O
GHG Emissions			
Viva Energy would undertake an internal energy audit of the Project Area following completion of the demolition and construction works to take stock of how the operation of the Clyde Terminal has reduced electricity consumption and improved energy efficiency. Recommendations arising from the audit would then be taken into consideration where significant further energy savings can be made.			✓
Landscape and Visual Amenity			
Dust control measures included in the CEMP and outlined in the Surface Water, Industrial Water and Flooding section of this table would avoid or minimise potential visual impacts from dust.	✓	✓	
The riparian vegetation within the wetlands would be retained thereby conserving the visual amenity and landscape character of the area.	✓	✓	✓
Ongoing Monitoring at the Converted Clyde Terminal			
Viva Energy would continue to undertake existing environmental and safety monitoring at the Project Area following completion of the conversion including: • Interceptor sampling; • Wetlands management; • Waste management; • Groundwater sampling and analysis; • Safety critical equipment inspection and maintenance; • Safety management system auditing; • Process safety observations and audits; • Emergency response exercises and plan reviews; • Hazard and effect management process reviews; and • Competency assessment of all operational staff.	✓	✓	✓

15.2 Environmental Management

15.2.1 Overview

Current operations at the Clyde Terminal comply with relevant legislative and regulatory requirements including SSD 5147 and EPL 570. This EPL is regularly updated to ensure the management of the terminal meets certain environmental requirements. As the terminal operations change the EPL is updated to ensure that it remains relevant to current activities being undertaken.

In order to maintain compliance with relevant legislative and regulatory requirements, Viva Energy implements an Environmental Management Strategy (EMS). The EMS consists of a suite of internal policy documents and plans. The EMS would continue to be updated and apply throughout the modification works.

This MR has outlined a suite of measures that would assist in avoiding, mitigating or managing the anticipated impacts associated with the modification works. These measures would be incorporated into the modified conditions of consent for the Conversion Project. During the modification works, all relevant measures would be implemented through the DWP and associated existing sub-plans.

The DWP would be updated to be relevant to the expanded scope of works and to include any additional or updated measures resulting from the assessments within **Chapters 8.0 to 15.0** of this MR as required.

The DWP and associated sub-plans would help ensure that:

- All work complies with all relevant environmental legislation, regulations and standards;
- Environmental factors are taken into account for each activity;
- Maintenance of environmental compliance and performance is achieved through ongoing environmental monitoring and reporting; and
- Regular audits are performed to confirm compliance with environmental policies and standards.

Updated measures included in this MR would be incorporated into the current operating procedures and existing EMS for the Site.

15.2.2 Demolition Work Plan

The DWP outlines the procedures that would be implemented to address and manage environmental impacts associated with modification works to the Conversion Project. The DWP would be updated by Viva Energy prior to the commencement of the modification works.

The primary purpose of the DWP is to provide a reference document outlining the relevant safeguards and mitigation measures that are in line with the conditions of consent, and ensure that these are implemented and maintained. The DWP outlines the key steps to be taken by personnel and contractors to manage the environmental hazards and risks associated with the modification works and to effectively minimise the potential for environmental harm. The DWP is subject to ongoing review throughout the Conversion Project.

The DWP includes, and would be updated to include, the following:

- A consolidated description of the conversion and modification works;
- An outline of the conversion and modification works program;
- Relevant statutory requirements – including applicable licences and approvals;
- Standards and/or performance measures for the relevant environmental issues associated with the conversion and modification works;
- A description of what actions and measures would be implemented to mitigate the potential impacts associated with the conversion and modification works and ensure that these works would comply with the relevant standards and/or performance measures;
- A description of the procedures to ensure all personnel and contractors are trained in regards to their responsibilities under the DWP;

- A description of the procedures that would be implemented to register, report and respond to complaints during the conversion and modification works;
- A description of the procedures that would be implemented to manage environmental incidents and associated reporting requirements;
- Identification of key personnel who would be involved in the conversion and modification works, and provide their contact numbers;
- Monitoring procedures and a description of the process to be followed if any non-compliance is identified;
- Detailed sub-plans including:
  - Soil and Water Management Plan;
  - Noise and Vibration Management Plan;
  - Air Quality Management Plan;
  - Traffic Management Plan;
  - Flood Emergency Response Plan;
  - Waste and Resource Recovery Plan; and
  - Biodiversity Management Plan.

These items are consistent with the management measures presented in **Table 15-1**.

15.2.3 Environmental Management Manual

The Environmental Management Manual (EMM) has been developed to outline environmental management measures and policies for the ongoing operation of the Clyde Terminal. The EMM is implemented in conjunction with the EMS to manage the concurrent operation of the Clyde Terminal while the Conversion Project progresses.

Should the modification works receive development consent, no notable change to the ongoing operation of the Clyde Terminal is anticipated. Notwithstanding this the EMM would be updated, if required, to include additional operational management measures required as a result of the modification works.

16.0 Revised Conditions of Consent

The conditions of consent provided for SSD 5147 (14 January 2015) were reviewed based on the outcomes of the assessments within this MR to determine their relevance to the modification works.

In particular, Viva Energy is proposing to modify condition of consent B6 to allow the GGBF habitat restoration works at the Wetland Area to be completed following delays in finalising the design. Other conditions are also proposed for deletion or amendment to simplify compliance requirements in the future.

Table 16-1 identifies which conditions are relevant to the proposed modification works and provides a reason from proposed updates and changes. Conditions recommended for modification are highlighted.

Table 16-1 Relevant Conditions of Consent for the Modification Works

Condition No.	Condition Title and Summary	Relevance to the modification works
Schedule A	Site Characteristics	Relevant - update references from Shell to Viva Energy Australia Pty Ltd and Lot 1 DP 109739 to Lot 100 DP 1168951
B1	Obligation to minimise harm to the environment	Relevant - no change needed
B2	Terms of consent - in accordance with specified documents	Relevant - update to include this MR
B3	Terms of consent - inconsistency of above documents	Relevant - no change needed
B4	Terms of consent – comply with Secretary requirements	Relevant – no change needed
B5	Limits of consent - not store in excess of 264 ML of finished petroleum products and 1,550 m^3 of petroleum gasses.	Not relevant - no change in limits of consent proposed in this modification
B6	Limits of consent - construction shall not extend beyond four years from the date of approval	Relevant – request that this condition is amended to state that "*construction shall not extend beyond five years from the date of approval*"
B7	Limits of consent - demolition shall not extend beyond ten years from the date of approval	Relevant - no change needed
B8	Surrender of existing development consents	Relevant – update wording to be consistent with letter sent to Department of Planning on 27 April 2016. Consents listed in Appendix B to be revised to only include relevant development consents within the Conversion Works area.
B9	Statutory requirements – all licences, permits and approval / consents are obtained	Relevant – no change needed
B10	Structural adequacy – new buildings and structures and any alterations or additions are constructed in accordance with the Building Code of Australia	Not relevant

Condition No.	Condition Title and Summary	Relevance to the modification works
B11	Operation of plant and equipment – ensure plant and equipment is maintained and operated in proper and efficient condition	Relevant – no change needed
B12	Protection of public infrastructure – prepare and submit a copy of the dilapidation report to the Secretary and Council	Not relevant – completed
B13	Protection of public infrastructure – repair / relocate public infrastructure that is damaged by the development	Relevant – no change needed
B14	Protection of private and commercial property - repair, replace, cleanup or compensate private or commercial property physically damaged by the development	Relevant – no change needed
B15	Protection of Ausgrid infrastructure - requirements for works within two metres of underground Ausgrid cables	Not relevant – the modification works are not located close to the Ausgrid infrastructure.
B16	Staged submission of plans or programs – submit plans etc. on a progressive basis or combine plans etc.	Relevant – no change needed
B17	Staged submission of plans or programs - existing plans or programs remain relevant until replaced by an equivalent plan or program under this consent	Relevant - no change needed
B18	Dispute resolution - refer matter to the Secretary or Minister	Relevant – no change needed
B19	Compliance – employee, contractor and sub-contractor awareness of conditions of consent	Relevant – no change needed
B20	Compliance – the Applicant is responsible for environmental impacts	Relevant – no change needed
B21	Section 94A contributions - Applicants requirement for development contribution to Council	Not relevant - completed
C1	Hazard and risks terms of approval - carry out the development and implement control measures accordance with the PHA	Relevant – no change needed
C2	Hazard and risks pre-construction - prior to commencement of construction or demolition applicant will undertake hazard and safety studies and submit for the approval of the Secretary	Relevant – no change needed

Condition No.	Condition Title and Summary	Relevance to the modification works
C3	Hazard and risk pre-commissioning - applicant shall prepare an emergency plan and safety management system prior to commissioning of any component of the development (no later than two months prior to the commencement) and to be approved by the Secretary	Not relevant
C4	Hazard and risk pre-start-up compliance report one month prior to commencement of operation of each asset or system applicant shall demonstrate compliance with conditions C1, C2 and C3 and submit details of compliance to the Secretary	Not relevant
C5	Hazard and risk post startup compliance report - three months after commencement of operation of first asset or system, applicant shall demonstrate compliance with conditions C3(a) and C3(b)	Not relevant
C6	Hazard and risk hazard audit - audit shall be taken within 12 months of the approval and every three years thereafter. Within one month of each audit, required to submit a report to the Secretary	Relevant – no change needed
C7	Hazard and risk hazard audit - audits shall be undertaken by a qualified person at the applicants expense and in accordance with HIPAP No. 5	Relevant – no change needed
C8	Hazard and risk hazard audit - audit report requirements provided in HIPAP No. 5	Relevant – no change needed
C9	Hazard and risk further requirements - applicant shall comply with all reasonable requirements of the secretary in respect to any measures arising from reports submitted in respect of conditions C1 to C6	Relevant – no change needed
C10	WorkCover requirements - applicant shall consult with WorkCover to discuss preventative and recovery barriers	Not relevant – complete. Recommend removing condition from development consent.
C11	WorkCover requirements - prior to finalising FHA, applicant shall meet with WorkCover to agree with LPG vessel modes and frequency	Relevant - no LPG vessels to be retained. Recommend removing condition from development consent.
C12	Demolition approvals / licencing - demolition shall be undertaken in accordance with relevant guidelines	Relevant – no change needed

Condition No.	Condition Title and Summary	Relevance to the modification works
C13	Demolition approvals / licencing - demolition shall be undertaken by licenced demolition experts	Relevant – no change needed
C14	Demolition management plan - applicant shall prepare a demolition management plan, to the satisfaction of the Secretary	Relevant – no change needed
C15	Stack demolition management plan - applicant shall prepare a stack demolition management plan, to the satisfaction of the Secretary	Not relevant – complete. The stacks have been demolished and the latest Independent Environmental Audit (IEA) report (2018) confirms that Viva Energy complied with the condition. Recommend removing condition from development consent.
C16	Asbestos handling, transport, disposal and clearance - applicant shall ensure asbestos encountered is monitored, handled, transported and disposed of appropriately (by qualified and licensed contractors)	Relevant – no change needed
C17	Contamination management plan - applicant shall prepare and implement a contamination management plan, to the satisfaction of the Secretary	Relevant – no change needed
C18	Removal of sub-grade infrastructure - removal of underground infrastructure undertaken in accordance with relevant guideline	Not relevant
C19	Removal of sub-grade infrastructure - contamination report shall be provided to the EPA outlining contamination in the vicinity of subgrade asset removal	Not relevant
C20	Acid sulphate soils management plan prepared in accordance with relevant requirement	Relevant – no change needed
C21	Operational noise limits	Not relevant
C22	Hours of work	Relevant – no change needed
C23	Hours of work exceptions	Relevant – no change needed
C24	Noise operating conditions	Relevant – no change needed
C25	Construction and demolition noise management plan shall be prepared by a suitably qualified and experienced expert, consulted with the EPA and approved by the Secretary prior to commencement	Relevant – no change needed
C26	Blasting hours 9:00am and 5:00pm Monday to Friday inclusive. Not permitted on Sundays, public holidays or at any other time without the written approval of the Secretary	Not relevant – complete. The stacks have been demolished, blasting is complete and the latest IEA report (2018) confirms that Viva Energy complied with the condition. Recommend removing condition from development consent.

Condition No.	Condition Title and Summary	Relevance to the modification works
C27	Blast management plan shall be prepared, to the satisfaction of the Secretary	Not relevant – complete. The stacks have been demolished, blasting is complete and the latest IEA report (2018) confirms that Viva Energy complied with the condition. Recommend removing condition from development consent.
C28	Dust minimisation measures shall be implemented	Relevant – no change needed
C29	Offensive odours shall not be emitted from the Site	Relevant – no change needed
C30	Operational air quality monitoring program shall be prepared for the operation of the Site by a suitably qualified and experienced expert, consulted with the EPA and approved by the Secretary within 3 months of the date of this consent	Relevant – no change needed
C31	Construction and demolition air quality management plan shall be prepared by a suitably qualified and experienced expert, approved by the Secretary prior to commencement and provided to the EPA	Relevant – no change needed
C32	Meteorological monitoring shall be undertaken in the vicinity of the Site	Relevant -no change needed
C33	Energy efficiency and greenhouse gas emissions shall be minimised during construction, demolition and operation	Relevant – no change needed
C34	Transport and access operating conditions	Relevant – no change needed
C35	Transport and access - provide sufficient parking facilities on-site	Relevant – no change needed
C36	Traffic management plan shall be prepared, to the satisfaction of the Secretary.	Relevant – no change needed
C37	Flood design and structural certification - new buildings and additions constructed in accordance with relevant requirements	Not relevant
C38	Flood design and structural certification - new electrical substation shall be constructed above the 1% AEP flood level	Not relevant
C39	Flood study - within two months of receiving consent, applicant shall provide site data to update the Duck River flood study, to the satisfaction of Council.	Not relevant - completed

Condition No.	Condition Title and Summary	Relevance to the modification works
C40	Flood study - Within one month of the completion of the updated flood study, the applicant shall review and outline any additional flood management measures for the Site	Not relevant - complete
C41	Flood warning signs - flood warning signs are to be maintained throughout the Site	Relevant – no change needed
C42	Flood emergency response plan shall be updated and implemented. The plan must be prepared by a suitably qualified and experienced expert, consulted with the EPA and approved by the Secretary within 1 month prior to the commencement	Relevant – no change needed
C43	Soil and water - imported VENM or ENM to be approved by EPA and be accurately recorded	Not relevant
C44	Erosion and sediment control plan to be prepared to the satisfaction of the Secretary and in accordance with Managing Urban Stormwater: Soils and Construction	Relevant – no change needed
C45	Erosion and sediment control plan to be implemented prior to construction or demolition commencing	Relevant – no change needed
C46	Discharge limits - the development must not result in the pollution of waters	Relevant – no change needed
C47	Discharge limits - signs shall be displayed and maintained adjacent to all stormwater drains	Relevant – no change needed
C48	Foreshore management - foreshore and intertidal areas are to be protected	Relevant – no change needed
C49	Bunding - fuels chemical and oils used on sited to be stored in bunded areas	Relevant – no change needed
C50	Water management plan to be updated and implemented, to the satisfaction of the Secretary	Relevant – no change needed
C51	Waste management - waste shall be assessed, classified and managed in accordance with EPA guidelines	Relevant – no change needed
C52	Waste management - waste generated outside the Site shall not be received at the Site unless permitted by a licence under the POEO Act	Not relevant
C53	Waste management - chemical fixation shall be managed in accordance with relevant EPA guidelines	Not relevant

Condition No.	Condition Title and Summary	Relevance to the modification works
C54	Waste management - scheduled chemical waste and polychlorinated biphenyls shall be managed with the applicable Chemical Control Order	Not relevant
C55	Waste management - radioactive waste shall be managed in accordance with relevant EPA guidelines	Not relevant
C56	Waste management - all sampling and waste classification data for the life of the development to be retained in accordance with the requirements of the EPA	Relevant – no change needed
C57	Waste management plan to be updated and implemented to the satisfaction of the Secretary	Relevant – no change needed
C58	Biodiversity management plan to be prepared and implemented to the satisfaction of the Secretary	Relevant - include update regarding modification works
C59	Heritage archival record - archival photographic and documentary recording of the existing fabric to be commissioned	Relevant - update to include archival recording for demolition of additional items
C60	Heritage management plan to be prepared and implemented for ongoing management of heritage items.	Not relevant – complete. As agreed with the Department of Planning and Environment in a letter dated 8 July 2015 and confirmed within the IEA report (2018) “Viva has adequately satisfied all requirements of condition C60”. As the site does not contain archaeological heritage potential, recommend removing condition from development consent.
C61	Unexpected finds protocol - should unexpected archaeological relics be uncovered, works shall cease and OEH Heritage Branch contacted	Relevant – no change needed
C62	Unexpected finds protocol - should Aboriginal objects are uncovered works must stop and the OEH Regional Operation Group contacted	Relevant – no change needed
C63	Lighting - lighting associated with the development shall comply with relevant requirements and not create a nuisance to surrounding properties or roads	Not relevant
C64	Signage - advertising signs shall not be installed without consent of the Secretary	Not relevant
D1	Environmental management strategy shall be prepared and implemented for the development to the satisfaction of the Secretary	Relevant - include update regarding modification works

Condition No.	Condition Title and Summary	Relevance to the modification works
D2	Management plan requirements - management plans required under the consent are to be prepared in accordance with relevant guidelines	Relevant – no change needed
D3	Review and revision of strategies, plans and programs shall be undertaken as required	Relevant – Recommend amending condition to allow for minor amendments without documentation having to be approved by the Secretary. Recommended revision: *… the Applicant shall review, and if necessary revise, the strategies, plans, and programs required under this consent. Any revised strategies, plans, or programs will be provided to the Department alongside a letter detailing the revisions. Where revisions are deemed significant by the Department, the revised documentation will need to be updated to the satisfaction of the Secretary.*
D4	Annual review – review environmental performance	Relevant – no change needed
D5	Incident reporting – notify of incidents within 24 hours	Relevant – no change needed
D6	Incident reporting - report shall be provided within 7 days of the detection of an incident	Relevant – no change needed
D7	Independent environmental audit – conduct audit within a year of the date of this consent, and every 3 years thereafter	Relevant – no change needed
D8	Independent environmental audit – submit a copy of the audit within 3 months of commissioning this audit	Relevant – no change needed
D9	Access to information – make information available on the internet to the satisfaction of the Secretary	Relevant - include update regarding modification works and refer to MR.
Appendix A	Development Plans - Figure 1: Conversion of Existing Infrastructure	Relevant - include update regarding modification works
Appendix A	Development Plans - Figure 2: Excavation, Profiling and Grading Activities	Not relevant
Appendix A	Development Plans - Figure 3: Demolition Phasing	Relevant - include update regarding modification works
Appendix A	Development Plans - Figure 4: Construction Phasing	Not relevant
Appendix B	Consents to be surrendered	Relevant – update to be consistent with letter sent to Department of Planning on 27 April 2016. Consents to include only historical development consents from within the Conversion Project Area.

Condition No.	Condition Title and Summary	Relevance to the modification works
Appendix C	Management and mitigation measures	Relevant - include amended and additional management measures associated with the modification works

17.0 Justification

17.1 Introduction

This chapter provides and evaluation of the proposed modification works and the outcomes of this MR, including a justification for proceeding with the modification works. This chapter also provides:

- An environmental risk assessment (ERA);
- An assessment of the modification works against the principles of Ecologically Sustainable Development (ESD);
- A description of the benefits of the modification works;
- Consideration of the consistency of the modification works with the objects of the *Environmental Planning and Assessment Act 1979* (EP&A Act); and
- The justification for the modification works.

17.2 Environmental Risk Assessment

The following ERA provides an analysis of the environmental risks that have been identified and outlined as part of this MR.

An initial qualitative environmental scoping exercise was completed in **Chapter 7.0 Environmental Scoping Assessment**. This exercise identified the key environmental issues for the modification works, described them and categorised them according to their risk of resulting in a significant impact.

The assessment has confirmed the potential environmental impacts associated with the modification works, proposed mitigation measures for those impacts and potentially significant residual environmental impacts which still exist after the application of the proposed mitigation measures.

This ERA was undertaken using the methodology described below to determine the risk associated with each environmental issue.

The analysis categorised levels of risk for a given event based on the significance of effects (consequences) and the manageability of those effects (likelihood). The measures of likelihood categories and the measures of consequences categories as well as the risk ranking matrix are detailed in **Table 17-1**, **Table 17-2** and **Table 17-3** below.

Table 17-1 Measures of Probability Categories for the ERA

Rank	Likelihood	Description
A	Almost Certain	Happens often and is expected to occur
B	Likely	Could easily happen and would probably occur
C	Possible	Could happen and has occurred elsewhere
D	Unlikely	Unlikely to happen but may occur
E	Rare	Could happen, but only in extreme circumstances

Table 17-2 Measures of Consequence Categories for the ERA

Rank	Consequence	Description
1	Extreme	Permanent and catastrophic impacts on the environment; large impact area; reportable incident to external agency; large fines and prosecution; operational constraints; substantial community concern.
2	Major	Permanent and detrimental impacts on the environment; large impact area; reportable incident to external agency; may result in large fines and prosecution; operational constraints; high level of community concern.
3	Moderate	Substantial temporary or minor long term detrimental impacts on the environment; moderate impact area; reportable incident to external agency; action required by reportable agency; community interested.
4	Minor	Minor detrimental impacts on the environment; small impact area; reportable incident internally; no operational constraints; some local community interest.
5	Low	Nil or temporary impacts on the environment; small or isolated impact area; not reportable incident; no operational constraints; uncontroversial project no community interest.

Table 17-3 Risk Matrix for ERA

		CONSEQUENCES				
		1 Extreme	2 Major	3 Moderate	4 Minor	5 Low
Likelihood	A (Almost Certain)	VH	VH	H	H	M
	B (Likely)	VH	H	H	M	M
	C (Possible)	H	H	M	M	L
	D (Unlikely)	H	M	M	L	L
	E (Rare)	H	M	L	L	L

Risk Matrix is defined as follows: VH = Very High, H = High, M = Medium and L = Low.

Taking into account the location and nature of the modification works, the mitigation measures described in **Chapters 8.0** to **13.0**, the Cumulative Impact Assessment in **Chapter 14.0 Cumulative Impacts** and the commitments provided in **Chapter 15.0 Revised Management and Mitigation Measures**. **Table 17-4** provides an assessment of the mitigated risks associated with the modification works, or the residual risk analysis. This has been completed for each potential environmental impact identified in **Table 17-4** based on the likelihood of occurrence and potential environmental consequence.

Table 17-4 Environmental Risk Analysis

Notes: PL: Potential Likelihood; PC: Potential Consequence; RP: Residual Likelihood; RC: Residual Consequence

Environmental Aspect	Potential Impacts Based on Unmitigated / Inherent Risk	PL	PC	Potential Risk Before Mitigation	Actions / Proposed Mitigation Measures	RL	RC	Residual Risk Post Mitigation
Hazards and Risk (Chapter 8)	Damage to adjacent plant or injury to workers due to uncontrolled or unplanned falling of infrastructure or, object.	D	2	M	Demolition activities would be undertaken by licenced contractors inducted into the terminal. Existing WHS policies, procedures and controls would be maintained including incident reporting and response requirements.	E	2	M
	Contractors may be exposed to contaminated materials potentially resulting in negative health outcomes.	D	3	M	Personnel would be trained in identifying and handling potentially hazardous substances. Relevant safety equipment and appropriate personal protective equipment would be required by all contractors	E	4	L
	The modification works could change the injury and fatality risk profiles of the terminal, potentially increasing risk at surrounding properties	D	2	M	A FHA has been undertaken and identifies that the removal of LPG storage facilities would result in a decrease in the hazard profile of the terminal. Ongoing safety practices at the site would be maintained as required under the Conditions of Consent for SSD 5147.	E	3	L
Air Quality (Chapter 9)	The modification works could potentially generate air quality impacts such as dust, VOC emissions and odour.	C	4	M	The modification works would be undertaken in accordance with the existing Air Quality Management Plan for the Project.	D	5	L
Noise and Vibration (Chapter 10)	The modification works could cause acoustic impacts at identified sensitive receptors.	B	4	M	Working hours and noise limits would be limited to within those specified in the conditions of consent for SSD 5147. Management and mitigation measures implemented for the Conversion Project would continue to apply to the modification works.	D	4	L
Ecology (Chapter 11)	Modification works could increase the spread of noxious weed infestations.	D	4	L	The existing Biodiversity Management Plan would continue to be implemented and include specific measures related to the control of noxious weeds.	E	4	L

Environmental Aspect	Potential Impacts Based on Unmitigated / Inherent Risk	PL	PC	Potential Risk Before Mitigation	Actions / Proposed Mitigation Measures	RL	RC	Residual Risk Post Mitigation
	Clearing of vegetation could result in a decrease in the ecological value of the terminal and remove potential fauna habitat, including habitat of the Grey-headed Flying-fox.	C	3	M	Clearing would be restricted to the area surrounding the State Office Building and would be minimised as far as practicable. Pre clearance surveys would be undertaken prior to clearing to identify the presence of any protected fauna species.	D	4	L
	The modification works could impact upon the Commonwealth listed GGBF or its habitat.	C	2	H	Potential impacts on the GGBF would continue to be managed with the specific measures outlined in the Green and Golden Bell Frog Plan of Management.	E	3	L
Non-Aboriginal Heritage (Chapter 12)	The modification works would have an impact on the state significant value of the Clyde Terminal.	D	4	L	Additional photographic archival recordings would be undertaken of additional components proposed for demolition.	E	4	L
Soil, Water and Contamination (Chapter 12.1)	Potential erosion and sedimentation from ground disturbance associated with demolition activities impacting stormwater quality.	C	3	M	Demolition activities would only be undertaken to grade and would not require excavations. The modification works would be undertaken in accordance with the existing Soils and Water Management Plan which forms part of the DWP for the Conversion Project.	D	4	L
	Modification works could impact on the flood profile of the terminal.	D	4	L	Potential impacts of flooding would continue to be managed through an updated Flood Emergency Management Plan forming part of the DWP for the Conversion Project. The modification works would not involve the removal of any bunded areas on the terminal.	E	4	L
	Potential contamination through leaks and spills from demolition vehicles, plant and equipment.	E	4	L	Demolition equipment would be regularly serviced and maintained to ensure mechanical issues are identified.	E	5	L
	Potential disruption or mobilisation of contamination including ASS and hydrocarbons	C	3	M	Demolition activities would only be undertaken to grade and would not require excavations. The modification works would be undertaken in accordance with the existing Soils and Water Management Plan which forms part of the DWP for the Conversion Project.	D	4	L

Environmental Aspect	Potential Impacts Based on Unmitigated / Inherent Risk	PL	PC	Potential Risk Before Mitigation	Actions / Proposed Mitigation Measures	RL	RC	Residual Risk Post Mitigation
Transport and Access (Chapter 12.2)	Modification works traffic could impact the local road network.	D	5	L	Existing traffic management plan for the Conversion Project would be implemented to manage potential traffic impacts during the modification works.	E	5	L
Waste Management (Chapter 12.3)	The modification works could create additional waste streams that require management	E	4	L	Measures to ensure appropriate waste management during the modification works would be documented within the Demolition Work Plan	E	5	L

17.2.1 Summary of Risk Analysis

The ERA in **Table 17-4** illustrates how the assessments and mitigation measures contained within **Chapters 8.0** to **14.0** have helped understand the proposed modification works and reduce the potential environmental risks. The implementation of the identified mitigation measures in **Chapter 15.0 Revised Management and Mitigation Measures**, and careful management would help avoid and mitigate potential impacts as far as practicable.

It can therefore be concluded that, provided the management and mitigation measures are implemented, remaining residual impacts would be negligible.

17.3 Ecologically Sustainable Development

17.3.1 The Principles

This section provides a review of the modification works, their impacts and associated safeguards against the principles of ESD in accordance with *the Environmental Planning and Assessment Regulation 2000* (EP&A Regulation). The principles, as listed in the clause 7(4) of Schedule 2 of the EP&A Regulation, are as follows:

a. *the **precautionary principle**, namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation*

b. ***inter-generational equity**, namely, that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations*

c. ***conservation of biological diversity and ecological integrity**, namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration*

d. ***improved valuation, pricing and incentive mechanisms**, namely, that environmental factors should be included in the valuation of assets and services*

These principles are discussed below.

17.3.2 Precautionary Principle

The precautionary principle deals with certainty in environmental and technical decision-making. It provides that where there is a threat of serious or irreversible environmental damage, the absence of full scientific certainty should not be used as a reason to postpone measures to prevent environmental degradation.

A modification application undergoes a public process that allows for better examination of the potential effects of proposed activities or development. Thus, the assessment process can be considered as precautionary in nature. The requirement to assess the impacts of the modification works is a form of regulation designed to identify and address uncertainty about the effects of these activities.

Viva Energy has commissioned specialists to conduct detailed assessments on several environmental aspects identified during the Environmental Risk Assessment process as outlined in **Chapter 7.0 Environmental Scoping Assessment**. These assessments provide sufficient scientific understanding of the modification works, their interactions with the surrounding environment and implications they may have to enable a decision to be made that is consistent with this principle. The precautionary principle has driven the development of a number of management and mitigation measures presented within the previous SSDA and this MR.

Modification Objectives

The modification works would be undertaken in a manner that reduces the severity of potential impacts and to reduce likelihood of potential impacts occurring. The modification works would also comply with environmental criteria, community expectations and the development consent, as well as relevant statutory requirements. This is achieved through the effective implementation of the proposed management and mitigation measures.

Modification Works Safeguards

A number of safeguards specific to the modification works would ensure mitigation of impacts would be undertaken in a manner that would satisfy ESD principles. These include:

- **Spatial limits of the modification works area footprint**: the area where the works would be undertaken would not extend beyond the boundary of the Conversion Project Area, aside from some activities associated with waste management and vehicle movements. Mitigation measures to manage these impacts are largely consistent with those that have been developed for the approved conversion works.
- **Updates to and implementation of the existing DWP**: should the modification works be approved, the DWP would be updated to include specific measures for the modification works. The DWP would be implemented throughout the works.

17.3.3 Inter-Generational Equity

Inter-generational equity requires that the present generation pass onto the next generation an environment that does not limit the ability of those future generations to attain a quality of life at least equal to that of the current generation.

Through the implementation of mitigation and management measures for avoiding and minimising short-term or long-term environmental impacts, and the proposed rehabilitation of any disturbed areas, inter-generational social equality impacts have been addressed. Examples of matters that are relevant to the modification works are described below.

Modification Objectives

The modification works would contribute to the conversion of the Site into a safe and efficient finished petroleum products terminal.

Modification Works Safeguards

The proposed modification works would maintain inter-generational equity by ensuring components of the existing bio-physical, social and economic environment available now would also be maintained for future generations. Aspects of the modification works that would assist in achieving inter-generational equity include the following:

- No ecological features would be significantly impacted as a result the modification works;
- Potential risks to the GGBF would be reduced by managing risks through a suite of measures and controls;
- Preservation of the nominated heritage values of the terminal via the implementation of the Heritage Management measures listed in **Table 15-1**;
- Continue the use of the site as a finished petroleum products terminal in a safe manner; and
- Ongoing notification and engagement with the surrounding businesses and community to provide an opportunity to ask questions and identify and manage areas of concern.

17.3.4 Conservation of Biological Diversity and Ecological Integrity

This MR includes an assessment of the ecological impacts of the modification works. The modification works would not cause significant ecological impacts. Measures to further minimise impacts are outlined in the DWP and Green and Golden Bell Frog: Plan of Management for the Conversion Project.

17.3.5 Improved Valuation and Pricing of Environmental Resources

This ESD principle is premised on an assumption that all resources should be appropriately valued and that the value of environmental resources should be considered alongside any economic or cost benefit analysis for the life of the project.

Modification Objectives

The modification works would allow for the continued safe operation of the finished petroleum products terminal at Clyde, thereby allowing the site to operate efficiently into the future.

The value placed by Viva Energy on environmental resources is evident from the extent of site-specific investigations, planning and environmental safeguards and measures that have been undertaken and which would be implemented to prevent damage to the local environment.

17.3.6 Compatibility with the Principles of ESD

The approach taken in undertaking the modification works has been multi-disciplinary. Emphasis has been placed on the avoidance of impacts through careful design as well as management and mitigation measures to minimise potential negative environmental, social and economic impacts, during the modification works. The principles of ESD have been incorporated into the proposed modification works.

17.4 Objects of the Environmental Planning and Assessment Act 1979

Consideration has been given to the consistency of the modification works with the objects of the EP&A Act as outlined below.

a. to promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources

The modification works would allow for the safe and continued use of the terminal in line with existing land use designations. The proposal would support the ongoing use of the terminal for employment purposes and not impact upon areas of significant ecological significance.

b. to facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment

This MR assesses the proposed modification works and identifies the likely impacts on the environment and surrounding community. With management and mitigation measures as outlined in **Chapter 15 Revised Management and Mitigation Measures**, residual impacts on the environment are anticipated to be negligible. The proposed modification works would support the goal of maintaining a safe and efficient finished petroleum product terminal at Clyde, providing a positive economic outcome for NSW.

c. to promote the orderly and economic use and development of land

The *Parramatta Local Environmental Plan 2011* (LEP) provides for the land use and zoning for the terminal and surrounding area. Pursuant to the LEP, the terminal is mainly designated as IN3 Heavy Industrial. The objectives of this zone are:

- To provide suitable areas for those industries that need to be separated from other land uses;
- To encourage employment opportunities;
- To minimise any adverse effect of heavy industry on other land uses;
- To support and protect industrial land for industrial uses;
- To allow a wide range of industrial and heavy industrial uses serving the Greater Metropolitan Area of Sydney and beyond; and
- To ensure that opportunities are not lost for realising potential foreshore access on land that is contaminated and currently not suitable for public access.

The modification works would support the existing and permissible land use at the site by ensuring that the terminal would continue to be used as a finished petroleum products terminal, which is permissible under the land zones in the LEP and therefore is in line with orderly and economic use and development of land.

d. to promote the delivery and maintenance of affordable housing

The modification works would not affect the provision or maintenance of affordable housing.

e. ***to protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats***

The mitigation measures outlined within this MR, would allow for the protection of the environment, including the protection and conservation of native animals and plants, threatened species, populations and ecological communities, and their habitats.

Specific measures to prevent impacts upon the GGBF would remain in line with existing practices at the terminal. With measures implemented, additional impacts on the GGBFare not anticipated.

f. ***to promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage)***

The modification works support the sustainable management of built and cultural heritage. While modification works would have a minor negative impact on the heritage significance of the terminal, the retention of components proposed for demolition is not considered viable due to financial and political reasons. The modification works would support the objective of the site remaining as an efficient finished petroleum products terminal

g. ***to promote good design and amenity of the built environment***

The proposed modification works would not result in a change in use of the site which would continue to operate as a finished petroleum products terminal.

h. ***to promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants***

The modification works would not involve the construction or maintenance of any buildings.

i. ***to promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the State***

The modification works is to be assessed as modification to a State Significant Development under Part 4 of the EP&A Act by the Department of Planning and Environment (DPE). Ongoing consultation has occurred with Parramatta City Council regarding the conversion of the Clyde Refinery and would continue through the implementation of the modification works.

j. ***to provide increased opportunity for community participation in environmental planning and assessment.***

Viva Energy has an existing relationship with local businesses and the community and has existing, established communication pathways including the terminal website, phone lines and letterbox updates. Viva Energy has consulted with the local community and local businesses regarding the Conversion Project as documented in the EIS. Consultation with the community with respect to the modification works would continue in line with existing communication pathways.

17.5 Project Justification

The modification works would support the objectives of the Conversion Project through allowing Viva Energy to operate an effective and efficient finished petroleum products terminal, improve environmental performance and safety along with better serving the NSW economy.

Maintaining redundant infrastructure would require ongoing maintenance which would have an associated cost. Maintaining infrastructure which serves no purpose would not be in line with the objective of the Conversion Project as it would affect the efficiency of the terminal and could potentially impact worker safety.

The retention of two tanks originally proposed for demolition under the Conversion Project is also proposed. The retention of additional tanks would improve operational flexibility thereby allowing the terminal to operate more efficiently.

This MR provides a comprehensive assessment of the modification works and includes investigations regarding all relevant environmental issues.

Potential impacts have been assessed and strategies to avoid, minimise and mitigate those impacts form a key part of the MR. The MR includes a number of commitments to manage environmental impacts during the modification works, which are largely consistent with the measures already in place for the Conversion Project.

This MR has concluded that the modification works should proceed because they would:

- Result in no long term adverse impacts to the environment or local community;
- Ensure the primary objectives of the Conversion Project continue to be achieved; and
- Satisfy the principles of Ecologically Sustainable Development as described in the EP&A Regulation.

This MR has highlighted a range of issues which would be addressed through the careful undertaking of the modification works.

On the basis of the findings detailed within this Modification Report, the modification works are considered to be justified.

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Appendix A

Final Hazard Analysis

CLYDE TERMINAL CONVERSION PROJECT

CLYDE SITE

FINAL HAZARD ANALYSIS

VIVA ENERGY AUSTRALIA LTD

PREPARED FOR:	**Julie Seymour**

DOCUMENT NO:	**20874-RP-002**
REVISION:	**4**
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DOCUMENT REVISION RECORD

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1	20-12-17	Updated with revised vapour cloud modelling, tank layout and updates for consistency with the Fire Safety Study	M. Braid P. Johnson	G. Peach	G. Peach	Email PDF
2	26-03-18	Updated Section 3.2 with comments around T53 allocation and export configuration for gasoline	M. Braid P. Johnson	G. Peach	G. Peach	Email PDF
3	18-09-18	Updated for removal of Butane facilities and T106	P. Johnson	G. Peach	G. Peach	Email PDF
4	10-10-18	Updated with AECOM comments	M. Braid	G. Peach	G. Peach	Email PDF

Title: **Clyde Terminal Conversion Project** **Clyde Site** **Final Hazard Analysis**	**QA verified:** N. Benova **Date: 10-10-2018**

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ABBREVIATIONS

ALARP	As Low As Reasonably Practicable
AS	Standards Australia
BLEVE	Boiling Liquid Expanding Vapour Explosion
BoM	Bureau of Meteorology
CBD	Central Business District
DA	Development Application
DC	Development Consent
DEP	Design and Engineering Practice
DG	Dangerous Goods
DGR	Director Generals requirements
DPE	NSW Department of Planning and Environment
EFV	Excess Flow Valve
EIS	Environmental Impact Statement
ERP	Emergency Response Plan
EST	End State Terminal
FABIG	Fire and Blast Information Group
FHA	Final Hazard Analysis
FRAED	Failure Rate and Event Data
g/mol	grams per mole
HAZID	Hazard Identification
HEMP	Hazard & Effects Management Process
HIPAP	Hazardous Industry Planning Advisory Paper
HSE	Health and Safety Executive
HSL	Health and Safety Laboratory
ITO	'Interim' Terminal Operation
JUHI	Joint User Hydrant Installation
kg/s	kilograms per second
km	kilometres
kPa	kilo-Pascals
kW/m^2	kilo-watts per square metre
LEP	Local Environment Plan
LFL	Lower Flammability Level
LOPA	Layer of Protection Analysis
LUIIP	Land Use and Infrastructure Implementation Plan
LUSS	Land Use Safety Study
m	metres
m/s	metres per second

m^2	square metres
MA	Major Accident
mg/m^3	milligrams per cubic metre
MHF	Major Hazard Facility
min.	minutes
mm	Millimetres
OREDA	Offshore Reliability Data
pa	per annum
PFD_{avg}	Average Probability of Failure on Demand
PHA	Preliminary Hazard Analysis
pmpy	per million per year
ppm	parts per million
QRA	Quantitative Risk Assessment
SEP	Surface Emissive Power
SEPP	State Environmental Planning Policy
SIF	Safety Instrumented Function
SIL	Safety Integrity Level
SSD	State Significant Development
TF	Tankfarm
UK	United Kingdom
ULP	Unleaded Gasoline
VCA	Vapour Cloud Assessment
VCE	Vapour Cloud Explosion

1. SUMMARY

1.1. Introduction

Viva Energy Australia Ltd (Viva Energy) has converted Clyde Refinery to a finished products storage terminal with no production or processing facilities (the Conversion Project). The scope of the Conversion Project is limited to the changes specified in the Environmental Impact Statement (EIS) for SSD 5147 and does not extend to the import pipeline or export pipelines that continue to operate without change to the assets or operation of them. The Gore Bay Terminal is also outside the scope of the Conversion Project.

Motor gasoline (gasoline), diesel and jet fuel is imported to the Clyde Terminal via pipeline. Pigging facilities for the pipelines are located north of the pump house No. 2 building. Product export is via pipeline to the adjacent Parramatta Terminal, or via the Hunter pipeline to Newcastle or Joint User Hydrant Installation (JUHI) pipeline to Sydney Airport.

Sherpa Consulting Pty Ltd (Sherpa) was retained to prepare a Preliminary Hazard Analysis (PHA) for the proposed Terminal at the Clyde Refinery site to determine whether it was 'hazardous' and/or 'offensive' in the context of NSW State Environmental Planning Policy No. 33 (SEPP 33 - Ref. 1).

This document is the Final Hazard Analysis (FHA), which is an update of the PHA to incorporate details that were not available when the PHA was submitted to the NSW Department of Planning and Environment (DPE) in support of Development Application (DA) No. SSD 5147.

Since the PHA was submitted, The Shell Company of Australia Ltd (Shell) was purchased by Vitol, resulting in a change of name to Viva Energy. In this document, there are instances where the operating company is referred to as Shell, e.g. by DPE when commenting on the PHA, and to describe key processes. These references have not been changed due to one or more of the following reasons:

- when the comments were made in the PHA, the operating company was Shell
- the processes attributed to Shell are still in use by Viva Energy
- the text describes activities that were carried out when the operating company was Shell.

1.2. Process

The DPE multi-level risk assessment guideline (Ref. 2) was consulted to identify the most appropriate level of risk assessment.

This FHA is based on a Level 3 Risk Assessment where the results are sufficiently quantified to allow an assessment of the offsite risk levels against acceptance criteria.

The risk assessment process and risk acceptance criteria set out in Hazardous Industry Planning Advisory Paper (HIPAP) 6 (Ref. 3) and HIPAP 4 (Ref. 4) were followed.

1.3. Revision history

The initial PHA was submitted to DPE in August 2012, and comments were received on 14 September 2012. As part of the commenting process, Shell met with DPE to review the comments and agree close-out actions.

The updated PHA was provided to DPE in January 2013, and an additional set of comments were generated by DPE in November 2013. Shell responded to the comments and then met with DPE to discuss and agree close-out actions in August 2014.

All comments and responses are provided in APPENDIX E and the FHA Rev 0 incorporated all the agreed close-out actions.

Changes were made for Rev 1 of the FHA, under three categories described below, and further described in the following sections.

- Modelling software
- Update to the hazard identification word table
- Refinements to the design.

Minor changes were made for Rev 2 regarding Tank 53 contents, including text notes on Table 3.2 and minor updates to Section 3.2.3.

The Butane facilities and Tank 106 were removed for Rev 3 of the FHA.

Additional comments provided by AECOM Australia Pty Ltd (AECOM) were minor in nature with no impact on the results or conclusions of the FHA. These were included in the update to Rev 4.

1.3.1. Modelling software

The DPE, in partnership with Parramatta City Council, has developed a Land Use and Infrastructure Implementation Plan (LUIIP) for the Camellia Precinct and subsequent rezoning proposal. For this project, a Land Use Safety Study (LUSS) was conducted for the Camellia precinct, which took the FHA Revision 0 model, and converted it from Shell Shepherd software to TNO RiskCurves. During this conversion, modelling changes have been made. It has been decided that Shell Shepherd should no longer be used by Viva Energy, and therefore the LUSS model has been used from Revision 1 of this FHA.

1.3.2. Hazard identification

The hazard identification word table was extracted from the latest version of the Fire Safety Study (Ref. 5).

1.3.3. Refinements to the design

The design of the Clyde Terminal has matured since Revision 0 of the FHA. Changes include:

- change to the diesel tankage
- modelling of the 'worst case' tank arrangement
- finalisation of the Safety Integrity Level (SIL) of the overfill protection after verification activities
- adjustment of the site boundary
- removal of Butane facilities and Tank 106.

1.4. Findings

The hazards inherent to the Clyde Terminal include flammable liquids in bulk storage (i.e. gasoline, jet fuel, and diesel). Loss of containment scenarios include leaks from pipework, fittings and pumps, overfill of and leaks from atmospheric tanks.

The following scenarios have the potential for off-site impact, i.e. thermal radiation from fire of 4.7 kW/m^2 or greater, or vapour concentration above the lower flammable limit:

- Tank roof fire: Tank 90
- Tank overfill cascade leading to flash fire/vapour cloud explosion: all gasoline tanks
- Tank bund fires: Tank Farm B, Tank Farm B1, Tank Farm B2, Tank Farm K, Slops Tank Farm 103/4/5, Slops Tank Farm 91/92 and ULP delivery pump pit
- Pipe track pool fires
- Pipe track leaks leading to flash fire/vapour cloud explosion.

1.5. Conclusions

The hazards associated with the development were identified and the risks (even when conservatively assessed) have been found to be below the NSW Land-use Planning Risk Tolerability Criteria set by DPE.

Conclusions from the risk assessments results are summarised below.

Individual fatality risk: As shown in Figure 9.2, the 50 x 10^{-6} /year contour (target to be retained onsite) marginally extends beyond the site boundary into the Parramatta Terminal as the risk contour goes offsite by approximately 10 m. However, Parramatta Terminal is operated by Viva Energy and hence the sites are under a single ownership. The part of the site that is impacted would only have an occasional presence of people and the contour does not reach buildings, muster points or populated areas. There is a joint Emergency Response Plan (ERP) in place and Parramatta Terminal would be notified of emergencies at Clyde.

The individual fatality risk conclusion has changed since the Rev 0 report as the boundary with SUEZ to the east of Tank 90 has been moved to reflect the location at End State. This has created a buffer zone around the Tank 90 bund to retain the 50 x 10^{-6}/year individual fatality risk contour on site.

- Individual injury risk: The injury risk level does not impact residential development at frequencies of more than 50 x 10^{-6} /year, as shown in Table 9.3.
- Accident propagation/escalation risk: As shown in Table 9.4, the 50 x 10^{-6} /year contour remains within the site boundary.

In the context of SEPP 33, the facility is therefore considered:

- ‘potentially hazardous’ (rather than ‘hazardous’); and
- ‘potentially offensive’ (rather than ‘offensive’).

Viva Energy has in place systems for ensuring that the risk posed by the proposed facility is minimised during design and for managing the residual risk associated with the facility when in operation. The status of related studies is reported in Table 1.1.

Table 1.1: Risk management activities

Activity	Status
Hazard Identification	Complete – latest version reported in this document
Preliminary Hazard Analysis	Complete
Hazard & Operability Study	Complete
Fire Safety Study	Complete
Final Hazard Analysis	Complete – reported in this document
Emergency Plan Review	Complete – emergency response plan submitted for approval
Construction Safety Study	Complete
Safety Management System Update	Complete

2. INTRODUCTION

2.1. Clyde Terminal background

The Clyde Terminal receives, stores and distributes finished petroleum products. The terminal is owned and operated by Viva Energy. It is located at the confluence of Parramatta and Duck Rivers, 16 km west of Sydney's CBD, within the Camellia Peninsula industrial area at 9 Devon Street, Rosehill.

The 'Interim' Terminal Operation (ITO) was established with the cessation of manufacturing at the Clyde Refinery in late 2012 and the subsequent decommissioning of the processing plants. The refinery process areas and some tank farms were decommissioned, and the ITO continued to use existing assets (various tankfarms, support areas and administration buildings) to operate as an import terminal facility for the receipt, storage and distribution of finished petroleum products.

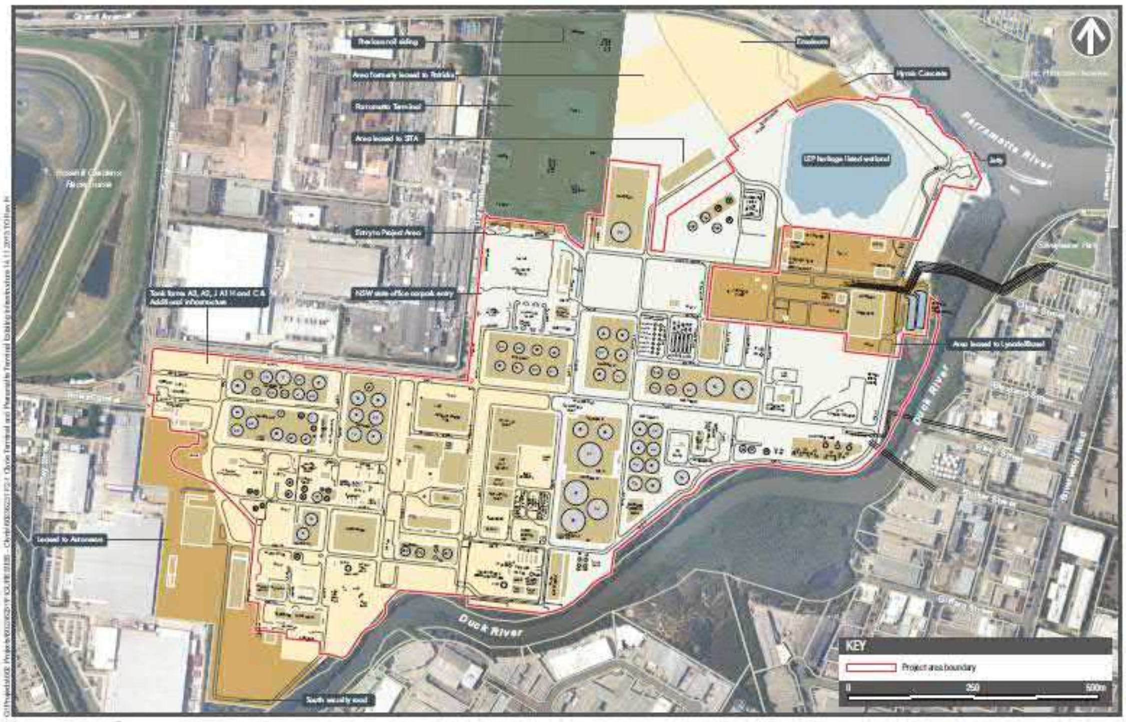
The following finished petroleum products are stored in ITO:

- Gasoline (Unleaded 91, 95 and 98)
- AGO (Diesel)
- Jet fuel.

In addition to these products, small quantities of chemicals and oils that are used for wastewater treatment, site maintenance, and as lubricants for operating equipment are also stored.

The boundaries of the Site and the configuration of the ITO prior to the works commencing are depicted in Figure 2.1.

Figure 2.1: Clyde Terminal development boundary and ITO configuration prior to the Works



CLYDE TERMINAL AND PARRAMATTA TERMINAL EXISTING INFRASTRUCTURE
Clyde Terminal Conversion Project
Environmental Impact Statement

2.2. The development

On 14 January 2015, the Planning Assessment Commission of NSW (as delegate of the Minister for Planning) approved the State Significant Development (SSD) application for the Clyde Terminal Conversion Project. The Development Consent (DC) is located on the DPE website[1].

The main objectives of the Clyde Terminal Conversion Project are:

- To improve the efficiency of the Clyde Terminal by upgrading existing facilities and structures.
- To improve environmental and safety performance of the Clyde Terminal while continuing to operate as a viable and efficient finished petroleum product receipt storage and distribution terminal.

The Works associated with the DC include the demolition of existing surplus assets and redundant manufacturing infrastructure, and the conversion of a number of remaining assets within the Clyde Terminal to more efficiently receive, undertake product dosing

1 Website URL: https://majorprojects.affinitylive.com/public/0a0961c16ac6514883e191e4e827ffdc/Signed%20Development%20Consent.pdf

activities, store and distribute solely imported finished petroleum products. In addition to retaining assets, the Conversion Project proposes to reuse tanks, pipework, pumps and associated assets where reasonably practicable. No new product tanks are to be constructed.

Upon completion of construction and demolition activities, the site configuration depicted in Appendix A of the Development Consent (reproduced in Figure 2.2), will be in place with the resulting operations known as 'end-state terminal' or EST. The ITO and EST terminology is used in the EIS, the Development Consent and this document to differentiate between terminal operations before (ITO) and after (EST) the Works are executed.

Figure 2.2: Clyde Terminal EST site configuration

2.3. Study objectives

HIPAP 6 defines the objective of a hazard analysis *'is to develop a comprehensive understanding of the hazards and risks associated with an operation or facility and the adequacy of the safeguards.'*

This objective is achieved by:

- Conducting a suitable level of assessment for the proposed Clyde Terminal with reference to the Multi-level Risk Assessment guide and HIPAP 6.
- Validating the level of risk assessment chosen based on the findings of the hazard analysis.

- Assessing the proposed development against the DPE Land-use Safety Planning Risk Criteria.
- Determining if the proposed facility is 'hazardous' and/or 'offensive' in the context of SEPP 33.

2.4. Scope

The scope of this study includes the Clyde Terminal; specifically:

- Atmospheric product (gasoline, jet fuel, diesel) storage tanks and bunds.
- Product pumps (Pump house 2 Area) and pigging facilities.
- Pipework at the site, used to transport liquids.
- Pipelines for product import/export within the site boundary.

2.5. Report overview

This report follows the methodology described in Applying SEPP 33, Multi-level Risk Assessment (Ref. 2) and HIPAP No. 6 Guidelines for Hazard Analysis (Ref. 3).

The process assesses the potential impact of the facility on the surrounding area and can be summarised as follows:

- Description of proposed development.
- Hazard Identification (HAZID).
- Selection of an appropriate level of assessment.
- Analysis of the consequences of a hazard, should it be realised.
- Analysis of the frequency of hazards occurring, noting that the depth of analysis will be dependent on the results of the consequence analysis.
- Calculation of overall risk results.
- Comparison of risk results against NSW Land-use Planning risk tolerability criteria.
- Discussion of risk management approach.
- Discussion and conclusion on risk levels.

Each stage of the process is reported in this FHA report. Detailed calculations are contained within the relevant section of this report. The intention is to provide sufficient detail in the report to allow an objective assessment of the risk.

In addition to the above, the Director General's Requirements (DGRs), (Ref. 6), for SSD 5147 contained the following specific item:

- Address all relevant recommendations arising from the Buncefield incident.

2.6. Limitations

The following limitations apply to this study:

- This study evaluates the immediate (acute) effects to people and asset from the consequences of loss of containment scenarios only. Potential human health effects are covered in the human health risk assessment detailed in the EIS. Potential biophysical environmental effects from a loss of containment are addressed in the ecological assessment shown separately in the EIS (Section 4.2.3 of Volume 2, Appendix D of the EIS).

2.7. Assumptions

The following assumptions have been made in preparing this study:

- Pipe connection failures were modelled as 50 mm release sizes with leak frequency assumed to be one order of magnitude lower than instrument fittings.
- Pump seal leaks were modelled as 10 mm release sizes.
- Pump casing failures were modelled as full-bore release at the pipe flow rate.
- Jet fuel (kerosene) is not capable of generating flammable vapour clouds; it will be handled at ambient conditions.
- Bunds for dangerous goods storage tanks comply with Australian Standard AS1940 (by equivalent level of safety) and hence are assumed to have sufficient integrity to withstand a sudden loss of containment from a tank.

3. FACILITY DESCRIPTION

3.1. The development

The Works include the construction and demolition activities approved by the Development Consent (DC). The construction and commissioning of Works will be progressed on a system by system basis in accordance with the construction schedule. The Clyde Terminal will continue to operate throughout the duration of the Works with operational interruptions due to construction and/or commissioning activities minimised to the extent possible. The interface between the ongoing operations and construction/demolition activities is managed in accordance with the project Construction and Demolition Safety Study.

On completion of the construction Works, current terminal operations assets located in the western area of the site (such as diesel and jet storage and fire water systems) will no longer be required and will be decommissioned and demolished.

The DC places time limits upon the execution of the Works (construction and demolition) and requires that from the date of the consent (14 January 2015):

- construction shall not extend beyond four years
- demolition shall not extend beyond ten years.

Table 3.1 shows the terminal configuration and activities from development consent to EST.

Table 3.1: Development activities

Time	Configuration/Activities
Years 1 to 4 (2015 – 2018)	Interim Terminal Operation (refer to Section 2.1) Construction in progress during this period with a number of tanks taken in and out of service to facilitate construction works.
Years 5 to 10 (2019 – 2025)	Figure 3.1 shows the expected tank configuration during the time period between the completion of construction activities (required by January 2019) and completion of demolition activities (required by January 2025). Tanks in service in the EST tank configuration are shown plus a number of tanks that (whilst ultimately nominated for demolition) are expected to remain operational during this period. These include: • T40 and T41 in Tankfarm E1; • T1704 in Tankfarm E2; • T105 in the Slops Tankfarm.
Configuration at conclusion of Works	End State Terminal Tanks in service at the conclusion of Works (demolition and construction) are shown in Figure 2.2. This is the Site configuration depicted in Appendix A of the Development Consent[(a)].
(a) From Rev 2 of this FHA, Tanks 78 and 79 were included in place of Tank 32. This modification was agreed with DPE.	

As the Development involves the substantial modification of an existing facility, this FHA is based upon the 'worst case scenario' as required by HIPAP 2. As noted above, this is a combination of the EST tank configuration **plus** the additional gasoline tanks (T40/T41) and slops tanks (T105/T1704[2]) which are expected to be in use in Years 5 to 10.

It should be noted that whilst the above configuration has been used for completeness in this FHA, Viva Energy is at all times required to stay within the DC 'Limits of Consent'; it is this limit that ultimately determines the tanks in service at any particular time.

3.2. Facility description

3.2.1. Product import

Motor gasoline, diesel and jet fuel will be delivered via pipeline from the Gore Bay terminal at a nominal flow rate of 1000 m^3/h. Gasoline and diesel may also be imported via the Hunter pipeline, but this would not be a normal mode of operation. Site emergency access points are shown in Figure 3.4.

3.2.2. Product storage

The following finished petroleum products will be stored at the Clyde Terminal:

- Gasoline (Unleaded 91, 95 and 98)
- AGO (Diesel)
- Jet fuel.

In addition to these products, the Clyde Terminal will continue to store small quantities of chemicals and oils that are used for fuel dosing, wastewater treatment, site maintenance, and as lubricants for operating equipment.

Storage of liquid fuels will be in 19 tanks, which are either refurbished existing tanks, or newly constructed tanks[3]. An additional 7 existing tanks will be used for storage of slops or containment of pipeline relief fluid from the Gore Bay pipeline. Other tanks will be decommissioned. Table 3.2 summarises the dimensions and the volumes for each of the tanks to be used for the 'worst case scenario', i.e. EST, plus Tanks 40, 41, 1704, and 105. Figure 3.1 shows the 'worst case' configuration tank layout.

All refurbished tanks were previously used to store hydrocarbon material. Floating roof tanks used for jet fuel storage will be provided with new geodesic domes.

[2] T1704 in Tankfarm E2 will mainly be operated as the Gore Bay Pipeline relief valve discharge tank. The tank will have a diesel heel, however during T82 outages, it may be used as a back-up interface slops tank. Therefore, consistent with T82, the content is described as 'slops'.

[3] T78 and T79 will be newly constructed.

Table 3.2: Storage tank capacities

Tank Farm	Tank No.	Diameter (m)	Height (m)	Tank roof type[b]	Product	Volume (m^3)	Bund volume[a]
K	90	39	22	EFR	Gasoline	21,410	30,000
E1	36	24.4	16.5	EFR	Gasoline	6,150	15,600
	37	24.4	16.5	EFR	Gasoline	5,830	
	38	24.4	16.5	EFR	Gasoline	5,920	
	39	24.4	16.5	EFR	Gasoline	6,130	
	40	24.4	16.5	EFR	Gasoline	6,100	
	41	24.4	16.5	EFR	Gasoline	6,140	
B	50	34	22	EFR	Gasoline	17,020	40,500
	51	49	22	EFR	Diesel	35,640	
	53[e]	34	22	EFR	Gasoline	17,130	
B1	34	39	18	EFR (GD)	Jet fuel	11,105	23,800
	35	44	18	EFR (GD)	Jet fuel	23,240	
	42	44	18	EFR (GD)	Jet fuel	23,540	
E2	82	17	13	EFR	Slops	2,100	27,700
	84	24	22	CR (FP)	Gasoline	8,090	
	86	39	22	EFR	Gasoline	23,570	
	87	39	22	EFR	Gasoline	23,200	
	1704	19	15	CR (FP)	Slops(c)	3,200	
B2	78	32	19.7	CR	Diesel	15,100[d]	21,500
	79	32	19.7	CR	Diesel	15,100[d]	
	33	36	16	CR	Diesel	14,670	
91/92	91	6.1	6.1	CR	Slops	179	440
	92	6.1	6.1	CR	Slops	179	
Green tanks	103	7.6	5.5	CR	Slops	208	640
	104	6.1	7.6	CR	Slops	208	
	105	7.6	5.5	CR	Slops	208	

Notes:

(a) Viva Energy, (Ref. 7, 8)

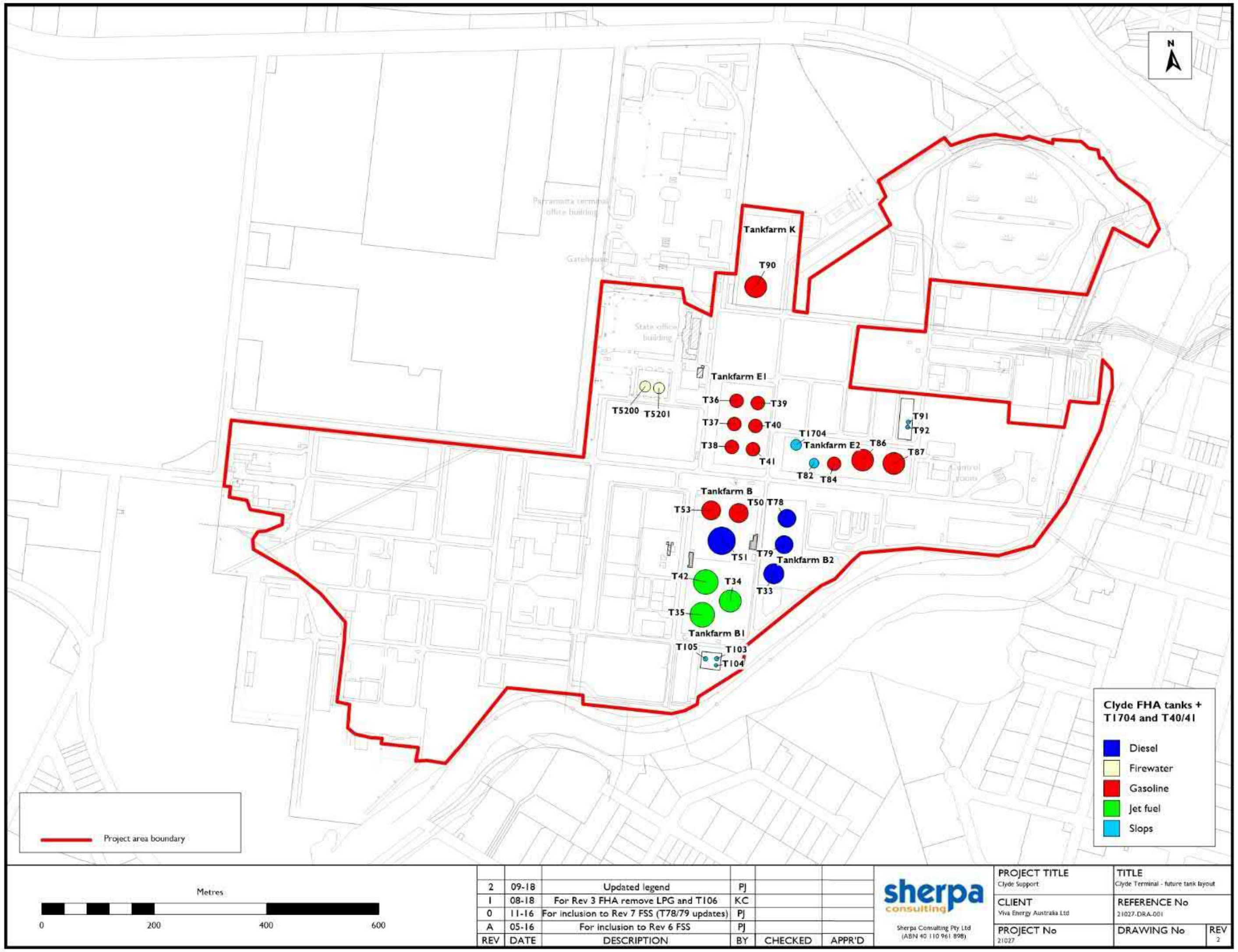
(b) EFR = External floating roof, CR = Cone roof, GD = Geodesic dome, CR (FP)= cone roof with internal floating pan

(c) T1704 in Tankfarm E2 will mainly be operated as the Gore Bay Pipeline relief valve discharge tank. The tank will have a diesel heel, however during T82 outages, it may be used as a back-up interface slops tank. Therefore, consistent with T82, the content is described as 'slops'.

(d) Nominal design capacity from Saunders Drawing: 2103B-GA-Rev 0.

(e) The product in T53 is scheduled to change from Gasoline to Jet. However, in the FHA, Gasoline is retained as a 'worst case'.

Figure 3.1: Clyde Terminal - Basis for Fire Safety Study (EST tanks with T40/T41, T105 and T1704)



Some new pumps may be purchased where existing pumps cannot be used. The main location for liquid fuel pumps will be in the pump house 2 area, where the following pumps will be located: P342, P353, P354, P355, P356, P357, P362, P367, P368, P369 and P5155A/B. Other pumps will be located at the pipetrack south of Tanks T86/T87 (gasoline), west of T90 (gasoline), between Tankfarms B and B1 to the west (jet fuel) and east (diesel). The site will also contain jet fuel and gasoline filters.

3.2.3. Product export

The Clyde Terminal provides bulk supply of Jet fuel via a direct pipeline to Sydney Airport, and fuel supply via the Hunter and Silverwater pipelines.

Fuels will be exported from the terminal as follows:

- Motor gasoline (U91/U95/U98) will be exported through to the loading gantry at Parramatta terminal by pumps P5030A/B located adjacent to Tankfarm K for U91, as well as P368/P369 when pumping U91 out of T86/T87/T50. Gasoline U95 is exported by pumps P5024A/B located adjacent to Tankfarm E2, when pumping out of T39/T40/T41. Gasoline U98 is exported by pumps P353/P354 located in PH2, when pumping out of T36/T37/T38/T84. It is also possible to export via the Hunter pipeline, but this is not a frequent operation.
- Jet fuel will be exported to the Joint Users Hydrant Installation (JUHI) facility at Sydney Airport and Parramatta Terminal via pumps P5204/5/6[4] located adjacent to Tankfarm B and B1.
- Diesel will be exported through pumps P5201/2/3 adjacent to Tankfarm B[5] prior to loading at Parramatta terminal. It is also possible to export via the Hunter pipeline (using the recirculation pump P5200) and there is a connection to the Silverwater pipeline. Export via the Hunter pipeline is not a normal operation. The Silverwater pipeline is currently not used and is scheduled for demolition.

Jet fuel filters are provided by the jet fuel pumps and gasoline filters are provided adjacent to P5030A/B. The filters are used to ensure product quality.

Intelligent pigging will be carried out for pipeline integrity checking approximately once every 5 years. Pigging facilities for the Gore Bay pipeline are located north of pump house 2. The location of the new JUHI pipeline pig launcher will be on the corner of road 15 and 2.

The location of the control room, referred to as the Movements Control Room, is approximately 70 m east of Tank 87.

[4] Also in this location is P5207, but this is a recirculation pump.

[5] Also in this location is P5200, but this is a recirculation pump.

3.2.4. Employment and operating hours

The Clyde Terminal will operate 24 hours per day, 7 days per week. Hours of work will be in accordance with Development Consent conditions, as shown in Table 3.3. Exceptions to this are as listed in C23 of the Development Consent.

Table 3.3: Hours of work

Activity	Product	Time
Construction and demolition	Monday - Friday Saturday	7 am to 6 pm 8 am to 5 pm
Operation	Monday - Sunday	24 hours/day

It is estimated that there will be approximately 30 to 50 people employed at the Clyde Terminal at the conclusion of the Works, performing operational, maintenance and/or administration roles. Additional people will also be present on site to perform specialist contracted activities.

Operational staffing levels (not including Parramatta Terminal staff) are not anticipated to be less than three people during day shift and two people during night shift.

3.3. Land zoning for Clyde Terminal and surrounding land

The Camellia Precinct is defined as the area bound by Parramatta River to the north, Duck River to the east, the M4 Motorway to the south and James Ruse Drive to the west. It is made up of the suburb of Camellia and parts of Rosehill and Clyde. The precinct is predominantly zoned IN3 (Heavy Industrial) and RE2 (Private Recreation), but also includes small sections which are zoned B5 (Business Development) and IN1 (General Industrial) under the provisions of the Parramatta Local Environmental Plan 2011.

The current land zoning is presented in Figure 3.2. The Terminal is situated on land zoned as Heavy Industrial. There are two areas to the west zoned as 'Private Recreation' which are occupied by Rosehill Racecourse and Sydney Speedway.

The NSW Government has identified Camellia Precinct as a Priority Revitalisation Precinct of the Greater Parramatta to Olympic Peninsula Priority Growth Area in *A Plan for Growing Sydney* (Ref. 9). Developing a Land Use and Infrastructure Strategy for the Camellia Precinct to underpin the future redevelopment of the area was identified as a priority for the NSW Government.

The DPE and Parramatta City Council prepared a Land Use and Infrastructure Strategy to guide the future redevelopment of the precinct, building on Parramatta Council's 2014 Discussion Paper titled *Camellia – 21st Century Business, Industry and Entertainment Precinct* (Ref. 10).

The current status of the NSW government's plans for Camellia can be found at http://www.planning.nsw.gov.au/camellia which advises:

- DPE is currently reviewing submissions made during the public exhibition of the Land Use and Infrastructure Strategy which closed on 18 September 2015.
- a more detailed rezoning proposal is being prepared which will be informed by further technical studies that will look at the infrastructure needed to support local transport and access, open space, community facilities and public amenity improvements.

3.4. Facilities adjacent to Clyde Terminal

Viva Energy currently owns land covering several Deposited Plans, and currently leases land to others. Adjacent facilities are shown in Figure 3.3 and described in Table 3.4.

Table 3.4: Adjacent facilities/operations

Facility Description	Land Ownership	Operational Control
SUEZ Resource Recovery and Treatment Facility	Viva Energy land leased to SITA Australia Pty Ltd	SITA Australia Pty Ltd (conducting business as SUEZ Recycling & Recovery).
AutoNexus (vehicle logistics and fleet services)	Viva Energy land leased to AutoNexus Pty Ltd	AutoNexus Pty Ltd.
LyondellBasell (polypropylene manufacturing plant – now decommissioned)	Viva Energy land leased to LyondellBasell Australia Pty Ltd	Under LyondellBasell Australia Pty Ltd operational control for leased land. Access to leased land via Clyde Terminal roads (under Viva Energy operational control).
Parramatta Terminal (bulk liquid fuel distribution and warehouse facility)	Viva Energy	Unincorporated joint venture arrangement with BP Australia under Viva Energy management/operational control.

3.5. Land surplus to EST operational needs

The asset configuration of the End State Terminal (EST) occupies a smaller land area compared with that used during refinery operations. At this revision (Rev 4), Viva Energy advised that no decision had been taken as to the future of land that (upon project completion) would be surplus to operational needs.

Viva Energy has provided an estimate of the area that would be required to support the end state terminal operational needs relative to the total land holding in Figure 3.4. It should be noted that this is indicative only and does not represent the future boundaries of the site.

Figure 3.2: Camellia Precinct - current land use (Ref. 10)

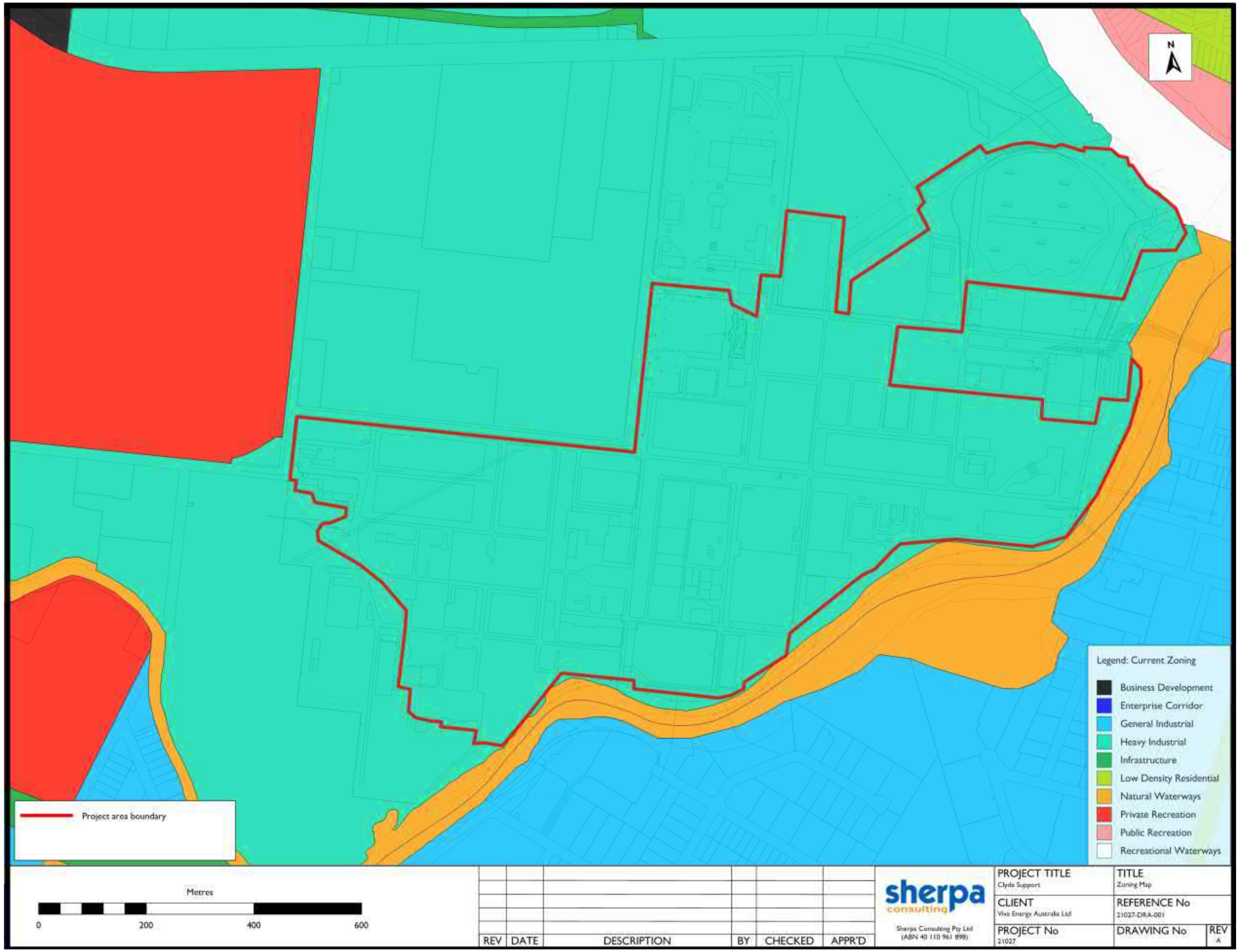


Figure 3.3: Clyde Terminal - Adjacent facilities

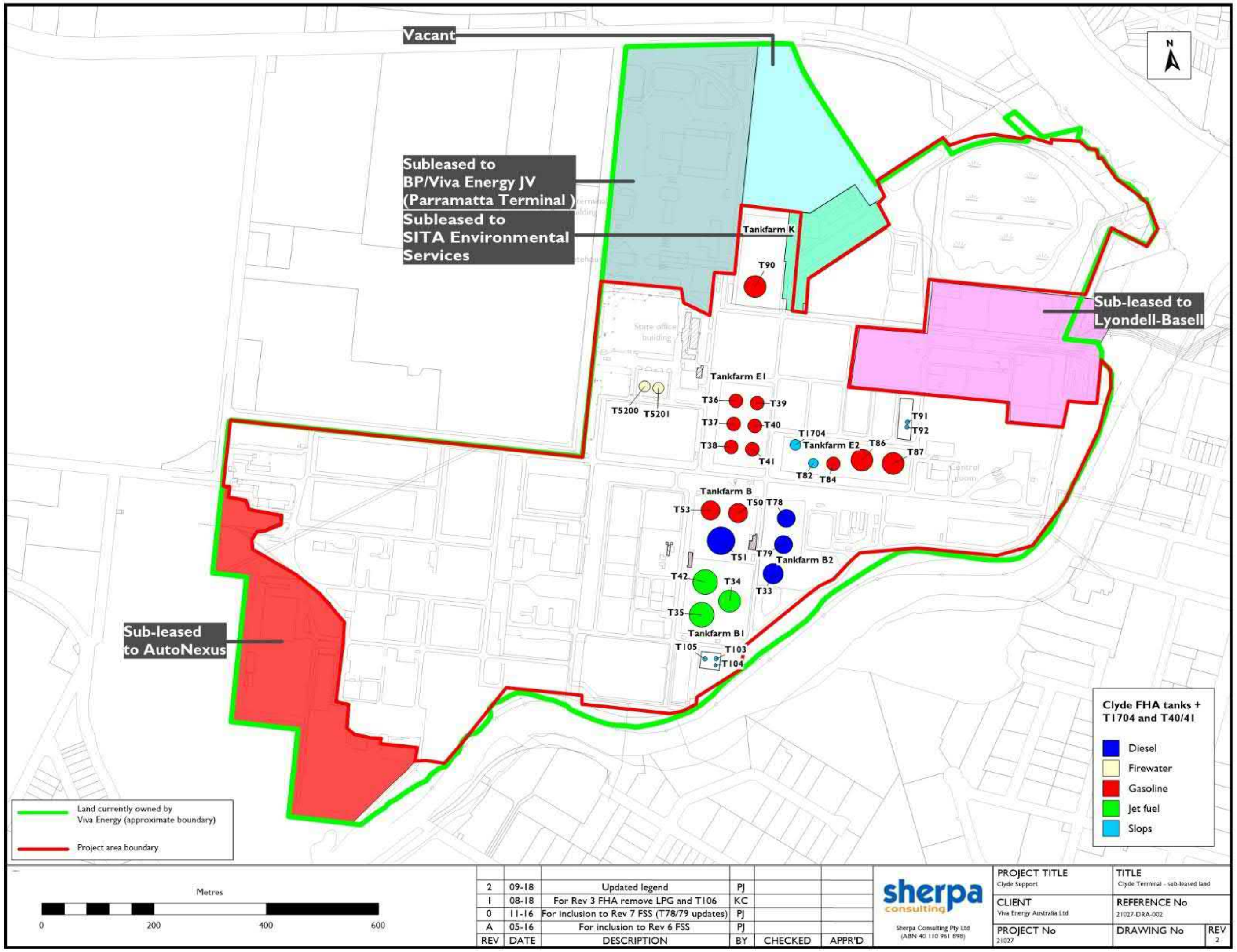
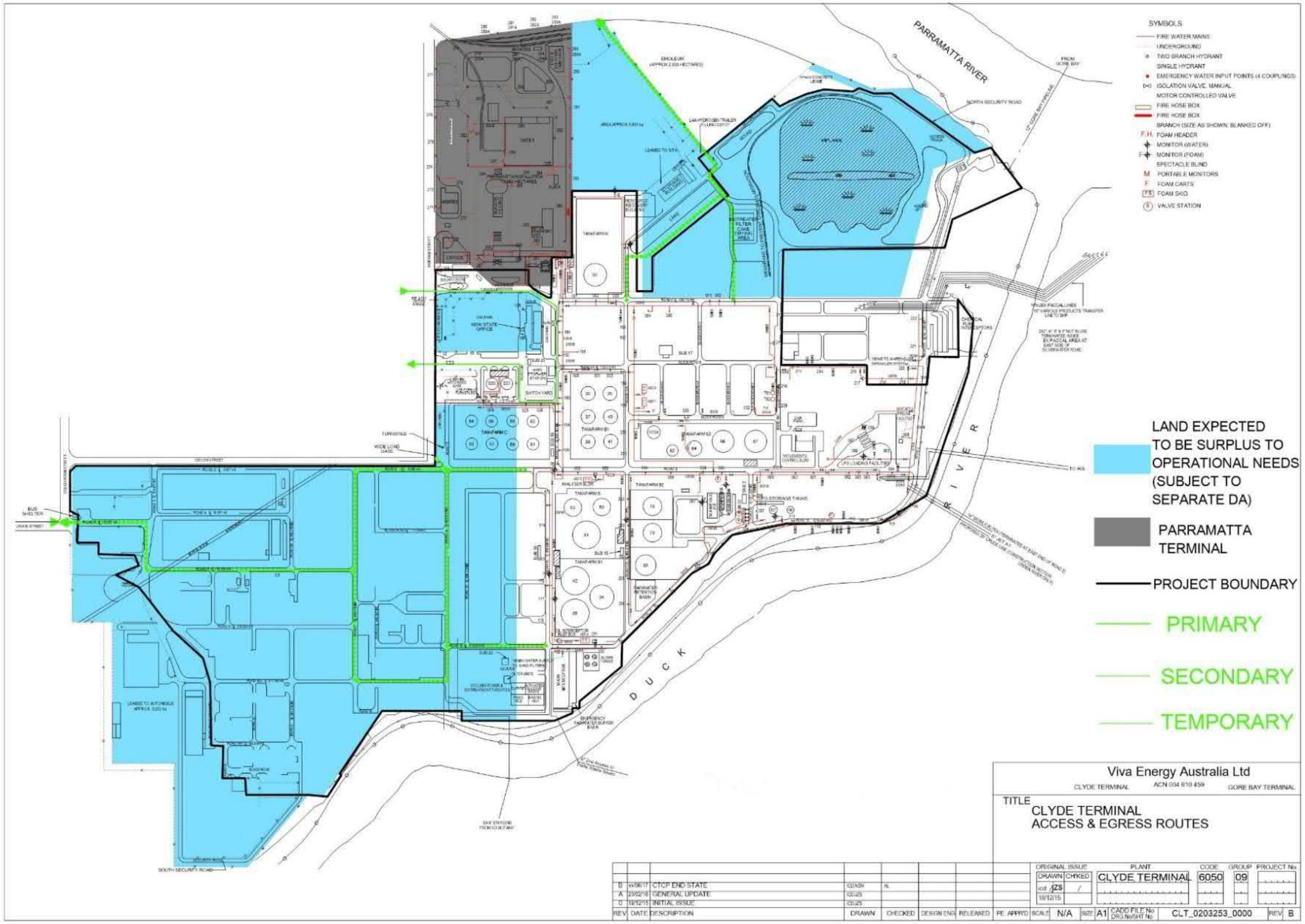


Figure 3.4: Clyde Terminal potential surplus land



4. INCORPORATING LESSONS FROM THE BUNCEFIELD INCIDENT

Clyde Terminal has addressed the recommendations of the Buncefield Major Incident Investigation Board, including:

- response to the lessons from the Buncefield incident, including actions taken, actions planned and proposed time frames for risk reduction related activities
- consideration of lessons learnt from other major incidents
- consideration of the issues raised in the Health and Safety Executive (HSE) publication: *Safety and the environmental standards for fuel storage sites* (Ref. 11).

A detailed point-by-point response is provided in APPENDIX F.

Vapour clouds have been modelled using the Vapour Cloud Assessment (VCA) method which is described in documents published by the HSE and the Fire and Blast Information Group (FABIG), (Ref. 12; 13).

5. LEVEL OF ASSESSMENT

5.1. Introduction

This study followed the guidelines given in *Applying SEPP 33* (Ref. 1) and *Multi-level Risk Assessment* (Ref. 2).

5.2. Level of assessment

Multi-level Risk Assessment (Ref. 2) was consulted to identify the level of assessment required. The document sets out three levels of risk assessment that may be appropriate. These are presented in Table 5.1.

Table 5.1: Scenarios carried forward for analysis

Level	Type of Analysis	Comments
1	Qualitative	Where there are no major offsite consequences and societal risk is negligible.
2	Partially Quantitative	Where there are offsite consequences but with a low frequency of occurrence.
3	Quantitative	Where level 1 and 2 are exceeded.

Based on the findings of the HAZID (Section 6), a quantitative Level 3 assessment was undertaken.

6. HAZARD IDENTIFICATION

6.1. Overview

The HAZID involved the following steps:

- Identification of hazardous materials.
- Identification of loss of containment and fire/explosion scenarios.
- Identification of safeguarding that will be provided.
- Development of specific scenarios to carry forward for assessment.

6.2. Hazardous materials stored and handled

Properties of the materials stored and handled at the site are summarised in Table 6.1. Properties are taken from the IP Refining Code and Kuchta (Ref. 14; 15) and are approximate for mixtures. Although large quantities of smoke can be produced from hydrocarbon fires, especially liquids, it rarely leads to dangerous conditions at ground level due to rise of the hot plume and dispersion.

All products are refined with no water content, therefore boilover is not credible for tank fires.

Table 6.1: Hazardous properties of materials

Material	DG Class	UN Number	Hazchem Code	Flash Point (°C)	Auto-ignition Temperature (°C)
Gasoline	3 PGII	1203	3YE	< -35	280
Jet fuel	3 PGIII	1863	3Y	> 23	210
Diesel	C1	3082	-	> 60	210

6.3. Potential hazardous incident scenarios

The HAZID word diagram for the site is included in APPENDIX A. The table contains the following information:

- accident event (resulting in leak or fire)
- cause
- prevention measures
- consequences
- detection measures
- protection measures.

All scenarios listed in APPENDIX A were carried forward for further analysis, with the following exceptions:

- Combustible liquids: Diesel has a high flash-point and is handled at ambient temperatures. The chance of ignition and involvement in a fire is remote unless due to an existing fire.
- Rim seal fires: These occur at elevation and the tank shell and wind girder provide shielding to anyone at grade. The study conservatively assumes that all rim seal fires will escalate to full-surface tank roof fires (which, although unlikely, have been considered in this study). It should be noted that the firewater and foam systems are not designed to fight a full surface tank top fire, refer to the Fire Safety Study (Ref. 5).

A summary of the scenarios carried forward is provided in Table 6.2.

Table 6.2: Scenarios carried forward for analysis

Equipment	Scenario	Comments
Atmospheric Storage Tanks and Bunds	Tank roof fire	Ignition of seals (external floating roof tanks) or vents/vapour space (internal floating roof tanks) by lightning.
	Full bund fire	Due to tank overfill, strake/structural catastrophic failure, pipe/flange leak, valve leak, drain leak, floor leak and corrosion.
	Vapour Cloud Explosion/Flash Fire	A potential outcome of gasoline tank overfill.
Pump House No. 2 and Pump Pits	Bund fire	Fire covering full bunded area of pump house.
Pipe Tracks	Pool fire	Fire covering pipe track routes.

7. CONSEQUENCE ASSESSMENT

7.1. Introduction

Consequence analysis involves the analysis and quantification of the potential for a hazardous scenario to cause injury, fatality, damage or loss. The consequence of an incident is assessed independently of the likelihood.

The purpose of the consequence analysis is to determine if the identified hazardous incidents have an offsite impact that exceeds the impairment criteria described in HIPAP 4 (Ref. 4) or can escalate to a scenario that can have an offsite impact.

The distinction between the physical consequences of a release and the effects on people or property are discussed in the following sections.

7.2. Physical consequence models

Modelling used the following software:

- Shell FRED for scenarios that were modelled in FRED during refinery operations.
- The VCA method for vapour clouds due to tank overfill events.

The modelling is described in more detail in the following sections.

7.2.1. FRED modelling

The proprietary modelling package Shell FRED (Fire Radiation Explosion, Dispersion) Version 6.0 was used to quantify the consequences of the identified scenarios using the view factor method including:

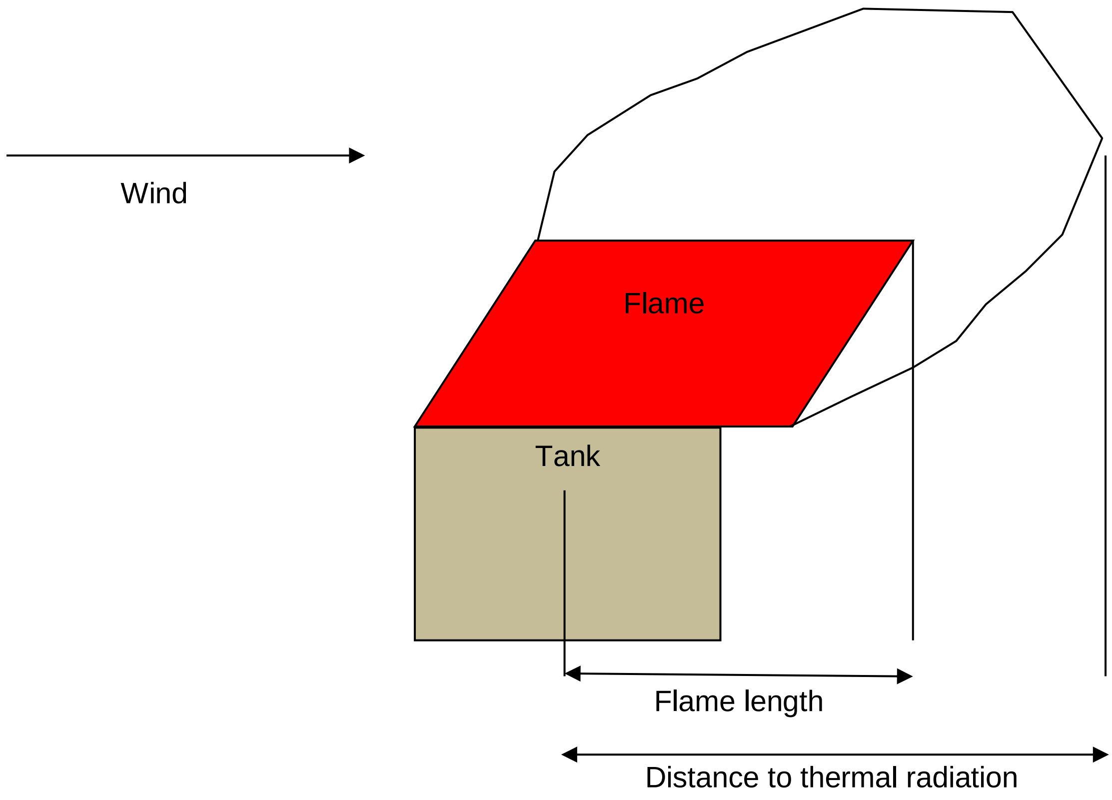
- Release rate
- Gas dispersion
- Jet fire
- Pool fire.

The following modelling assumptions were adopted for the modelling:

- Wind speed: two cases assessed 5 m/s and 2 m/s
- Atmospheric stability: D (neutral) and F (very stable)
- Relative humidity: 70%
- Ambient temperature: 20°C.

Distances to consequence levels are measured conservatively, and with the aim of entering the data into the Riskcurves Quantitative Risk Assessment (QRA) model. This means that jet fires are measured with a following wind and a horizontal angle, and the consequences from tank top fires are projected down, as shown in Figure 7.1.

Figure 7.1: Tank top fire consequence modelling



7.2.2. VCA method

In addition to the tank top full surface and bund fires historically accounted for in hydrocarbon tank farm consequence assessment, flash fire scenarios due to large spills of hydrocarbons (such as those that have occurred in Buncefield, Puerto Rico and Jaipur in recent years) have been included.

The investigations into the Buncefield (2005) and Jaipur (2009) events identified a number of common factors in the incidents that have occurred including:

- Potential for overfill or other release of hydrocarbon containing volatile material that continues undetected for some time
- Low wind speed, stable atmospheric conditions
- An ignition source in the vicinity
- Factors that may result in localised congestion or confinement of the dispersing flammable vapours.

At Buncefield, a tank was overfilled and the released product (gasoline) subsequently cascaded over the tank edge/girder resulting in large amounts of spray and vapour formation due to vaporisation of volatile components and formation of very fine hydrocarbon droplets. An ignition of the vapour cloud and explosion with overpressures far higher than would have been predicted by conventional methods occurred at Buncefield.

Extensive work including large scale experiments and CFD modelling were undertaken as part of the Buncefield investigation resulting in further explanation of the severity of the event.

In 2013, the UK HSE and the industry body the FABIG issued a model for use based on the Health Safety and Laboratory (HSL) paper that can be used to estimate cloud sizes from overfills of volatile materials for zero wind speed conditions, (Ref. 13). This is primarily dependent on falling droplets drawing in air as they spray, forming a cold, well-mixed flammable cloud that moves due to gravity and local eddies rather than bulk air wind speed. This is known as the VCA model.

The technique provides a specific model for assessing the physical behaviour of an overfill from a specific tank geometry and uses empirical correlations to predict a mass addition rate and concentration of hydrocarbon in the initial cloud from a cascading overfill.

For this QRA, loss of containment of gasoline due to tank overfill and the extent of the flammable cloud envelope was modelled using the VCA method, which provides a means of calculating the rate at which the volume of a vapour cloud increases during an overfilling incident. It also provides a means of estimating the extent of overpressures outside the edge of the cloud.

As the applicability of the VCA method is for very low or zero windspeeds only, for this study, the distances were implemented for the lowest windspeed analysed, i.e. 2.1 m/s.

7.3. Effects models

The following consequences were analysed for their effects on people and equipment:

- fire/fireball heat radiation
- flammable vapour cloud flash fire
- flammable vapour cloud explosion (see note below Table 7.1).

The selection of impairment criteria and modelling techniques is detailed in APPENDIX D and summarised in the subsequent sections.

7.3.1. Effects on people

The impairment criteria for people are summarised in Table 7.1. These values relate to acute effects. Impairment is considered to occur if the levels are equal to or higher than those given in the table.

Table 7.1: Impairment criteria

Impediment	Effect Criteria
Thermal Radiation	≤ 4.7 kW/m^2 (injury)
	4.7 – 14 kW/m^2 (50% chance of fatality)
	≥ 14 kW/m^2 (100% chance of fatality)
Flash Fire	100% chance of fatality within flammable vapour cloud defined by Lower Flammability Limit (LFL) concentration

7.3.2. Effects on equipment and structures

Equipment and structures subject to direct flame impingement from fires can weaken with time, from a combination of thermal radiation and convective heating. Eventually failure occurs, resulting in possible escalation of the incident, escape route impairment, and significant plant damage.

It is difficult to assign a specific value for structural failures, since failure is determined by structural characteristics (e.g. material type, pipe thickness and beam dimensions), handling conditions (whether the equipment is subject to internal pressure) and flame characteristics (surface emissive power, flame dimensions).

Heat-up calculations were undertaken, during the Clyde Refinery Formal Safety Assessment, to estimate failure times of specific critical structures under jet fire loading. The findings of that study (summarised in APPENDIX D) were verified using proprietary software Vessfire and were carried forward to this study.

The effect of explosion overpressures in the terminal will depend on the location of the explosion and the likely targets; the impairment criteria are summarised in APPENDIX D.

7.4. Findings

The consequence analysis results are summarised in the subsequent section and in Table 7.2 through to Table 7.6.

The analyses include tank overfill cascade dispersion modelling (i.e. the Buncefield scenario) for gasoline storage tanks only, noting that diesel and jet fuel are of too low volatility to generate vapour clouds at atmospheric conditions.

Table 7.2: Tank roof fire consequences

ID	Tank number	Content	Diameter (m)	SEP (kW/m^2)	Distance (m) to heat radiation from tank centre			
					Flame length	23 kW/m^2 [(a)]	14 kW/m^2	4.7 kW/m^2
01_1T_033	33	Diesel	36	-	Not a tank-on-fire and escalation unlikely			
01_1T_034	34	Jet fuel	39	22	46	46[(a)]	48	64
01_1T_035	35	Jet fuel	44	21	50	50[(a)]	51	69
01_1T_036	36	Gasoline	24	31	36	36	38	50
01_1T_037	37	Gasoline	24	31	36	36	38	50
01_1T_038	38	Gasoline	24	31	36	36	38	50
01_1T_039	39	Gasoline	24	31	36	36	38	50
01_1T_040	40	Gasoline	24	31	36	36	38	50
01_1T_041	41	Gasoline	24	31	36	36	38	50
01_1T_042	42	Jet fuel	44	21	50	50[(a)]	51	69
01_1T_050	50	Gasoline	34	24	43	43	44	59
01_1T_051	51[(b)]	Diesel	49	21	50	50[(a)]	54	73
01_1T_053	53	Gasoline	34	24	43	43	44	59
01_1T_082	82	Slops	17	42	29	29	32	42
01_1T_084	84	Gasoline	24	31	36	36	38	50
01_1T_086	86	Gasoline	39	22	48	48[(a)]	49	64
01_1T_087	87	Gasoline	39	22	48	48[(a)]	49	64
01_1T_090	90	Gasoline	39	22	48	48[(a)]	49	64
01_1T_091	91	Slops	6	86	15	15	18	24
01_1T_092	92	Slops	6	76	15	15	18	24
01_1T_103	103	Slops	8	74	18	19	21	28
01_1T_104	104	Slops	6	74	15	15	18	24
01_1T_105	105	Slops	8	74	18	19	21	28

ID	Tank number	Content	Diameter (m)	SEP (kW/m^2)	Distance (m) to heat radiation from tank centre			
					Flame length	23 kW/m^2 [(a)]	14 kW/m^2	4.7 kW/m^2
01_1T_1704	1704	Slops	19	40	31	32	34	45

Note:

(a) Where there was not result generated (NG) in the Clyde FHA report at 23 kW/m^2, distance to the flame length was used as distance to the heat radiation at 23 kW/m^2.

(b) Diesel tank T51 could be impinged from tank roof fire from adjacent tanks 50 and 53; hence tank top fire was modelled.

Table 7.3: Tank overfill cascade vapour dispersion

Tank	Content	Diameter (m)	Height (m)	Overfill rate (m^3/hr)	Distance to LFL (m)		Distance to 14 kPa (m)
					Length	Width	
36	Gasoline	24.4	16.5	1,000	398	398	327
37	Gasoline	24.4	16.5	1,000	398	398	327
38	Gasoline	24.4	16.5	1,000	398	398	327
39	Gasoline	24.4	16.5	1,000	398	398	327
40	Gasoline	24.4	16.5	1,000	398	398	327
41	Gasoline	24.4	16.5	1,000	398	398	327
50	Gasoline	34	22	1,000	473	473	380
53	Gasoline	34	22	1,000	473	473	380
82	Slops	17	13	1,000	335	335	283
84	Gasoline	24	22	1,000	420	420	342
86	Gasoline	39	22	1,000	496	496	397
87	Gasoline	39	22	1,000	496	496	397
90	Gasoline	39	22	1,000	496	496	397
91	Slops	6.1	6.1	150	150	150	152
92	Slops	6.1	6.1	150	150	150	152
1704	Slops	19	15	1,000	358	358	299

Notes:

Where the distance to LFL is different for tanks within the same bund (i.e. Tank Farm E2), the worst case LFL distance was used as representative for the bund and fed as an input to the model.

Weathered slops in T103/4/5 were determined not to have the potential for a vapour cloud.

Width of the LFL cloud is assumed to be similar to the LFL downwind distance This is consistent with CFD modelling results undertaken as part of the Buncefield investigation but may be affected by specific bund and building configurations (Ref. 16).

Table 7.4: Bund and pump pit fires

ID	Tank bund or pump pit	Content	Diameter (m)	SEP (kW/m^2)	Distance (m) to heat radiation [(a)]			
					Flame length	23 kW/m^2	14 kW/m^2	4.7 kW/m^2
01_2B_00B	Tank Farm B	Gasoline and diesel	127	20	102	NG	105	149
01_2B_0B1	Tank Farm B1	Jet fuel	137	20	104	NG	109	158
01_2B_0B2	Tank Farm B2	Diesel	50	21	53	NG	55	75
01_2B_0E1	Tank Farm E1	Gasoline	89	20	80	NG	82	114
01_2B_0E2	Tank Farm E2	Gasoline and slops	74	20	71	NG	73	99
01_2B_00K	Tank Farm K	Gasoline	87	20	79	NG	81	112
01_2B_912	Gasoline slops tankfarm (T91/92)	Slops	28	27	39	39	41	54
01_2B_001	Green slops tankfarm	Slops	32	25	41	42	44	58
01_5P_001	Tank Farm B/B1 pump pit WEST (jet filters)	Jet fuel	17	43	28	29	32	42
01_5P_002	Pump House 2	Gasoline	16	44	28	29	31	41
01_5P_003	ULP delivery pump Pit	Gasoline	18	39	30	31	33	44
01_5P_004	Gasoline pumps	Gasoline	16.3	44	28	29	31	41

Note:
(a) All distances measured from bund/pool centre. NG = Not Generated.

Table 7.5: Pipe track pool fires

ID	Pipe name	Modelled Product	Diameter (mm)	Pressure (bara)	Mass flow (kg/s)	Hole diameter (mm)	Usage	Distance (m) to heat radiation [a]			
								Flame length	23 kW/m^2	14 kW/m^2	4.7 kW/m^2
01_5P_005	Gasoline Import from Gore Bay	Gasoline	300	20	201	4	43%	13	13	15	20
						25		48	48	50	65
						100		56	NG	57	76
						300		56	NG	57	76
01_5P_006	Gasoline from Pumphouse 2 to Hunter Export Line	Gasoline	150	19	91	4	30%	12	12	15	19
						25		45	45	50	62
						50		55	NG	57	75
						150		55	NG	57	75
01_5P_007	Gasoline from Pumphouse 2 to Tank 90	Gasoline	200	2	131	4	100%	5	5	8	12
						25		24	24	30	40
						67		55	NG	57	75
						200		55	NG	57	75
01_5P_008	Jet transfer from Pumphouse 2 to jet pumps	Jet Fuel	300	2	131	4	30%	40	NG	46	63
						25		54	NG	55	75
						100		54	NG	55	75
						300		54	NG	55	75
01_5P_009	Jet transfer from Pumphouse to JUHI pipeline	Jet Fuel	200	36	42	4	30%	54	NG	55	75
						25		54	NG	55	75
						67		54	NG	55	75
						200		54	NG	55	75

ID	Pipe name	Modelled Product	Diameter (mm)	Pressure (bara)	Mass flow (kg/s)	Hole diameter (mm)	Usage	Distance (m) to heat radiation [a]			
								Flame length	23 kW/m^2	14 kW/m^2	4.7 kW/m^2
01_5P_010	Gasoline to Tankfarm B	Gasoline	400	20	201	4	100%	13	13	15	20
						25		48	48	50	65
						133		56	56	57	76
						400		56	56	57	76

Note:

(a) All distance measured from pool centre. NG = Not Generated.

Pool fires were generated based on equilibrium between burning rate and release rate. This generated very large diameter fires, which are not realistic based on the physical constraints at the site. Hence a 50 m diameter limit was used which is equivalent to the distance between tankfarm bunds across Road 2 and Road 17.

For jet fuel, the pools generated by FRED were very large, and quickly exceeded the models valid range. Again a 50 m diameter limit was imposed.

Import/export pipelines have impact distances that go offsite. Pumphouse 2 is approximately 60 m from the site boundary, so all pipework that passes through this area has the potential for offsite consequences.

Table 7.6: Pipe track vapour dispersion

ID	Pipe name	Pressure (bara)	Mass flow (kg/s)	Hole diameter (mm) [(a)]	Usage	Distance (m) to LFL [(a)]	
						D5 Case	F2 Case
01_5P_005	Gasoline Import from Gore Bay	20	201	4	43%	9	20
				25		58	151
				100		89	222
				300		89	222
01_5P_006	Gasoline from Pumphouse 2 to Hunter Export Line	19	91	4	30%	9	20
				25		58	151
				50		89	222
				150		89	222
01_5P_007	Gasoline from Pumphouse 2 to Tank 90	2	131	4	100%	3	6
				25		27	57
				67		76	161
				200		89	222
01_5P_010	Gasoline to Tankfarm B	20	201	4	100%	9	20
				25		58	151
				133		89	222
				400		89	222

Note:
(a) All distance measured from leak source. A 50 m pool diameter case was limited for releases from large hole size.

7.5. Combustion products

Toxic products of combustion (e.g. carbon oxides and soot) have the potential to affect (by respiratory irritation) those attending a fire emergency and possibly people off-site.

The products of combustion rising from a fire typically have a temperature in the range 800-1200ºC and a density a quarter that of air (Ref. 17). Therefore, impact from toxic products of combustion will be significant only local to the fire, since the plume of combustion products would be buoyant and the combustion products will tend to rise and disperse with the prevailing weather.

7.6. Conclusions

The following scenarios have the potential for off-site impact, i.e. exposes off site locations to thermal radiation of 4.7 kW/m^2 or higher or exposes offsite locations to flammable vapour above the lower flammable limit:

- Tank roof fire: Tank 90
- Tank overfill cascade leading to flash fire/vapour cloud explosion: all gasoline tanks
- Tank bund fires: Tank Farm B, Tank Farm B1, Tank Farm B2, Tank Farm K, Slops Tank Farm 103/4/5, Slops Tank Farm 91/92 and ULP delivery pump pit
- Pipe track pool fires
- Pipe track leaks leading to flash fire/vapour cloud explosion.

Escalation was found to be possible between tanks. As such, the consequences of a diesel tank top fire (T51) were carried forward, as shown in Table 7.7.

Table 7.7: Diesel tank top fire

Tank No.	Contents	Tank Diameter (m)	Surface Emissive Power (kW/m^2)	Fire/Heat Radiation Distances (m)				Distance to Boundary (m)	Off-Site Impact?
				Flame	4.7 kW/m^2	14 kW/m^2	23 kW/m^2		
51	Diesel	49	21	50	73	54	NG	180	No

All scenarios and not just those with offsite impact were carried forward for likelihood and risk analysis.

8. LIKELIHOOD ASSESSMENT

8.1. Introduction

The likelihood analysis is used in conjunction with the consequence analysis to determine the risk of an event. The likelihood analysis is a method for predicting the occurrence of future events based on past data. In terms of the QRA, events may occur due to either an equipment failure, for example a leak from a flange, or following a process control failure (e.g. a tank overfill).

A leak frequency data set was developed for equipment failure scenarios and was combined with a parts count (refer to Section 8.3).

The frequency of tank overfill was modelled using the residual risk values evaluated in the site's Model Bow Tie Layer of Protection Analysis (LOPA) (Ref. 18), which was updated to reflect the proposed Terminal operating conditions.

The subsequent sections summarise the frequency analysis, which is detailed in APPENDIX C and summarised in Table 8.3.

8.2. Ignition model

The ignition probabilities that were used for the study were derived from data provided in Cox, Lees and Ang (Ref. 19). Although based on a relatively old publication, the ignition probabilities have been compared with the most recent, publicly available data (Ignition Probability Review by the Energy Institute, Ref. 20) and were found to be conservative up to a release rate of 200 kg/s, as shown in Figure 8.1.

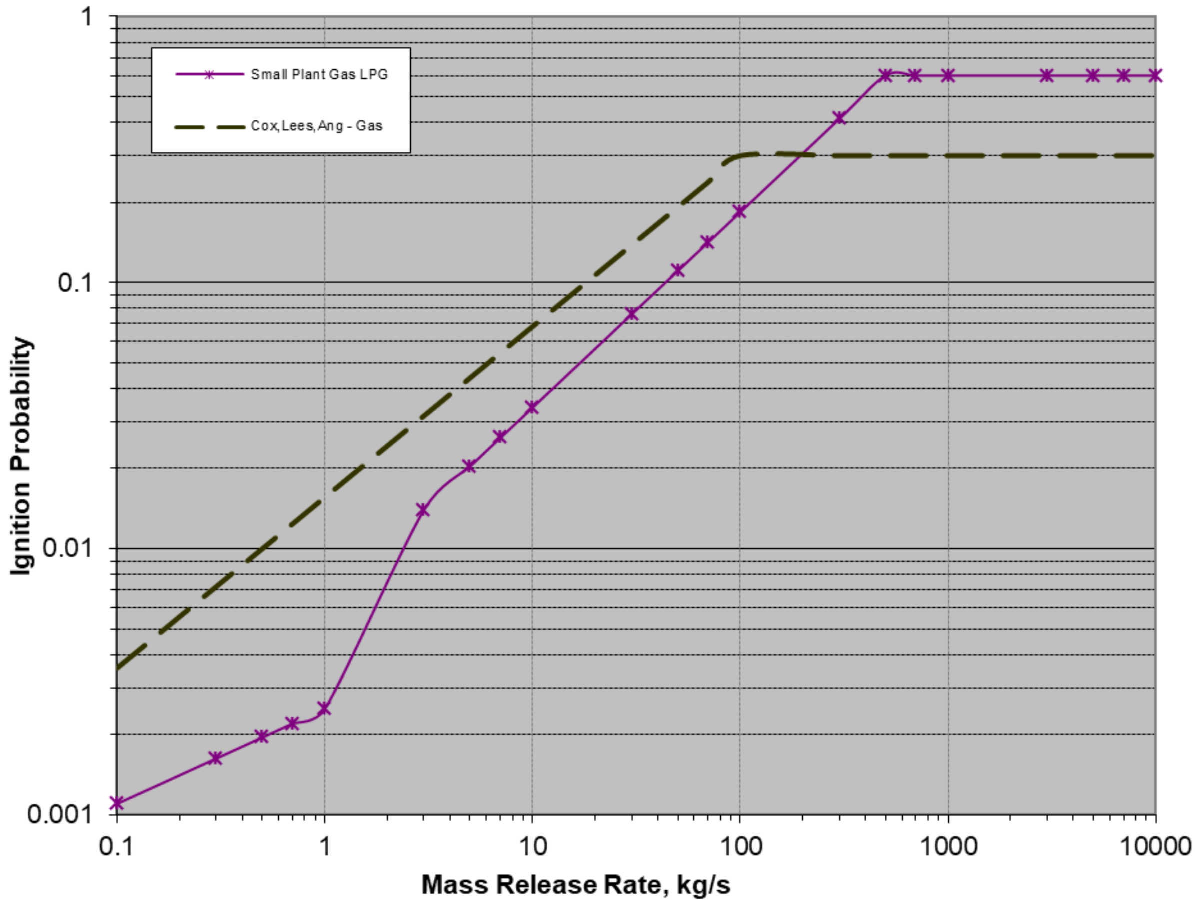
A summary of the ignition probabilities used in this study for vapour and liquid releases for a range of leak rates is shown in Table 8.1.

For diesel bund fires, the probability of ignition of diesel was assumed to be an order of magnitude lower than the ignition probability of liquid releases (i.e., ignition probability of 0.0056 for a diesel release >50 kg/s was used in this study).

Table 8.1: Summary of ignition probabilities

Release Rate	Vapour / Mixed Releases		Liquid Releases	
	Immediate Ignition	Delayed Ignition	Immediate Ignition	Delayed Ignition
<1 kg/s	0.0096	0.0004	0.0096	0.0004
1 - 50 kg/s	0.0616	0.0084	0.0264	0.0036
>50 kg/s	0.21	0.09	0.056	0.024

Figure 8.1: Ignition probabilities



8.3. Parts count

The equipment parts count is summarised in Table 8.2. The parts count was based on a standard design for equipment conforming to Shell Design & Engineering Practices (DEPs) and confirmed by cross-check with actual parts (in the field or off drawings, where possible). The parts count is the average count across all equipment items of a given type.

Table 8.2: Parts count

Equipment Type	Average Leak Source Count per Equipment Item		
	Connections (> 25 mm)	Flange / Valve Equivalents	Fittings (< 25 mm)
Pumps	1	18	9
Pipe	3	20	3

8.4. Summary of leak frequencies used in QRA

The leak frequency data are detailed in APPENDIX C and summarised in Table 8.3.

Table 8.3: Summary of failure & event frequencies used in QRA

Equipment Item	**Equivalent Leak Size Diameter (mm)**	**Frequency (per item-year)**
Equipment Leaks		
Flanges and equivalent valves	2.5	2.2×10^{-4}
Instrument fitting (< 1 inch diameter)	20	1×10^{-4}
Connection (> 1 inch diameter)	50	1×10^{-5}
Pipe rupture	< 300	2×10^{-7} /m
	≥ 300	7×10^{-8} /m
Pump seal	10	3×10^{-3} (single seal)
Pump casing failure	Full Bore	3×10^{-5}
Atmospheric Storage Tanks		
Full-surface tank roof fire	-	Fixed roof: 2.1×10^{-5} Ext. floating roof: 5.3×10^{-5} Int floating roof 4.4×10^{-6}
Tank catastrophic rupture	-	3×10^{-6}

9. RISK ASSESSMENT

9.1. Introduction

The risk analysis brings together the physical consequence model, effects models, leak frequency and parts count. The modelling also includes site specific factors such as equipment layout and prevailing weather conditions.

The FHA process requires an assessment of the offsite risk against set criteria. This section presents the comparison of the risk, developed from the consequence and frequency analyses, against the HIPAP 4 Offsite Risk Tolerability Criteria (Ref. 4).

9.2. Modelling approach

The QRA methodology adopted in this study is consistent with the guidance provided in HIPAP 6 (Ref. 3).

The risk profile for the site was produced by the proprietary package TNO Riskcurves.

9.3. Assessment criteria

The risk guidelines provided in the DPE publication Risk Criteria for Land Use Safety Planning (Ref. 4) are outlined below for fatality, injury, accident propagation and damage to the biophysical environment.

9.3.1. Fatality, injury & accident propagation risk criteria

The fatality, injury and accident propagation risk criteria are described in Table 9.1, Table 9.2 and Table 9.3 respectively for new facilities. Despite the development being a modification to an existing facility, and as such the criteria may be relaxed, the 'new facility' criteria were used for this study.

Table 9.1: NSW individual fatality risk criteria

Limit (per year)	Land-use
0.5×10^{-6}	Hospitals, child-care facilities and old age housing developments
1×10^{-6}	Residential developments and places of continuous occupancy such as hotels and tourist resorts
5×10^{-6}	Commercial developments, including offices, retail centres, warehouses with showrooms, restaurants and entertainment centres
10×10^{-6}	Sporting complexes and active open space areas
50×10^{-6}	Industrial – must not be exceeded any boundary adjacent to another industrial facility

Table 9.2: NSW individual injury risk criteria

Limit (per year)	Land-use
50 x 10^{-6}	Residential areas – 4.7 kW/m^2 heat flux radiation
50 x 10^{-6}	Residential areas – 7 kPa explosion overpressure
10 x 10^{-6}	Residential areas – injurious toxic concentrations NOTE: risk contour not evaluated – no toxics handled at Terminal
50 x 10^{-6}	Residential areas – toxic concentrations causing irritation NOTE: risk contour not evaluated – no toxics handled at Terminal

Table 9.3: NSW accident propagation/escalation risk criteria

Limit (per year)	Land-use
50 x 10^{-6}	Potentially hazardous installations – 23 kW/m^2 heat flux radiation (flame impingement)
50 x 10^{-6}	Potentially hazardous installations – 14 kPa explosion overpressure

9.3.2. Criteria for risk to the biophysical environment

The risk tolerability criteria suggested by DPE for sensitive environmental areas relate to the potential effects of an accidental emission on the long-term viability of the ecosystem or any species within it. The criteria are expressed as follows:

- Industrial developments should not be sited in proximity to sensitive natural environmental areas where the effects of the more likely accident emissions may threaten the long-term viability of the ecosystem or any species within it.
- Industrial developments should not be sited in proximity to sensitive natural environmental areas where the likelihood of impacts that may threaten the long-term viability of the ecosystem, or any species within it, is not substantially lower than the background level of threat to the ecosystem.

9.3.3. Societal risk

The DPE suggests that judgements on societal risk be made based on a qualitative approach rather than on specifically set numerical criteria. Societal risk estimation is warranted only where significant and potentially vulnerable populations exist beyond the boundary of the proposed development. This is not the case for the proposed terminal, since the surrounding area (within the worst-case consequence distance generated by the Terminal hazards) includes only industrial, and no residential, land-uses. Following advice from DPE in HIPAP 4, societal risk is not evaluated in this study.

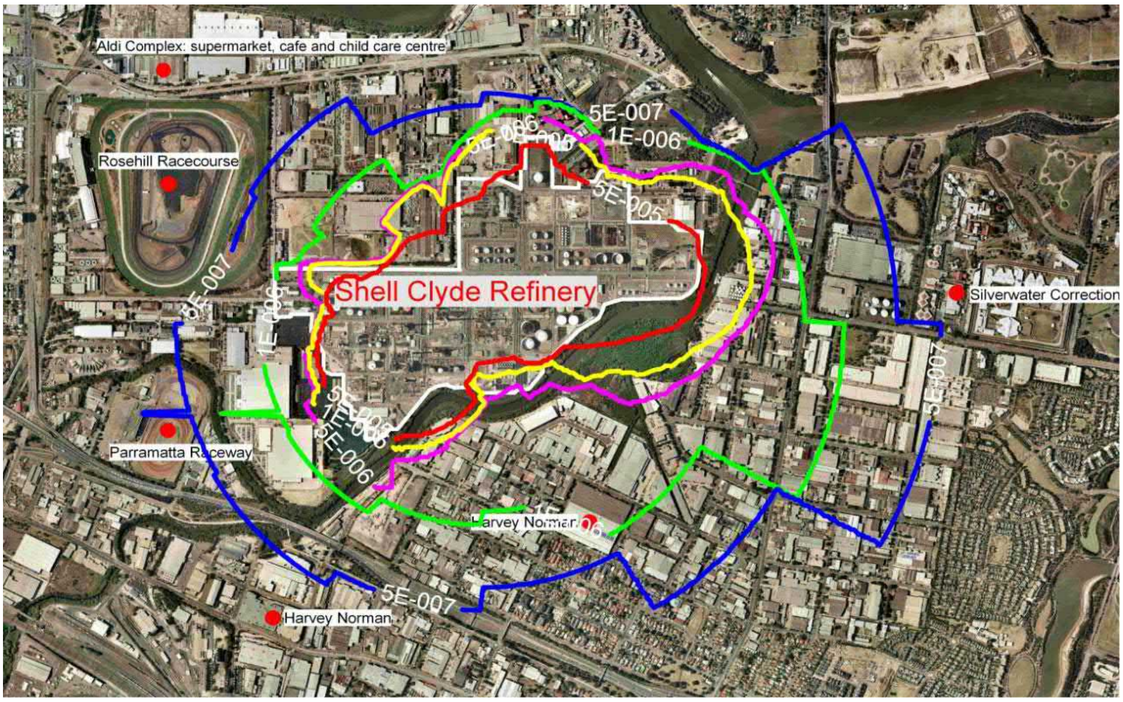
9.4. Risk assessment

9.4.1. Refinery mode of operations

Individual fatality risk contours for the facility when operating as a refinery were produced for the Clyde Refinery Safety Report (Ref. 21) and these are reproduced in Figure 9.1

as a baseline from which all proposed changes can be reviewed. The red 5 x 10^{-5} /year contour extended marginally offsite and all other contours cover large portions of the surrounding area. This is typical of an operating refinery storing substances that on release have large consequence distances such as Hydrofluoric Acid.

Figure 9.1: Individual fatality risk contours (safety report)



9.4.2. Terminal mode of operations

Individual fatality risk contours for the Terminal are shown in Figure 9.2 and a summary of the risk assessment findings against the HIPAP 4 fatality risk criteria is provided in Table 9.4. The contours include all refinements to the design outlined in Section 1.3.3.

When compared against the Refinery contours, the picture is very different with much smaller contour extents, typical of a fuel storage and distribution site.

Injury risk contours are shown in Figure 9.3. A summary of the findings against the injury risk criteria is provided in Figure 9.5.

Accident propagation risk contours are shown in Figure 9.4. A summary of the findings against the accident propagation risk criteria is provided in Table 9.6.

Figure 9.2: Individual fatality risk contours

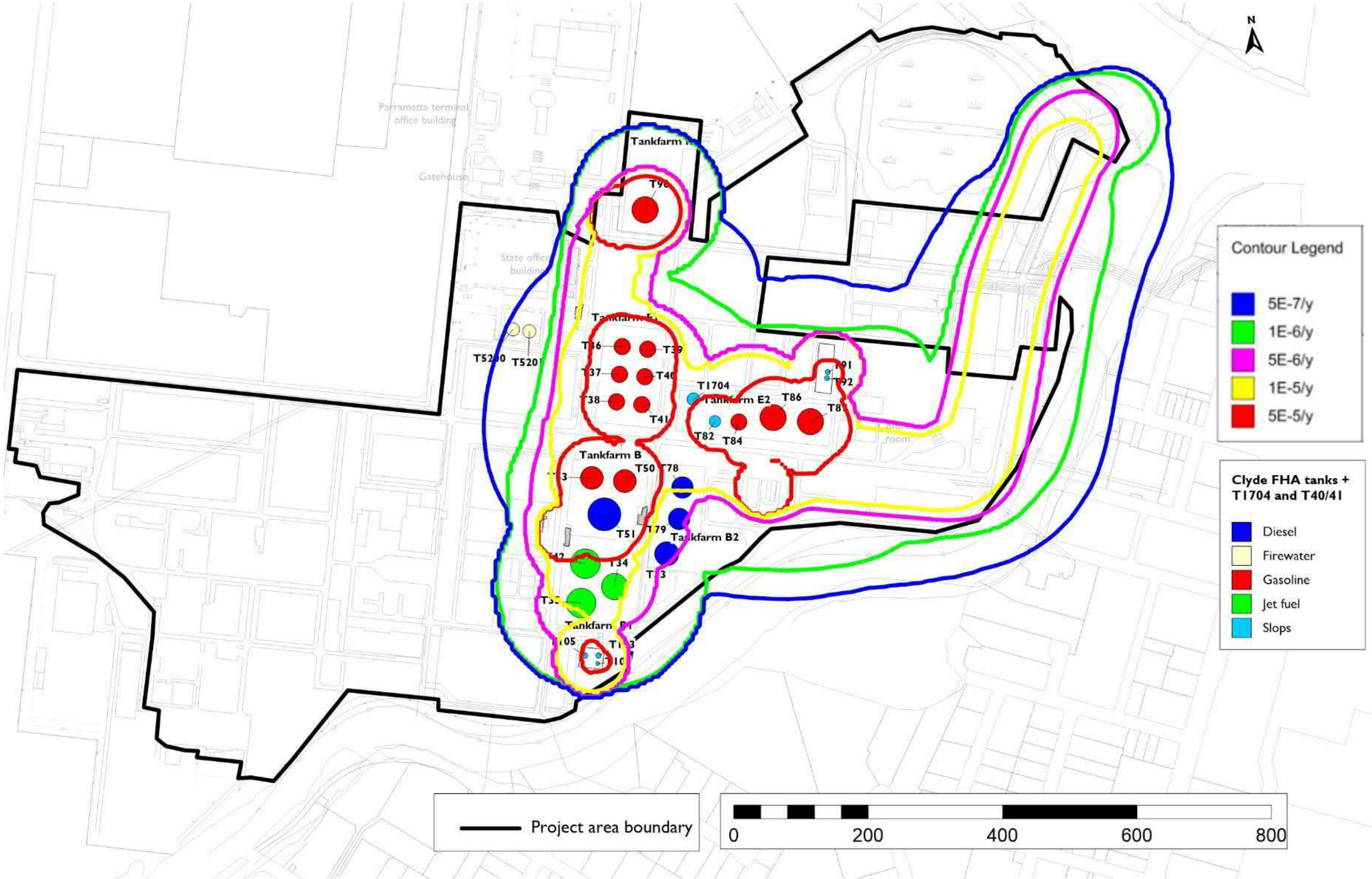


Figure 9.3: Injury risk contours

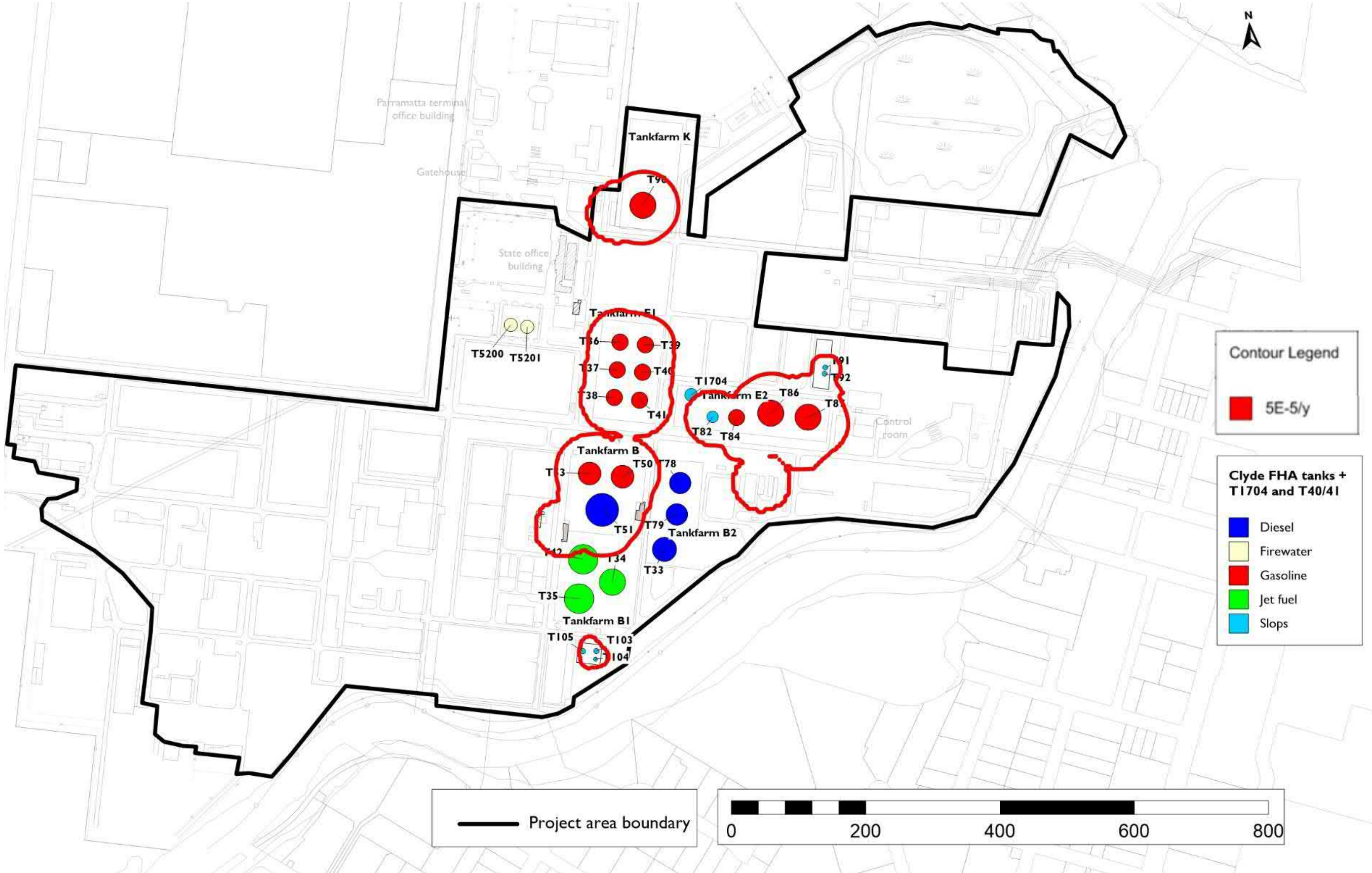


Figure 9.4: Accident propagation (escalation) risk contours

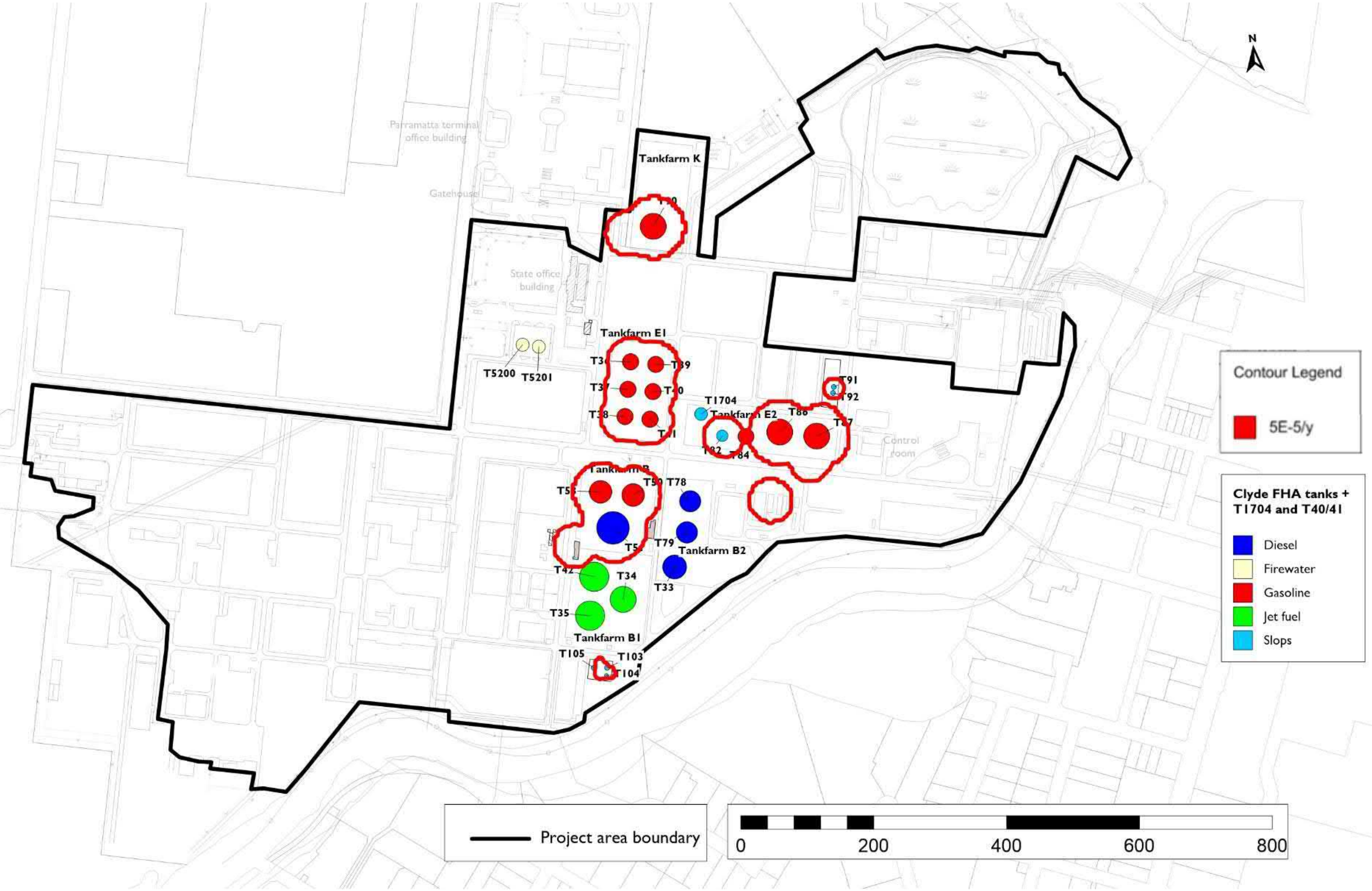


Table 9.4: Individual fatality risk assessment

Land-use	Outcome
Hospitals, child-care facilities and old age housing developments	The risk at the nearest existing hospital, child-care facility and old age housing development is less than 0.5 x 10^{-6} /year (blue)
Residential developments and places of continuous occupancy such as hotels and tourist resorts	The risk at the nearest existing residential area is less than 1 x 10^{-6} /year (green)
Commercial developments	The risk at the nearest existing commercial development is less than 5 x 10^{-6} /year (purple)
Sporting complexes and active open space areas	The risk at the nearest existing sporting complex is less than 10 x 10^{-6} /year (yellow)
Industrial – must not be exceeded any boundary adjacent to another industrial facility	The 50 x 10^{-6} /year contour marginally extends beyond the site boundary into the Parramatta Terminal (red)

Table 9.5: Individual injury risk assessment

Land-use	Contour Level (colour)
Residential areas – 4.7 kW/m² heat flux radiation	Heat flux radiation levels of 4.7 kW/m² do not impact residential development at frequencies of more than 50 x 10^{-6} /year, as shown in Figure 9.3 (red)
Residential areas – 7 kPa explosion overpressure	There are no explosion overpressures generated that can reach residential areas. The nearest residential area is located at least 350 m away from the largest cloud fire.

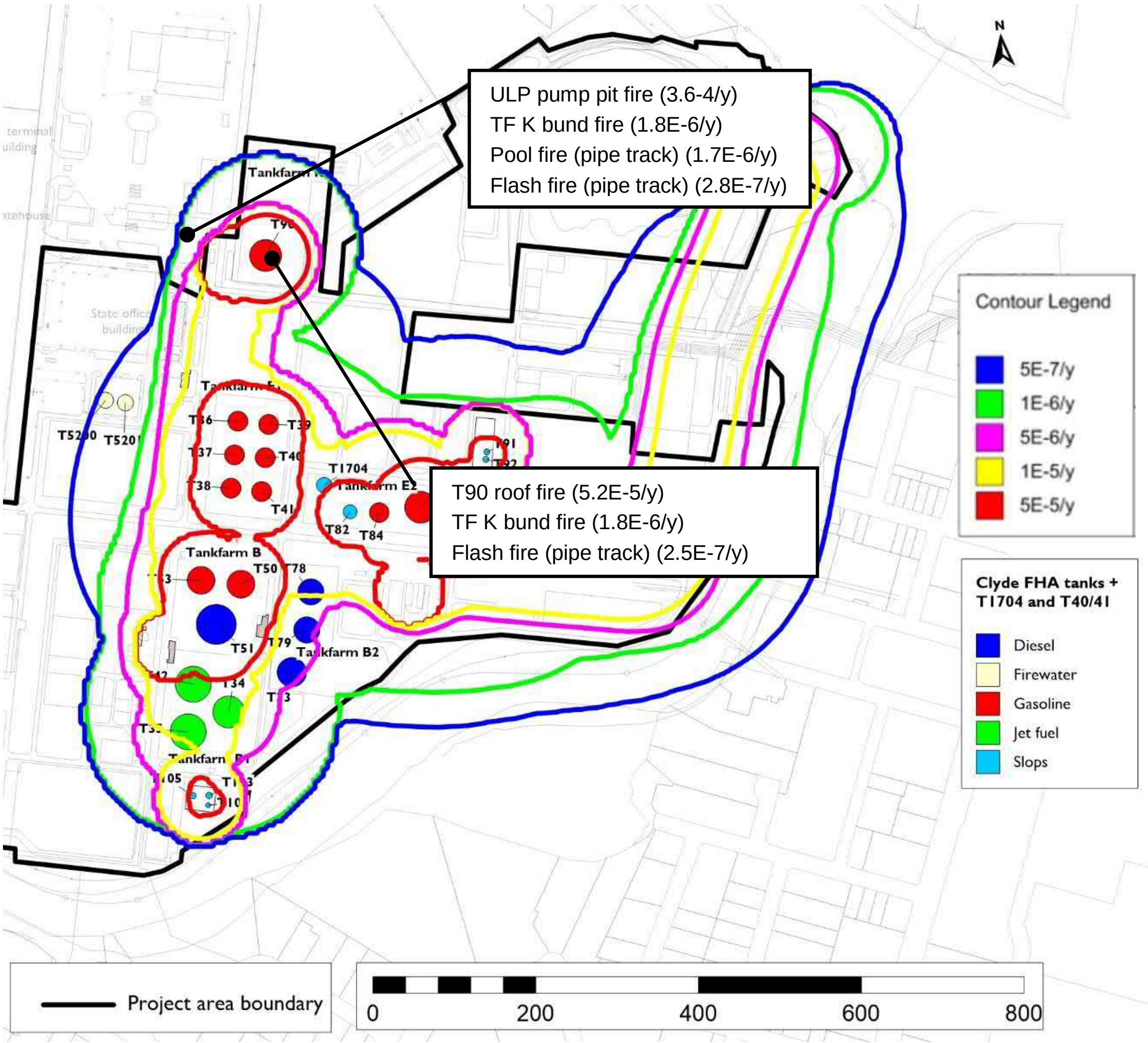
Table 9.6: Accident propagation/escalation risk assessment

Land-use	Contour Level (colour)
Potentially hazardous installations – 23 kW/m² heat flux radiation (flame impingement)	As shown in Figure 9.4 (red), the 50 x 10^{-6} /year contour remains within the site boundary.
Potentially hazardous installations – 14 kPa explosion overpressure	As shown in Figure 9.4 (red), the 50 x 10^{-6} /year contour remains within the site boundary.

9.5. Key risk contributors

The main contributors to off-site fatality risk were found to be the ULP pump pit fire and the Tank Farm K bund fire. Location specific key contributors are shown in Figure 9.5.

Figure 9.5: Map showing key contributors



9.6. Risk to the biophysical environment

An assessment of the potential for long-term effects, due to an accidental emission of hydrocarbon from the site, on the viability of ecosystems in the area surrounding the Terminal is undertaken in the Environmental Impact Statement (EIS) for SSD 5147 (Ref. 22).

The EIS found that:

- the effects of the more likely accident emissions do not threaten the long-term viability of the local ecosystems and the species within it; and
- the likelihood of the impacts that potentially threaten the long-term viability of the ecosystem, or any species within it, is lower than the background level of threat to the ecosystem.

9.7. Conclusions

Conclusions from the risk assessments results are summarised below.

- Individual fatality risk: As shown in Figure 9.2, the 50 x 10^{-6} /year contour (target to be retained onsite) marginally extends beyond the site boundary into the Parramatta Terminal as the risk contour goes offsite by approximately 10 m. However, Parramatta Terminal is operated by Viva Energy and hence the sites are under a single ownership. The part of the site that is impacted would only have an occasional presence of people and the contour does not reach buildings, muster points or populated areas. There is a joint Emergency Response Plan (ERP) in place and Parramatta Terminal would be notified of emergencies at Clyde.

The individual fatality risk conclusion has changed since the Rev 0 report as the boundary with SUEZ to the east of Tank 90 has been moved to reflect the location at End State. This has created a buffer zone around the Tank 90 bund to retain the 50 x 10^{-6} /year individual fatality risk contour on site.

- Individual injury risk: The injury risk level does not impact residential development at frequencies of more than 50 x 10^{-6} /year, as shown in Figure 9.3.
- Accident propagation/escalation risk: As shown in Figure 9.4, the 50 x 10^{-6} /year contour remains within the site boundary.

In the context of SEPP 33, the facility is therefore considered:

- 'potentially hazardous' (rather than 'hazardous'); and
- 'potentially offensive' (rather than 'offensive').

10. RISK CONTROLS

10.1. Introduction

Demonstrating that the risks meet the acceptance criteria is only one element of demonstrating that risks are being suitably managed.

In order to demonstrate that the risk is being controlled, ‘Multi-Level Risk Assessment’ (Ref. 2) requires a discussion of the technical controls, risk reduction measures and management measures in place.

Demonstration of control measure adequacy is detailed by compliance with the Shell Hazards & Effects Management Process (HEMP), which is covered in the Major Hazard Facility (MHF) Safety Case. The Safety Case is currently under review and will be re-submitted to WorkCover to reflect terminal operations. This section summarises the risk controls under two broad headings:

- Safety in Design
- Safety in Operation.

10.2. Safety in design

10.2.1. Codes and standards

All tanks are/will be constructed to recognised Australian and International Standards. These will be supported by the Shell Design and Engineering Practices (DEPs). Project documentation includes a complete list of standards.

An example of applicable codes and standards are AS1940 for bund walls and AS1170.2 and AS1170.4 for wind and earthquake design loadings.

10.2.2. Risk management in design

The design will be subject to the Shell risk management process. Risk management activities that directly relate to the NSW Seven Stage Planning Process are shown in Table 10.1.

Table 10.1: Risk management activities

Activity	Status
Hazard Identification	Complete - latest version reported in this document
Preliminary Hazard Analysis	Complete
Hazard & Operability Study	Complete
Fire Safety Study	Complete
Final Hazard Analysis	Complete - reported in this document
Emergency Plan Review	Complete – emergency response plan submitted for approval
Construction Safety Study	Complete
Safety Management System Update	Complete

10.2.3. Safety systems

A summary of the proposed safety systems is given in Table 10.2. Further details are available in project documentation.

Table 10.2: Proposed safety activities

System	Comment
Process Control	The process control system (tank level gauging) integrated within the Distributed Control System will be further upgraded for the new terminal operations. All product tanks and large slops tanks will be fitted with two radar gauges, one used as a primary level measurement device and the other used as an independent level measurement device connected to the safeguarding system. This arrangement allows automatic cross-checking of tank levels and will alert the operator of discrepancies between the two instruments. The independent level measurement device on the small slops tanks will be a switch.
Process Shutdown Systems	Existing pump interlocks will be retained and new tank high level trips will be provided as required to demonstrate ALARP risk. The new trips will be connected to the independent level measurement device described under 'Process Control'.
Bund Walls and Drains	The existing bunds and drains will be retained.
Fire Water	The existing firewater main, monitors and hydrants will be modified for the new terminal operations. Further details are provided in the Fire Safety Study.
Fire Protection System	The existing tank fire system will be revised and remotely operable for the new terminal operations.
Hazardous Area Classification	Ignition sources will be controlled by the application of suitable hazardous area classification standards

10.3. Safety in operation

The Clyde Refinery and Gore Bay Management System covers the following activities (relevant to Terminal operations):

- training of operators on new plant
- operating procedures
- spares and maintenance of new equipment.

As the design progresses the relevant sections of the management system will be triggered.

In addition, the management system has been updated in line with the move from refining to product import, storage and distribution.

10.4. Proposed automation & safeguarding upgrades

The following safeguards and automation upgrades are proposed:

- Yokogawa Prosafe safeguarding system will be installed to replace the functionality of the existing relay logic.
- Permissives (interlocks) will be improved to prevent the incorrect valves being opened.
- Additional valves will be installed at tanks to allow remote operation.
- The reliability of telemetry between Clyde/Gore Bay will be improved.
- The Independent High Level Alarm and tank gauging systems will be improved.
- Pump trip systems will be improved.
- The site fire system and deluge valve logic will be improved.
- Fully integrated and remotely operable foam system will be installed.
- Non-safeguarding controls will also be upgraded.

DPE requested that Viva Energy provide Safety Integrity Level (SIL) selection and verification information for tank overfill SIFs. This is separately documented in the SIL Allocation and Verification report for the tank overfill protection system (Ref. 23). Findings of the SIL study are summarised as follows:

- SIL (Average Probability of Failure on Demand, PFD_{avg}): All the SIFs assessed met the required SIL in terms of PFD_{avg}. The Safety Instrumented Functions (SIFs) meet the required SIL provided the SIF components (i.e. sensors and final elements) are tested at the specified proof test interval (Ref. 23).
- SIL (architectural constraints): All the SIFs assessed met the required SIL in terms of architectural constraints.
- SIL (systematic capability): All the SIFs assessed met the required SIL in terms of systematic capability. SIL certificates are available for all components of the SIF except for the pump relays. The pump relay was deemed to be appropriately verified and ‘proven in use’ (i.e. SIFPro data used for the pump relays).

APPENDIX A. HAZARD IDENTIFICATION WORD DIAGRAM

Table A.1: Hazard identification word diagram

Major Accident Event (Leak or Fire)	Causes	Prevention Measures	Consequences	Detection and Protection Measures
Atmospheric Storage Tanks and Bunds: Gasoline: tanks 36, 37, 38, 39, 40, 41. 50, 53, 84, 86, 87, 90; Jet fuel: tanks 34, 35, 42; Diesel: tanks 78, 79, 51; Slops: tank 82, 1704.				
Tank and associated pipework integrity failure	Internal scoring by floating roof	Tanks inspected internally on a routine basis by Inspection. Routine operator surveillance.	Leak into bund and large pool/ bund fire, if ignited. Note: diesel requires strong ignition source (eg adjacent tank/ bund fire) to result in fire. Diesel tanks considered to be tanks-on-fire only if there is potential for escalation from gasoline or jet fuel tank/ bund fire.	**Detection** Fire detection by operator or CCTV. Linear heat detection on floating roof tanks containing gasoline. **Protection** Foam and cooling water application via hydrants and monitors (fixed/ portable). Emergency Response Plan.
	Mechanical impact	Tanks in bund. Access restricted (vehicles and lifting equipment). Pipework in designated pipe tracks. Adjacent roads include crash barriers at bridges and corners, i.e. at higher risk locations. Site speed limit at 20 km/hr.		
	Corrosion	Routine operator surveillance. Risk based inspection interval set for each tank. Tank inspected internally as per API653 on a routine basis by Inspection. Corrosion allowance added to tank design. Tank outer walls painted. Online ultrasonic thickness testing undertaken routinely (as part of standard maintenance procedure), epoxy coating of the tank floor and half way up the first strake on the tank wall.		
	Underfloor corrosion	Risk based inspection interval set for each tank. Magnaflux testing undertaken. API653 and AS1940 - Inspections and operator surveillance.		
	Vacuum pulled on tank during lowering by Pressure/Vacuum valve failure	PV valves installed and overhauled on an ad-hoc basis by Inspection. Floating roof tanks are fitted with leg vents (vacuum breakers) which are serviced during tank turnarounds. Operator surveillance.		
	Crane impact (cranes will be used post commissioning for maintenance activities)	Maintenance and lifting procedures. Verification/check as part of procurement process to ensure compliance of lifting equipment with standards and legislation.		
	Excessive filling rate	Flowrates are displayed on Tank Master. Recommissioning procedures.		

Major Accident Event (Leak or Fire)	Causes	Prevention Measures	Consequences	Detection and Protection Measures
	Incorrect material lined up to tank (low flash added to high flash tank or off-grade rundown)	Operational vigilance. By design, difficult to do.		
	Hot work on tank	Permit to Work system. Hot work undertaken under constant gas monitoring. Tanks taken out of service and mechanically ventilated prior to hot work. Individual procedure issued for each tank outage. Gas monitoring of adjacent tanks.		
	Vapour space ignition - geo dome option	Ignition sources excluded by PTW. Anti-flash gauze fitted to PV valves (flame arrestor). Earthing of the roof and operator surveillance.		
Tank overfill	Level gauging failure	Level gauges calibrated on a routine basis. Independent high high level trips fitted on tank, routinely tested/calibrated. Operator monitors tank levels.		
	Passing valves	All tanks have independent high level trips fitted. Operator monitors tank levels. Flowrates are displayed on the Tank Master.		
	Isolation failure, inadvertent operation/ gravitation	Operator training and vigilance. Independent high high level trips fitted on tank, routinely tested/calibrated. Operator monitors tank levels. Non-return valve in line. Tank Master. Operator surveillance.		
	Incorrect material lined up to tank (low flash added to high flash tank)	Operational vigilance. By design, difficult to do. Tank Master.		

Major Accident Event (Leak or Fire)	Causes	Prevention Measures	Consequences	Detection and Protection Measures
Floating tank roof sink, exposing liquid.	Roof drain failure (floating roof option)	Routine operator surveillance to ensure water is not on roof and no hydrocarbon is passing into tank farm. Tanks are internally inspected on a routine basis.	Full-surface tank roof fire, if ignited. Note: diesel requires strong ignition source (eg adjacent tank/ bund fire) to result in fire. Diesel tanks considered to be tanks-on-fire only if there is potential for escalation from gasoline or jet fuel tank/ bund fire.	**Detection** Leak/ fire detection by operator or CCTV. Linear fire detection above rim seals for some tanks. **Protection** Foam header for tank roof (rim seal pourers) foam application by fire brigade tender. Foam and cooling water application via hydrants and monitors (fixed/ portable). Emergency Response Plan.
	Jammed roof	Routine operator surveillance to ensure roof is not jammed (only applicable to roofs that can be seen - cannot readily see internal pans on internal floating roof tanks) Fill rate kept inside limits. Routine monitoring.		
	Corrosion (holed roof)	Scheduled (risk based) inspection and testing of roof surface and pontoons. Operator surveillance.		
	Gas build-up under roof.	PV valves installed and overhauled during tank turnarounds. Floating roof tanks are fitted with leg vents (vacuum breakers) which are serviced during tank turnarounds.		
	Leaking pontoon	Scheduled (risk based) inspection and testing of roof surface and pontoons. Operator surveillance.		
Tank fire	Roof drain failure	Routine operator surveillance to ensure water is not on roof and no hydrocarbon is passing into tank farm. Tanks are internally inspected on a routine basis.	Rim seal fire or full-surface tank roof fire Note: diesel requires strong ignition source (eg adjacent tank/ bund fire) to result in fire. Diesel tanks considered to be tanks-on-fire only if there is potential for escalation from gasoline or jet fuel tank/ bund fire.	**Detection** Leak/ fire detection by operator or CCTV. Linear fire detection above rim seals for some tanks **Protection** Foam header for tank roof (rim seal pourers) foam application by fire brigade tender. Foam and cooling water application via hydrants and monitors (fixed/ portable). Emergency Response Plan.
	Hot work on tank	Permit to Work system. Hot work undertaken under constant gas monitoring. Tanks taken out of service and mechanically ventilated prior to hot work. Individual procedure issued for each tank outage. Gas monitoring of adjacent tanks.		
	Static electricity	Tank earth straps fitted. Floating roofs earthed through shell. Straps inspected on a routine basis by IE. Routine operator surveillance of earth straps. Filling rate on return-to-service is limited by procedure.		

Major Accident Event (Leak or Fire)	Causes	Prevention Measures	Consequences	Detection and Protection Measures
Hydrocarbon release to bund	Leaking roof drains and product release via drain	Operator surveillance. Drains isolated if found to be leaking and floating roofs monitored.	Leak into bund and large pool/ bund fire, if ignited. Note: diesel requires strong ignition source (eg adjacent tank/ bund fire) to result in fire. Diesel tanks considered to be tanks-on-fire only if there is potential for escalation from gasoline or jet fuel tank/ bund fire.	**Detection** Leak/ fire detection by operator or CCTV. Line of sight gas detection at pumphouse 2 **Protection** Foam and cooling water application via hydrants and monitors (fixed/ portable). Emergency Response Plan.
	Leaking or overfilled tank	Tank inspected internally on a routine basis by Inspection. Corrosion allowance added to tank design. Tank outer walls painted. Online ultrasonic thickness testing undertaken routinely, epoxy coating of the tank floor and half way up the first strake on the tank wall. Routine operator surveillance to detect minor leakage. Independent high level trips.		
	Piping and gasket failures	Operator surveillance. Routine inspection. Only steel piping used.		
	Pump seal leaks	Operator surveillance. Routine inspection: temperature and vibration monitoring/ survey.		
	Isolation and drain valve failure	Only steel piping used. Operator surveillance. Routine inspection.		
	Sample points and water drain left inadvertently open	Policy to install double valves. Operator training and surveillance. Water draining continually monitored. Spring loaded valve.		

Major Accident Event (Leak or Fire)	Causes	Prevention Measures	Consequences	Detection and Protection Measures
	Pipe failure through bund wall	Operator surveillance. Ad-hoc inspection.		
Pump House No. 2				
Loss of containment	Piping and gasket failures	Operator surveillance. Routine inspection. Only steel piping used.	Leak into bund and large pool/ bund fire, if ignited. Note: diesel requires strong ignition source.	**Detection** IR flammable gas detectors in pump house building. Cable fire detection in pump house building and various pumps. **Protection** Firewater deluge Foam and cooling water application via hydrants and monitors (fixed/ portable). Emergency Response Plan.
	Mechanical impact	Access restricted (vehicles and lifting equipment). Pipework in designated pipe tracks. Adjacent roads include crash barriers at bridges and corners, i.e. at higher risk locations. Site speed limit at 20 km/hr.		
	Pump seal leaks	Operator surveillance. Routine inspection: temperature and vibration monitoring/ survey		
	Isolation and drain valve failure	Only steel piping used. Operator surveillance. Routine inspection.		
	Sample points left inadvertently open	Policy to install double valves. Operator training and surveillance. Spring loaded valves (Deadman handle).		
Gasoline pumps/filters (T90)				
Loss of containment	Piping and gasket failures	Operator surveillance. Routine inspection. Only steel piping used.	Leak into bund and large pool/ bund fire, if ignited.	**Detection** Melt tube fire detection. **Protection** Automatic firewater deluge Foam and cooling water application via hydrants and monitors (fixed/ portable).
	Mechanical impact	Access restricted (vehicles and lifting equipment). Pipework in designated pipe tracks. Adjacent roads include crash barriers at bridges and corners, i.e. at higher risk locations. Site speed limit at 20 km/hr.		

Major Accident Event (Leak or Fire)	Causes	Prevention Measures	Consequences	Detection and Protection Measures
	Pump seal leaks	Operator surveillance. Routine inspection: temperature and vibration monitoring/ survey		Emergency Response Plan.
	Isolation and drain valve failure	Only steel piping used. Operator surveillance. Routine inspection.		
	Sample points left inadvertently open	Policy to install double valves. Operator training and surveillance. Spring loaded valves (Deadman handle).		
Jet Fuel Pumps				
Loss of containment	Piping and gasket failures	Operator surveillance. Routine inspection. Only steel piping used.	Leak into bund and large pool/ bund fire, if ignited. Note: diesel requires strong ignition source.	**Detection** No automatic detection. **Protection** Melt tubes initiating MCR alarm and operator action using local monitors Foam and cooling water application via hydrants and monitors (fixed/ portable). Emergency Response Plan.
	Mechanical impact	Pumps in bund. Access restricted (vehicles and lifting equipment). Pipework in designated pipe tracks. Adjacent roads include crash barriers at bridges and corners, i.e. at higher risk locations. Site speed limit at 20 km/hr.		
	Pump seal leaks	Operator surveillance. Routine inspection: temperature and vibration monitoring/ survey		
	Isolation and drain valve failure	Only steel piping used. Operator surveillance. Routine inspection.		
	Sample points left inadvertently open	Policy to install double valves. Operator training and surveillance. Spring loaded valves.		
Gasoline pumps south of T86/T87				
Loss of containment	Piping and gasket failures	Operator surveillance. Routine inspection. Only steel piping used.	Leak into pipe track and large pool/ bund fire, if ignited.	**Detection** No automatic detection.

Major Accident Event (Leak or Fire)	Causes	Prevention Measures	Consequences	Detection and Protection Measures
	Mechanical impact	Access restricted (vehicles and lifting equipment). Pipework in designated pipe tracks. Adjacent roads include crash barriers at bridges and corners, i.e. at higher risk locations. Site speed limit at 20 km/hr.		**Protection** Foam and cooling water application via hydrants and monitors (fixed/ portable). Emergency Response Plan.
	Pump seal leaks	Operator surveillance. Routine inspection: temperature and vibration monitoring/ survey		
	Isolation and drain valve failure	Only steel piping used. Operator surveillance. Routine inspection.		
	Sample points left inadvertently open	Policy to install double valves. Operator training and surveillance. Spring loaded valves.		

APPENDIX B. METEOROLOGICAL DATA

Data of wind speed and probability of it being to/from a certain direction is specified by the user and is based on meteorological data (wind rose), from a nearby weather station, obtained from the Bureau of Meteorology (BoM). The BoM does not have direct observations from Clyde. The nearest observations were taken from Olympic Park (about 4 km to the east of the site), where an automatic weather station (BoM site number 066195) provides observations of temperature, average wind speed and direction and standard deviation of wind direction.

The closest cloud observations were taken from an automatic ceilometer at Bankstown Airport (BoM site number 066137), about 10 km south of Clyde, which gives a cloud base measurement every 12 seconds. For times when the ceilometer was not available, manual cloud observations from Sydney Airport (site number 066037) were also obtained. All these data are stored in ADAM, the Bureau of Meteorology's national climate data archive, and go back to at least December 1998. However, a 30-degree error in wind direction from Olympic Park occurred sometime between an inspection in May 1999 and one in June 2000. For this reason, the four-year period from January 2001 to December 2004 was chosen by the BoM for the data analysis.

A summary of the wind speed and weather stability data from the raw data from the Bureau of Meteorology (BoM) is shown in Table B.1. The data was converted for use in Riskcurves as shown in Table B.2.

Table B.1: BOM raw data

Direction wind toward (degrees true)	Wind speed (m/s) and stability class					
	2.5 B	3.6 C	2.9 D	6.4 D	3.3 E	1.6 F
000 - 030	2.95	2.04	8.08	4.83	4.02	4.06
030 - 060	4.84	5.47	7.36	1	5.06	6.55
060 - 090	9.47	12.51	10.92	11.13	19.45	16.66
090 - 120	11.15	16.58	9.92	13.66	23.28	22.94
120 - 150	13.05	9.88	3.97	4.61	9.04	9.7
150 - 180	14.98	7.4	3.33	4.63	9.14	5.14
180 - 210	12.91	5.64	4.22	0.42	4.02	6.99
210 - 240	8.21	4.86	6.21	4.41	8.35	7.71
240 - 270	7.89	13.06	8.62	7.43	4.52	7.49
270 - 300	8.52	10.26	9.28	5.48	2.34	4.98
300 - 330	3.61	8.9	16.01	23.61	6.39	4.69
330 - 360	2.42	3.39	12.08	18.78	4.4	3.11
Number of cases	**2851**	**5283**	**9480**	**4510**	**3162**	**9404**
Fraction of total	**8.15**	**15.1**	**27.09**	**12.89**	**9.04**	**26.87**

Figure B.1: Windrose used in Riskcurves model (wind from)

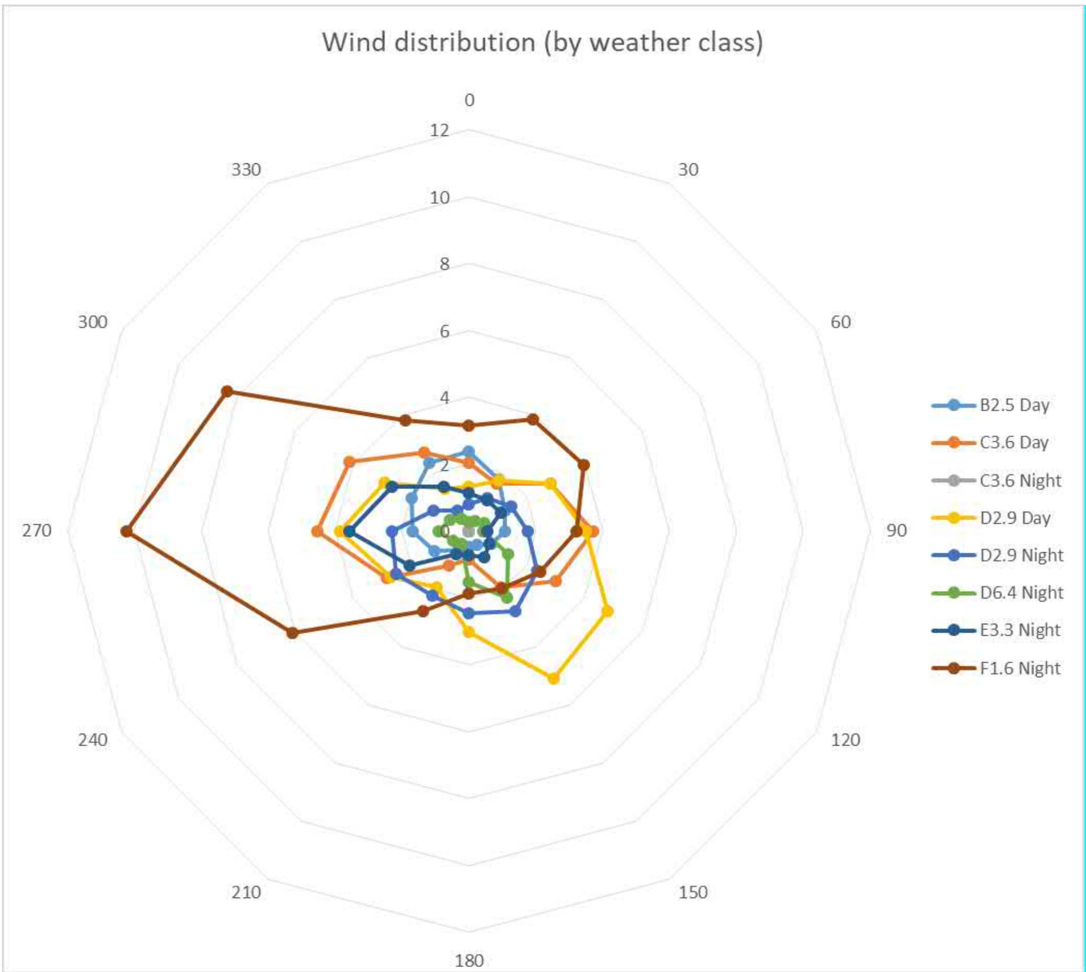


Table B.2: Weather data converted for Riskcurves model

Direction wind from (degrees true)	B2.5 Day	B2.5 Night	C3.6 Day	C3.6 Night	D2.9 Day	D2.9 Night	D6.4 Day	D6.4 Night	E3.3 Day	E3.3 Night	F1.6 Day	F1.6 Night	Total Day	Total Night
0	2.37	0.00	2.04	0.00	1.34	0.81	0.40	0.27	0.00	1.15	0.00	3.16	6.15	5.40
30	1.80	0.00	1.63	0.00	1.76	1.12	0.37	0.36	0.00	1.08	0.00	3.85	5.56	6.42
60	1.25	0.00	2.83	0.00	2.83	1.47	1.02	0.51	0.00	1.10	0.00	3.95	7.93	7.04
90	1.07	0.00	3.71	0.00	3.50	1.75	1.21	0.41	0.00	0.55	0.00	3.21	9.48	5.92
120	0.77	0.00	3.00	0.00	4.80	2.37	2.64	1.36	0.00	0.72	0.00	2.45	11.21	6.90
150	0.47	0.00	1.92	0.00	5.08	2.76	3.60	2.30	0.00	0.90	0.00	1.98	11.08	7.94
180	0.46	0.00	0.85	0.00	3.02	2.44	1.92	1.52	0.00	0.72	0.00	1.86	6.25	6.54
210	0.66	0.00	1.18	0.00	1.95	2.21	0.52	0.45	0.00	0.79	0.00	2.77	4.30	6.23
240	1.19	0.00	2.83	0.00	2.71	2.53	1.02	0.55	0.00	2.06	0.00	6.10	7.75	11.24
270	1.69	0.00	4.53	0.00	3.85	2.30	2.24	0.91	0.00	3.56	0.00	10.25	12.32	17.02
300	1.99	0.00	4.13	0.00	2.89	1.24	1.69	0.65	0.00	2.64	0.00	8.35	10.70	12.88
330	2.34	0.00	2.71	0.00	1.45	0.71	0.75	0.43	0.00	1.52	0.00	3.81	7.25	6.47
Total	**16.06**	**0.00**	**31.37**	**0.00**	**35.19**	**21.71**	**17.38**	**9.73**	**0.00**	**16.82**	**0.00**	**51.74**	**100.00**	**100.00**

APPENDIX C. FREQUENCY DATA

C1. Overview

The leak frequency results and representative leak sizes were adjusted during the conversion from Shell Shepherd to TNO Riskcurves, and these are described below.

Table C.1: Summary of changes to the frequencies in the risk model

Scenario/ consequence	Frequency	Description of changes to frequency (if any)
Tank roof fires	Tank roof fire frequency	No change
Tank overfill cascade vapour dispersion	Tank bund overfill flash fire frequency	No change in method, but frequencies updated with the latest information.
Tank bund fires	Tank bund fire frequency	No change in method, but frequencies updated with the latest information.
Pump pit fires	Pump pit fire frequency	No change
Pipe track pool fires	Pipe track pool fire frequency	Revised frequencies based on HSE Failure Rate and Event Data (FRAED) (Ref. 24). Changes to pipe track pool fire frequencies described in C1.7.
Pipe track vapour dispersion	Pipe track flash fire frequency	Revised frequencies for pipework with added hole sizes based on FRAED. Revised frequencies for all hole sizes to include pipework usage factor. Changes to pipe track flash fire frequencies described in C1.7.

C2. Hole size

Loss of containment from equipment was modelled for the representative range of hole sizes summarised in Table C.2. Additional hole sizes for other pipework were based on FRAED.

Table C.2: Clyde terminal – Representative hole sizes for modelling loss of containment

Equipment Item	Equivalent Leak Size Diameter (mm)
Flanges and equivalent valves	2.5
Instrument fitting (< 1 inch diameter)	20
Connection (> 1 inch diameter)	50
Pipework	3
	4
	25
	1/3 pipework diameter
	Guillotine
Pump seal	10
Pump casing failure	Full Bore

C3. Parts count

The equipment parts count is summarised in Table C.3, based on information in the FHA.

Table C.3: Parts count

Equipment Type	Average Leak Source Count per Equipment Item		
	Connections (> 25 mm)	Flange / Valve Equivalents	Fittings (< 25 mm)
Pumps	1	18	9
Filter[(a)]	1	5	1
Pipe	3	20	3
(a) Not shown in the FHA.			

C4. Usage factor

The usage factor for pipelines and equipment is summarised in Table C.4. The usage factor was based on the online time factor from the FHA.

Table C.4: Usage factor

ID	Pipe/ equipment	Usage
01_5P_005	Gasoline Import from Gore Bay	43%
01_5P_006	Gasoline from Pumphouse 2 to Hunter Export Line	30%
01_5P_007	Gasoline from Pumphouse 2 to Tank 90	100%
01_5P_008	Jet transfer from Pumphouse 2 to jet pumps	30%
01_5P_009	Jet transfer from Pumphouse to JUHI pipeline	30%
01_5P_010	Gasoline to Tankfarm B	100%

C5. Ignition probability

The ignition probabilities that were used for the study were derived from data provided in Cox, Lees and Ang (Ref. 19). Table C.5 and Table C.6 were extracted from Table 15.3 and Table 16.3 in Cox, Lees and Ang (Ref. 19), and an example of the ignition probabilities used for various materials is shown in Table C.7, based on a 2 kg/s release rate.

In TNO Riskcurves, the consequence and frequency of a delayed ignition is required, whereas in Shell Shepherd, the delayed ignition is derived based on the area covered an event not immediately ignited, e.g. a gas cloud. Thus, events such as flash fires have different frequencies in the two models.

Table C.5: Estimated probability of ignition of leaks of flammable gas or liquid

Leak rate	Probability of ignition	
	Gas	Liquid
<1 kg/s	0.01	0.01
1 - 50 kg/s	0.07	0.03
>50 kg/s	0.3	0.08

Table C.6: Estimated probability of explosion given ignition for leaks of flammable gas

Leak rate	Probability of explosion given ignition [a]
<1 kg/s	0.04
1 - 50 kg/s	0.12
>50 kg/s	0.3
Note: (a) Probability of explosion given leak of a flammable gas is equal to the delayed ignition probability of a flammable gas.	

Table C.7: Example ignition probabilities used in the study (2 kg/s leak)

Material	Probabilities		Outcome frequencies assuming a leak frequency of 1/ year	
	Immediate ignition	Delayed ignition	Pool Fire/ Jet Fire	Flash Fire
Gasoline/ Ethanol	0.07	0.12	0.062	0.0084
Jet Fuel	0.03	0	0.03	0
Diesel [a]	0.003	0	0.003	0
Note: (a) Releases for combustible liquids such as diesel are more difficult to ignite due to their high flash point. In this study, an assumption was factored to the ignition probability for diesel to be one-tenth that of flammable liquids such as Jet Fuel.				

C6. Summary of leak frequencies

A summary of the leak frequencies used in the risk model is presented in Table C.8 and Table C.9. The reference sources for the leak frequencies used in the risk model are presented in Table C.10.

Table C.8: Summary of failure & event frequencies used in risk model

Equipment Item	Equivalent leak size diameter (mm)	Frequency (per item-year)
Flanges and equivalent valves	2.5	2.2×10^{-4}
Instrument fitting (< 1 inch diameter)	20	1×10^{-4}
Connection (> 1 inch diameter)	50	1×10^{-5}
Pipe rupture	Refer to Table C.10	Refer to Table C.10
Pump seal	10	3×10^{-3} (single seal)
Pump casing failure	Full bore	3×10^{-5}
Tank catastrophic failure	-	3×10^{-6}

Table C.9: FRAED leak frequencies for other pipework

Hole size (mm)	Frequency (per m-year) for pipework diameter (mm)				
	0 – 49	50 – 149	150 – 299	300 – 499	500 – 1000
3	1×10^{-5}	2×10^{-6}	-	-	-
4	-	-	1×10^{-6}	8×10^{-7}	7×10^{-7}
25	5×10^{-6}	1×10^{-6}	7×10^{-7}	5×10^{-7}	4×10^{-7}
1/3 pipework diameter	-	-	4×10^{-7}	2×10^{-7}	1×10^{-7}
Guillotine	1×10^{-6}	5×10^{-7}	2×10^{-7}	7×10^{-8}	4×10^{-8}

Table C.10: Summary of leak frequencies and reference sources

Equipment Item	Representative Release Orifice			Leak Frequency (per item-year)
	Diameter (mm)	Justification	Reference	
Flanges and equivalent valves	2.5	Spiral wound gaskets are used for all flanges in hydrocarbon service at the Refinery. A spiral wound gasket failure results in leaks along the spiral path. Valve gland failure, for pipes sized 50 mm or larger, are typically represented by 10 mm leak orifices. SHEPHERD models flange and valve leaks as one component; therefore, a 2.5 mm hole was carried forward.	Cox, Lees, Ang (1991)	2.2×10^{-4}
Instrument fitting (< 1" diameter)	20	Failure of an instrument fitting (typically 20 mm inner-bore diameter) could result in a 20 mm hole size. Material failure or poor installation may result in a major pipe leak 20 mm in size.	Cox, Lees, Ang (1991)	1×10^{-4}
Connection (> 1" diameter)	50	Failure of a connection (typically 50 mm inner-bore diameter) could result in a 50 mm hole size.	Assumption	1×10^{-5}
Pump Seal	10	Mechanical seals limit the leak size due to close tolerances and small bleed points. The leak is approximated by 10 mm in the worst case.	Assumption	3×10^{-3} (single seal)
Pump Casing Failure	Full Bore	Catastrophic failure of a casing may be due to external causes (e.g. external impacts, unchecked vibration) resulting in a leak size equivalent to a full bore rupture of the pipework attached to the pump.	Assumption	3×10^{-5}
Pipe Rupture	Refer to Table C.10	Excessive stress, corrosion/erosion and impact are potential causes of a full-bore rupture of a pipe. The release size is dependent on the diameter of the pipe.	FRAED	Refer to Table C.10
Tank Failure	-	Catastrophic failure of an atmospheric storage tank	OGP Storage incident frequencies report, (Ref. 25)	3×10^{-6}

C7. Fire frequencies

The fire frequencies were calculated using leak frequencies, parts counts, usage factor and ignition probabilities. In some cases, historical data was used directly for the fire frequency.

C7.1. Tank roof fire

Full surface tank roof fire frequencies were estimated from the most recent LASTFire project (Ref. 26) based on the storage tank type.

The LASTFire study was updated in 2012, and the revised full surface tank top fire frequencies have been adopted:

- Fixed roof: 2.1×10^{-5} /year
- External floating roof: 5.3×10^{-5} /year
- Internal floating roof: no full-surface tank roof fires recorded.

The rim seal fire frequency for internal floating roof tanks is given as 4.4×10^{-5} /year, and assuming that there is a 10% chance that the foam pouring system fails to prevent a rim seal fire escalating to a full surface roof fire (based on the assumed performance and reliability of the foam pouring system), a tank fire frequency of 4.4×10^{-6} /year was adopted for internal floating roof tanks for this study.

C7.2. Tank overfill

Tank overfill frequencies were taken from the site's Layers of Protection Analyses (LOPA), which considers two threats:

- Failure of the tank gauging system leading to either:
  - incorrect ullage calculation prior to tank filling and hence the risk of too much product directed to the tank; or
  - incorrect level measurement during tank filling and hence the risk of a false indication of the fill level in the tank and incorrect level alarms from the tank gauging system.
- Valve line-up error during tank change-overs to tank filling leading to:
  - Changing the product flow path to, and thus filling, the incorrect tank (which may be full); or
  - Failing to change the product flow path and thus continuing to fill the previously filled tank.

A summary of the tank overfill LOPA calculation is given in Table C.13 and Table C.14.

Based on the overfill LOPA, the catastrophic failure frequencies and the ignition probabilities frequencies shown in Table C.11 and Table C.12 were used in the QRA.

Table C.11: Bund fire frequencies

Bund	Frequency (/year)
E1	7.9E-06
E2	1.1E-05
K	1.8E-06
B	3.5E-06
B1	1.6E-06
B2	1.2E-07
Green	6.2E-06
91/92	2.7E-05

Table C.12: VCE frequencies

Tank	Frequency (/year)
36	2.9E-07
37	2.9E-07
38	2.9E-07
39	2.9E-07
40	2.9E-07
41	2.9E-07
50	4.7E-07
53	4.7E-07
82	6.7E-07
84	5.1E-07
86	7.2E-07
87	7.2E-07
90	5.1E-07
91	1.8E-06
92	1.8E-06
1704	6.7E-07

Table C.13: Summary of tank overfill LOPA [main import]

																Overfill frequency for QRA		
Tank Number	Tank Farm	Service	Modelled as	Type of High Level Alarm	Type of High-High Level Alarm	Frequency of Tank Line-ups [incl. critical steps] (pa)	PFD Line-up	IEF (A) Level Gauge Failure (pa)	IEF (B) ValveLine-up Error (pa) [A]	PFD High Level Alarm & Operator Response	PFD High Level Trip (Note 5)	Trip (Note 5)	Emergency Response	PFD Rough Dips	PFD Independent Valve Line-up Check	Line-up	Level Gauge	Total
										C2(B)	C4			C5(A)	C6			
T33	B2	Diesel	Diesel	Radar	Radar	46	0.001	0.01	0.046	0.1	0.0029	SIL-1	1	0.1	0.1	1.35E-06	2.93E-06	4.3E-06
T34	B1	Jet fuel	Jet fuel	Radar	Radar	38	0.001	0.01	0.038	0.1	0.0044	SIL-2	1	0.1	0.1	1.67E-06	4.39E-06	6.1E-06
T35	B1	Jet fuel	Jet fuel	Radar	Radar	38	0.001	0.01	0.038	0.1	0.0044	SIL-2	1	0.1	0.1	1.67E-06	4.39E-06	6.1E-06
T36	E1	Gasoline	Gasoline	Radar	Radar	26	0.001	0.01	0.026	0.1	0.0025	SIL-2	1	0.1	0.1	6.40E-07	2.46E-06	3.1E-06
T37	E1	Gasoline	Gasoline	Radar	Radar	26	0.001	0.01	0.026	0.1	0.0025	SIL-2	1	0.1	0.1	6.40E-07	2.46E-06	3.1E-06
T38	E1	Gasoline	Gasoline	Radar	Radar	26	0.001	0.01	0.026	0.1	0.0025	SIL-2	1	0.1	0.1	6.40E-07	2.46E-06	3.1E-06
T39	E1	Gasoline	Gasoline	Radar	Radar	26	0.001	0.01	0.026	0.1	0.0025	SIL-2	1	0.1	0.1	6.40E-07	2.46E-06	3.1E-06
T40	E1	Gasoline	Gasoline	Radar	Radar	26	0.001	0.01	0.026	0.1	0.0025	SIL-2	1	0.1	0.1	6.40E-07	2.46E-06	3.1E-06
T41	E1	Gasoline	Gasoline	Radar	Radar	26	0.001	0.01	0.026	0.1	0.0025	SIL-2	1	0.1	0.1	6.40E-07	2.46E-06	3.1E-06
T42	B1	Jet fuel	Jet fuel	Radar	Radar	38	0.001	0.01	0.038	0.1	0.0044	SIL-2	1	0.1	0.1	1.67E-06	4.39E-06	6.1E-06
T50	B	Gasoline	Gasoline	Radar	Radar	18	0.001	0.01	0.018	0.1	0.0044	SIL-2	1	0.1	0.1	7.89E-07	4.39E-06	5.2E-06
T51	B	Diesel	Diesel	Radar	Radar	46	0.001	0.01	0.046	0.1	0.0044	SIL-1	1	0.1	0.1	2.02E-06	4.39E-06	6.4E-06
T53	B	Gasoline	Gasoline	Radar	Radar	18	0.001	0.01	0.018	0.1	0.0044	SIL-2	1	0.1	0.1	7.89E-07	4.39E-06	5.2E-06
T78	B2	Diesel	Diesel	Radar	Radar	46	0.001	0.01	0.046	0.1	0.0029	SIL-1	1	0.1	0.1	1.35E-06	2.93E-06	4.3E-06
T79	B2	Diesel	Diesel	Radar	Radar	46	0.001	0.01	0.046	0.1	0.0029	SIL-1	1	0.1	0.1	1.35E-06	2.93E-06	4.3E-06
T82	E2	Slops	Gasoline	Radar	Radar	60	0.001	0.01	0.06	0.1	0.0044	SIL-2	1	0.1	0.1	2.63E-06	4.39E-06	7.0E-06
T84	E2	Gasoline	Gasoline	Radar	Radar	26	0.001	0.01	0.026	0.1	0.0044	SIL-2	1	0.1	0.1	1.14E-06	4.39E-06	5.5E-06
T86	E2	Gasoline	Gasoline	Radar	Radar	74	0.001	0.01	0.074	0.1	0.0044	SIL-2	1	0.1	0.1	3.25E-06	4.39E-06	7.6E-06
T87	E2	Gasoline	Gasoline	Radar	Radar	74	0.001	0.01	0.074	0.1	0.0044	SIL-2	1	0.1	0.1	3.25E-06	4.39E-06	7.6E-06
T90	K	Gasoline	Gasoline	Radar	Radar	130	0.001	0.01	0.13	0.1	0.0025	SIL-2	1	0.1	0.1	3.20E-06	2.46E-06	5.7E-06
T91	91/92	Slops	Gasoline	Radar	Switch	12	0.001	0.02	0.012	0.1	0.1	SIL-a	1	0.1	0.1	1.20E-05	2.00E-04	2.1E-04
T92	91/92	Slops	Gasoline	Radar	Switch	12	0.001	0.02	0.012	0.1	0.1	SIL-a	1	0.1	0.1	1.20E-05	2.00E-04	2.1E-04
T103	Green	Slops	Jet fuel	Radar	Radar	0												
T104	Green	Slops	Jet fuel	Radar	Radar	12	0.001	0.01	0.012	0.1	0.1	SIL-a	1	0.1	0.1	1.20E-05	1.00E-04	1.1E-04
T105	Green	Slops	Jet fuel	Radar	Radar	12	0.001	0.01	0.012	0.1	0.1	SIL-a	1	0.1	0.1	1.20E-05	1.00E-04	1.1E-04
T1704	E2	Slops	Gasoline	Radar	Radar	60	0.001	0.01	0.06	0.1	0.0044	SIL-1	1	0.1	0.1	2.63E-06	4.39E-06	7.0E-06

Notes:

1. Critical steps for Clyde have been set at 2 for main import. This means that there is the chance of an error when manipulating valves on the manifold (1), and the chance of an error when setting the target tank (1).
2. Manual tank fills, eg 91/92 from road tanker is assumed to have a similar number of critical steps.
3. Data checked at meeting on 1 September 2014 (A Aloisio, J Anandanathan), plus subsequent confirmation 26 September 2014.
4. LOPA based on Shell Downstream Model Bow tie (DS-20-01-RP-02) and Shell Downstream Manufacturing Model Bow tie (DSM-2500003-RP-25). Gauge cross-check functionality has been used to reduced IEF(A) by 50%, when 2 radar gauges are available. ER credit is not taken, as no detection is included. Rough dips are taken, assuming monthly manual dipping, or other independent form of level verification, independent line-up check credit taken, ie valves lined up and checked by either an independent operator, or a DCS based checking system.
5. The tanks will have a high level alarm, and a high-high level trip, except for slops tanks 103/104/105/106 and 91/92 which have an alarm in place of the trip. PFDs for high level trips are based on the SIL Selection and Verification report - Clyde Terminal Conversion Project Option A Minus (Report no. 20884-RP-001 Rev 1).
6. Instrumentation on tanks T103/104/105 updated with revised information from D. Tan.
7. Green slops tanks T103/104/105 are arranged such that T103 will overflow to T104/105. Therefore only two sources of overfill from tanks T104/105.

Table C.14: Summary of tank overfill LOPA [tank-to-tank fills]

																Overfill frequency for QRA		
Tank Number	**Tank Farm**	**Service**	**Modelled as**	**Type of High Level Alarm**	**Type of High-High Level Alarm**	**Frequency of Tank Line-ups [incl. critical steps] (pa) (Note 6)**	**PFD Line-up**	**IEF (A) Level Gauge Failure (pa)**	**IEF (B) ValveLine-up Error (pa) [A]**	**PFD High Level Alarm & Operator Response**	**PFD High Level Trip (Note 5)**	**Trip (Note 5)**	**Emergency Response**	**PFD Rough Dips**	**PFD Independent Valve Line-up Check**	**Line-up**	**Level Gauge**	**Total**
										C2(B)	C4			C5(A)	C6			
T33	B2	Diesel	Diesel	Radar	Radar	9.2	0.001		0.0092	0.1	0.0010	SIL-1	1	0.1	0.1	9.31E-08		9.3E-08
T34	B1	Jet fuel	Jet fuel	Radar	Radar	7.6	0.001		0.0076	0.1	0.0025	SIL-2	1	0.1	0.1	1.87E-07		1.9E-07
T35	B1	Jet fuel	Jet fuel	Radar	Radar	7.6	0.001		0.0076	0.1	0.0025	SIL-2	1	0.1	0.1	1.87E-07		1.9E-07
T36	E1	Gasoline	Gasoline	Radar	Radar	5.2	0.001		0.0052	0.1	0.0025	SIL-2	1	0.1	0.1	1.28E-07		1.3E-07
T37	E1	Gasoline	Gasoline	Radar	Radar	5.2	0.001		0.0052	0.1	0.0025	SIL-2	1	0.1	0.1	1.28E-07		1.3E-07
T38	E1	Gasoline	Gasoline	Radar	Radar	5.2	0.001		0.0052	0.1	0.0025	SIL-2	1	0.1	0.1	1.28E-07		1.3E-07
T39	E1	Gasoline	Gasoline	Radar	Radar	5.2	0.001		0.0052	0.1	0.0025	SIL-2	1	0.1	0.1	1.28E-07		1.3E-07
T40	E1	Gasoline	Gasoline	Radar	Radar	5.2	0.001		0.0052	0.1	0.0025	SIL-2	1	0.1	0.1	1.28E-07		1.3E-07
T41	E1	Gasoline	Gasoline	Radar	Radar	5.2	0.001		0.0052	0.1	0.0025	SIL-2	1	0.1	0.1	1.28E-07		1.3E-07
T42	B1	Jet fuel	Jet fuel	Radar	Radar	7.6	0.001		0.0076	0.1	0.0025	SIL-2	1	0.1	0.1	1.87E-07		1.9E-07
T50	B	Gasoline	Gasoline	Radar	Radar	3.6	0.001		0.0036	0.1	0.0025	SIL-2	1	0.1	0.1	8.87E-08		8.9E-08
T51	B	Diesel	Diesel	Radar	Radar	9.2	0.001		0.0092	0.1	0.0025	SIL-1	1	0.1	0.1	2.27E-07		2.3E-07
T53	B	Gasoline	Gasoline	Radar	Radar	3.6	0.001		0.0036	0.1	0.0025	SIL-2	1	0.1	0.1	8.87E-08		8.9E-08
T78	B2	Diesel	Diesel	Radar	Radar	*No additional filling operations carried out for these tanks (all considered under the 'main' import)*												
T79	B2	Diesel	Diesel	Radar	Radar													
T82	E2	Slops	Gasoline	Radar	Radar	12	0.001		0.012	0.1	0.0031	SIL-2	1	0.1	0.1	3.72E-07		3.7E-07
T84	E2	Gasoline	Gasoline	Radar	Radar	5.2	0.001		0.0052	0.1	0.0025	SIL-2	1	0.1	0.1	1.28E-07		1.3E-07
T86	E2	Gasoline	Gasoline	Radar	Radar	14.8	0.001		0.0148	0.1	0.0025	SIL-2	1	0.1	0.1	3.65E-07		3.6E-07
T87	E2	Gasoline	Gasoline	Radar	Radar	14.8	0.001		0.0148	0.1	0.0025	SIL-2	1	0.1	0.1	3.65E-07		3.6E-07
T90	K	Gasoline	Gasoline	Radar	Radar	*No additional filling operations carried out for these tanks (all considered under the 'main' import)*												
T91	91/92	Slops	Gasoline	Radar	Switch													
T92	91/92	Slops	Gasoline	Radar	Switch													
T103	Green	Slops	Jet fuel	Radar	Radar													
T104	Green	Slops	Jet fuel	Radar	Radar													
T105	Green	Slops	Jet fuel	Radar	Radar													
T1704	E2	Slops	Gasoline	Radar	Radar	12	0.001		0.012	0.1	0.0031	SIL-1	1	0.1	0.1	3.72E-07		3.7E-07

Notes:
1. Critical steps for Clyde have been set at 2 for main import. This means that there is the chance of an error when manipulating valves on the manifold (1), and the chance of an error when setting the target tank (1).
2. Manual tank fills, eg 91/92 from road tanker is assumed to have a similar number of critical steps.
3. Data checked at meeting on 1 September 2014 (A Aloisio, J Anandanathan), plus subsequent confirmation 26 September 2014.
4. LOPA based on Shell Downstream Model Bowtie (DS-20-01-RP-02) and Shell Downstream Manufacturing Model Bowtie (DSM-2500003-RP-25). Gauge cross-check functionality has been used to reduced IEF(A) by 50%, when 2 radar gauges are available. ER credit is not taken, as no detection is included. Rough dips are taken, assuming monthly manual dipping, or other independent form of level verification, independent line-up check credit taken, ie valves lined up and checked by either an independent operator, or a DCS based checking system.
5. The tanks will have a high level alarm, and a high-high level trip, except for slops tanks 103/104/105/106 and 91/92 which have an independent high level alarm at an appropriate level such that an operator will be able to respond to prevent an overfill. PFDs for high level trips are based on the SIL Selection and Verification report - Clyde Terminal Conversion Project Option A Minus (Report no. 20884-RP-001 Rev 1).
6. Alternative filling, ie tank-to-tank, estimated to be 20% of the number of main fills. The flow rate is smaller than for the main fills, but still above 50kg/s.
7. Only tanks that may be subject to tank-to-tank fills shown.

With reference to the column headings in Table C.12 and Table C.13, the tank overfill Model Bow Tie Layers of Protection Analysis (LOPA) was quantified in the context of the following:

- C2 is not independent of Initiating Event A, level gauge failure, since the High Level Alarm is generated by the level gauge system (which by definition has failed in Event A). No credit given for C2 in Initiating Event A.
- C4 is independent of the tank gauging system (the signal is from an independent tank gauge) so credit for both Initiating Events A and B.
- C5 requires that the site has in place a procedure for follow-up of deviations found with rough dips or indications that tank gauging system is not working. This is achieved via a single yearly tank dip to calibrate the tank gauging system and daily stock reconciliation. This constitutes an alternate means of measuring tank level, which satisfies the intent of the barrier and thus valid.
- C6 is in place and credit is given.

The LOPA calculation to evaluate overfill frequency can be summarised as follows:

Overfill frequency = $[(IEF_A \times C4 \times C5) + (IEF_B \times C2 \times C4 \times C6)]$

Where:

IEF_A = Failure rate of ATG (1/30 pa for servo-gauge type or 1/50 pa for radar gauge type)

IEF_B = Frequency of tank line-ups x PFD Line-Up (ie the human error probability per critical line-up = 0.001 if there is written line-up procedure with a checklist)

C2 = Probability of failure on demand (PFD) of High Level Alarm (from ATG) & Operator Response = 0.1

C4 = Probability of failure on demand (PFD) of trip = 0.1 or 1

C5 = PFD of procedure to follow up deviations from rough dips = 0.1

C6 = PFD of independent valve line-up check = 0.1

Note: the ignition probabilities are described in Section 8.2.

C7.3. Pump pit fire frequencies

The pump pit fire frequencies were calculated using the product of the leak frequencies, parts count of pumps and vessels within a pump pit and number of pumps and vessels within a pump pit and ignition probabilities as described in Appendix C5.

The leak frequencies for equipment are summarised in Table C.15. The number of pumps and vessels and the pump pit fire frequencies for each location used for the risk model are summarised in Table C.16.

Table C.15: Equipment leak frequencies

Equipment Item	Leak Frequency (per item-year)
Flanges and equivalent valves	2.2×10^{-4}
Instrument fitting (< 1 inch diameter)	1×10^{-4}
Connection (> 1 inch diameter)	1×10^{-5}
Pump seal	3×10^{-3} (single seal)
Pump casing failure	3×10^{-5}

Table C.16: Pump pit fire frequencies

ID	Location of pump pit	Number of pumps	Number of filters	Fire frequency (per year)		
				Pumps	Filters	Total
01_5P_001	Tankfarm B/B1 pump pit WEST (jet filters)	4	5	6.39E-04	7.40E-05	7.13E-04
01_5P_002	Pump House 2	8[(a)]	0	2.31E-03	0.00E+00	2.31E-03
01_5P_003	ULP delivery pump Pit	2	6	5.73E-04	1.04E-04	6.78E-04
01_5P_004	Gasoline pumps	2	0	5.76E-04	0.00E+00	5.76E-04
Note: (a) 7 existing pumps plus re-installed GB slops transfer pump						

C7.4. Pipe track pool fire frequencies

The pipe track pool frequencies were calculated using the product of the leak frequencies usage factor and ignition probabilities as described in Appendix C5.

Changes to the frequencies in the risk model compared to Clyde terminal FHA report are that additional hole sizes and corresponding frequencies based on UK HSE Failure Rate and Event Data (Ref. 24) were added for compatibility of risk modelling from Shell Shepherd to TNO Riskcurves.

The pipe track pool fire frequencies used in the risk model are summarised in Table C.17.

Table C.17: Pipe track pool fire frequencies

ID	Pipe name	Content	Pipe diameter (mm)	Hole size (mm)	Pool fire frequency (per m year)
01_5P_005	Gasoline Import from Gore Bay	Gasoline	300	4	3.30E-09
				25	1.33E-08
				100	1.81E-08
				300	6.32E-09
01_5P_006	PH2-Hunter	Gasoline	150	4	2.88E-09
				25	1.30E-08
				50	2.52E-08
				150	1.26E-08
01_5P_007	PH2-T90	Gasoline	200	4	9.60E-09
				25	4.34E-08
				67	2.48E-08
				200	4.20E-08
01_5P_008	JTPH2-JP	Jet Fuel	300	4	2.40E-09
				25	4.50E-09
				100	4.80E-09
				300	1.68E-09
01_5P_009	JTPH2-JUHI	Jet Fuel	200	4	3.00E-09
				25	6.30E-09
				67	3.60E-09
				200	6.30E-10
01_5P_010	PH2-TFB	Gasoline	400	4	7.68E-09
				25	3.10E-08
				133	4.20E-08
				400	1.47E-08

C7.5. Pipe track vapour dispersion (flash fire) frequencies

The pipe track flash fire frequencies were calculated using the product of the leak frequencies, usage factor and ignition probabilities as described in Appendix C5.

The pipe track flash fire frequencies used in the risk model are summarised in Table C.18.

Table C.18: Pipe track flash fire frequencies

ID	Pipe name	Content	Pipe diameter (mm)	Hole size (mm)	Flash fire frequency (per m year)
01_5P_005	Gasoline Import from Gore Bay	Gasoline	300	4	1.38E-10
				25	1.81E-09
				100	7.74E-09
				300	2.71E-09
01_5P_006	PH2-Hunter	Gasoline	150	4	1.20E-10
				25	1.76E-09
				50	1.08E-08
				150	5.40E-09
01_5P_007	PH2-T90	Gasoline	200	4	4.00E-10
				25	5.88E-09
				67	3.36E-09
				200	1.80E-08
01_5P_010	PH2-TFB	Gasoline	400	4	3.20E-10
				25	4.20E-09
				133	1.80E-08
				400	6.30E-09
				20	4.20E-11
				100	1.68E-11

APPENDIX D. IMPAIRMENT CRITERIA

D1. Impairment criteria

Impairment criteria were used to determine the effects that the physical consequences may have on defined receivers, viz.:

- Offsite populations
- Structures and equipment.

The following types of effects were assessed:

- Thermal radiation
- Explosion overpressure.

The type of effect for each receiver is discussed in this Appendix.

D1.1. Thermal effects on people

The effect of thermal radiation on people is a function of the incident heat flux and time of exposure. TNO Green Book (and is quoted in Lees, Ref.27) suggests the following probit (Y) equation for personnel protected by normal clothing:

$$Y = -37.23 + 2.56\ln(tI^{4/3})$$

For average exposure durations (times to escape), the probit equation gives the following:

Table D.1: Incident heat flux for various fatality levels

Probability of fatality	Incident heat flux (kW/m^2)		
	120 seconds exposure	60 seconds exposure	30 seconds exposure
1%	3.3	5.5	9.3
10%	4.5	7.5	12.7
50%	6.5	11.0	18.4
90%	9.5	15.9	26.8
99%	13.2	22.1	37.2

In terms of fatality calculations, the Riskcurves model represents a fire with three fatality zones. The user defines the heat radiation level and the fatality probability in each zone, as described below:

Heat radiation fatality zone	Fatality probability
>14 kW/m^2	100% fatality
Between 14 and 4.7kW/m^2	50% Fatality
< 4.7 kW/m^2	Injury

D1.2. Explosion Overpressure Effects on People

To calculate the individual fatality risk contours in Riskcurves, the effects on people (in terms of fatalities) from vapour cloud explosion overpressure are accounted for by the fire consequence size (i.e. personnel within the flash fire are assumed to be fatalities).

The method to predict the vapour cloud consequences outlined by the Health and Safety Executive (HSE) (Ref. 28) confirms that the extent of the vapour cloud corresponds with the maximum extent of damage caused by an explosion. Hence, in this study, the extent of the vapour cloud is used to represent the VCE consequence.

D1.3. Thermal effects on equipment and structures

Shell FRED contains a heat-up model. The Clyde Refinery Formal Safety Assessment (Ref. 29), conducted in 2000, identified 9 classes of fire (representing jet, spray and pool fires for different hydrocarbon releases) and 30 target vessels. The target vessels were rationalised based on the material type and wall thickness and heat up calculations were executed. The conclusion of the study was a representative rule set for critical time to vessel failure due to fire, as shown in Table D.2. This rule set was verified using Vessfire and carried forward for this study.

No updates to this methodology were made for the Clyde Terminal operation.

Table D.2: Rule set for critical time to vessel failure

Fire scenario	Wall thickness (mm)	Time to failure (minutes)
Jet / Spray	< 20	2
	> 20	6
Pool fire (leak rate > 20kg/s)	< 20	10
	> 20	30
Pool fire (leak rate < 20kg/s)	< 20	5
	> 20	10
Non-impinging fire	< 20	30
	> 20	60

APPENDIX E. RECORD OF INCORPORATION OF NSW DPE COMMENTS FOR PHA

A draft version of the PHA Report (Clyde Terminal Conversion Project, Clyde Refinery Site, Document No J20648-001, rev. A, dated August 2012) was provided to the NSW Department of Planning and Infrastructure (DPE) for initial review and comment prior to formal submission.

Comments were received from Lilia Donkova (Lilia.Donkova@planning.nsw.gov.au), on behalf of the NSW DPE, by email on Friday 14/09/2012 10:27 AM.

The following table summarises the updates made to address DPE's comments. Sections, tables and figures referenced are based on the PHA and are not reflective of the FHA.

Item	NSW DPE Comments	Close-Out Discussion
1	Sufficient information on the equipment and the activities to be undertaken on site. For example:	Report includes additional information on activities to be undertaken on site (see below):
1.1	Details on the pipeline from the Wharf 1 at Gore Bay, including operating pressure, diameter, etc.;	N/A for Clyde Terminal
1.2	Details on the surrounding land uses, including distance to the nearest residential and sensitive land use, where applicable;	Additional information is provided
2	During the presentation given by Shell to the Department it was stated that both developments would upgrade the safeguards and would increase the automation on site. It is recommended details on the upgrade to be provided.	Additional information is provided.
3	Information on compliance with relevant standards and in particular AS 1940 and AS 2885. If compliance cannot be demonstrated, then information on the alternative (existing and proposed) safety measures in place to ensure the same or higher level of safety to be provided.	This has not been addressed herein. Queries regarding the degree of compliance with Australian Standards should be directed to the project engineering managers.
4	All DGRs must be addressed.	A PHA has been completed, including a discussion on how lessons from the Buncefield Incident have been incorporated.
5	The analysis undertaken for selection of the appropriate frequencies. (The frequencies of the equipment should be based on review of the	More information regarding the review and selection of frequency data is now provided.

Item	NSW DPE Comments	Close-Out Discussion
	available data and should demonstrate that they are appropriate for the type and the age of the facility.)	
6	The assumption of the PHA, for example:	The assumptions list has been expanded.
6.1	The integrity of a bund in an event of sudden loss of containment;	As above.
6.2	Drawings representing the arrangement of tanks within the bunds;	Detail of tanks within bunds are now provided.
6.3	Justification on the assumption to adopt thermal radiation of 14 kW/m^2 as end point for calculation of the distance to fatality. It is noted (Table D1 of Gore Bay report) that the probability of fatality calculated is 99% at 13.2 kW/m^2 for 120 sec of exposure. The PHA assumes 100% probability of fatality at heat radiation higher than 14kW/m^2. No information on assumed time of exposure in SHEPERD model is provided.	Based on the probit-evaluated heat fluxes (see APPENDIX D Section D.1.1) for 99% and 99.9% chance of fatality for 120s exposure (ie 13.2 kW//m^2 and 16.2 kW//m^2, respectively), a value of 14 kW/m^2 was conservatively assumed to cause 100% chance of fatality.
6.4	Time for isolation (in case of the pipe leak for example)	The leak detection and isolation time is discussed in APPENDIX D (Section D.1.1).
7	Methodology/theory for modelling – for example view factor or point source for was used for the pool fires	The view factor method, using Shell FRED software, was adopted.
8	Details on the consequence modelling to allow understanding of the models used, such as:	Further details have been provided as requested (see below):
8.1	SEP of the flame for pool fires (if a view factor model is used)	SEPs are now provided.
8.2	The assumed diameter for bund fires	Equivalent pool diameters are now provided, if evaluated in the study.
9	Based on the previous modelling undertaken by the Department and on the information provided for similar developments consequence distances to fatality for pool fires appears to be optimistic (in the range of 1-3 m). It is recommended the parameters and the assumptions of the models to be revisited.	It is unclear as to which analyses that the DPE comments apply; however, all consequence analyses have been revised.
10	The assumption that full bund fire will occur only as a result of overfill appears to be optimistic. Catastrophic failure of a tank, even though more unlikely event, should be considered.	Leaks into the bunds, other than overfill, have now been considered in detail.
11	It is noted that the total effects on people in terms of fatalities from VCE are accounted for by the fireball consequence size. However this methodology does not account for injuries as a result of	The PHA considers injury due to explosion overpressure.

Item	NSW DPE Comments	Close-Out Discussion
	explosion overpressure. Account for injuries due to explosion should be made.	
12	Discussion on the potential for irritation due to combustible products of fires.	Discussion regarding combustion products is provided.
13	Sec 6.4 states that the off-site impacts are based on a conservative assumption of the exposure time and the vulnerability of the people. Please provide details on the assumptions.	Section 6.4 has been deleted.
14	A map showing the location of Basel facility in respect to the refinery should be provided.	This is now provided.

Additional comments for the PHA report were received on behalf of the NSW DPE, by email on Friday 28/11/2013.

The following table summarizes the updates made to address the additional DPE comments, these were finalised at a meeting on 18/08/2014.

All open actions are only open as instruction from DPE has not been received indicating that they are closed. Viva Energy considers these actions to be closed based on the additional information provided (shown in red text). Sections, tables and figures referenced are based on the PHA and are not reflective of the FHA.

DPE Comments	Response by Shell	Status of Response to DPE Comments (09/07/2014) **Additional responses (RED)**
Supplementary Letter (Received 28-11-13)		
The PHA (Section 4) and supplementary information supplied to the Department in the letter received 28-11-13, does not specifically address all of the relevant recommendations from the final report of the Buncefield major incident investigation board. For example, Recommendation 13 of the final incident investigation report indicates that flammable gas detection should be considered in bunds containing vessels or tanks into which large quantities of highly flammable liquids or vapour may be released, however, this is not addressed in the PHA or Shell's supplementary letter. Additional information should be provided to demonstrate that all relevant recommendations have been addressed, as required by the DGRs. A tabular format, listing each recommendation and Shell's response, would be an appropriate format.	Specifically related to flammable gas detection - Engineering have advised that this equipment is not as reliable as it would appear to be and because there are vapours generated by a number of sources in these bunds (such as sampling, water draining, etc) it was better to provide more preventative controls such as increasing the reliability of overfill protection devices, etc. Operational requirements include regular visual checks of bunds and filling operations and tanks are monitored by unplanned movement alarms.	**OPEN** Refer to 'Status' column of Table in APPENDIX F. The Department is not satisfied that sufficient justification has been provided to reject the provision of flammable gas detection in the bunds. The Department notes that other similar facilities have provided detection systems in conjunction with comparable overfill protection systems in order to demonstrate that the risk has been reduced 'so far as is reasonably practicable'. Shell is installing a Prosafe-RS system. This has a logic controller suitable for use in SIL3 applications and is used for safeguarding plant equipment as well as the tank overfill system. Each tank is to be fitted with tank gauging with high level alarms and an independent high-high level overfill protection system that will shut down all pumps at Clyde and import pumps at Gore Bay Terminal. The Prosafe logic controller also monitors the two independent radar gauges and will activate an alarm in the event of a volume/level deviation. The deviation functionality of the Prosafe logic controller is a significant difference when compared to the Buncefield Terminal which provides, effectively, a third form of level monitoring and alarm on the tanks. In terms of demonstrating that the risk has been reduced so far as is reasonably practicable, the threatline risk is determined in the model bow tie for each tank, and it has been determined that bund gas detection is not reasonably practicable based on the cost of implementation, the effectiveness of the measure and the already low risk posed by the overfill event (based on the existing and proposed safeguards).

DPE Comments	Response by Shell	Status of Response to DPE Comments (09/07/2014) Additional responses (RED)
In the supplementary information supplied to the Department (letter received 28-11-13), it is stated that "Should an overflow incident occur, the rate of flow around the tank circumference has been calculated and has been determined to run down the outer tank shell minimizing the vapour generation normally present through a turbulent cascade." Additional information should be provided to justify this statement and to explain how it was used to estimate the risk results presented in the PHA.	This statement is a prediction based on the design of the outside of tanks. It does not affect the modelling which is based on the "Vapour Cloud Analysis Method" (VCA) published by the UK Health and Safety Executive (HSE)[a] and the thermodynamic package ST-Flash[b] used to calculate the equilibrium state for the mixing of air and fuel. The VCA method takes into account the amount of fuel vaporised in the cascade as well as the vapour resulting from the splashing liquid when it hits the ground. The output is the concentration of fuel in the resulting vapour cloud, which can be used as source term for the dispersion of the vapour cloud and calculation of the distance to the lower flammable limit of the fuel (LFL). The dense gas dispersion model in the FRED 6.0 software was used to perform this calculation. (a) Atkinson, G.; Coldrick, S.; *Vapour cloud formation-Experiments and Modelling*; FP/11/04. (b) ST Flash 8.3b, 2009© Shell Global Solutions	**CLOSED** Update for Rev 1 Report Vapour clouds have been modelled using the VCA method which is described in Section 7.2.2, and Section 4.
Preliminary Hazard Assessment		
What throughput was assumed as the basis of the operational data used in the PHA (It is noted in Section 6.3 of the EIS that the forecast throughput is 4,400 ML per year, increasing at ~4% per year)?	The tank fills were estimated based on the specific product throughput +15%. The specific product throughputs are: • Diesel 3.6mT per day • Jet 3.0mT per day • Gasoline 3.0mT per day	**CLOSED**

DPE Comments	Response by Shell	Status of Response to DPE Comments (09/07/2014) **Additional responses (RED)**
It is stated in Section 2.5 that “potential biophysical environmental effects from a loss of containment are addressed in the ecological assessment”. It is assumed that this is a reference to Appendix D of the EIS. Cross references to the specific sections of the Ecological Assessment should be included in the PHA to demonstrate that all accidental events are addressed (eg spillages outside bunded areas, contaminated firefighting water, etc.).	Section 2.5 will be updated to reference Section 4.2.3 of Volume 2, Appendix D.	**OPEN** This response is only adequate if Section 4.2.3 of Volume 2, Appendix D demonstrates that all accidental events have been addressed (eg spillages outside bunded areas, contaminated firefighting water, etc.) and can therefore be used to justify compliance with the Department’s risk criterion for damage to the biophysical environment (HIPAP No. 4). Shell should provide additional information to demonstrate that all accidental events have been addressed and to demonstrate compliance with the Department’s risk criterion for damage to the biophysical environment. Credible accident events assessed and included in the site Emergency Response Plans include the following scenarios: • Full surface and rim seal tank fires; • Full surface bund fires; • Product loss of containment within the bund; • Product loss of containment outside bund (including pipetracks); • Pump seal failure and product spill/fire; • Marine (river) oil spill; • Switchboard fire; • Bomb threat; • Confined space incident; • Personnel recovery incident; • Hazmat release; • Natural gas loss of primary containment and fire; • Neighbouring property impact on facility; • Floodwater ingress to site (including 1:20 and 1:100 events)

DPE Comments	Response by Shell	Status of Response to DPE Comments (09/07/2014) **Additional responses (RED)**
		The impact of the terminal was also considered on flora and fauna shown in the species list in Table 5 (not reproduced in this FHA). Bund capacities have been shown to be adequate to contain the volumes proposed to be stored in the tanks including the freeboard volume requirements. The interceptor system is, additionally, classified as a secondary containment system for overflows with the main interceptor also having two bays emptied as contingency storage and is regularly pumped dry following rain events. Shell also has the capability of pumping product, fire water and stormwater to bunds in the event of an emergency. DPE only publishes a qualitative description of criteria for damage to the biophysical environment in HIPAP 4, i.e. ... the Department suggests the following relevant criteria (HIPAP 4): • Industrial developments should not be sited in proximity to sensitive natural environmental areas where the effects (consequences) of the more likely accidental emissions may threaten the long-term viability of the ecosystem or any species within it. • Industrial developments should not be sited in proximity to sensitive natural environmental areas where the likelihood (probability) of impacts that may threaten the long-term viability of the ecosystem or any species within it is not substantially lower than the background level of threat to the ecosystem. These two criteria are considered in the PHA (9.3.2). In addition, the fire safety study describes that for all credible accident scenarios, the site has sufficient capacity to contain run-off for the loss of containment event and the associated firewater.
The site boundary shown in Figures 3.2 and 3.3 is not the same as that shown in any other section of the EIS (eg Figure 1-3 in Section 1.2 of the EIS). Why is this different? The Department requires an accurate boundary map to ascertain the acceptability of the risk contours.	Note that the PHA represents the expected site boundary after conversion and sell off of unused land. This will be explained in the PHA, and the EIS site boundary will be presented for comparison.	**OPEN** The PHA should use the same site boundary as the EIS. This is required to ensure any subsequent approval of the EIS and PHA is based on a consistent area. Any subsequent change to the boundary due to sell off of unused land will need to be addressed separately at a later stage. Correct site boundary is used in FHA.

DPE Comments	Response by Shell	Status of Response to DPE Comments (09/07/2014) Additional responses (RED)
The Parramatta Terminal is shown as being within the boundary of the facility in the PHA (Figures 3.2 and 3.3), but is not shown as being within the scope of the study in the EIS (eg Figure 1-3). How was the Parramatta Terminal addressed in the PHA? If not included, then additional information should be provided to justify that the risks are compliant with the Department's risk criteria (Noting that the forecast increasing throughput may increase the number of tanker filling operations at the terminal). It is noted that the underground ethanol tank at the Parramatta Terminal is reported as being included in the scope of the PHA (Refer to Section 2.3 of PHA), however, there are no consequence analysis results for incidents at this tank and it does not appear to be included in the Hazard Identification Word Diagram (Appendix A of PHA).	Parramatta Terminal was included as 'on-site' for the PHA. We have updated the report (Rev 3) to include the ethanol tank in the word diagram (page 52-53) and the consequence modelling (Table 7.4).	**CLOSED** Note: The Department has not been provided with Rev 3 of the report. Therefore, it is expected that these amendments will be demonstrated in the Final Hazard Analysis. Parramatta Terminal is excluded from the FHA, as it is not part of the development application.
How were the pigging facilities (Section 3.2 of PHA and Section 6.1 of the EIS) included in the QRA?	Pigging is not explicitly modelled in the QRA, but is considered separately in HEMP/ Bow Tie analysis which are risk management tools used within the site and are standard Shell risk management tools.	**CLOSED**
The total quantity of potentially hazardous materials proposed to be stored in the warehouse should be provided in the PHA (eg Section 3.3.3).	The total quantity of materials in the warehouse will be reduced in quantity and classification in the final terminal configuration, however, it was felt that until this change takes place it would be better to show the conservative nature of the current warehouse stocks until the exact product types and quantities are known. The PHA has been developed on that basis.	**OPEN** Please indicate the total quantity and type of packaging for each potentially hazardous material (ie Dangerous Good) proposed to be stored in the warehouse. The types and quantities of packaged products proposed to be stored in the final terminal configuration is minimal and is expected to comprises the following: 2000kg Diesel (combustible) expected to be in 200kg drums 2000kg Lubricants (combustible) expected to be in 20kg drums Open storage of: 4000kgs Stadis (flammable Class 3) expected to be in 200kg drums The Stadis will be stored approximately 75m from the closest flammable product storage tank and at least 75m from the site boundary. Parramatta Terminal is excluded from the FHA, as it is not part of the development application. The warehouse is part of Parramatta Terminal.

DPE Comments	Response by Shell	Status of Response to DPE Comments (09/07/2014) **Additional responses (RED)**
The distance to the nearest residential and sensitive land use is not reported (Despite the statement in Appendix E, Item 1.2 that it is included in Section 3.6 of the PHA). The distance to the nearest residential and sensitive land use should be reported and shown on an appropriate map.	There are no sensitive land uses within close proximity of the Terminal. However, we will include the maps submitted as part of the safety report to illustrate this. The closest residential land use is approximately 300m from the wetlands to the north of the site, across Parramatta River. The wetlands are approximately 300m from the terminal storage area.	**CLOSED**
The locations of the LPG road gantry, Butane spheres (V-137 and V-140), slops tanks (T-91, T92, T-103 and T-105), on-site pipeline corridors and pigging facilities (existing and relocated) should be provided on an appropriately scaled drawing.	Refer to Figure 3.3	**CLOSED** Butane/LPG equipment was removed in Rev 3 of this FHA.
The bund dimensions and retention capacities should be reported (including increased capacities following proposed excavation works).	Bund retention capacities are attached in Table 3, however, note that no excavation is being carried out, only re-profiling of bund floors so that they drain properly to existing sumps.	**OPEN** The capacity of the largest tank in each bund has been added to Table 3 based on the information from the PHA. It is noted that the capacity of the largest tanks in bund B1 (T35 and T42) exceed the retention capacity of the bund. How was this accounted for in the PHA? If the data in Table 3 is correct, then it is noted that the bund capacity does not comply with Clause 5.8.2 of AS1940. Shell should comment on this apparent non-compliance. The tank volumes and bund volumes provided were calculated on a different basis. The tank volumes provided were estimates based on the tank height and diameter. Now provided are the tank and bund volumes based on AS1940 compliant calculations (See Table 3.1)
In Section 6.3 of the PHA (Table 6.2) it is stated that a VCE is a potential outcome of a release of butane. However, there are no overpressure consequence analysis results in the PHA for this event or any other potential explosion events (eg ULP tank overfill). Explosion overpressure results should be included and assessed accordingly.	Refer to Table 7.1 and related note, plus Appendix D, Section D1.2. This provides information on how vapour clouds are modelled. In line with the discussion from the above references, flash fire consequences for butane are provided in Table 7.8.	**OPEN** The Department is not satisfied that Shell has adequately addressed this comment. However, this will be reconsidered once the outstanding information for comment no. 13 (see below) has been submitted to the Department. Please see item 13.

DPE Comments	Response by Shell	Status of Response to DPE Comments (09/07/2014) Additional responses (RED)
In Section 7.3.1 (Table 7.1) and Appendix D.1.2 of the PHA it is stated that the effects on people from vapour cloud explosion overpressure are accounted for by the dimensions of the fireball or flash fire. Due to the absence of any overpressure consequence results in the PHA, the Department cannot verify the conclusions made in Section 9.4.2 of the PHA that explosion overpressure levels of 7 kPa and 14 kPa "would not be expected to occur at frequencies of more than 50 chances in a million". Additional analysis should be provided to substantiate compliance with the overpressure risk criteria (7 kPa and 14 kPa) and to demonstrate that explosion overpressure has been appropriately addressed in the analysis of fatality risk.	Shepherd generates the frequency of vapour cloud generation and the user defines areas of congestion from which overpressure may be produced. Flammable gas clouds are only generated at greater than the frequency of 5E-5/year in localised areas at the site, as shown in the attached figure. However, when combined with an ignition probability, the areas affected shrink to a small area in tankfarms E1, E2 and B, plus pumphouse 2. No congested areas are defined at these locations and hence the statement that explosion overpressure levels of 7 kPa and 14 kPa 'would not be expected to occur at frequencies of more than 50 chances in a million'.	**OPEN** Please provide the figure referred to in response Update for Rev 1 No $50x10^{-6}$/ year contour is now generated because the overfill frequency (and hence vapour cloud frequency) was reduced from Rev 1 of this FHA.
Use of the LFL concentration, rather than 1/2 LFL, to define the maximum hazard range from flash fires should be justified (with reference to HSE's document "On Defining a Safety Criterion for Flammable Clouds", HSL/2007/30", available at: http://www.hse.gov.uk/research/hsl/assessmt.htm	Distance to LFL is an input to the Shepherd model and cannot be modified. This may be seen as a limitation of the model. However, the HSE VCA model for tank overfill based dispersion uses LFL to test whether the gas cloud may be ignited, and so based on this, LFL would be the most appropriate end point for this type of release.	**CLOSED**
How was an explosion within a conical roofed tank (eg T-84) or the proposed domed roof tanks (Refer to Section 1.1 of EIS) addressed in the PHA?	Build-up of flammable vapour in the tank void space is acknowledged in the hazard identification word diagram, and assigned appropriate safeguards. However confined explosions were not modelled in the PHA. Note that tank top fires, which are modelled, could result from an explosion in the tank void, but have a greater offsite impact. Note that the domed roofs simply protects the product from water ingress, they are not sealed and are vented around the sides.	**CLOSED**

DPE Comments	Response by Shell	Status of Response to DPE Comments (09/07/2014) **Additional responses (RED)**
Butane may form a pool and subsequently a potential pool fire. This event has been incorrectly omitted from the PHA.	Pool fire of butane is included, refer to p51, Table 6.2.	**OPEN** The results are not included in the version of the report supplied to the Department. Please provide these results. The referenced information is included in APPENDIX A.
Why was overfilling of the butane tanks modelled as a jet fire (Refer to Table 7.7 of PHA)?	In Shepherd, a jet fire is specified as a worst case to model domino effects as well as the initial fire.	**CLOSED**

DPE Comments	Response by Shell	Status of Response to DPE Comments (09/07/2014) **Additional responses (RED)**
The PHA does not identify if rocketing drums could occur from a fire in the warehouse. This should be assessed accordingly.	'Rocketing' is normally associated with containers that can contain pressure, e.g. gas cylinders. Drums subjected to heat normally split. The flammable drum quantities noted in the DG Manifest would be maximums for flammable materials and the quantities are very small. The modelling for a fire event in the warehouse is currently very conservative, but still does not impact areas outside the site boundary.	**OPEN** The Department is not satisfied that Shell has adequately addressed this comment. However, this will be reconsidered once the outstanding information for comment no. 8 (see above) has been submitted to the Department. Note: It is acknowledged that 'rocketing' is more commonly associated with high pressure cylinders, however, the potential for rocketing of 200 litre drums is also acknowledged in many sources (eg HSE, Assessment of Benefits of Fire Compartmentation in Chemical Warehouses, Research Report 152). The referenced document appears to discuss escalation within a warehouse due to drums rocketing through compartment walls. For the warehouse at the Terminal, the modelling was based on the whole warehouse being filled with flammable liquid and ignited. In this case, the results would not be offsite. This is the worst possible consequence and detailed analysis of rocketing drums within the warehouse to cause an escalating event is not required. Warehoused products will continue to be documented via the Dangerous Goods Notification. This has been recently updated and shows a significant reduction in products since refining ceased and products no longer required disposed of. The types and quantities of packaged products proposed to be stored in the final terminal configuration is minimal and is expected to comprises the following: 2000kg Diesel (combustible) expected to be in 200kg drums 2000kg Lubricants (combustible) expected to be in 20kg drums Open storage of: 4000kgs Stadis (flammable Class 3) expected to be in 200kg drums The Stadis will be stored approximately 75m from the closest flammable product storage tank and at least 75m from the site boundary. Parramatta Terminal is excluded from the FHA, as it is not part of the development application. The warehouse is part of Parramatta Terminal.

<table>
<tr><th>DPE Comments</th><th>Response by Shell</th><th>Status of Response to DPE Comments (09/07/2014)
Additional responses (RED)</th></tr>
<tr><td>Table 7.4 includes consequence analysis results for the Gate 1 Warehouse Package Store. Please advise how fires in this store were modelled (eg is this a fire involving the whole store or only the contents of one drum?).</td><td>The pool fire diameter was very conservatively estimated based on the bunded area being filled with kerosene and ignited. The volume modelled would be equivalent to hundreds of 200L drums, but neither goes off site, nor impacts on other hydrocarbon inventories. This is overly conservative as these quantities of 200lt drums are not stored in the warehouse but as the effects do not go off site, it was believed that this conservative approach was sufficient.</td><td>CLOSED</td></tr>
<tr><td>The consequence analysis results are presented in Section 7.4 for D5 and F2 wind stability class – speed conditions. However, F1.5 (Not F2) is identified in Appendix B of the PHA as being a representative condition for this location. Furthermore, the data included in Appendix B of the PHA is inconsistent with the data included in Appendix B of the Air Quality Assessment (see summary table below). Justification should be provided for use of the significantly different wind data.

<table>
<tr><th>Appendix B of PHA</th><th>Appendix B of Air Quality Assessment</th></tr>
<tr><td>>4 m/s occurs ~73% of time</td><td>>4 m/s occurs ~10% of time</td></tr>
<tr><td>F conditions occur ~36% of time (No E)</td><td>E and F conditions occur ~47% of time</td></tr>
<tr><td>Max wind speed is 9 m/s</td><td>Max wind speed is < ~6.5 m/s</td></tr>
<tr><td>< 2 m/s occurs for ~27% of time</td><td>< 2 m/s occurs for ~65% of time</td></tr>
</table></td><td>As described in Appendix B, consequence data is input to shepherd for weather conditions F2 and D5. These values are then scaled for other wind speeds.
Conversion of weather data from raw BoM data is carried following a method described in the Shepherd Technical Guide, i.e.:

Pasquil A-D, <2m/s --> D1.5
Pasquil A-D, 2m/s-6ms/ --> D5
Pasquil A-D, >6m/s --> D9
Pasquil E,F, <2m/s --> F1.5
Pasquil E,F, >2m/s --> F5

The raw data better matches the air quality assessment data:

>4m/s ~13% of the time
E/F ~35% of the time
Max wind is ~6.4m/s
<2m/s ~27% of the time</td><td>CLOSED
Tables showing the conversion from raw data (BoM) to Shepherd input are provided in APPENDIX B.

FHA Rev 1 update
Appendix B has been updated to reflect data input to RiskCurves. This has simplified the presentation.</td></tr>
</table>

DPE Comments	Response by Shell	Status of Response to DPE Comments (09/07/2014) **Additional responses (RED)**
Published immediate ignition probabilities for Butane are potentially higher than the probabilities presented in Table 8.1 of the PHA. Additional information should be provided to justify the immediate ignition probabilities used for Butane.	There are many options for determining ignition probability for various substances. Globally, Shell uses the immediate ignition probability data based on Cox et al. This has been used in all previous PHAs for Clyde Refinery and Gore Bay Terminal as well as for the Safety Reports which has been accepted by Workcover as appropriate.	Butane/LPG equipment was removed in Rev 3 of this FHA.
A map showing the ignition density areas used in the QRA to estimate the delayed ignition probability (as per Section 8.2.2 of PHA) should be provided.	Ignition probability has been stated as 0.2x10-4/m2 around the site. A map is not believed to be required.	**OPEN** A map has been requested to ensure the extent of the ignition probability area used in the QRA is consistent with the dispersion analysis results. A map was included in Rev 0 (from Shepherd), where the hatching represents the area where the area ignition probability is applied. The largest consequence distance is in the order of 600m, and ignition probabilities have been applied up to approximately 2km from the site boundary. Hence, the ignition probability is applied over a much large distance than the largest consequence distance. From Rev 2 of this FHA, TNO RiskCurves was used, which does not produce an area ignition map.
The BLEVE frequencies used in the QRA should be reported.	Shepherd reports the BLEVE frequency, as follows: V137: 1.15E-5/year V140: 9.99E-6/year. Note that this is separate from the cold catastrophic failure frequency mentioned in item 32.	Butane/LPG equipment was removed in Rev 3 of this FHA.
The number of LPG tanker transfer operations should be provided in the PHA.	The current expectation is that the number of operations per year when the Butane system is recommissioned will be less than 100 unloaded over a 4-5 month winter period. This is considerably less that was initially modelled and will be modified in the next version of the model/PHA.	Butane/LPG equipment was removed in Rev 3 of this FHA.

DPE Comments	Response by Shell	Status of Response to DPE Comments (09/07/2014) Additional responses (RED)
The tank overfill frequencies presented in Table 8.3 are different to the frequencies presented in Table C.1. Which data is correct? and which was used in the QRA?	Table C.1 contains a typo in the exponents. This is possibly related to changes made over the course of the project. Table 8.3 is correct, and the two tables have been updated to match. Note that the model has been checked and does contain the values in Table 8.3; the conclusions are based on these input data.	**CLOSED**
It is stated in Section 9.3.2 that there are no nearby "sensitive environmental areas". This is inconsistent with the Ecological Assessment and should be reviewed.	The phrase will be changed to sensitive receivers. The nearest sensitive receivers, from the air quality report are 450, 600, 850m, 1100m away from the site boundary. In the context of the PHA this is not 'nearby'.	**CLOSED** Note: The Department's comment related to the assessment of the risk to the biophysical environment. This comment has been closed, however, it is subject to a satisfactory response to comment no. 4 (see above).
The contours shown in Figure 9.4 of the PHA do not appear to coincide with the locations of the equipment. Whilst this can sometimes occur when there are large numbers of potentially hazardous events, the reason for the positioning of the contours should be determined and explained.	Please advise which areas require explanation? I attach a better copy of the output.	**CLOSED** The supplementary information provided by Shell has clarified the Department's concerns.
The PHA should include tables of major risk contributors for key locations. These key locations should, as a minimum, include all locations where the 50 pmpy fatality risk contour is close to the site boundary.	It is unclear why DPE would want this, although we do investigate what the key risk drivers are internally. DPE should note that the demonstration aspects of the MHF Regulations are satisfied by Shell's Hazard and Effects Management Process, which does not rely on the QRA, but substance/ location specific Bow Ties with LOPA threat-line analysis. A new MHF submission is currently in progress and Shell has been given 6 months in which to complete this and submit to Workcover. Please advise which locations are required, and we will provide the details. To do this, we have to locate a receiver and re-run the model.	**OPEN** The Department requires this information to assist with their assessment. It is also a requirement of HIPAP No.6 to include a table of major risk contributors (Refer to Section 8.2 of HIPAP No. 6). The key locations should, as a minimum, include all locations where the 50 pmpy fatality risk contour is close to the site boundary. Therefore, one such location on the north, east, south and west boundaries would be appropriate. In light of other DPE comments relating to the site boundary, the only location where the 5E-5/y contour is close to the boundary is adjacent to Tank 90, and to the south of the site. Information is provided for these locations in Section 9.5 of this report.

DPE Comments	Response by Shell	Status of Response to DPE Comments (09/07/2014) **Additional responses (RED)**
In Appendix C – Leak Rule-Set for LPG Equipment, it is stated that "the release size is dependent on the diameter of the pipe, but is limited to 100 mm". A similar limitation appears to have been applied for non-LPG piping. All pipe diameters should be reported in the PHA and further justification provided to substantiate limiting the release size to 100 mm (ie if larger diameter pipes are in fact present).	The maximum diameter for LPG pipework is 150 mm. The 100mm limit is a standard limitation in Shepherd. All equipment sizes are reported in the MHF Safety Report.	**OPEN** Shell's response does not address the Department's comment. Note: The Department does not have access to the MHF Safety Report and the PHA must be a standalone document. Pipe sizes will be provided at the next revision. In addition, the limitation of 100mm hole size in a pipe will be checked with SGSi and updated if necessary. FHA update - the 100mm limit has been removed. Butane/LPG equipment was removed in Rev 3 of this FHA.
In Appendix C – LPG Loading Hose Coupling Failure (p.60), it is stated that "In the event that the EFV fails to close, the outflow would not be isolated and the release would continue, albeit restricted by a 1.4 mm controlling orifice, in accordance with AS1596". Whilst a 1.4 mm limiting orifice might be applicable for an instrument line, it is unclear why this would be relevant for a hose / loading arm. This requires further explanation and justification (with reference to relevant clause/s of AS1596).	Agreed, this statement will be removed; note that the analysis does not account for the 1.4mm orifice.	Butane/LPG equipment was removed in Rev 3 of this FHA.
In Appendix C – Leak Rule-Set for LPG Equipment, it is stated that a pump casing failure is not relevant as the pumps are submerged in the tanks. Whilst this might be correct for the tanks, how were the pumps on the tanker included in the QRA? How is the butane transferred from the tankers to the storage tanks?	We have the gantry equipment modelled as a source of leak, plus the road tanker as a target for escalation (BLEVE). The butane is transferred by road tanker pump, but we do not include the road tanker pump as a leak source. The butane spheres do not have submerged pumps, but external pumps which have been modelled (P5012/5/8).	Butane/LPG equipment was removed in Rev 3 of this FHA.

DPE Comments	Response by Shell	Status of Response to DPE Comments (09/07/2014) **Additional responses (RED)**
The cold catastrophic tank failure frequency reported in Appendix C – LPG Vessel Catastrophic Failure is 2.4 x 10-8 per year. This is significantly lower than reported by the UK HSE (viz. 2 x 10-6 per year) and OGP (viz. 5 x 10-7 per year). The HSE commissioned a review of this data in 2006 and confirmed its validity, therefore the frequency adopted in the QRA does not appear to be sufficiently conservative.	As previously discussed with DPE and WorkCover, the statistical justification for the predicted 2.4x10-8/year is provided on page 60 and 61 of the document and is based on a Chi –square hypothesis test of the mean for an event that has not occurred in history. The QRA assesses the potential for escalation and other initiating leak sizes up to full rupture, see Table 7.7. Refer to item 23 for the BLEVE frequency. Please also refer to comments made by HSE on Shell's interpretation of 'cold catastrophic failure' in the report that you cite.	Butane/LPG equipment was removed in Rev 3 of this FHA.
In Appendix D – Tank Leaks (p.66), it is stated that the tanks will not be provided with a mixer. How will butane mixing be undertaken and how was this operation accounted for in the PHA?	There will be no butane mixing.	**CLOSED**
Appendix D – Tank Leaks (p.68). Further justification should be provided for the frequency of a leak due to corrosion and detection by an operator, particularly as the historical rate (viz. 5 x 10-4 per year) would already take some account of periodic inspections by site personnel.	The explanation is considered sufficient. If there are further specific questions that are required to be answered, please advise so these can be responded to.	**OPEN** Why does Shell believe that the historical rate can be reduced by a factor of 0.003 when the historical rate would already account for failure to detect the early signs of failure? By applying a reduction factor of 0.003, the implication is that no other facilities undertake visual inspections. This does not appear to be consistent with the 'conservative best estimate' approach required for a PHA. The failure to provide leak detection in the bund (see comment no. 1) also does not justify the use of a significantly lower undetected leak frequency than the historical average rate. The frequency of corrosion leaks was taken as 5x10-4. This represented all corrosion leaks from storage tanks, noting that none had led to a full bund scenario. To take credit for operator detection and intervention after a leak had started (rather than routine inspection which would aim to detect thinning and prevent a leak occurring) a factor of 0.003 to account of the operator failing to pick up a minor leak and preventing it leading to a major leak was used. The fact corrosion leaks have occurred but never led to a full bund indicates that it is credible to consider another factor is involved preventing the smaller leaks leading to a bigger leak but the use of a factor does not discount the event from occurring.

DPE Comments	Response by Shell	Status of Response to DPE Comments (09/07/2014) **Additional responses (RED)**
Also, this frequency does not appear in Table C.2 or Table 8.3, which suggests that it might not have been included in the QRA. Was this event included in the QRA?	No it was not as it is insignificant compared with the overfill frequencies which are 1-2 orders of magnitude higher.	**OPEN** The Department will reconsider Shell's response to this comment when comment 34 has been addressed. Please see item 34
The overfill frequencies reported in the last column of Table C.1 appear to have been calculated incorrectly. This table should be checked and amended accordingly.	Table C.1 contains a typo in the exponents. This is possibly related to changes made over the course of the project. Table 8.3 is correct, and the two tables have been updated to match. Note that the model has been checked and does contain the values in Table 8.3; the conclusions are based on these input data.	**CLOSED**
Also, the data presented for Table C.1 for CM4 is inconsistent with the following statement on p.70: "CM4 = PFD of High-High Level Trip = 1".	'or 0.1' has been added.	**CLOSED**

DPE Comments	Response by Shell	Status of Response to DPE Comments (09/07/2014) **Additional responses (RED)**
Appendix E – Item 6.4 (p.77). Leak detection and isolation times are not reported in Section D.1.1 and should be provided.	Tankmaster has unplanned movement alarms which indicate an unplanned loss from tanks. The set point is 100m3. When the alarm is triggered operators are able to respond to the alarm within one minute. Tanks are the source of a potential major leak. Additionally pipelines to Sydney Airport and from Gore Bay Terminal have leak detection on them. These systems alarm, based on flow variances at respective ends of the pipeline, and the pipeline pumps can be shut down within one minute. Operators, Terminal Controllers and Security Guards perform rounds of the facility on a regular basis throughout the day so that on average, a person will be travelling the site on an hourly basis looking for any leaks. Once detected, isolation of pumps can be performed within 1 minute through emergency stops located in the control room and at strategic locations around the facility. Critical valves will be automated and can be remotely activated within 1 minute. If a tank was leaking and unable to be stopped, we would look to transfer the contents to another tank so that the tank level could be brought down below the leak point. Leaks in the LPG area would be detected by the gas detection system, which would alert the operator who would take appropriate action depending on the location of the leak.	**OPEN** The Department has the following additional comments: What detection time was assumed? How was the total detection and isolation time used in the PHA (eg was it used to limit the size of a release or was the release still assumed to fill the bund, etc.)? The Department will reconsider this comment, depending on Shell's response to the additional comments a-b above. However, it is noted that the times quoted by Shell are less than commonly reported by other facilities and by TNO ('Purple Book'). If the detection and isolation time assumed in the PHA is a significant factor for limiting the extent of the risk contours, then additional information will be required to justify the lower values used in the PHA. In order to take credit for an operator response, in the case of a tank overfill: Shell requires a time of 10-15 minutes for alarm and operator response when the operator is in the control room and can act to stop the overfill incident. Shell requires a time of 20-25 minutes for alarm and operator response when an operator requires to be sent out into the field to take an action to stop the overfill. These two former timings are used to set alarm points in the tanks. As Shell considers these to be enough time to intervene to stop an overfill, the alarm and operator response barrier is considered to be valid and assigned a probability of failure on demand of 0.1. Once tank overfill has occurred, no further credit is taken for leak detection and isolation, i.e. the bund fills/ vapour cloud forms/ pool fire occurs without further reducing the likelihood.

APPENDIX F. BUNCEFIELD RECOMMENDATIONS - RESPONSE TABLE

Recommendation		Status at Clyde Terminal	Status of Response to Recommendation
1. Design and Operation of Fuel Storage Sites			
Systematic assessment of safety integrity levels (SIL's)			
1	The competent authority and operators of Buncefield type sites should develop and agree a common methodology to determine the SIL level for overfill prevention systems in line with EN61511. This methodology should take account of : • The existence of nearby sensitive resources or populations • The nature and intensity of depot operations • Realistic reliability expectations for tank gauging systems; and • The extent/rigour of operator monitoring Application of the methodology should be clearly demonstrated in the COMAH safety report.	As part of the Safety Case, Shell has undertaken the assessments of the risks and the impact that these could reasonably be expected to have on the surrounding community. These risks reduced significantly with the cessation of refining and further again when Lyondell Basell ceased manufacturing in December 2013. Shell has provided formal notification of the current operational arrangements to Workcover as required by the Major Hazard Facility legislation in NSW and will prepare a new Safety Report as required. Shell has requested guidance from Workcover to determine whether they require a Safety Report for the current operational arrangements or whether Shell can prepare one for the final proposed End State Terminal arrangements where Butane will be re-introduced into the site. Shell has recently received guidance from Workcover advising that a single "end-state" Safety Report can be produced. Shell also has an internal safety case which is a risk assessment detailing the risks, barriers and recoveries. New risk contours have been produced and revised Emergency Response Plans have been developed according to these new risk contours. As part of the conversion project, the engineering assessments of integrity systems have been undertaken with mindfulness of the existing and potential sensitive receptors.	**CLOSED**
Protecting against loss of primary containment using high-integrity systems			
2	Operators of Buncefield type sites should, as a priority, review and amend as necessary their management systems for maintenance of equipment and systems to ensure their continuing integrity in operation. This should included, but not be limited to reviews of the following: • The arrangements and procedures for periodic proof testing of storage tank overfill prevention systems to minimise the likelihood of any failure that could result in loss of containment; any revisions identified pursuant to this review should be put into immediate effect • The procedures for implementing changes to equipment and systems to ensure any such changes do not impair the effectiveness of equipment and systems in preventing loss of containment or in providing emergency response.	Since the Buncefield incident, Shell upgraded the protective barriers for all gasoline tanks and to include tank gauging that is independent from the tank overfill protection system. As part of the engineering work in preparation for the conversion project commencement once development consent is granted, Shell has further replaced some of the overfill protection probes in the gasoline tanks with a newer and more reliable unit to meet the Shell reliability requirements. Shell has also now upgraded the overfill protection system for the jet and diesel tanks to provide the required degree of independence between tank gauging and overfill protection systems. These probes meet the requirements of BS EN 61511. This equipment is maintained and inspected as required by the manufacturer and records of these inspections are maintained. In addition to the physical inspection and testing of these assets, the integrity of the tank gauging is undertaken and the associated alarm systems. Operators competency in calculation of ullage, transfers and use of these systems is also assured. The conversion project is proposing to install SIL rated equipment on tanks as part of the upgrade to the safeguarding systems. The equipment that Shell has fitted retrospectively since 2012 all meets the requirements so will be re-used in the conversion project.	**CLOSED**
3	Operators of Buncefield type sites should protect against loss of containment of gasoline and other highly flammable liquids by fitting a high integrity, automatic operating overfill prevention system that is physically and electrically separate from the tank gauging system.	The overfill protection system is independent from the tank gauging fitted on all tanks in use. The conversion project that Shell is undertaking at Clyde is proposing to provide automatic shutdown to the product flow in the event of activation of the overfill protection system. This is planned to trip the pumps at Clyde and/or Gore Bay and shut inlet valves. This is part of the safeguarding system upgrades to be undertaken as part of the conversion.	**CLOSED**
4	Overfill protection systems (comprising means of level detection, logic/ control equipment and independent means of flow control) should be engineered, operated, and maintained to achieve and maintain an appropriate level of safety integrity in accordance with the requirements of BS EN 61511.	Maintenance and testing programs are established to maintain the reliability of the level alarms on tanks. Any automated overfill protection systems will be testing and maintained as per the requirements of the Shell Instrumented Protective Function (IPF) methodology. The Shell IPF methodology is consistent with BS EN 61511. Testing and maintenance of an IPF includes all elements of the IPF.	**CLOSED**

Recommendation		Status at Clyde Terminal	Status of Response to Recommendation
5	All elements of an overfill protection system should be proof tested in accordance with the validated arrangements and procedures sufficiently frequently to ensure the specified safety integrity level is maintained in practice in accordance with the requirements of BS EN 61511.	Refer recommendation 4	**CLOSED**
6	The sector should put in place arrangements to ensure the receiving site (as opposed the transmitting location) has ultimate control of tank filling. The receiving site should be able to safely terminate or divert a transfer without depending on the actions of a remote third party, or on the availability of communications to a remote location. These arrangements will need to consider upstream implications for the pipeline network, other facilities on the system and refineries.	Shell Clyde continues to have control over the filling of the Clyde tanks regardless of whether these are being filled by transfer from other Clyde tanks, Gore Bay tanks or directly from ships berthed at Gore Bay. This ensures that the Clyde Operators calculate ullage and control the filling rate and monitor and manage the tank volumes. Clyde Terminal operators also have the ability to terminate the transfer at any time by tripping the pumps within Gore Bay or Clyde. Similarly for filling of Gore Bay storage tanks from ship discharge, the Gore Bay operators have the ability to terminate the transfer at any time.	**CLOSED**
7	In conjunction with Recommendation 6, the sector and the Competent Authority should undertake a review of the adequacy of existing safety arrangements, including communications, employed by those responsible for pipeline transfers of fuel.	Not applicable	**CLOSED**
8	The sector, including its supply chain of equipment manufacturers and suppliers, should review and report without delay on the scope to develop improved components and systems, including but not limited to the following: • alternative means of ultimate high level detection for overfill prevention that do not rely on components internal to the storage tank, with the emphasis on ease of inspection, testing, reliability and maintenance; • increased dependability of tank level gauging systems through improved validation of measurements and trends, allowing warning of faults and through using modern sensors with increased diagnostic capability; and • systems to control and log override actions.	As stated under Recommendation 2, at End State, as described in the PHA, Clyde Terminal will use radar gauges for level measurement. Radar gauges are considered to be current best Industry Practice. All overrides to alarms are managed. The Distributed Control System (DCS) has the ability to track the application of overrides. This is monitored by the Shift Controller who will follow up on any unusual activity.	**CLOSED**
9	Operators of Buncefield-type sites should introduce arrangements for the systematic maintenance of records to allow a review of all product movements together with the operation of the overfill prevention systems and any associated facilities. The arrangements should be fit for their design purpose and include, but not be limited to, the following factors: • the records should be in a form that is readily accessible by third parties without the need for specialist assistance; • the records should be available both on site and at a different location; • the records should be available to allow periodic review of the effectiveness of control measures by the operator and the Competent Authority, as well as for root cause analysis should there be an incident; • a minimum period of retention of one year.	Shell have reviewed installation of the tank overfill protection equipment. While not all is easily accessible for inspection and testing, it is able to be accessed to perform the necessary testing. This arrangement will be further improved as part of the conversion project by providing more ready access to the required equipment. The equipment now in use is fail-safe equipment resulting in the shutdown of the transfer or inability to commence a transfer where lack of feedback is received from the overfill protection probe. This provides reliability and guards against an unrecognized failure during transfer. Calibration records are maintained showing calibration trends over time and successive tests where calibrations are shown to be out of tolerance result in the probe being replaced. Monthly, the tank levels as determined by the tank gauging system are verified with physical dips. Shell requires all overrides of safety critical equipment to be authorized before activation and logging of the circumstances and the alternative barriers put in place as a consequence of the removal of barriers. These requirements will be maintained as a part of the engineering design of the conversion project.	**CLOSED**

Recommendation		Status at Clyde Terminal	Status of Response to Recommendation
10	The sector should agree with the Competent Authority on a system of leading and lagging performance indicators for process safety performance.	Clyde Terminal has a number of Process Safety leading and lagging indicators that are monitored and reported on regularly.	**CLOSED**
Engineering against escalation of loss of primary containment			
11	Operators of Buncefield-type sites should review the classification of places within COMAH sites where explosive atmospheres may occur and their selection of equipment and protective systems (as required by the Dangerous Substances and Explosive Atmospheres Regulations 2002). This review should take into account the likelihood of undetected loss of containment and the possible extent of an explosive atmosphere following such an undetected loss of containment. Operators in the wider fuel and chemicals industries should also consider such a review, to take account of events at Buncefield.	Clyde Terminal has assessed Hazard Area Classification consistent with the requirements of the Area Classification Code for Installations Handling Flammable Liquids (Part 15 of the IP Model Code of Safe Practice for the Petroleum Industry).	**CLOSED**
12	Following on from Recommendation 11, operators of Buncefield-type sites should evaluate the siting and/or suitable protection of emergency response facilities such as fire fighting pumps, lagoons or manual emergency switches.	The siting of emergency response facilities is based on the requirements of the relevant Shell Design & Engineering Practices and Australian Standards that include the Buncefield learnings. The Clyde Terminal fire fighting pumps are proposed to be moved to the west end of the Terminal, adjacent to the current State Business Office, with sufficient separation distance to flammable product storage tanks.	**CLOSED**
13	Operators of Buncefield-type sites should employ measures to detect hazardous conditions arising from loss of primary containment, including the presence of high levels of flammable vapours in secondary containment. Operators should without delay undertake an evaluation to identify suitable and appropriate measures. This evaluation should include, but not be limited to, consideration of the following: • installing flammable gas detection in bunds containing vessels or tanks into which large quantities of highly flammable liquids or vapour may be released; • the relationship between the gas detection system and the overfill prevention system. Detecting high levels of vapour in secondary containment is an early indication of loss of containment and so should initiate action, for example through the overfill prevention system, to limit the extent of any further loss; • installing CCTV equipment to assist operators with early detection of abnormal conditions. Operators cannot routinely monitor large numbers of passive screens, but equipment is available that detects and responds to changes in conditions and alerts operators to these changes.	Flammable gas detection is not installed on any tanks at Clyde Terminal. The risk of tank overfill was evaluated as per Recommendation 1. This analysis indicated that the addition of flammable gas detection was not justified and that the risk of a Major Incident resulting from tank overfill could be reduced to an acceptable level by other means. Some tank farm areas are covered by CCTV, including the Western Tank Farm. There are limitations to the effectiveness of CCTV as a detection barrier. CCTV has been installed where it is believed to provide the most benefit to assist operations. Refer to DPE Comment No. 1	**OPEN** Refer to the first DPE Comment (APPENDIX E).

Recommendation		Status at Clyde Terminal	Status of Response to Recommendation
14	Operators of new Buncefield-type sites or those making major modifications to existing sites (such as installing a new storage tank) should introduce further measures including, but not limited to, preventing the formation of flammable vapour in the event of tank overflow. Consideration should be given to modifications of tank top design and to the safe re-routing of overflowing liquids.	Not applicable to Clyde Terminal – all existing tanks.	**CLOSED**
15	The sector should begin to develop guidance without delay to incorporate the latest knowledge on preventing loss of primary containment and on inhibiting escalation if loss occurs. This is likely to require the sector to collaborate with the professional institutions and trade associations.	Not applicable to Clyde Terminal – industry wide requirement	**CLOSED**
16	Operators of existing sites, if their risk assessments show it is not practicable to introduce measures to the same extent as for new ones, should introduce measures as close to those recommended by Recommendation 14 as is reasonably practicable. The outcomes of the assessment should be incorporated into the safety report submitted to the Competent Authority.	Clyde Terminal has chosen to concentrate efforts on preventing overfill from occurring rather than tank modifications to limit the impact of any overfill. Refer to the results of the Tank Overfill MBT assessment.	**CLOSED**
Engineering against loss of secondary and tertiary containment			
17	The Competent Authority and the sector should jointly review existing standards for secondary and tertiary containment with a view to the Competent Authority producing revised guidance by the end of 2007. The review should include, but not be limited to the following: • developing a minimum level of performance specification of secondary containment (typically this will be bunding); • developing suitable means for assessing risk so as to prioritise the programme of engineering work in response to the new specification; • formally specifying standards to be achieved so that they may be insisted upon in the event of lack of progress with improvements; • improving firewater management and the installed capability to transfer contaminated liquids to a place where they present no environmental risk in the event of loss of secondary containment and fires; • providing greater assurance of tertiary containment measures to prevent escape of liquids from site and threatening a major accident to the environment.	Shell has in place secondary containment for all tanks at Clyde Terminal. This has been maintained by the refinery operations and has been further reviewed as part of the engineering works for the conversion project and where deficiencies have been identified, the necessary remediation steps including where practicable bringing the infrastructure up to current Australian Standards has been included in the scope of works. Additionally, Shell has a system of tertiary containment with a number of large interceptors across the site further minimizing the risk of environmental damage. Included in the containment calculations is the capability to manage fire water within the bunds.	**CLOSED**
18	Revised standards should be applied in full to new build sites and to new partial installations. On existing sites, it may not be practicable to fully upgrade bunding and site drainage. Where this is so operators should develop and agree with the Competent Authority risk-based plans for phased upgrading as close to new plant standards as is reasonably practicable.	New tanks are not envisaged in the conversion program but reallocation of existing tanks is considered. The engineering and design work performed has considered this and will ensure that the Australian Standards for containment and risk management are met.	**CLOSED**

Recommendation		Status at Clyde Terminal	Status of Response to Recommendation
Operating with high reliability organisations			
19	The sector should work with the Competent Authority to prepare guidance and/or standards on how to achieve a high reliability industry through placing emphasis on the assurance of human and organisational factors in design, operation, maintenance, and testing. Of particular importance are: • understanding and defining the role and responsibilities of the control room operators (including in automated systems) in ensuring safe transfer processes; • providing suitable information and system interfaces for front line staff to enable them to reliably detect, diagnose and respond to potential incidents; • training, experience and competence assurance of staff for safety critical and environmental protection activities; • defining appropriate workload, staffing levels and working conditions for front line personnel; • ensuring robust communications management within and between sites and contractors and with operators of distribution systems and transmitting sites (such as refineries); • prequalification auditing and operational monitoring of contractors' capabilities to supply, support and maintain high integrity equipment; • providing effective standardised procedures for key activities in maintenance, testing, and operations; • clarifying arrangements for monitoring and supervision of control room staff; and • effectively managing changes that impact on people, processes and equipment.	Shell has selected a management and organizational structure to suit the current terminal operations requirements. This will be further reviewed at the completion of the conversion project once new technology has been implemented and commissioned. All current operators have undergone a comprehensive training and competence verification process before operating unassisted. The site has a comprehensive communications protocol from a Leadership Team review of operations and project work weekly to individual shift handovers between oncoming and outgoing shifts and contractor work planning meetings and job starts. Operational activities are brought together through Shell's Permitting and Work Clearance systems where an individual is responsible for the safe conduct of the work and the conditions around which that work will commence and proceed. This ensures adequate communication and integration of the operational and project work activities across the sites so that conflicting activities can be addressed before such conflicts eventuate. Half of this meeting weekly is devoted to Health, Safety, Security and the Environment. Specific discussion concerns potential incidents, near misses, incidents and learnings at site, nationally, globally and relevant industry learnings against which the operations are reviewed to identify gaps and develop remediation plans. All personnel have the authorization to stop any work at any time and this is provided to them at the initial induction and by virtue of the authorization card that they carry with them at all times. Shell operates a Management of Change and Statement of Fitness process. The former addresses urgent, temporary and permanent changes of an operational, organizational or physical nature across the site/s. The latter ensures adequate commissioning and handover before new equipment is operated. Both processes require all parties to fully understand the changes and the safe operating environments required and that adequate communication and training of relevant individuals has taken place. Shell has a register of safety critical roles and safety designated positions. This shows each role that is considered to be a safety critical role and what the training and responsibilities of the role is against which training and behaviours can be managed. Each role has been assessed for workload and content to determine the number of individuals required for the operation. The organizational structure has been determined by the work duties to ensure we have sufficient roles and positions to undertake the required activities. Rosters are assessed for potential of fatigue by using a fatigue management tool. The ongoing fatigue management process has provided training and education to those personnel in safety critical roles and fatigue procedures introduced to the site in 2013.	**CLOSED**
20 - 22	Recommendations for the industry sector and competent authority	Not applicable for Clyde Terminal	**CLOSED**
Delivery high performance through culture and leadership			
23	The sector should set up arrangements to collate incident data on high potential incidents including overfilling, equipment failure, spills and alarm system defects, evaluate trends, and communicate information on risks, their related solutions and control measures to the industry.	Shell investigates all incidents and high potential near misses. Relevant events are shared through a global Shell network and reviewed in the Leadership Team meetings weekly. It is decided in these meetings which of these need to be shared with the sites and whether the current barriers are adequate or need to be strengthened to prevent or minimize the occurrence of a similar incident at Clyde.	**CLOSED**

Recommendation		Status at Clyde Terminal	Status of Response to Recommendation
24	The arrangements set up to meet Recommendation 23 should include, but not be limited to, the following: • thorough investigation of root causes of failures and malfunctions of safety and environmental protection critical elements during testing or maintenance, or in service; • developing incident databases that can be shared across the entire sector, subject to data protection and other legal requirements. Examples exist of effective voluntary systems that could provide suitable models; • collaboration between the workforce and its representatives, duty holders and regulators to ensure lessons are learned from incidents, and best practices are shared.	All incidents and high potential near misses at Clyde are also investigated, the root causes and contributing factors shared with the Leadership Team and remedial action plans developed. Learnings from Incidents are prepared and shared globally within the Shell network and with all contractors who will perform work at Shell sites. These incidents and the learnings are shared with the workforce generally through weekly and daily communications and planning sessions. Development of the Safety Case and Safety Report consolidate the learnings from significant incidents and high potential near misses through the development and review of the Shell Hazard and Effects Management Process (HEMP). This determines the risk ranking of hazards and the threat release pathways based on the industry and Shell global experiences with incidents. HEMP is shared with the site and determines the maintenance and inspection schedule for Safety Critical Equipment and the training and competence review of Safety Critical Activities.	**CLOSED**
25	In particular, the sector should draw together current knowledge of major hazard events, failure histories of safety and environmental protection critical elements, and developments in new knowledge and innovation to continuously improve the control of risks. This should take advantage of the experience of other high hazard sectors such as chemical processing, offshore oil and gas operations, nuclear processing and railways.	Refer above	**CLOSED**
2. Emergency Preparedness for, response to and recovery from incidents			
Assessing the potential for a Major Incident			
1	Operators of Buncefield-type sites should review their emergency arrangements to ensure they provide for all reasonably foreseeable emergency scenarios arising out of credible major hazard incidents, including vapour cloud explosions and severe multi-tank fires that, before Buncefield, were not considered realistically credible. The Competent Authority should ensure that this is done.	Shell completed a review of the Emergency Response Plans following the cessation of refining operations and altered the Emergency Response Plans accordingly. This was further reviewed and amended once Lyondell Basell ceased its manufacturing operations in December 2013. The plans are currently reviewed on a minimum of a 12 month frequency or as major changes to the arrangements and configuration take place throughout the conversion project. The latest review and amendment has taken place in May 2014. The plans for Clyde are consistent with those within Shell operations nationally and are part of the co-ordinated and tiered Country emergency response processes. These plans include the learnings from the Buncefield events, specifically generation of vapour clouds and the control measures required to prevent or minimise these effects. Consequently, the scope of works planned as part of the conversion include the potential for escalation of events in the Fire Safety study and the Hazard Analyses and the Emergency Response Plans have been developed accordingly. These plans have also been reviewed by Shell's global Emergency Response subject matter expert and Williams Fire and Hazard consultant.	**CLOSED**
2 & 3	Action for the competent authority	N/A	**CLOSED**
4	Operators should review and where necessary revise their on-site emergency arrangements to ensure that relevant staff are trained and competent to execute the plan and should ensure that there are enough trained staff available at all times to perform all the actions required by the on-site emergency plan.	Emergency exercises on a range of scenarios are regularly. The minimum number of emergency response personnel has been established over time. Checks are conducted each shift to ensure that sufficient trained personnel are available on site.	**CLOSED**

Recommendation		Status at Clyde Terminal	Status of Response to Recommendation
5	For Buncefield-type sites, operators should evaluate the siting and/or suitable protection of emergency response facilities such as the emergency control centre, fire fighting pumps, lagoons or manual switches, updating the safety report as appropriate and taking the necessary remedial actions.	Refer previous response to Recommendation 12 – Design and operation of fuel storage sites.	**CLOSED**
6	Operators should identify vulnerable critical emergency response resources and put in place contingency arrangements either on or off site in the event of failure at any time of the year and make appropriate amendments to the on-site emergency plan. This should include identifying and establishing an alternative emergency control centre with a duplicate set of plans and technical information.	A procedure is in place to assess the risk associated with any identified deficiency in the emergency response system and determine what interim measures are required. The Incident Control Centre is located in the Main Office complex at the Clyde Terminal. It is difficult to foresee an event that would compromise this location. If this was to occur alternatives are available offsite.	**CLOSED**
7	For COMAH sites, if the operator relies on an off-site Fire and Rescue Service to respond, the operator's plan should clearly demonstrate that there are adequate arrangements in place between the operator and the service provider. The Competent Authority will need to check that this is done	Shell has renewed and amended the Memorandum of Understanding with FRNSW for the provision of support and to ensure effective understanding of the integration of the resources in the event of an emergency. Mutual Aid arrangements are in place within the oil industry which cover responses to Shell facilities. This mutual aid can be accessed by Shell, other participants or the relevant combat agencies. Additionally, Shell can call on oil spill resources from AMOSC as a participating member of that group. The conversion project has designed fire fighting changes that are appropriate for a smaller terminal footprint and have located the resources in locations that are suitable for the proposed arrangements. Redundancy is built into the design and the Emergency Response Plans will be updated before the Statement of Fitness is completed and the fire fighting assets commissioned.	**CLOSED**
Warning and Informing the Public			
8	COMAH site operators should review their arrangements to communicate with residents, local businesses and the wider community, in particular to ensure the frequency of communications meets local needs and to cover arrangements to provide for dealing with local community complaints. They should agree the frequency and form of communications with local authorities and responders, making provision where appropriate for joint communications with those bodies.	Where Shell has assessed the potential for off-site impacts on neighbours from an emergency event, these neighbours have been informed and have their own Emergency Response Plans in place to respond to these. Shell's Emergency Response Plans provide for notification of these parties and the request to enact their own emergency response plans. As required by NSW Emergency Response legislation and exercised, it is the role of the NSW Police or relevant combat agency to invoke evacuation of the community beyond the facility boundary. This is exercised in the Shell exercises. Communications with the community and the media is primarily the role of FRNSW or other agency providing Incident Command. Despite this, Shell has its own communications processes to answer questions but will do this in conjunction with the relevant government agency.	**CLOSED**
9 - 32	Not applicable to MHF operators		**CLOSED**
Investigation of the Explosion Mechanism			
Recommendations 1 - 3	Not applicable to MHF operators		**CLOSED**
Land use planning and the control of societal risk around major hazard sites			
Recommendations 1 - 18	Not applicable to MHF operators		**CLOSED**

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Appendix B

Statement of Heritage Impact

Viva Energy Clyde Terminal SSD 5147
Modification Works (MOD1)
Viva Energy Australia Pty Ltd
11-Jan-2019

Statement of Heritage Impact

Viva Energy Clyde Terminal SSD 5147 Modification Works (MOD1)

Statement of Heritage Impact

Viva Energy Clyde Terminal SSD 5147 Modification Works (MOD1)

Client: Viva Energy Australia Pty Ltd

ABN: 46004610459

Prepared by

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11-Jan-2019

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Quality Information

Document Statement of Heritage Impact

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Date 11-Jan-2019

Prepared by Ameera Mahmood

Reviewed by Darren Jordan

Revision History

Rev	Revision Date	Details	Authorised	
			Name / Position	Signature
1	10-September-2018	Draft Report	Ameera Mahmood Senior Heritage Architect	
2	11-Jan-2019	Final	Ameera Mahmood Senior Heritage Architect	

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Executive summary

Viva Energy Australia Pty Ltd (Viva Energy) has commissioned AECOM Australia Pty Ltd (AECOM) to undertake a Statement of Heritage Impact (SoHI) for the demolition of structures at Clyde Terminal. These works are part of an application to modify the existing consent (SSD 5147) for the conversion of Clyde Refinery into Clyde Terminal i.e. ceasing the refinery activity and adapting the site for sole use as a finished fuels terminal.

The Clyde Terminal (former Clyde Refinery) was established by John Fell & Co. between 1918 and 1926. The site was purchased by Shell in 1928 and operated as a Crude Oil refinery. The Refinery operations ceased in 2012 and conversion to a Terminal commenced with the demolition of refinery associated infrastructure. Viva Energy purchased the site in 2014.

Although the site is not a heritage item, the Director-General's Requirements (DGRs) issued by the Department of Planning and Infrastructure on 16 March 2012 stated that a non-Aboriginal cultural heritage assessment including a SoHI (with significance assessment) be provided. A historical and archaeological assessment was undertaken by AECOM in 2013 (as part of the SSD 5147 application) which identified that the site is of State historical, associative, rarity and representative significance. It assessed that the proposed demolition works, as part of the conversion to the Terminal, would have a negative impact on the significance of the site. Conservation of the site was not deemed to be a viable option due to financial and practical reasons around the on-going management and maintenance of the site.

Although most of the refinery infrastructure has been demolished, this report has re-assessed the historical significance of Clyde Terminal and determined that it continues to be of State significance based on historical and associative heritage values. It also has local significance for its social and technical significance.

Viva Energy is seeking approval for the demolition of additional structures within Clyde Terminal which includes:

- Demolition of the State Office Building – the main administrative building for the terminal;
- MTS1 33kV switch yard;
- Tank T106 (slops tank);
- Two LPG spheres; and
- LPG truck loading gantry.

In addition to the demolition works, Viva Energy is seeking to retain Tank 40 and 41 for the continued use for gasoline storage.

An assessment of the proposed works against the heritage significance of Clyde Terminal concluded that the proposed works would have a minor impact on the heritage significance of Clyde Terminal. Conservation of these items is not a viable option due to financial and practical reason based on management and maintenance of the site.

Mitigation measures have been provided in this report to minimise impacts to the heritage significance of the site. The assessment has also concluded that there is no impact to heritage items listed within the Project Area and to items in the vicinity.

1.0 Introduction

1.1 Background

Viva Energy Australia Pty Ltd (Viva Energy) has commissioned AECOM Australia Pty Ltd (AECOM) to undertake a Statement of Heritage Impact (SoHI) for an application for demolition works at Clyde Terminal.

In 2015 Viva Energy gained consent (SSD 5147) for the conversion of the former Clyde Refinery to Clyde Terminal i.e. for sole use as a finished fuels terminal. The conversion included the demolition and removal of redundant refinery infrastructure. Viva Energy is seeking modification to the existing consent which consists of demolition of additional structures and retention of two tanks (previously approved for demolition). This report forms part of the Statement of Environmental Effects (SEE) which accompanies the application for consent.

The site was previously owned by the Shell Company of Australia (Shell). In 2013, AECOM produced a historical and archaeological assessment of the Clyde Terminal for Shell (AECOM Australia Pty Ltd, 2013b), which formed part of the SSD 5147 application. The objective of the assessment was to address the Director-General's Requirements (DGRs) for the project, issued by the Department of Planning and Infrastructure on 16 March 2012 which stated that the following must be completed:

- a non-Aboriginal cultural heritage assessment (including both cultural and archaeological significance) which must:
  - include a statement of heritage impact (including significance assessment) for any State significant or locally significant historic heritage items including the Shell Oil Refinery Wharf and the surrounding wetland areas on the banks of the Parramatta and Duck Rivers and their tributaries; and
  - outline any proposed management and mitigation measures.

The historical and archaeological assessment by AECOM identified that the site is of State historical, associative, rarity and representative significance. It assessed that the proposed demolition works would have a negative impact on the significance of the site. Conservation of the site was not deemed to be a viable option due to financial and practical reasons around the on-going management and maintenance of the site. The assessment recommended that oral histories and a photographic archival recording be undertaken. It was also recommended that an Archaeological Research Design and Methodology be developed and implemented.

A photographic archival recording was completed by Alexander Mayes Photography in 2014 and a documentary recording of the refinery process at Clyde Terminal was completed by Australian Museum Consulting in 2015.

In 2015 Australian Museum Consulting undertook an archaeological assessment (Australian Museum Consulting, 2015b) for Clyde Terminal to fulfil Department of Planning and Infrastructure's draft heritage Conditions of Consent. This report addressed the potential for archaeological relics to be present in the area defined by Boundary and Colquhoun Streets (the site of residences associated with John Fell & Co and the Shell Refinery).

The approved works for demolition and removal of refinery infrastructure (SSD 5147) were planned to occur in stages. Most of the approved works have been completed except for the removal of some of the tank farms. In parallel to the demolition works, site remediation is also underway.

Additional works for demolition and retention of structures have been identified and this SoHI assessment forms part of the application for modifying the existing consent (SSD 5147).

1.2 Site location

Clyde Terminal is located at the confluence of the Parramatta and Duck Rivers in Rosehill, New South Wales (NSW); approximately 16 km west of Sydney's CBD (see Figure 1). The Terminal, which receives crude oil from Shell's Gore Bay Terminal via 19 km of underground pipeline, is bounded to the north by Parramatta River, to the south and east by Duck River, and to the west by industrial complexes. The Project area falls wholly within the Parramatta Local Government Area (LGA) and is zoned *IN3 Heavy Industrial* under the Parramatta Local Environment Plan 2011 (Parramatta LEP 2011).

1.3 Project description

Viva Energy is seeking approval for the demolition of additional structures within Clyde Terminal (see Figure 2). These include:

- Demolition of the State Office Building – the main administrative building for the terminal;
- MTS1 33kV switch yard;
- Tank T106 (slops tank);
- Two LPG spheres; and
- LPG truck loading gantry.

In addition to the demolition works, Viva Energy is seeking to retain Tank 40 and 41 for the continued use for gasoline storage.

1.4 Report methodology

This heritage assessment has been undertaken in accordance with the NSW Heritage Division guidelines *Assessing Heritage Significance* (NSW Heritage Office, 2001) and *Statements of Heritage Impact* (NSW Heritage Office, 2002) and includes:

- Desktop searches of relevant heritage registers.
- Review of the following key documents:
  - Clyde Terminal Conversion Project, Appendix E – Clyde Terminal Historical Archaeological Assessment, AECOM Australia Pty Ltd, 2013 (AECOM Australia Pty Ltd, 2013b);
  - Clyde Terminal Conversion Project: Documentary Recording, Australian Museum Consulting, 2015 (Australian Museum Consulting, 2015a);
  - SSD 5147 Shell Oil Refinery, Clyde Archival Recording, Alexander Mayes Photography, 2014 (Mayes, 2014);
  - Clyde Terminal Conversion Project: Historic Archaeological Assessment, Australian Museum Consulting, 2015.
- Limited additional research. Research for this report has been based AECOM's 2013 report (AECOM Australia Pty Ltd, 2013b). Additional research has been contained to the specific items that are being proposed for demolition and is limited to desktop research.
- A site inspection carried out on 16 August 2018 to assess the structures proposed for demolition. Note: all photographs within this report were taken during the site inspection unless otherwise stated.
- A re-assessment of the heritage significance of the site. The assessment has been undertaken in light of the conservation processes and principles found in *The Burra Charter: The Australian ICOMOS Charter for Places of Cultural Significance* (2013). *The Burra Charter* is considered to be the pre-eminent guidance document for the management of change for places of heritage significance within Australia.

1.5 Report authorship and acknowledgements

This report has been prepared by Ameera Mahmood (Senior Heritage Architect) and includes historical background prepared by Dr Susan Lampard (Senior Heritage Specialist). Dr Darran Jordan (Senior Archaeologist) provided a technical review of the content.

1.6 Report limitations

The purpose of this report is to identify and assess historic heritage and archaeological potential which might be impacted by the proposed works. Predictions have been made within this report about the probability of subsurface archaeological materials occurring within the site, based on surface indications and environmental contexts. However, it is possible that materials may occur in areas without surface indications and in any environmental context. These would be addressed in accordance with Transport for NSW's *Unexpected Heritage Finds Guideline* (Transport for NSW, 2015). This report is based on the reference design for the Project. It is noted that during detailed design, details of the Project may change or be refined.

A summary of the statutory requirements regarding historical heritage is provided in Section 2.0. The summary is provided based on the experience of the author with the heritage system in Australia and does not purport to be legal advice. It should be noted that legislation, regulations and guidelines change over time and users of the report should satisfy themselves that the statutory requirements have not changed since the report was written.

Research has been limited to desktop searches.

Due to Viva Energy health and safety protocols, photographs could only be taken within the confines of the vehicle during the site inspection. This constraint has limited the quality and detail of data collection and recording.

FIGURE 1: THE CONVERSION PROJECT AREA

AECOM

0 100 200 300 m

KEY

Conversion project area boundary

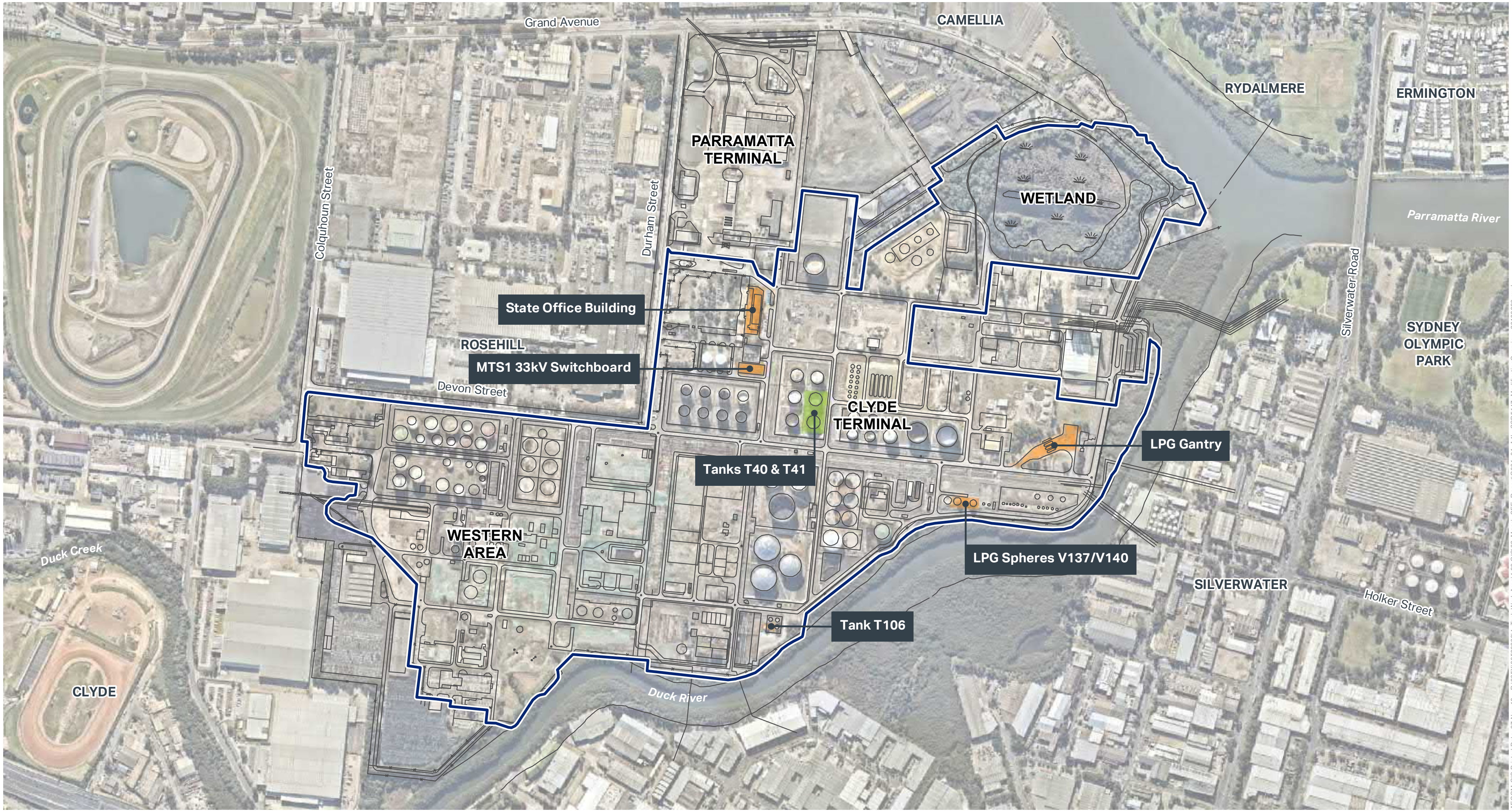

FIGURE 2: SSD 5147 MODIFICATION 1 – MODIFICATION OVERVIEW

AECOM

0 100 200 300 m

KEY

Conversion project area boundary

Site Modifications

Retain

Demolish

2.0 Statutory context

2.1 Commonwealth legislation

2.1.1 Environmental Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) defines the 'environment' as both natural and cultural environments and therefore includes Aboriginal and non-Aboriginal historic cultural heritage items. Under the EPBC Act, protected heritage items are listed on the National Heritage List (NHL) (items of significance to the nation) or the Commonwealth Heritage List (CHL) (items belonging to the Commonwealth or its agencies). These two lists replaced the Register of the National Estate (RNE). The RNE has been suspended and is no longer a statutory list; however, it remains as an archive.

Under Part 9 of the EPBC Act, any action that is likely to have a significant impact on a matter of National Environmental Significance (known as a controlled action under the EPBC Act), may only progress with approval of the Commonwealth Minister for the Department of the Environment and Energy (DoEE). An action is defined as a project, development, undertaking, activity (or series of activities), or alteration. An action would also require approval if:

- it is undertaken on Commonwealth land and would have or is likely to have a significant impact on the environment on Commonwealth land; and,
- it is undertaken by the Commonwealth and would have or is likely to have a significant impact.

Searches of the heritage registers mandated by the EPBC Act have been undertaken on 31 August 2018 and there are no items within the Project Boundary on these registers. There are two items listed on the non-statutory RNE as being adjacent to the Project Boundary, comprising the Lower Duck River Wetlands (RNE No. 19254) and the Parramatta and Lane Cove River Landscapes (RNE No. 14309). In relation to heritage, the EPBC Act is not of further relevance to the subject site.

2.2 State legislation

2.2.1 Environmental Planning and Assessment Act 1979

The Environmental Planning and Assessment Act 1979 (EP&A Act) is the primary legislation for development within NSW. The Act is supported by the Environmental Planning and Assessment Regulation 2000 (EP&A Regulation and a number of Environmental Planning Instruments (EPIs) which include State Environmental Planning Policies (SEPPs) and Local Environment Plans (LEPs).

Upon repeal of Part 3A of the EP&A Act on 1 October 2011, the Environmental Planning and Assessment Amendment (Part 3A Repeal) Act 2011 inserted a new Division 4.1 in Part 4 of the EP&A Act. Division 4.1 provides for a new planning assessment and determination regime for State Significant Development (SSD). On 20 April 2018, the project was declared an SSD.

In line with Section 4.5 of the EP&A Act, the consent authority for the Project will be the NSW Minister for Planning. As noted in Section 4.40, SSD applications are evaluated and determined in line with the requirements of Section 4.15 of the EP&A Act.

Section 4.41 of the EP&A Act lists the Acts and sections of Acts relating to approvals which do not apply to SSD projects. This includes approval under Part 4, or an excavation permit under section 139, of the *Heritage Act 1977.*

2.2.2 Heritage Act 1977

The Heritage Act 1977 (as amended) was enacted to conserve the environmental heritage of NSW. Under Section 32, places, buildings, works, relics, moveable objects or precincts of heritage significance are protected by means of either Interim Heritage Orders (IHO) or by listing on the NSW State Heritage Register (SHR). Items that are assessed as having State heritage significance can be listed on the SHR by the Minister on the recommendation of the NSW Heritage Council.

Archaeological relics (any relics that are buried) are protected by the provisions of Section 139. Under this section it is illegal to disturb or excavate any land knowing or suspecting that the disturbance or excavation will or is likely to result in a relic being discovered, exposed, moved, damaged or destroyed. In such cases an excavation permit under Section 140 is required. Note that no formal listing is required for archaeological relics; they are automatically protected if they are of local significance or higher.

Proposals to alter, damage, move or destroy places, buildings, works, relics, moveable objects or precincts protected by an IHO or listed on the SHR require an approval under Section 60. Demolition of whole buildings will not normally be approved except under certain conditions (Section 63). Some of the sites listed on the SHR or on LEPs may either be ‘relics’ or have relics associated with them. In such cases, a Section 60 approval is also required for any disturbance to relics associated with a listed item.

Under Section 170 of the Heritage Act 1977, NSW Government agencies are required to maintain a register of heritage assets. The Register places obligations on the agencies, but not on non-government proponents, beyond their responsibility to assess the impact on surrounding heritage items. The subject site is not listed on any Section 170 registers.

2.3 Local government

2.3.1 Parramatta Local Environmental Plan 2011

The Parramatta LEP 2011 controls development in relation to heritage items within the Rosehill area. Schedule 5 of the LEP provides a list of identified heritage items, conservation areas and archaeological sites, which has been examined to determine whether the items could potentially be directly impacted by the Project. Clause 5.10(2) of the Parramatta LEP 2011 provides that consent is required for development that involves, demolishing, moving, altering, disturbing or excavating heritage items, or erecting a building on land or subdividing land where a heritage item or heritage conservation area is located. The Project Area contains LEP 2011 heritage listed wetlands and is adjacent to several items zoned as Heritage under LEP 2011.

2.4 Heritage registers

Table 1 provides the results of the relevant statutory heritage schedules.

Table 1 Summary of listed heritage items within and adjacent to the Project area

Heritage list	Sites within the Project site	Level of significance	Sites adjacent to the Project site	Level of significanc e
World Heritage List	None	n / a	None	n / a
National Heritage List	None	n / a	None	n / a
Commonwealth Heritage List	None	n / a	None	n / a
Register of the National Estate (non-statutory)	None	n / a	Lower Duck River Wetlands (RNE No. 19254, Registered Place) Parramatta and Lane Cove Rivers Landscapes (RNE No. 14309, Indicative Place)	Registered Indicative Place
State Heritage Register	None	n / a	None	n / a
Section 170 Heritage and Conservation Register	None	n / a	None	n / a

Heritage list	Sites within the Project site	Level of significance	Sites adjacent to the Project site	Level of significanc e
Parramatta LEP 2011	Wetlands (Item No. I1)	Local	Pumping Station (Item No. I5) Tram alignment (Item No. I6) Silverwater Bridge (Item No. I73) Capral Aluminium (Item No. I575) RTA Depot (Item No. I576)	Local Local Local Local Local
Parramatta Archaeological Zoning Plan	Parramatta Archaeological Management Unit 2966	No archaeological potential	N / A	N / A

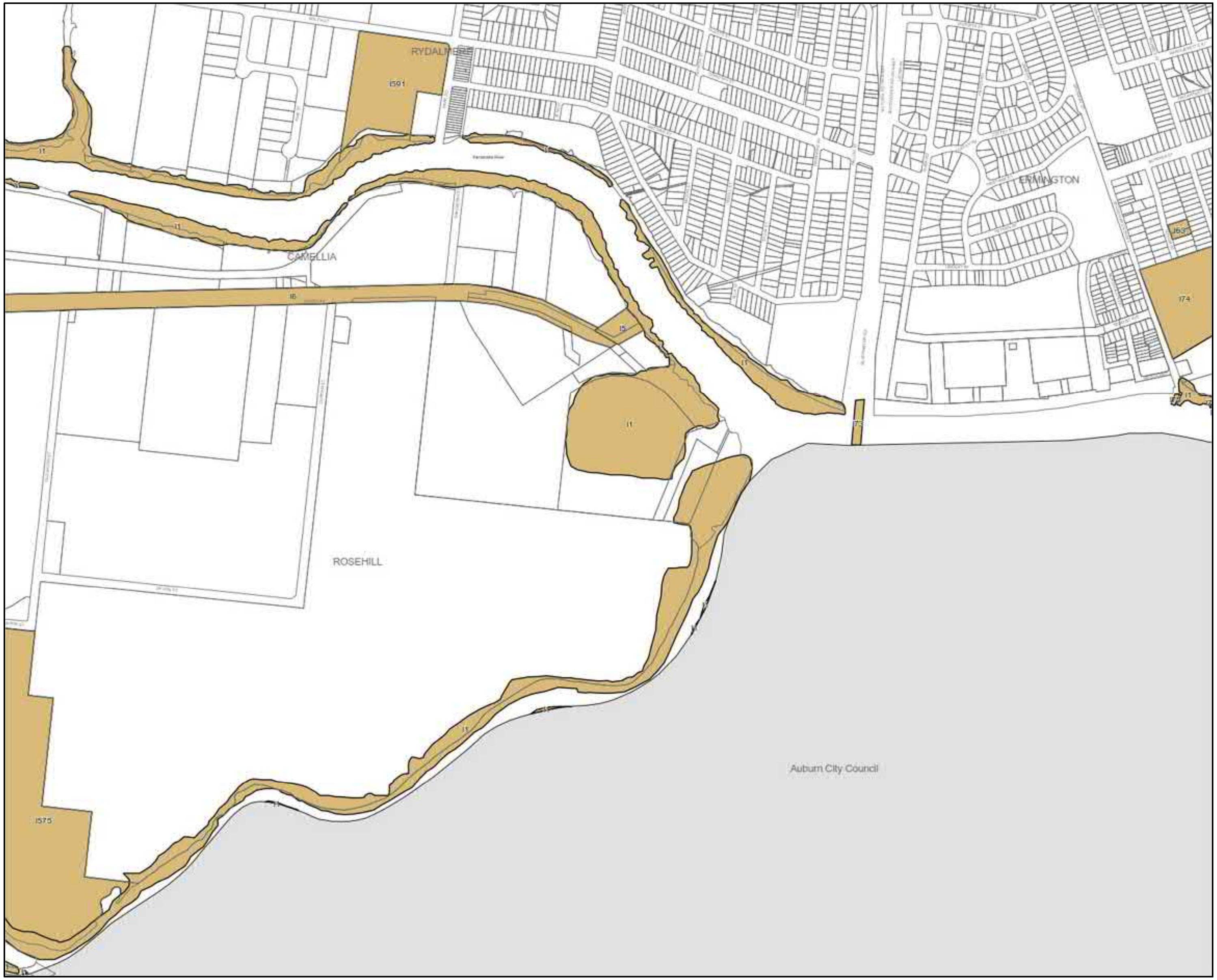

Figure 3: Heritage items within the vicinity of Clyde Terminal (Source: Parramatta LEP 2011)

3.0 Historical context

3.1 Site history

The following historical evidence is from AECOM's previous heritage assessment (AECOM Australia Pty Ltd, 2013b) which provides the historical context and history of development of the Clyde Terminal (formerly Clyde Refinery) site.

The Project site has four historical phases: Aboriginal occupation (pre c.1804); early land grants and Elizabeth Farm (1816-1918); John Fells & Co. (1918-1927); and British Imperial Oil / Shell (1928-present). Each of these is discussed below.

Aboriginal Occupation (Pre c.1804)

The Project Area falls within the traditional country of the Darug (also spelt Dharuk, Dharruk, Dharug and Daruk) language group. Available archaeological data indicate that Aboriginal people have occupied the Sydney Region for at least 20,000 years (McDonald 2005). Further details regarding Aboriginal occupation of the area can be found in the Clyde Terminal Conversion Aboriginal Report (AECOM Australia Pty Ltd, 2013a).

Early Land Grants: Elizabeth Farm (1793-1918)

In 1793, John Macarthur (c.1767-1834) was granted 100 acres of land adjacent to the Parramatta River by Major Francis Grose, Commanding Officer of the New South Wales Corps. Macarthur named the property 'Elizabeth Farm' after his wife. The Macarthurs' were very successful farmers and eventually became the biggest land-holders in New South Wales. By 1800, Elizabeth Farm comprised nearly 300 acres, sustaining approximately fifty head of cattle, a dozen horses and 1000 sheep, and John Macarthur's total land-holdings amounted to nearly 1300 acres. It was during these early years of the nineteenth century that John Macarthur became interested in, and a pioneer of, the Australian wool industry, importing Merino sheep from Spain to Australia.

On the 8 October 1816, the Crown granted John Macarthur an additional 850 acres of land, which encompassed the area currently occupied by the Shell Clyde Terminal. John Macarthur died in 1834 and Elizabeth Farm was passed on to his son, Edward Macarthur. Edward did not, however, immediately inherit the property, as Elizabeth Macarthur, John's widow, had use of the property until her death in 1850. From 1850 until Edward's death in 1872, Elizabeth Farm was managed by agents who may also have resided on the property in the Elizabeth Farm homestead. In the years 1869-1874, Thomas Icely, who was a pioneer pastoralist and member of the Legislative Council, is documented as a tenant of Elizabeth Farm on a five year lease. After Icely, the property was leased by William Whalen Billyard, the Civil Crown Solicitor for NSW. Billyard paid £1000 to terminate his lease. From the death of Edward in 1872 to the sale of the property in 1881, the Elizabeth Farm property was administered by trustees (Young & Barnett, 1979).

Elizabeth Farm was purchased in 1881 by Septimus Alfred Stephen for £50,000. Stephen and his brother, Arthur, subdivided and sold off the property. The first subdivision was auctioned on the 17 February 1883, and the second was sold on the 26 May 1883. The third subdivision known as the 'Granville Portion' was auctioned on the 13 October 1883. The fourth and final subdivision, comprising the remaining unsold lots from the second subdivision sale, was eventually sold on the 13 September 1884. Elizabeth Farm homestead was purchased by J.W Cliff (Young & Barnett, 1979).

The 1926 St Johns parish plan indicates that the northern portion of the Project Area had been resumed for a sewerage farm, but it also notes on the plan that it was "now sold", indicating that the works were never constructed.

The Clyde Terminal - Introduction

From the 1860s onwards, the Australian shale oil industry supplied a small proportion of Australia's oil needs. Until the 1920s, shale oil was refined at small scale distillation plants near the shale mining sites, predominantly in the state of New South Wales. In 1906, Sir George Newnes, a London publisher and financier, sponsored the Commonwealth Oil Corporation (COC) to take over and re-invigorate the ailing shale oil industry near Lithgow, NSW. In 1908, the COC purchased a large expanse of scrubby land at the confluence of the Parramatta and Duck Rivers, on land formerly part of the Elizabeth Farm estate, for future expansion. In 1911 the Corporation struck financial difficulties and went into receivership. No evidence can be found that COC constructed or operated a refinery on the site and it seems unlikely that precious capital would have been expended on speculative venture when the Corporation as a whole was in jeopardy. This land was subsequently acquired from COC by John Fell & Co. in 1913, when all the assets of the Corporation were transferred (Murray, 2001).

The Clyde Terminal - Establishment of the Clyde Refinery: John Fells & Co. (1918-1927)

John Fell was born in 1862 in Scotland, the son of Scottish oil pioneer Alexander Morrison Fell. Alexander Morrison Fell later transferred his shale-oil refining operations to Australia. John Fell relocated to Australia with his family as a teenager, where he served in a number of positions with his father's company – AM Fell and Sons. John was eventually promoted to a managing partner of the company, however, in 1903 he decided to leave his father's company, and established his own, known as John Fell & Co Pty Ltd (John Fell & Co; Fell & Co.) (Stanley, Rothschild, & Higginbotham, 2009).

John Fell & Co Pty Ltd was established to refine, blend and distribute oil, and went on to become pioneers of the Australian oil industry (Macleod, 2012). Fell established his refinery at Gore Bay, next door to the British Imperial Oil's Gore Bay terminal facilities, which had officially opened in 1901. By 1910, John Fell & Co was buying their supplies from Tarakan Crude Oil from British Imperial Oil, a subsidiary of the Shell Transport & Trading Co. For several years, John Fell & Co was their largest Australian customer.

In 1913, John Fell & Co Pty Ltd acquired the assets of the bankrupt Commonwealth Oil Company's shale oil mine at Newnes. The COC and Fell & Co operations were run in tandem, with references to COC being phased out in preference of Fell & Co. The Newnes operations were initially quite successful, and increasing market-growth and demand for oil lead John Fell & Co. to further expand operations. In 1918 the Company supplemented its existing shale oil operations by establishing a shale oil refinery on 60 acres of land at Clyde, NSW. As mentioned above, the land upon which Fell & Co. established the refinery had previously been part of Elizabeth Farm, before being transferred to the COC in 1908.

The genesis of the refinery remains unclear. It seems unlikely that COC established active operations at Clyde, it is therefore speculated that it was John Fell & Co. who commenced construction. A Shell publication (Shell Company of Australia, n.d.) states that, in 1918, John Fell & Co. decided to establish a shale oil refinery at Clyde. In the same year, Fell offered the company's assets to Shell, however Shell did not accept as they were not considering moving into refining at the time (Murray, 2001). Facing fierce and increasing competition, falling international prices, and reductions on government import taxes, John Fell & Co was increasingly under pressure to keep their business profitable. By 1922, the shale at Newnes was exhausted and unprofitable, and Fell's refining operations there were suspended. The Newnes shale oil mine subsequently closed in 1924.

It is unclear whether refining began in 1918 – there is no mention in contemporary newspapers. Shell believe that refining was underway by 1923, when John Fell & Co. began purchasing Crude Oil to refine at Clyde (Shell Company of Australia, n.d.). (Murray, 2001) dates the agreement to sell Crude Oil to 1925 – when it is known that a refinery was definitely under construction.

In 1925, John Fell & Co consolidated their operations at Clyde, moving the storage and processing plant from Gore Bay and refining equipment from Newnes, to the site. Work on a rail siding for the refinery commenced and the area was cleared for development. The 750 Dubbs cracking plant was installed, which was the first of its kind in the southern hemisphere. The remainder of the refinery's equipment was relocated from Newnes (Murray, 2001). John Fell & Co then signed an agreement with Shell for the supply of 1,500 tonnes of Crude Oil per month, refining of which commenced at Clyde in 1926. At this time, about 40 people were employed at the then Clyde Refinery, handling the refining and distribution operations. Access to the site was generally limited to the railway siding, and the Refinery was producing Dux Motor Spirit, petroleum, coke, tractor distillate, gas oil, and Ajax Power Kerosene. In 1927, the Duck River Wharf opened, which enabled crude feed stock to be barged in along the river from Gore Bay.

Throughout 1927, the then Clyde Refinery experienced a series of unfortunate incidents. In May, a large fire at the Clyde Refinery enveloped the surrounding suburbs in smoke, and was reported in the media as far away as Adelaide:

> *"A fire which attracted attention over a wide area of Granville and surrounding suburbs occurred on Friday night at the Clyde Oil Refinery of John Fell & Co., Limited, situated at Duck Creek Granville. The burning of 1,000 gallons of crude oil, which was contained in an open vat away from buildings, caused dense clouds of black smoke, which enveloped the whole district. It is thought that the fire was caused by a light coming in contact with a leak in a gaspipe in a brick furnace. The furnace was seriously damaged. The firemen subdued the outbreak in about half an hour" (The Register, 1927)*

On the 18 August 1927, a horrific explosion of an oil still at the then Clyde Refinery resulted in the death of three men, including the son of the proprietor, and caused extensive damage to the facility:

> *"A dreadful disaster resulting in the death of one man and serious injury to two others occurred at the Refinery of John Fell & Co, at Granville. The victims are: killed; Alfred Ward of Darlinghurst; injured; John Fell; severe burns, shock and abrasions, Henry Spencer of Westmead; severe burns and concussion. Neither of the injured men are expected to recover. The explosion occurred in a gigantic still which was boiling oil, contained in the main building. John Fell with two other men were standing 15 feet away from the stills when there was a fierce roar and the top of the still was hurled with tremendous force through the roof of the building. Huge torrents of oil then leaped with irresistible fury out of the still. The explosion rendered Ward senseless and the oil streaming down in torrents engulfed him as he lay on the ground. He was almost totally incinerated. Fell was hurled bodily through an aperture in the wall of the still room over two lines of rail way trucks and a barbed wire fence and into a paddock 60 yards away. Spencer was smothered in blazing oil. His clothing was burnt from his body and he was hurled against the side of the wall of the room. Work men hearing the explosion rushed to the aid of the victims. It was impossible to do anything for Ward but wait until the oil flow ceased. It was then found that his legs and arms had been burnt away and practically nothing was left of the dead man" (Northern Territory Times, 1927)*

The coronial inquiry, as reported in the Sydney Morning Herald on the 23 September 1927 reported that accidental death had been returned on all three deaths, with the most likely cause of explosion inconclusive, but thought to be the introduction of water to the still.

Following the explosion, the Clyde Refinery was shut down until the end of September 1927, while an investigation was conducted, and all but a small number of employees were dismissed. These events, in conjunction with John Fell's increasing age and deteriorating health resulted in the Refinery once again being offered to Shell. Shell accepted the offer, and John Fell & Co's Clyde and Gore Bay assets and facilities were sold together for £240,000, of which £40,000 was made in two annual instalments under the proviso that John Fell would operate the Refinery for Shell for a period of not more than two years and that during this time he had to demonstrate that the Refinery could be operated economically on good quality Crude Oil.Shell as Owner / Operator of Clyde Refinery (1928-present).

On the 1 January 1928, Shell took over as the owner and operator of the then Clyde Refinery. Shell's ownership and operation of the Clyde Refinery marked the commencement of the first stage of expansions to the Clyde Refinery, with an additional seven acres of land purchased on July 30, 1928. Subsequently, a further 150 acres were purchased from the Ford Motor Company in June 1930, which increased the total extent of the Clyde Refinery to 217 acres.

During the period 1929 to 1939, the Clyde Refinery underwent its first major expansion. This expansion was complemented by the purchase and construction of new equipment and buildings, as summarised below. The first element to be upgraded was the Dubbs Cracking Unit, which was restarted as a topping plant processing Crude Oil on January 16 1928. Following this, the No. 2 Boiler was built in 1929 and the Clyde Refinery commenced manufacture of black oil residue lubricating oils. The No. 3 Boiler still was also constructed in 1929, for the redistillation of heavy benzine from the topping plant. In 1930, 150 acres of land were purchased from the Ford Motor Company, which increased the total acreage of the Clyde Refinery to 217 acres. During these early years there was no fence around the perimeter of the refinery property.

In 1931, following the decision of the Commonwealth Government to impose a four pence per gallon excise duty on refined gasoline, the Clyde Refinery was temporarily closed to enable the rebuilding of the Dubbs furnace and undergo general maintenance. The Clyde Refinery was closed from May to July. The special boiling unit was constructed in 1934, the same year in which the Clyde Refinery ceased production of Shell Imperial, introducing in its place imported Super Shell Motor Spirit. In the period 1935 to 1939 the No 2 Coalinga heater was commissioned and the Dubbs heater decommissioned, a new laboratory, mess room and ablution block was erected, a Trumble fractioning unit was added to the distillation plant, and construction of a new topping plant,boilers, additional tankage, offices, and the development of the Parramatta wharf commenced. Upon the recommendation of Mr J.W Ernste, from B.P.M Holland following a visit to the site, the capacity of the Clyde Refinery was increased and a modern distillation unit was erected to eliminate the re-distilling of gasoline. In September 1938, a new topping plant / crude distillation unit was brought on stream and the old Dubbs unit was subsequently shut down on the 8 October. The first overseas manager of the Clyde Refinery, Mr Fred Mackley, was also appointed at this time. This first period of expansion concluded in 1939 with the construction of the drum and tin filling shed.

Following the outbreak of World War II, and in particular Japan's entry into the war in 1941, Crude Oil supplies were cut to the Clyde Refinery and efforts were redirected to supplying and supporting the requirements of the Australian armed forces. With the exception of the No. 1 and 2 boiler stills, the Clyde Refinery was closed on January 30 1942, and the Clyde Refinery adapted to become an essential wartime industry. For the duration of the war, the primary function of the Clyde Refinery was as a storage terminal and drum filling area. The only products manufactured during this period were solvents from imported gasoline and wash (gas) oil made from diesel fuels. Following the resolution of the conflict in 1945, Crude Oil was once again available and refining operations at the site recommenced. The Clyde Refinery was reopened on March 21 1946 by the Premier of NSW, Mr W.J. McKell, and underwent its second phase of development and expansion. This phase of development commenced in 1947, with the construction of the bitumen plant and neutralised lubricated oil production facilities, which were officially opened in 1948. The expansion culminated with the commissioning of the LVI Lubricating Oil Plant and the official opening of new laboratories at the site in May 1953.

From 1958 – 1959, the Clyde Refinery underwent its third major expansion and development. This cost approximately $18 million and involved the erection of a platformer, significant modernisation and extension of existing ancillary facilities, and the erection of double-storey administration buildings on site (see Plate 1). Another major expansion phase followed almost immediately, from 1960 – 1963, which totalled a capital expenditure of $34 million. Major additions to the Refinery during this expansion phase included the catalytic cracking complex, high vacuum unit, ethylene and epikote plants, and the construction of two pipelines.

In 1964, Shell completed construction of their Parramatta Terminal, which subsequently replaced the Clyde Refinery as Shell's primary distribution centre in NSW. All marketing distribution functions, with the exception of bitumen and bulk solvents, were transferred from Clyde across to the new Parramatta facility. Later that year, on the 10 June, the Clyde Refinery commenced refining of the first shipment of Australian Crude Oil from the Moonie oil fields in Queensland.

In the period 1966 – 1968, Clyde underwent another major overhaul and expansion, with a total capital expenditure of $20 million. This phase included the erection of a splitter treater, the introduction of the No. 2 crude distiller, No. 7 steam boiler, turbo generator 1, and the chemical and hydrocarbon solvents plant, as well as extensions and additions to existing ancillary facilities.

The expansion and development of Clyde continued with an additional 35 acres of land purchased from Mobil at a cost of $1.2 million in 1970. Also that year, a new polypropylene plant was erected for Shell Chemical at a capital cost of $16 million. Following this, in 1972, the processing capabilities of the Clyde Refinery experienced a significant development, with the addition of platformer 2 and turbo-generator 2 at a cost of $6 million. Despite these additions, however, the overall capacity of the Clyde Refinery's processing abilities was not affected. In 1974 -1975, at a cost of $4 million, a water recovery treatment and re-use system was installed for refinery process cooling. This enabled the Clyde Refinery to be isolated from the previous Parramatta River – Duck River system.

Following the conclusion of the major phases of expansion and development of the Clyde Refinery in the mid-1970s, only minor additions and modifications were made. In c.1987 the Butane De-Asphalting Plant (BDA Plant) and oil interceptor were demolished. The site that these elements had occupied was redeveloped, with the Central Control Room constructed at that location in 1988. In December 1993, work commenced on the Propylene Treatment Plant and in 1994 the mounded LPG Storage facility was built (Shell Refining (Australia) Pty Ltd, 1993). In 1999, however, with Shell – and the oil industry as a whole - increasingly challenged by a combination of tight economics and environmental concerns, the Clyde Refinery once again found itself facing the prospect of closure. In late 1999, the announcement was made that the closure of the Clyde Refinery at some point in time after c. 2006 was a real possibility. The Clyde Refinery continued to operate, along with six other Australian refineries, in the early years of the twenty-first century. In 2008, the Clyde Refinery was temporarily closed down in November for maintenance works, and did not resume operations until July the following year.

The former Shell Clyde Refinery was one of the longest operating, and one of the most complex, oil refineries in Australia. In April 2012, however, Shell announced that the Clyde Refinery would permanently cease refining operations as these operations were not economically sustainable. This was due to the fact that the former Clyde Refinery could no longer compete with the larger Asian refineries that have emerged in recent years, and which are capable of producing up to one million barrels of refined oil products per day, an average of 921,000 more barrels per day than the former Clyde Refinery was capable of producing.

The Clyde Terminal - Physical Development of the Site

The 1930 aerial photograph of the area (Plate 2) indicates that the Shell facility, shortly after it was purchased from John Fell & Co, was focussed on the corner of Devon and Unwin Streets, although at this time Devon Street had not been formed and was just a property boundary. At this time, the former Clyde Refinery consisted of a tank farm of approximately 18 tanks, which were located in the area now identified as Tank Farms A2 and A3. On the corner of Colquhoun and Devon Streets a residential house is indicated. This is known from anecdotal evidence to have been the manager’s residence. At the termination of Unwin Street, there appears to be some buildings of unknown function. The remainder of the facilities associated with the former Clyde Refinery are located along the southern boundary of the tank farm area. The quality of the aerial is not sufficient to allow identification of these structures. The remainder of the site is shown as saltmarsh, with no apparent development. Sometime between 1930 and 1951, a wharf was constructed on Duck Creek to the south of where the workshops now stand.

The 1951 aerial (Plate 3) indicates there had been extensive development at the site. Tank Farm A1 had been constructed adjacent to Tank Farms A2 and A3, and two more houses had been constructed along Devon Street. Where the current administration office block stands, there was an L shaped building. There was also a building on the site of the former Shell Credit Union and contractors amenities building. The Clyde Terminal is still consolidated to the south of the tank farms. The former Clyde Refinery appears to have been connected to the tramway to the north by a track and series of branch lines. Oriented NE-SW are two structures that appear to be rail loading facilities. The northernmost structure sits to the north of a new Tank Farm area, which correlates with where Tanks 201, 203 – 207 stand today. The tank farm originally comprised nine tanks, and the six extant tanks in this area appear to be the same as from this period. Two further sheds were constructed along the Durham Street boundary, roughly north of where the Shell NSW State office stands today. The wharf at the confluence of Parramatta River and Duck Creeks was in operation, and there appears to be a pipeline connecting the wharf to the former Clyde Refinery. The south-east portion of the site remains undeveloped.

The 1961 aerial (Plate 4) indicates that the residences on the corner of Devon and Colquhoun Street are still extant and have well developed gardens. The office blocks are now present on site. The Credit Union and contractors facilities, as they still stand, are evident, as is the Administration building for the bitumen rail loading facilities. Tank Farm B1 is under construction and Tank Farm B appears to be operational, but has a different configuration to the current one. Tank Farms C and E1 are complete and appear to be the same as those present on site today. Where the current distillate splitter stands, a new facility has been constructed, and the current CCU and GS plant at the corner of Road 2 and Road 11 is under construction. A third facility appears to be nearing completion to the north of Tank Farm E. The area today covered by the CCR and HVU is either occupied by a series of sheds or is vacant. The area to the east of Tank Farm E1 is largely undeveloped, although it appears that a series of causeways have been built through the swamp. The facilities to the south of Tank Farms A1, 2 and 3 have been augmented, particularly noticeable from the aerial is the insertion of a number of smaller tanks, particularly along Road 12A.

The 1965 aerial (Plate 5) indicates that Tank Farm B2 has been constructed, and the area to the east has been developed, with a series of smaller tanks, evident at the current location of the LPG storage tanks. The area to the east of Tank Farm E1 remains largely undeveloped. The facility previously under construction to the south of Tank Farm C has been completed. The current CCU and GS plant is now completed. The flares were in place by 1965.

The 1970 aerial (Plate 6) indicates that the distillate splitter treater is operational in its present location and the HVU is also in its current location. The collection of sheds that had stood on the corner where platform 3 now stands has been demolished. Some tanks have been inserted and removed from Tank Farms A2 and A3, and sheds have also been removed from where Tank Farm H now stands. Tank Farm B2 has been extended to the south and east, and Tank Farm E2 is under construction. Also, there was a Tank Farm on the current location and to the east of the mounded LPG facility. The houses on Devon Street are still extant.

The 1978 aerial (Plate 7) indicates that there have been extensive demolitions around the bitumen loading gantry and to the east and south – these activities appear to have removed the majority of the remaining infrastructure associated with the operation of John Fell & Co. The high vacuum unit appears to have been upgraded and has a similar configuration to today. The water treatment facility (cooling treatment facility) has been constructed. The main interceptor had been put in place by 1970. Between 1970 and 1978 the houses on Devon Street were demolished. Tank Farm H has been constructed, as has sub-station 24. Tank Farm E2 has been completed, as had been the LPG Loading Facility to the east of Tank Farm E2.

The 1986 aerial (Plate 8) indicates that there have been no major alterations to the site since 1978. The movements control building had been constructed and the NSW State Office had been constructed subsequent to the 1978 aerial and prior to that from 1986.

The 1994 aerial (Plate 9) indicates that the Central Control Room had been constructed. The shed on the current site of the bitumen loading gantry has been demolished, and the gantry constructed. The mounded LPG facility has also been constructed at this time.

Note: Aerial Photographs referred to in the above text are included in Appendix 1.

3.2 Summary of key historical phases and associated physical elements

Table 2 summarises the physical elements of the site that are associated with the key phases of development.

Table 2: Summary of key historical phases and associated physical elements (Source: AECOM Australia Pty Ltd, 2013

Phase	Activity
Phase 2: **Early land grants and Elizabeth Farm (1816-1918)**	Documentary evidence has not indicated that any physical evidence remains from this phase.
Phase 3: **John Fells & Co. (1918-1927)**	Documentary evidence has not indicated that physical evidence remains from this phase except for the property boundary.
Phase 4: **British Imperial Oil / Shell (1928-present)**	The following sub phases have been identifies as key development stages of the British Imperial Oil / Shell Phase:
	Stage 1 Major Expansion (1929-1939) evidence by: • Purchase of seven acres of land. • Upgrade to Dubbs Cracking Unit, restarted as topping plant to process Crude Oil (1928). • No. 2 Boiler and No.3 Boiler still constructed (1929) for the redistillation of heavy benzene from topping plant. • 150 acres of land purchased from Ford Motor Company (1930).

Phase	Activity
	• Rebuilding of the Dubbs furnace for maintenance following Government excise duty on refined gasoline (1931). • Import of Shell Imperial ceased and replaced by Super Shell Motor Spirit (1931). • Commissioning of No. 2 Coalinga heater and Dubbs heater decommissioned. New laboratory, mess room and ablution block was erected. A Tumble fractioning unit added to the distillation plant and construction of a new topping plant, boilers, additional tankage, office and development of Parramatta wharf commenced (1935-1939). • Modern distillation unit was erected to increase capacity. • New Topping plant / Crude distillation unit was brought on stream and the old Dubbs unit was shut down (1938). • Construction of a drum and tin filling shed (1939).
	Stage 2 Major Expansion (1946-1953) evidence by: • Reopening of Clyde Refinery post World War II (1946). The refinery was closed in 1942 and operated as a wartime industry as a storage terminal and drum filling area, producing solvents from imported gasoline and wash (gas) oil made from diesel fuels. • Construction of bitumen plant and neutralised lubricated oil production facilities (1947-1948). • Commissioning of LVI Lubricating Oil plant and official opening of new laboratories (1953).
	Stage 3 Major Expansion (1958-1959) evidence by: • Expansion and development costing $18 million involving erection of platformer, upgrade of existing ancillary facilities, erection of a double storey administration building.
	Stage 4 Major Expansion (1960-1963) evidence by: • Expansion and development costing $34 million with major additions to including catalytic cracking complex, high vacuum unit, ethylene and epikote plants, and the construction of two pipelines.
	Stage 5 Major Expansion and overhaul (1966-1968) evidence by: • Expansion and development costing $20 million with erection of splitter treater, introduction of the No. 2 crude distiller, No. 7 steam boiler, turbo generator, chemical hydrocarbon solvents plant and extensions and additions to existing ancillary facilities.
	Stage 6 Major Expansion and overhaul (1970-1975) evidence by: • Purchase of 35 acres from Mobil (1970) for expansion. • Polypropylene plant erected for Shell Chemical. • Platformer 2 and turbo-generator 2 added increasing the capacity of the refinery. • A water recovery treatment and re-use system was installed for refinery process cooling (1974-1975) enabling self-sufficiency from the previous Parramatta River – Duck River system.
Minor addition post 1975	• Construction of State Office Block building (1986). • Butane De-Asphalting Plant (BDA Plant) and oil interceptor demolished (1987) replaced by the Central Control Room (1988). • Work commenced on Propylene Treatment Plant. • Mounded LPG Storage facility built (1994).

3.3 Early historical images

The following historical aerial images evidence the array of physical changes to Clyde Terminal. The nature of the refinery activities has meant that the site is continually changing and evolving.

Figure 4: Clyde Refinery, Aerial photo, between 1943 and 1951 showing early residences on site (Source: Shell Australia)

Figure 5: Clyde Refinery, Aerial photo, date unknown (Source: Shell Australia)

Figure 6: Clyde Refinery, Aerial photo, 1961 (Source: Shell Australia)

Figure 7: Clyde Refinery, Aerial photo, 1996 (Source: Shell Australia)

3.4 State Office Building

The State Office Building was constructed in 1986 as an administrative centre for Clyde Terminal. The building does not appear in aerial photographs dated 1970 and 1978 Figure 8 and Figure 9. The covered walkway and entrance are not original as evidenced in their absence in an early aerial photo (Figure 10). The building is designed in a contemporary style typical of the era. Stylistic characters include, circular forms, tensioned membrane structures, internal conservatories, skillion roofs and clerestory windows. Online searches did not reveal whether the building was designed by a significant person. Considering the building's stylistic features it is likely to have been designed by an architect or designer.

The building is not linked with any key historical phases.

3.5 MTS1 33kV switchyard

The MTS1 33 kV switchyard is likely to have been constructed between 1970 and 1978. The switchyard is absent in the 1970 aerial (Figure 8) and present in the 1978 aerial (Figure 9).

The switchyard is associated with a key phase of development for the site, Phase 4: British Imperial Oil / Shell (1928-present). Within this phase it evidences the very last stages of development of the site identified as Stage 6 Major Expansion and overhaul (1970-1975).

Figure 8: 1970 Part image of Aerial photo does not show switchyard (Source: Shell Australia)

Figure 9: 1978 Part image of Aerial photo does not show the State Office Building. The switchyard is present (Source: Shell Australia)

Figure 10: 1986 Part image of Aerial photo showing State Office Building and switchyard (Source: Shell Australia)

Figure 11: Current Aerial photo showing State Office Building and switchyard (Source: Sixviewer maps)

3.6 Tank T106 (slops tank)

The aerial photographs indicate the Tank T106 is likely to have been constructed between 1965 and 1970. Tank T106 is associated with the key phase, Phase 4: British Imperial Oil / Shell (1928-present). Within this phase it evidences the very last stages of Stage 5 Major Expansion and overhaul (1966-1968).

Figure 12: 1951 Part image of Aerial photo does not show the slops tanks (Source: Shell Australia)

Figure 13: 1961 Part image of Aerial photo shows two tanks in the location of the slops tanks (Source: Shell Australia)

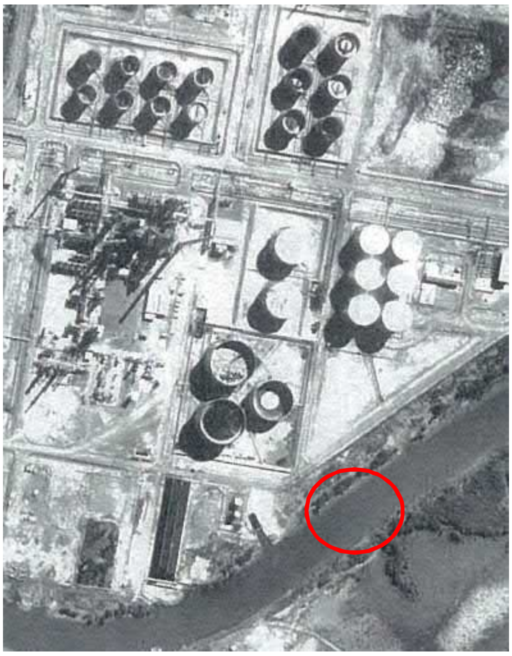

Figure 14: 1965 Part image of Aerial photo shows two tanks in the location of the slops tanks (Source: Shell Australia)

Figure 15: 1970 Aerial photo shows four tanks in the location of current slops tanks (Source: Shell Australia)

3.7 LPG spheres (V137 and V140) and LPG truck loading gantry

Documentary evidence indicates that LPG spheres were in use at Clyde as early as 1962 (Figure 17). These however may have been smaller spheres in comparison with V137 and V140 and whether they were used for LPG storage is unclear. A previous report (Australian Museum Consulting, 2015a) states that an LPG above ground storage area was added to Clyde Refinery in 1977 and that in 1994 4000 tonnes of mounded C_3 storage was added to the refinery. V137 and V140, according to photographic aerials are likely to have been constructed between 1970 and 1978.

The LPG truck loading gantry is linked to the LPG spheres as the gantry facilitates the export of LPG by road tankers. The LPG truck loading gantry appears to have been constructed between 1970 and 1978.

The LPG spheres and LPG truck loading gantry are associated with a key phase of development for the site, Phase 4: British Imperial Oil / Shell (1928-present). Within this phase the structures evidence the very last stages of development of the site identified as Stage 6 Major Expansion and overhaul (1970-1975).

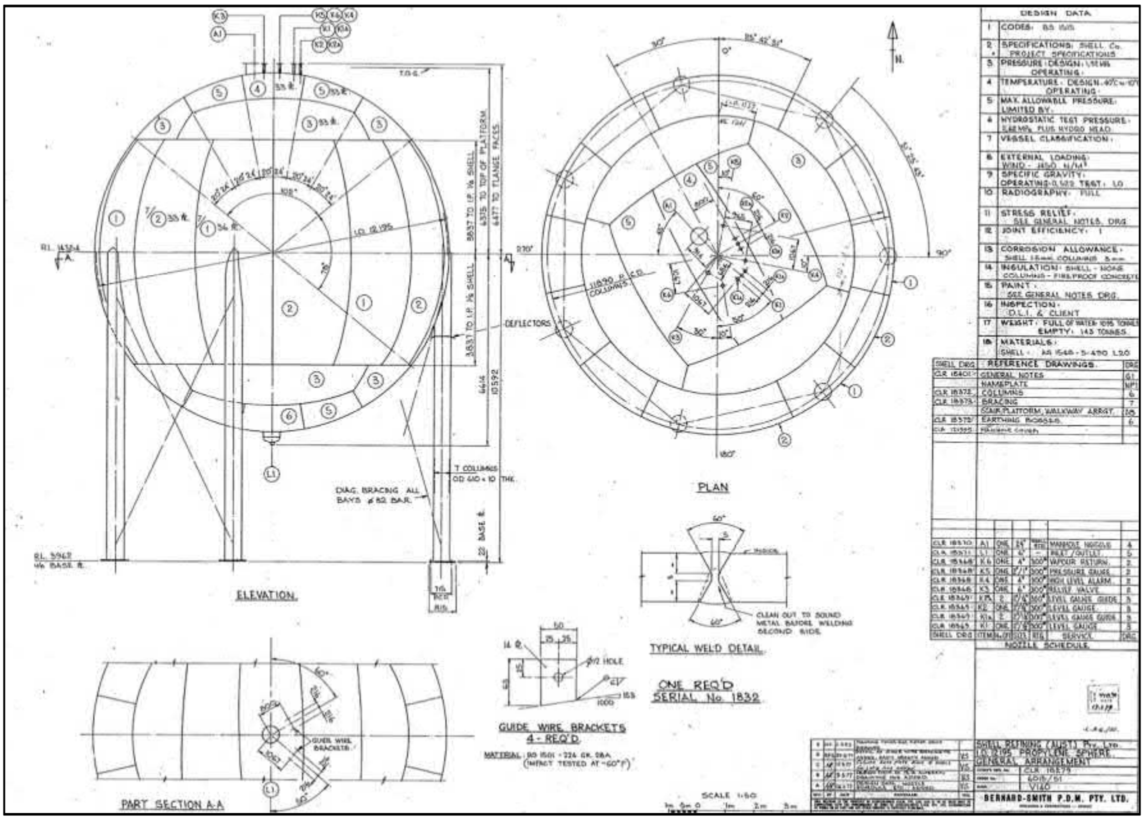

Figure 16: Shows general arrangement of LPG spheres modified drawing dated 1993, previous date 1977 (Source: Australian Museum Consulting, 2015a)

Figure 17: Construction of LPG spheres is seen in the background as early as 1962. These spheres appear to be those that are located east of V137 and V140 (Source: Shell Australia)

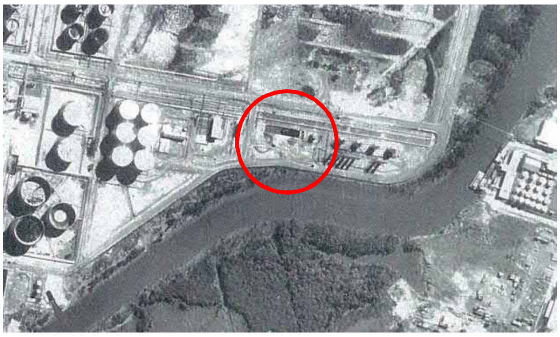

Figure 18: 1965 Part image of Aerial photo does not show any tanks in the location of V137 and V140 however, other cylindrical tanks are located to the east (Source: Shell Australia)

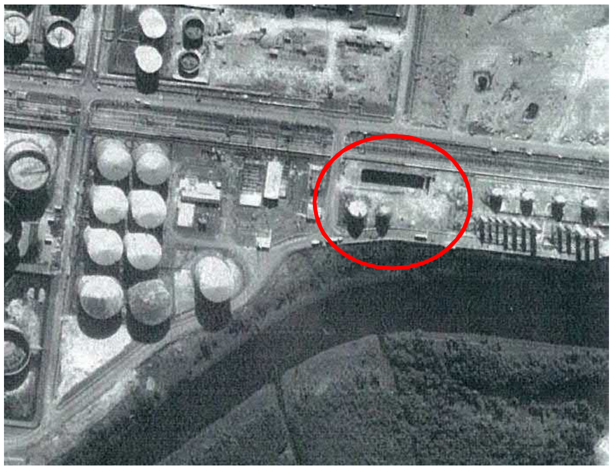

Figure 19: 1970 Part image of Aerial photo shows two tanks in the location of V137 and V140 tanks. Aerial image is cut off to the east. Other spheres are also noted to the east (Source: Shell Australia)

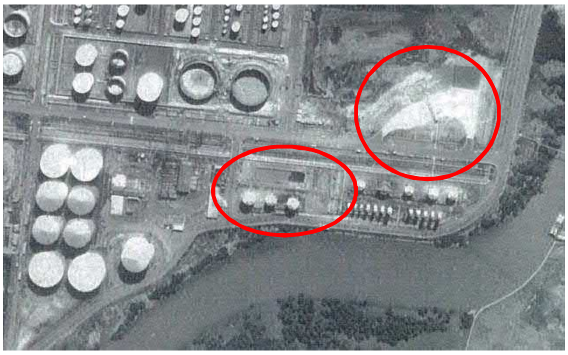

Figure 20: 1978 Part image of Aerial photo shows three tanks in the location of V137 and V140 tanks. Image also shows a structure similar to the gantry in its location (Source: Shell Australia)

3.8 Development after 2013

Refining activities ceased on the site in 2012. Finished fuel products continue to be transported to Clyde Terminal via a pipeline from the Gore Bay Terminal. These finished products would continue to be received, stored and blended at the Clyde terminal. In 2014, the Clyde and Gore Bay sites were purchased by Viva Energy.

The works approved for SSD 5147 (approved in 2015) are planned to occur in two stages. Removal of structures is all but complete except for some of the tank farms. Removal of the main infrastructure associated with the refining activity especially the removal of the stacks (the Crude Distillation Unit, Catalytic Cracking Unit, High Vacuum Unit, Boiler and Platformer), has changed the character of the Terminal. Apart from the remaining tanks and smaller processing equipment, the site no longer visibly associates with the historical refining activities.

3.9 Archaeological potential

The previous AECOM assessment (AECOM Australia Pty Ltd, 2013b) identified two areas of archaeological significance which have potential at a local level to provide information. The first relates to the three houses formerly located on the corner of Devon and Colqhoun Streets and the second relates to the initial refinery established by John Fell & Co.

The archaeological assessment undertaken in 2015 (Australian Museum Consulting, 2015b) concluded that there is no potential for significant relics to be present in the area adjacent to Boundary and Colquhoun Streets and that it is unlikely to yield archaeological information that is not readily available from other sources.

The archaeological sites identified in these reports are not in the vicinity of the proposed works.

4.0 Physical description

A site inspection was undertaken on 16 August 2018 and focussed on the areas proposed for demolition. The following subsections describe the observations made during this inspection.

4.1 Description of Clyde Terminal

Clyde Terminal is located at Gate 5, Durham Street, Rosehill at the confluence of the Parramatta and Duck Rivers approximately 16 km west of the Sydney Central Business District (CBD). Along with the Parramatta Terminal, the two Terminals are part of a fuel supply chain supplying 50 percent of the petroleum needs of NSW. Clyde Terminal receives stores and distributes fuel products including Diesel, Jet Fuel and Gasoline transferred from the Gore Bay Terminal via existing pipelines (Viva Energy, 2018).

The site comprises 86 hectares within the Parramatta LGA on parts of Lot 1, DP 109739, Lot 1 DP 383675, Lot 101 DP 809340, and Lot 2 DP 224288. The previous historical assessment (AECOM Australia Pty Ltd, 2013b) divided the site into precincts based upon their main function (see Figure 21). It is to be noted that the State Office Building and MTS1 33kV switch yard were located outside of the project area for the 2013 assessment.

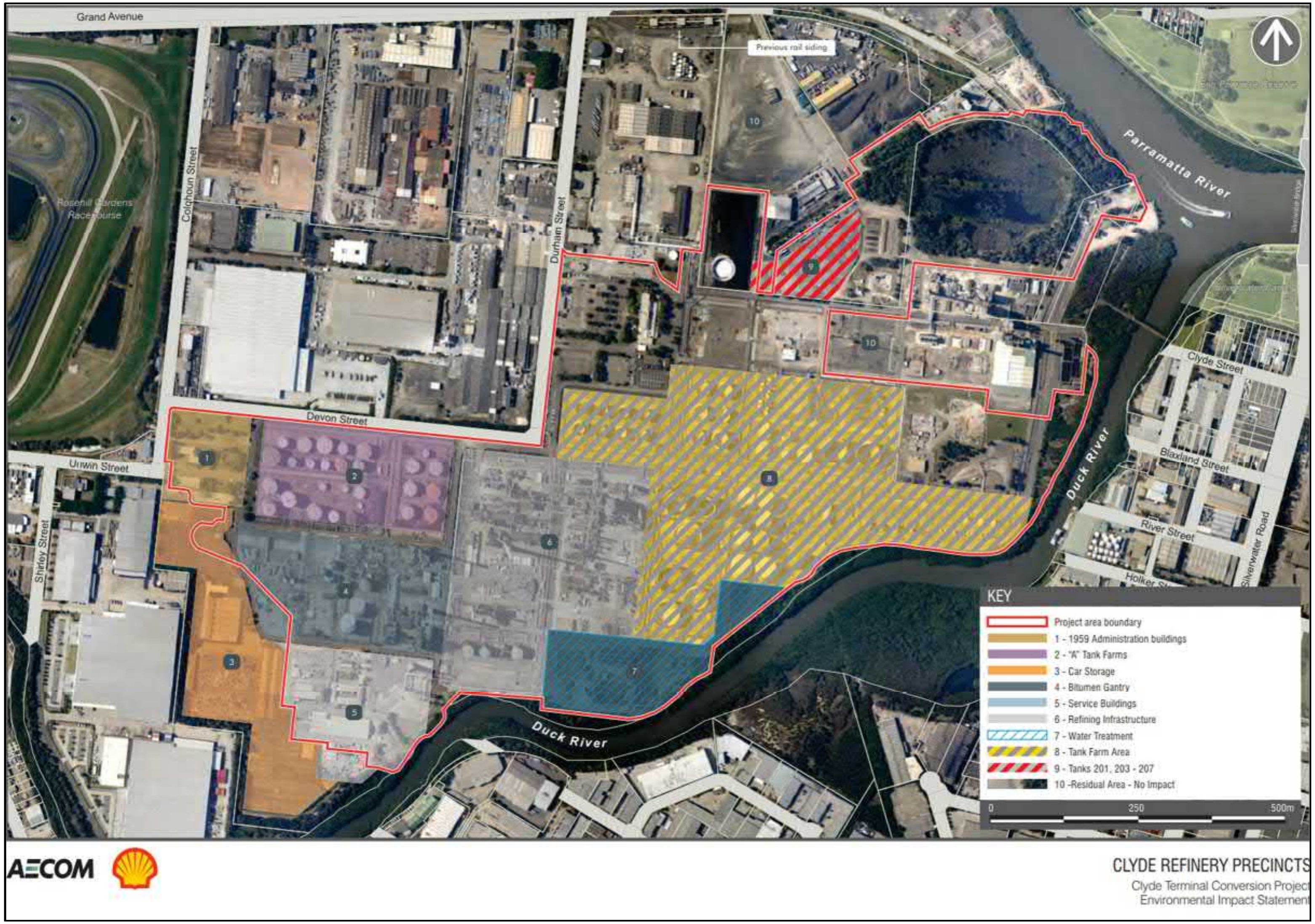

Figure 21: Project Area Precincts (Source: AECOM 2013)

4.2 State Office Building

The State Office Building is located north of the Project area and is accessed via a gated entrance (Gate 5) and carpark located east of Durham Street. The building is oriented in a north south axis and consists of two main rectilinear forms bridged by a tensioned membrane roof. The two forms, one three storey and the other single storey, are terminated by an L shaped single storeyed structure to the south. Construction materials include blond face brick, concrete spandrels and concrete slabs. The west elevation (principal elevation) features three cylindrical forms (stairwells) and a covered walkway that forms the entrance to the building (Figure 22). The entrance is defined by a curved shaped concrete roof and single storey rendered wall with glazed entry (Figure 23). A line of deciduous plantings, located adjacent to the building, screen the west elevation to Durham Street. The west elevation also features clerestory windows that are shaded by an external light weight steel framed screen.

The north elevation is unremarkable except for an angled wing wall, containing glazed sections, located at the centre of the three storey structure which extends to all three floors and curved glazed wall that bridges the three and single storey structure. The hierarchy of forms can be read in the east elevation with the three storey structure featured in the background followed by the clerestory windows to the skillion roof and the single storey structure (Figure 24). The single storey structure has metal cladding above its windows. A covered walkway entrance is located at the centre of the elevation and is accessed via a revolving turnstile (Figure 26).The south elevation is not visible as it is obscured by a fence and portable building.

The internal layout (Figure 33) of the three storey structure is arranged with a central circulation space, glazed partitioned rooms (Figure 28) to the western side and open planned office workspaces to the east (Figure 29). Lifts and amenities are located in the centre of the building. The single storey building was not accessed. The conservatory under the tensioned membrane structure is visible from the office workspaces (Figure 31). The common room is located in the L shaped building located to the south (Figure 32).

Condition: The building is in a good condition with little signs of structural defects or maintenance issues.

Integrity: The building has a high level of integrity. Significant features are largely intact and have not been compromised by modifications such as the entry walkway.

Figure 22: View of State Office Building looking east from carpark and entry off Durham Street

Figure 23: View of State Office Building entrance looking south east showing face brickwork, steel framed screen, stairwells and entrance

Figure 24: View of State Office Building looking east from carpark and entry off Durham Street showing single storey L shaped structure to south of building

Figure 25: View of State Office Building looking west from carpark (rear of building) showing single storey building with skillion roof and clerestory windows

Figure 26: View of State Office Building looking west showing gated entrance, covered walkway and steps

Figure 27: View of State Office Building looking south

Figure 28: State Office Building interior, Level 2, looking south

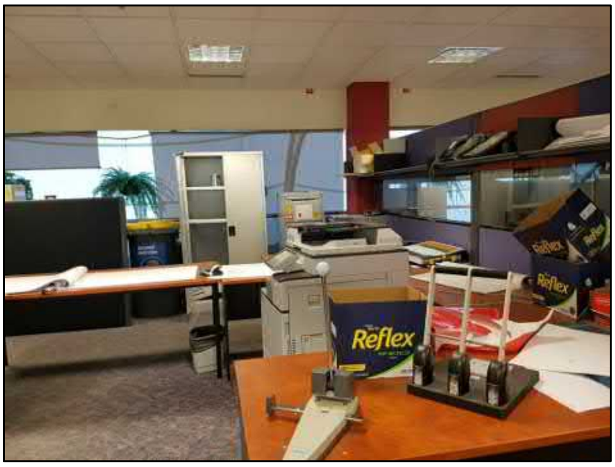

Figure 29: State Office Building interior, Level 2 looking east towards conservatory

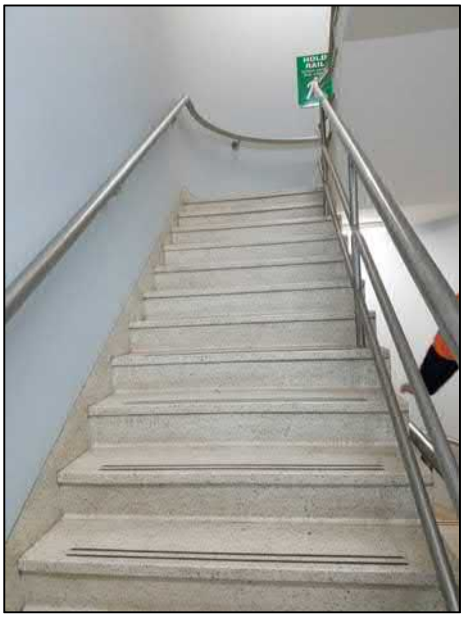

Figure 30: State Office Building interior, stairway

Figure 31: State Office Building interior, Conservatory

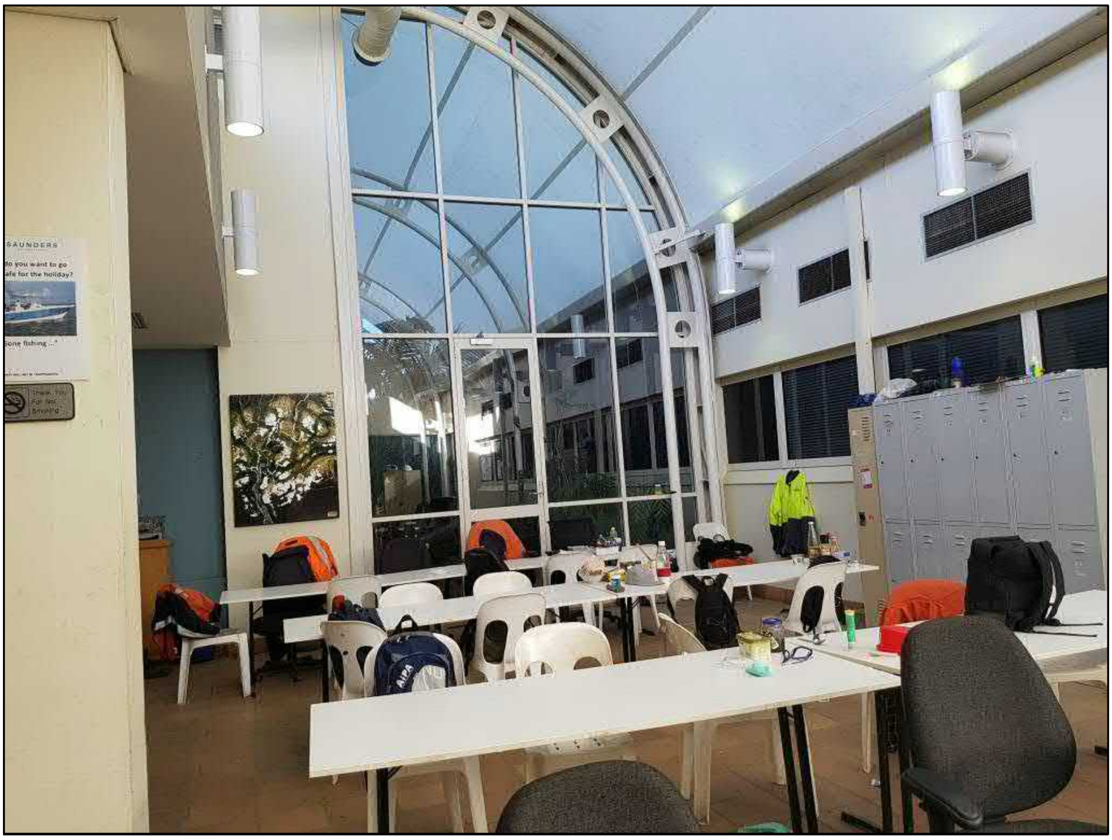

Figure 32: State Office Building interior, Level 1 Common room and view of entry to Conservatory

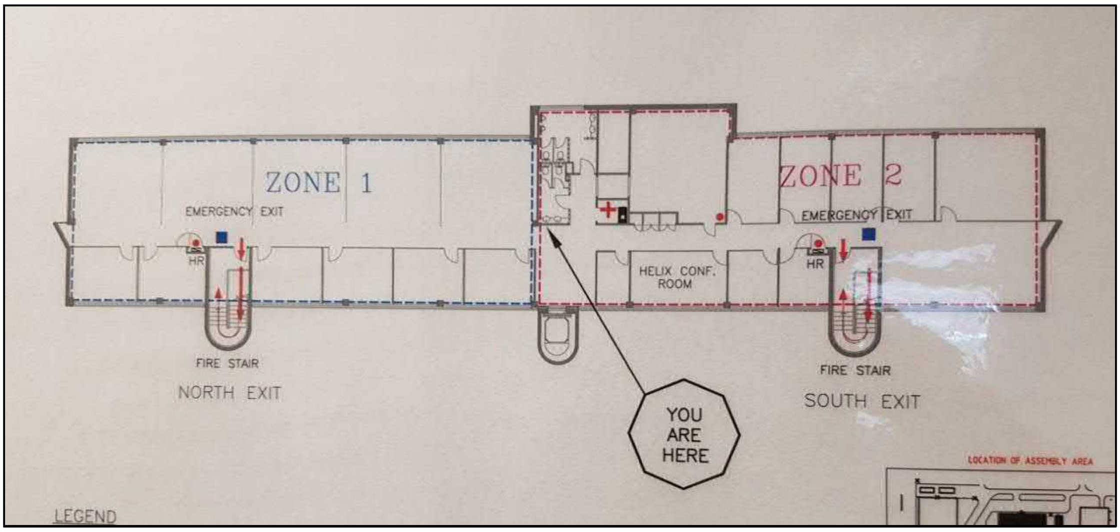

Figure 33: State Office Building interior Fire Exit Plan showing building layout.

4.3 MTS1 33kV switch yard

The MTS1 33kV switch yard is located north of the Project area, immediately south of the State Office Building. It is positioned at the intersection of two internal streets (Road 17 and Road 08) and is located behind a gated, anti-climb, chain wire fence with high voltage warning signs. The electrical equipment is mounted on steel framed posts and beams fixed to concrete pad footings. It was noted that all cable points and conduits have been decommissioned.

Condition: The switchyard is in fair condition with corrosion to steels and perimeter fence.

Integrity: The switchyard indicates a high level of integrity showing little signs of modification.

Figure 34: View of MTS1 33kV switch yard looking east

Figure 35: View of MTS1 33kV switch yard looking south west

4.4 Tank T106 (slops tank)

Tank T106 is located south of the Project area adjacent to Duck River within the No. 7 Water Treatment facility (Figure 21). There are four green painted tanks in this area which are contained by a drainage bund. Tank T106 is located in the south west corner. All four tanks are metal with rivet fixings. Tank T106 shows signs of corrosion to the tank surface and to the external access stair and balustrade. A maker's mark is located on Tank T106 but could not be deciphered. Circular access hatches are located to the base of the tank. The tanks are adjacent to large rectangular sludge basins that are located to the west. The area is screened to the south by plantings located along Duck River.

Condition: Tank T106 is in poor condition, showing signs of excessive corrosion.

Integrity: The tank has a high level of integrity and shows little signs of modification.

Figure 36: View of Tank T106 (slops tank) seen in the foreground to the left

Figure 37: View of Tank T106 (slops tank) seen in the background

4.5 LPG spheres (V137 and V140)

Two LPG spheres are located on the south eastern portion of the site adjacent to Duck River (Figure 38), previously identified as the Tank Farm Area (Figure 21). The area is mounded by a combination of brick retaining walls and concrete and asphalted plinths (Figure 39). The two spheres are oriented on an east west axis. The spheres are elevated on columns and are connected by a steel framed access stair and walkway. The columns are braced by steel tie rods. Service pipes on steel frames are located outside the brick retaining wall to the south of the spheres (Figure 39). Corrosion has been noted on the sphere surface. A third sphere, located to the east has been removed. LPG horizontal bullet style tanks that were located north of the spheres have been removed.

Condition: Both spheres appear to be in fair / poor condition showing signs of weathering and corrosion to surface of spheres, stairs and walkway.

Integrity: The spheres appear to have a high level of integrity with little signs of modification.

Figure 38: LPG spheres looking south east

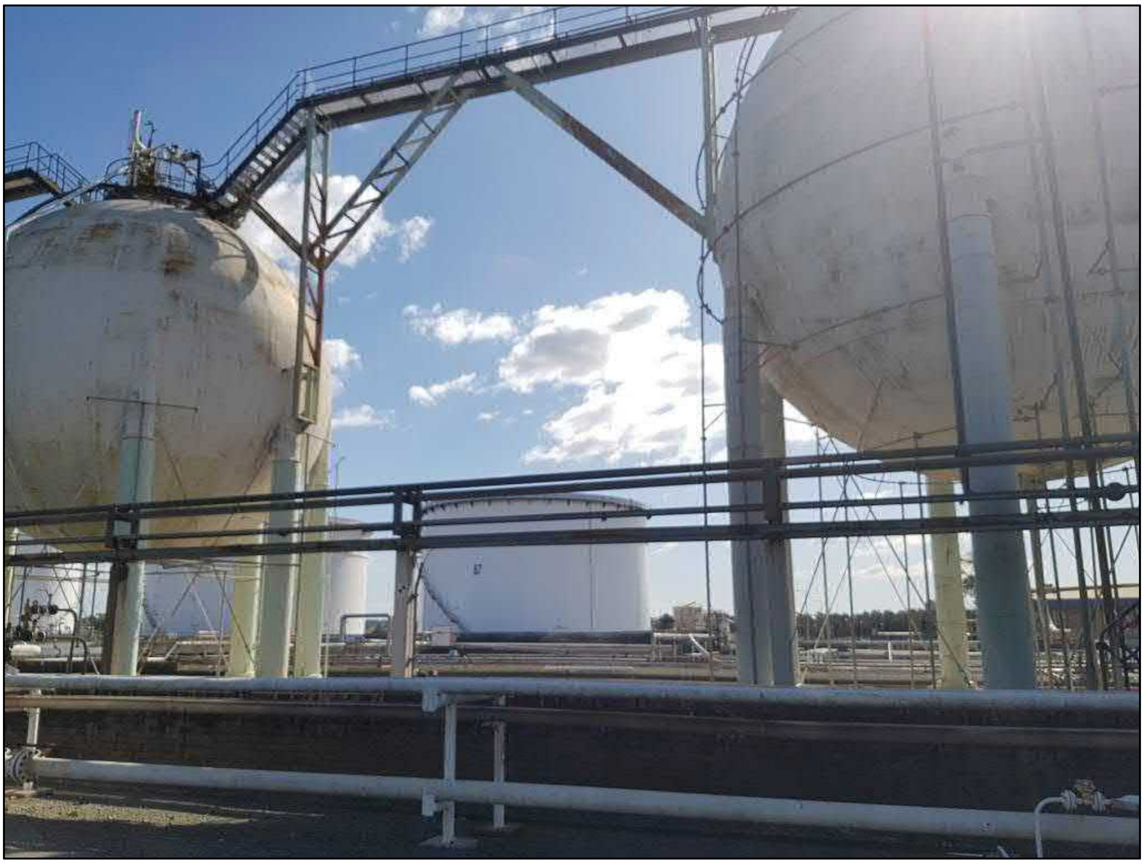

Figure 39: LPG spheres looking north

4.6 LPG truck loading gantry (LPG loading facilities)

The LPG truck loading gantry is located in the eastern section of the Project area adjacent to Duck River (Figure 40). The gantry is located on an irregular block with a north to east, south to west orientation. The area is accessed from the southern side of the block with both an entry and exit driveway located off Road 2. The gantry is steel framed and has four bays with steel portal structures above and is mounted on concrete plinths on concrete slab on ground. A permanent storage shed on a concrete base is located east of the structure and a portable building is located to the north east (Figure 40 and Figure 41).

Condition: The gantry appears to be in fair condition showing signs of weathering and corrosion to steel frame and equipment.

Integrity: The gantry appears to have a high level of integrity with little signs of modification.

Figure 40: View of LPG truck loading gantry looking north east

Figure 41: View of LPG truck loading gantry and storage shed looking east

4.7 Tanks 40 and 41

Tanks 40 and 41 are located at the centre of the Project area at the corner of Road 2 and Road 17A. The tanks are part of a group comprising six tanks aligned in two rows north-south. Tanks 40 and 41 are both concrete tanks with external access stairs. Tank 40 appears to be older than Tank 41 and shows signs of weathering.

Condition: Tank 40 is in poor condition showing signs of corrosion. Tank 41 is in good condition.

Integrity: The tanks appear to have a high level of integrity with little signs of modification.

Figure 42: View of Tank 40 and Tank 41 looking north

5.0 Significance assessment

5.1 Significance Assessment criteria

In order to understand how a development will impact on a heritage item it is essential to understand why an item is significant. An assessment of significance is undertaken to explain why a particular item is important and to enable the appropriate site management and curtilage to be determined. Cultural significance is defined in the Australia ICOMOS Charter for the conservation of places of Cultural Significance (the Burra Charter) as meaning "aesthetic, historic, scientific or social value for past, present or future generations" (Article 1.1). Cultural significance may be derived from a place's fabric, association with a person or event, or for its research potential. The significance of a place is not fixed for all time, and what is of significance to us now may change as similar items are located, more historical research is undertaken and community tastes change.

The process of linking this assessment with an item's historical context has been developed through the NSW Heritage Management System and is outlined in the guideline *Assessing Heritage Significance*, part of the NSW Heritage Manual (Heritage Branch, Department of Planning). The *Assessing Heritage Significance* guidelines establish seven evaluation criteria (which reflect four categories of significance and whether a place is rare or representative) under which a place can be evaluated in the context of State or local historical themes. Similarly, a heritage item can be significant at a local level (i.e. to the people living in the vicinity of the site), at a State level (i.e. to all people living within NSW) or be significant to the country as a whole and be of National or Commonwealth significance.

In accordance with in the guideline Assessing Heritage Significance (NSW Heritage Office, 2001), an item will be considered to be of State or local heritage significance if it meets one or more of the following criteria:

Table 3: Significance assessment criteria

Criterion	Inclusions / exclusions
Criterion (a) *– an item is important in the course, or pattern, of NSW's cultural or natural history (or the cultural or natural history of the local area).*	*Inclusion:* • *shows evidence of a significant human activity* • *is associated with a significant activity or historical phase* • *maintains or shows the continuity of a historical process or activity* *Exclusion:* • *has incidental or unsubstantiated connections with historically important activities or processes* • *provides evidence of activities or processes that are of dubious historical importance* • *has been so altered that it can no longer provide evidence of a particular association*
Criterion (b) *– an item has strong or special association with the life or works of a person, or group of persons, of importance in NSW's cultural or natural history (or the cultural or natural history of the local to area).*	*Inclusion:* • *shows evidence of a significant human occupation* • *is associated with a significant event, person, or group of persons* *Exclusion:* • *has incidental or unsubstantiated connections with historically important people or events* • *provides evidence of people or events that*

Criterion	Inclusions / exclusions
	are of dubious historical importance • *has been so altered that it can no longer provide evidence of a particular association*
Criterion (c) *– an item is important in demonstrating aesthetic characteristics and / or a high degree of creative or technical achievement in NSW (or the local area).*	*Inclusion:* • *shows or is associated with, creative or technical innovation or achievement* • *is the inspiration for a creative or technical innovation or achievement • is aesthetically distinctive* • *has landmark qualities* • *exemplifies a particular taste, style or technology* *Exclusion:* • *is not a major work by an important designer or artist* • *has lost its design or technical integrity* • *its positive visual or sensory appeal or landmark and scenic qualities have been more than temporarily degraded* • *has only a loose association with a creative or technical achievement*
Criterion (d) *– an item has strong or special association with a particular community or cultural group in NSW (or the local area) for social, cultural or spiritual reasons.*	*Inclusion:* • *is important for its associations with an identifiable group* • *is important to a community's sense of place* *Exclusion:* • *is only important to the community for amenity reasons* • *is retained only in preference to a proposed alternative*
Criterion (e) *– an item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the cultural or natural history of the local area). Significance under this criterion must have the potential to yield new or further substantial information.*	*Inclusion:* • *has the potential to yield new or further substantial scientific and / or archaeological information* • *is an important benchmark or reference site or type* • *provides evidence of past human cultures that is unavailable elsewhere* *Exclusion:* • *the knowledge gained would be irrelevant to research on science, human history or culture* • *has little archaeological or research potential* • *only contains information that is readily available from other resources or archaeological sites*
Criterion (f) *– an item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the cultural or natural history of the local area).*	*Inclusion:* • *provides evidence of a defunct custom, way of life or process* • *demonstrates a process, custom or other*

<table>
<tr><th>Criterion</th><th>Inclusions / exclusions</th></tr>
<tr><td></td><td>human activity that is in danger of being lost
• shows unusually accurate evidence of a significant human activity
• is the only example of its type
• demonstrates designs or techniques of exceptional interest
• shows rare evidence of a significant human activity important to a community
Exclusion:
• is not rare
• is numerous but under threat</td></tr>
<tr><td>Criterion (g) – an item is important in demonstrating the principal characteristics of a class of NSW’s (or local area’s):
• cultural or natural places cultural; or
• natural environments.</td><td>Inclusion:
• is a fine example of its type
• has the principal characteristics of an important class or group of items
• has attributes typical of a particular way of life, philosophy, custom, significant process, design, technique or activity
• is a significant variation to a class of items
• is part of a group which collectively illustrates a representative type
• is outstanding because of its setting, condition or size
• is outstanding because of its integrity or the esteem in which it is held
Exclusion:
• is a poor example of its type
• does not include or has lost the range of characteristics of a type
• does not represent well the characteristics that make up a significant variation of a type</td></tr>
</table>

5.2 Assessment of significance for Clyde Terminal

Table 4 assesses the Project Area against the NSW Heritage Branch *guidelines Assessing Heritage Significance* (NSW Heritage Office, 2001).

Table 4: Clyde Terminal Significance Assessment and individual elements against NSW Heritage Significance Criteria

Criterion	2013 Assessment for Clyde Terminal	2018 Assessment
Criterion (a) – *an item is important in the course, or pattern, of NSW's cultural or natural history (or the cultural or natural history of the local area).*	The former Clyde Terminal is of State significance through its ability to demonstrate the course of NSW history – from its reliance on natural resources towards fossil fuels. The then Clyde Refinery was established by John Fell & Co. sometime between 1918 and 1926 to refine shale oil. This source of feedstock was quickly supplemented by Crude Oil imported by Shell. When shale oil became unprofitable, the Fell Company came to rely solely on crude imported by Shell. Increasing competition in the market, combined with an accident at the newly opened Refinery, forced the Fell Company to sell to Shell. Shell took over operations in 1928, making it one of the longest operating refineries in Australia. The physical and technological development of the former Clyde Refinery demonstrated advancements in refining. Fell & Co. established the Refinery with a Dubb's Cracking Unit – leading technology for its time. The Clyde Refinery also demonstrated the development of business and enterprise in NSW. Initially established to exploit the natural resources of the State, it was altered to continue operations with the use of imported Crude Oil.	**Assessment of Clyde Terminal:** The 2013 Assessment is applicable. While little fabric remains of the early Clyde Refinery (1918-1926), the site is significant as a reminder of an important activity, the reliance on natural resources towards fossil fuels. **Threshold Significance:** • State **Assessment of individual elements:** • State Office Building: The building does not meet the criteria for inclusion. The building was constructed in 1986 and is not linked with a key historical phase. Hence, the building has incidental connections with the historically significant activity of the site. • MTS1 33kV switch yard, Tank T106 (slops tank), LPG spheres and LPG truck loading gantry: These elements have historical significance as contributory items in the very last stage of the key phase, Phase 4: British Imperial Oil, Shell (1928-present).
Criterion (b) – *an item has strong or special association with the life or works of a person, or group of persons, of importance in NSW's cultural or natural history (or the cultural or natural history of the local to area).*	The former Clyde Refinery is of State significance through its association with the Shell Company. The Project Area has been operated by Shell since it was purchased in 1928 and has supplied NSW with a large portion of its fuel needs.	**Assessment of Clyde Terminal:** The 2013 Assessment is applicable. **Threshold Significance:** • State **Assessment of individual elements:** • State Office Building: The building does not meet the criteria for inclusion as research has not evidenced an association with the life or works of a person or group of

Criterion	2013 Assessment for Clyde Terminal	2018 Assessment
		persons. • MTS1 33kV switch yard, Tank T106 (slops tank), LPG spheres and LPG truck loading gantry: These elements do not meet the criteria for inclusion.
Criterion (c) *– an item is important in demonstrating aesthetic characteristics and / or a high degree of creative or technical achievement in NSW (or the local area).*	The former Clyde Refinery is of local significance as a landmark within the Parramatta / Clyde area. The refinery stacks remaining at the current Clyde Terminal are clearly visible from a number of vantage points, including the M4 and the Ermington area.	**Assessment of Clyde Terminal:** The Clyde Terminal does not meet the criteria for inclusion. The refinery stacks, now demolished, a no longer visible from vantage points and hence the site no longer possesses landmark qualities. The few remaining tanks and equipment for processing finished fuels are not visible from vantage points. Although most of the refinery structure has been demolished, Clyde Terminal historically demonstrates technical developments in the process of refining Crude Oil which is assessed to be of local significance. **Threshold Significance:** • Local **Assessment of individual elements:** • State Office Building: The building is a good example contemporary Australian architecture in the 1980s. The building requires further research to determine if it was designed by a renowned architect. • MTS1 33kV switch yard, Tank T106 (slops tank), LPG spheres and LPG truck loading gantry: These elements do not meet the criteria for inclusion.
Criterion (d) *– an item has strong or special association with a particular community or cultural group in NSW (or the local area) for social,*	The former Clyde Terminal is likely to be of local social significance as a provider of employment and an active community member for over 80 years. Further research is required to confirm this assessment.	**Assessment of Clyde Terminal:** The 2013 Assessment is applicable. **Threshold Significance:** • Local **Assessment of individual elements:**

Criterion	2013 Assessment for Clyde Terminal	2018 Assessment
cultural or spiritual reasons.		• State Office Building, MTS1 33kV switch yard, Tank T106 (slops tank), LPG spheres and LPG truck loading gantry do not meet the criteria for inclusion.
Criterion (e) *– an item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the cultural or natural history of the local area). Significance under this criterion must have the potential to yield new or further substantial information.*	The former Clyde Terminal is of local significance due to its ability to demonstrate the development of refining technology. The current refining facilities appear to date from the 1960s through to the present. It does not meet the criteria for State significance as there is no physical evidence of the early development (pre 1950s) of the site. The site contains two areas of archaeological significance, which have the potential, at a local level, to provide information, through archaeological investigation, not available from other sources. One relates to three houses formerly located on the corner of Devon and Colqhoun Streets and anecdotally used as accommodation for the site managers. The second area may contain information relating to the layout and functions of the initial Refinery established by John Fell & Co.	**Assessment of Clyde Terminal:** The Clyde Terminal does not meet the criteria for inclusion. Archaeological assessments undertaken (Australian Museum Consulting, 2015b) have concluded that there is no potential for significant relics to be present at the site of the early refinery works and that excavations are unlikely to yield substantial information that is not readily available from other sources. **Threshold Significance:** • N / A **Assessment of individual elements:** State Office Building, MTS1 33kV switch yard, Tank T106 (slops tank), LPG spheres and LPG truck loading gantry do not meet the criteria for inclusion.
Criterion (f) *– an item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the cultural or natural history of the local area).*	The former Clyde Terminal is of State significance as it is one of only two oil refineries in NSW – both of which have announced their closure.	**Assessment of Clyde Terminal:** The Clyde Terminal does not meet the criteria for inclusion as the refinery activities have ceased in 2012. The site has been transformed to a Terminal which process finished fuels. **Threshold Significance:** • N / A **Assessment of individual elements:** State Office Building, MTS1 33kV switch yard, Tank T106 (slops tank), LPG spheres and LPG truck loading gantry do not meet the criteria for inclusion.

Criterion	2013 Assessment for Clyde Terminal	2018 Assessment
Criterion (g) *– an item is important in demonstrating the principal characteristics of a class of NSW's (or local area's):* • *cultural or natural places cultural; or* • *natural environments.*	The former Clyde Terminal is of State significance as a representative example of an oil refinery. It maintains all the critical elements of an oil refinery in working order.	**Assessment of Clyde Terminal:** The Clyde Terminal does not meet the criteria for inclusion as a representative example of an oil refinery as most of the distinct elements associated with refining activities have been demolished. **Threshold Significance:** • N / A **Assessment of individual elements:** • State Office Building: The building is a fine example of a contemporary Australian architecture in the 1980s. • MTS1 33kV switch yard, Tank T106 (slops tank), LPG spheres and LPG truck loading gantry do not meet the criteria for inclusion.

5.3 Statement of significance

2018 (Revised) Statement of significance:

The Clyde Terminal (former Clyde Refinery) is of State significance for its historical, associative values. Historically, it demonstrates NSW's increasing use of and reliance on fossil fuels and the expansion of business in the State from import to production. It is associated with the Shell Company, one of the leading producers and retailers of fuel in NSW.

The Clyde Terminal is of local social and technical significance. It is likely to be of social significance to the local community as it has been an employer of locals for over 80 years and has been an active participant and supporter of community events throughout that time. The former Clyde Refinery can also demonstrate technical developments in the process of refining Crude Oil.

Clyde Terminal does not have any potential for significant relics to be present at the site and that excavations are unlikely to yield substantial information that is not readily available from other sources.

The State Office Building is not linked to a key historical phase and has an incidental association with the historically significant activity of the site. It is however, a fine example of 1980s Australian architecture.

MTS1 33kV switch yard, Tank T106 (slops tank), LPG spheres and LPG truck loading gantry have historical significance as contributory elements within the key phase, Phase 4: British Imperial Oil / Shell.

Note: Significance grading of individual components was not considered appropriate for Clyde Terminal. Many of the structures that evidence the refinery activities have been demolished which makes it difficult to make a comparison of individual elements that display varying grades of significance.

6.0 Proposed works

6.1 Proposed works

Viva Energy is seeking approval for additional works as part of approval to SSD 5147 Clyde Terminal conversion project.

The additional works include demolition of the following redundant structures:

1. State Office Building;
2. MTS1 33kV switch yard;
3. Tank T106 (slops tank);
4. Two LPG spheres; and
5. LPG truck loading gantry.

The additional works also include the retention of Tanks 40 and 41 which will be used for the continued storage of gasoline.

The same methodology for the demolition of redundant infrastructure under approval SSD 5147 would be applied to the proposed works. Demolition is contained to ground level only and no changes to earthworks or drainage infrastructure are proposed. The following works are anticipated:

- Disconnection of existing services / pipework;
- Demolition to collapse structures using various machinery depending on the composition of the structure;
- Associated civil works to remove structures to grade;
- Repair of drainage systems (if required); and
- State Office Building and MTS1 33kV switchyard:
    - Small amounts of asbestos in fittings to fire doors and linoleum tiles will be carefully removed and disposed of appropriately prior to demolition of building;
    - Use of heavy machinery for the demolition of State Office Building and switchyard;
    - Some removal of trees and landscaped areas will be required for demolition equipment; and
    - Steel components to be recycled off site while concrete and bricks can be processed on site.

The works are to commence at the completion of consented demolition works.

7.0 Statement of Heritage Impact

7.1 Assessment of Heritage Impact

The objective of a SoHI is to evaluate and explain how the proposed development, rehabilitation or land use change will affect the heritage value of the site and / or place. A SOHI should also address how the heritage value of the site / place can be conserved or maintained, or preferably enhanced by the proposed works. This report has been prepared in accordance with the NSW Heritage Office & Department of Urban Affairs and Planning *NSW Heritage Manual* (1996) and NSW Heritage Office *Statements of Heritage Impact* (NSW Heritage Office, 2002). The guidelines pose a series of questions as prompts to aid in the consideration of impacts due to the Project. The questions of greatest relevance to the proposed works at Clyde Terminal relate to demolition of a structure. Those questions provided in the guideline that are not of relevance have been omitted and appropriate substitutes developed.

Have all options for retention and adaptive re-use been explored?

The former Clyde Refinery has been converted to a Terminal for processing finished fuels for a number of economic reasons including competitive overseas markets. The refining activity on the site was not profitable. Retaining redundant refinery infrastructure is not practical for the following reasons:

- Ongoing maintenance;
- Costs associated with maintenance; and
- Potential hazards of not maintaining infrastructure.

The former Clyde Refinery infrastructure was specialised to the refining of Crude Oil. Adaptive re-use of the refining infrastructure including MTS1 33kV switch yard, Tank T106 (slops tank) LPG spheres and LPG truck loading gantry is not possible due to the complex and specialised nature of these equipment.

The State Office Building is currently the administration centre for the site. The building is underutilised with only a small number of employees occupying the space. The administration activities will be relocated to other buildings on the site improving the overall efficiency of the site's operation. Retention and adaptive re-use of the State Office Building is not a viable option. The retention of the building will create unnecessary maintenance costs associated with the upkeep of an underutilised building. Adaptive re-use is also inappropriate as the State Office Building has been specifically designed as an administration facility and demand for an appropriate alternative use does not exist. The demolition of redundant infrastructure would also increase access to and from the site in case of emergency.

Is demolition essential at this time or can it be postponed in case future circumstances make its retention and conservation more feasible?

Due to market considerations and costs in operational requirements it is unlikely that future circumstance will make retention and conservation of structures more feasible. The nature of the site and complexity of ongoing management issues impose limitations to conservation. The benefits of conservation are outweighed by the financial and practical issues associated with conservation.

What measures have been put in place to mitigate the impact to the heritage significance of the Terminal?

The previous heritage assessment recommended that a photographic archival recording be undertaken for the project area. A photographic archival recording was completed by Alexander Mayes Photography in 2014 and a documentary recording of the refinery process at Clyde Terminal was also completed by Australian Museum Consulting in 2015. Whilst the recording focussed on the items specific to that project, it did not include the following items:

- State Office Building;
- MTS1 33kV switch yard;
- Tank T106 (slops tank);

- LPG spheres (V137 and V140); and
- LPG truck loading gantry.

A photographic archival recording should be undertaken for the above items to mitigate the impacts to heritage significance.

Has the advice of a heritage consultant been sought? Have the consultant's recommendations been implemented? If not, why not?

This report provides the required advice and recommendations of a heritage consultant. Viva will implement the recommendations within this report when project approval is granted.

7.2 Discussion of Heritage Impacts

The State Office Building is not linked to a key historical phase and has an incidental association with the historically significant activity of the site. It is however a fine example of 1980s Australian architecture. The demolition of the building will have a minor negative impact as a loss of a fine contemporary building which contributes to the aesthetic character as well as conveying the Terminal's administrative activity.

MTS1 33kV switch yard, Tank T106 (slops tank), LPG spheres and LPG truck loading gantry have historical significance as contributory elements within the key phase, Phase 4: British Imperial Oil / Shell. The structures have been constructed in the very last stages of this key phase. The loss of these items is considered a minor negative impact to the heritage significance of Clyde Terminal. The loss of the LPG spheres will have a visual impact to the overall site. The retention of Tanks 40 and 41 are considered to have no impact.

Previous archaeological assessments (Australian Museum Consulting, 2015b) have confirmed that there is no potential for archaeology that relates to the early refinery site. The proposed works are not located in the vicinity of the early refinery works and are contained to above ground demolition and therefore would have no impact on any archaeological deposits.

The proposed works are well contained within the Clyde Terminal and would have no visual impact to adjacent heritage items. The proposed works would also have no heritage impacts to the Wetlands (Item No. I1) located within the Project Area and listed as a local heritage item.

The adaptation and conservation of these structures are considered non-viable due to economic and practical reasons relating to maintenance and potential hazards associated with the site. The demolition works associated with SSD 5147 was previously assessed (AECOM Australia Pty Ltd, 2013b) as a negative impact on the heritage significance of the site. Considering the scale of these modifications and their impact, the proposed works are considered minor in comparison.

8.0 Conclusion and recommendations

The Clyde Terminal (former Clyde Refinery) was established by John Fell & Co. between 1918 and 1926. The site was purchased by Shell in 1928 and operated as a Crude Oil refinery. The Refinery operations ceased in 2012 and conversion to a fuel finishing Terminal commenced with the demolition of refinery associated infrastructure.

Although most of the refinery infrastructure has been demolished, this report has re-assessed the historical significance of Clyde Terminal and determined that it continues to be of State significance based on historical and associative heritage values. It also has local significance for its social and technical significance.

The proposed demolition of the State Office Building, MTS1 33kV switch yard, Tank T106 (slops tank), LPG spheres and LPG truck loading gantry have a minor negative impact on the significance of the site. Conservation of these items is not a viable option due to financial and practical reason based on management and maintenance of the site. The retention of Tanks 40 and 41 has been assessed to have no impact. A photographic archival recording of these structures is recommended to negate any impacts. During demolition if an unexpected relic, archaeological feature or deposit is exposed, works should cease and the advice of an archaeologist be consulted.

9.0 References

AECOM Australia Pty Ltd. (2013a). *Aboriginal Cultural Heritage Assessment - Clyde Terminal Conversion Environmental Impact Statement*. Unpublished report for The Shell Company of Australia Ltd.

AECOM Australia Pty Ltd. (2013b). *Clyde Terminal Conversion Project - Appendix E Clyde Terminal Historical Archaeological Assessment, Clyde Terminal Conversion Environmental Impact Statement*.

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Appendix A

Historical Aerials

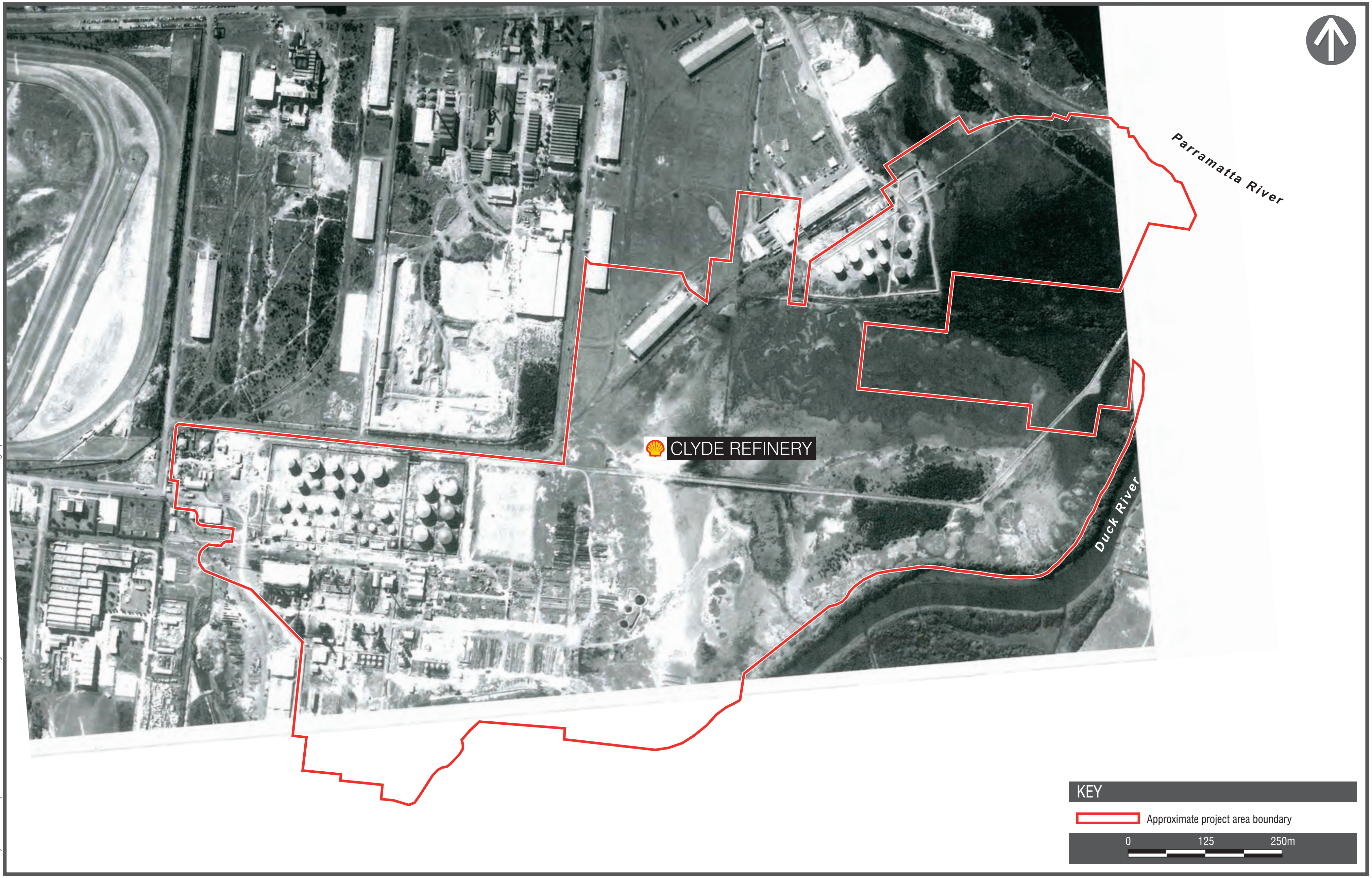
G:\Projects\602 Projects\60236231 Clyde\60236231\FIGURES\EIS - Clyde\60236231 Plate 2 - 1930 Historic Aerial Photograph 12 11 2012 TO

AECOM

1930 HISTORIC AERIAL PHOTOGRAPH

Gore Bay Terminal Modification
Environmental Impact Statement

PLATE 2



1951 HISTORIC AERIAL PHOTOGRAPH

Gore Bay Terminal Modification
Environmental Impact Statement

PLATE 3

G:\Projects\602 Projects\60236231 - Clyde\60236231\FIGURES\EIS - Clyde\60236231 Plate 3 - 1951 Historic Aerial Photograph 12 11 2012 TO

G:\Projects\602 Projects\60236231 - Clyde\60236231\FIGURES\EIS - 1961 Historic Aerial Photograph Plate 4 - 1961 Historic Aerial Photograph 12 11 2012 TO

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1961 HISTORIC AERIAL PHOTOGRAPH

Gore Bay Terminal Modification
Environmental Impact Statement

PLATE 4

G:\Projects\602 Projects\60236231\FIGURES\EIS - Clyde\60236231 Plate 5 - 1965 Historic Aerial Photograph 12 11 2012 TO

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1965 HISTORIC AERIAL PHOTOGRAPH

Gore Bay Terminal Modification
Environmental Impact Statement

PLATE 5

G:\Projects\602 Projects\60236231\FIGURES\EIS - Clyde\60236231 Plate 6 - 1970 Historic Aerial Photograph 12 11 2012 TO

AECOM

1970 HISTORIC AERIAL PHOTOGRAPH

Gore Bay Terminal Modification
Environmental Impact Statement

PLATE 6

G:\Projects\602 Projects\60236231\FIGURES\EIS - Clyde\60236231 Plate 7 - 1978 Historic Aerial Photograph 12 11 2012 TO

AECOM

1978 HISTORIC AERIAL PHOTOGRAPH

Gore Bay Terminal Modification
Environmental Impact Statement

PLATE 7

G:\Projects\602 Projects\60236231 - Clyde\60236231\FIGURES\EIS - Plate 8 - 1986 Historic Aerial Photograph 12 11 2012 TO

AECOM

1986 HISTORIC AERIAL PHOTOGRAPH

Gore Bay Terminal Modification
Environmental Impact Statement

PLATE 8

AECOM

1994 HISTORIC AERIAL PHOTOGRAPH

Gore Bay Terminal Modification
Environmental Impact Statement

PLATE 9

Appendix C

Species Likelihood of Occurrence

Appendix C Species Likelihood of Occurrence

Scientific name	Common name	FM Act	BC Act	EPBC Act	Habitat	Likelihood of Occurrence
Flora						
Acacia bynoeana	Bynoe's Wattle		E	V	Occurs mainly in heath and dry sclerophyll forest, open woodland with dense to sparse heath understorey; open woodlands with a sparse shrub cover and a grass/sedge ground cover; and heathlands with sparse overstorey. With sand or sandy clay substrate, often with ironstone gravel and usually well drained, infertile soil.	Low
Acacia pubescens	Downy Wattle		V	V	Occurs on alluviums, shales and at the intergrade between shales and sandstones. The soils are characteristically gravely soils, often with ironstone. Occurs in open woodland and forest, in a variety of plant communities, including Cooks River/Castlereagh Ironbark Forest, Shale/Gravel Transition Forest and Cumberland Plain Woodland. Concentrated around the Bankstown-Fairfield-Rookwood area and the Pitt Town area.	Moderate
Allocasuarina glareicola			E	E	Occurs in Castlereagh woodland on lateritic soil. Primarily restricted to the Richmond (NW Cumberland Plain) district, but with an outlier population found at Voyager Point, Liverpool.	Low
Asterolasia elegans			E	E	Occurs in the northern hills of Sydney. Habitat requirements are wet, sheltered sclerophyll forests on the mid to lower slopes of moist gullies and rocky outcrops.	Low
Caladenia tessellata	Thick Lip Spider Orchid		E	V	Requires low, dry sclerophyll woodland with a heathy or sometimes grassy understorey on clay loams or sandy soils, specifically in dry, low Brittle Gum (Eucalyptus mannifera), Inland Scribbly Gum (E. rossii) and Allocasuarina spp. woodland with a sparse understorey and stony soil.	Low
Cryptostylis hunteriana	Leafless Tongue Orchid		V	V	Does not appear to have well defined habitat preferences and is known from a range of communities, including swamp-heath and woodland. The larger populations typically occur in woodland dominated by Scribbly Gum (Eucalyptus sclerophylla), Silvertop Ash (E. sieberi), Red Bloodwood (Corymbia gummifera) and Black Sheoak (Allocasuarina littoralis); appears to prefer open areas in the understorey of this community and is often found in association with the Large Tongue Orchid (C. subulata) and the Tartan Tongue Orchid (C. erecta).	Low

Scientific name	Common name	FM Act	BC Act	EPBC Act	Habitat	Likelihood of Occurrence
Cynanchum elegans	White-flowered Wax Plant		E	E	The White-flowered Wax Plant usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; Coastal Tea-tree Leptospermum laevigatum – Coastal Banksia Banksia integrifolia subsp. integrifolia coastal scrub; Forest Red Gum Eucalyptus tereticornis aligned open forest and woodland; Spotted Gum Corymbia maculata aligned open forest and woodland; and Bracelet Honeymyrtle Melaleuca armillaris scrub to open scrub.	Low
Darwinia biflora			V	V	Occurs on the edges of weathered shale-capped ridges, where these intergrade with Hawkesbury Sandstone. Occurs in Sydney Sandstone Ridgetop Woodland, often on rock shelves. Associated overstorey species include Eucalyptus haemastoma, Corymbia gummifera and/or E. squamosa. The vegetation structure is usually woodland, open forest or scrub-heath.	Low
Deyeuxia appressa			E	E	A highly restricted NSW endemic known only from two pre-1942 records in the Sydney area. Was first collected in 1930 at Herne Bay, Saltpan Creek, off the Georges River, south of Bankstown. Was then collected in 1941 from Killara, near Hornsby. Has not been collected since and may now be extinct in the wild due to the level of habitat loss and development that has occurred within these areas.	Low
Eucalyptus camfieldii	Heart-leaved Stringybark		V	V	Occurs mostly in small scattered stands in exposed situations on sandstone plateaus, ridges and slopes near the coast, often on the boundary of tall coastal heaths or low open woodland. Requires shallow sandy soils.	Low
Eucalyptus sp. Cattai			CE		Occurs as a rare emergent tree in scrub, heath and low woodland on sandy soils, usually as isolated individuals or occasionally in small clustered groups. The sites at which it occurs are generally flat and on ridge tops.	Low
Genoplesium baueri	Bauer's Midge Orchid		E	E	Occurs in coastal areas. Habitats include heathland, open forest, shrubby forest, heathy forest and woodland with sandy/sandy loam and well draining soils.	Low

Scientific name	Common name	FM Act	BC Act	EPBC Act	Habitat	Likelihood of Occurrence
Grevillea parviflora subsp. parviflora	Small-flower Grevillea		V	V	Occurs in a range of vegetation types from heath and shrubby woodland to open forest. Found over a range of altitudes from flat, low-lying areas to upper slopes and ridge crests. Hunter occurrences are usually 30-70m ASL, while the southern Sydney occurrences are typically at 200-300m ASL. Often occurs in open, slightly disturbed sites such as along tracks.	Low
Hibbertia puberula subsp. glabrescens			CE	CE	Currently known to occur in only one population at Bankstown Airport in Sydney's southern suburbs, in the Bankstown local government area.	Low
Leptospermum deanei	Deane's Tea-tree		V	V	Woodland on lower hill slopes or near creeks. Sandy alluvial soil or sand over sandstone. Occurs in Riparian Scrub - e.g. *Tristaniopsis laurina, Baechea myrtifolia;* Woodland - e.g. *Eucalyptus haemastoma; and* Open Forest - e.g. *Angophora costata, Leptospermum trinervium, Banksia ericifolia.*	Low
Melaleuca biconvexa	Biconvex Paperbark		V	V	The species may occur in dense stands forming a narrow strip adjacent to watercourses, in association with other Melaleuca species or as an understorey species in wet forest.	Low
Melaleuca deanei	Deane's Paperbark		V	V	Endemic to Sydney Basin region and grows in heath on sandstone or flat broad ridge tops. Strongly associated with sandy loam soils that are low in nutrients, sometimes with ironstone present.	Low
Pelargonium sp. Striatellum	Omeo Storkbill		E	E	Known from only 4 locations in NSW, with three on lake-beds on the basalt plains of the Monaro and one at Lake Bathurst.	Low
Persoonia hirsuta	Hairy Geebung		E	E	Occurs in shrub-woodlands and dry sclerophyll forest. It grows in sandy to stony soils derived from sandstone or very rarely on shale, from near sea level to 600 m altitude. Narrow habitat that is usually just above the high-water level of irregularly inundated or ephemeral lakes, in the transition zone between surrounding grasslands or pasture and the wetland or aquatic communities.	Low

Scientific name	Common name	FM Act	BC Act	EPBC Act	Habitat	Likelihood of Occurrence
Persoonia mollis subsp. maxima			E	E	Occurs in sheltered aspects of deep gullies or on the steep upper hillsides of narrow gullies on Hawkesbury Sandstone. These habitats support relatively moist, tall forest vegetation communities, often with warm temperate rainforest influences. Associated species: Smooth Barked Apple Angophora costata, Sydney Peppermint Eucalyptus piperita, Red Bloodwood Corymbia gummifera, Turpentine Syncarpia glomulifera, Coachwood Ceratopetalum apetalum and Black Wattle Callicoma serratifolia. Flowers late December – March	Low
Persoonia nutans	Nodding Geebung		E	E	Restricted to the Cumberland Plain in western Sydney, between Richmond in the north and Macquarie Fields in the south. The species has a disjunct distribution, with the majority of populations (and 99% of individuals) occurring in the north of the species range in the Agnes Banks, Londonderry, Castlereagh, Berkshire Park and Windsor Downs areas. Northern populations are confined to aeolian and alluvial sediments and occur in a range of sclerophyll forest and woodland vegetation communities. The southern and northern populations have distinct habitat differences.	Low
Pimelea curviflora var. curviflora			V	V	Confined to the coastal area of the Sydney and Illawarra regions. Occurs on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands. Also recorded in Illawarra Lowland Grassy Woodland habitat at Albion Park on the Illawarra coastal plain.	Low
Pimelea spicata	Spiked Rice-flower		E	E	Occurs on an undulating topography on well-structured clay soils. On the Cumberland Plain sites it is associated with Grey Box communities (particularly Cumberland Plain Woodland variants and Moist Shale Woodland) and in areas of ironbark.	Low

Scientific name	Common name	FM Act	BC Act	EPBC Act	Habitat	Likelihood of Occurrence
Pterostylis gibbosa	Illawarra Greenhood		E	E	All known populations grow in open forest or woodland, on flat or gently sloping land with poor drainage. In the Illawarra region, the species grows in woodland dominated by Forest Red Gum Eucalyptus tereticornis, Woollybutt E. longifolia and White Feather Honey-myrtle Melaleuca decora. Near Nowra, the species grows in an open forest of Spotted Gum Corymbia maculata, Forest Red Gum and Grey Ironbark E. paniculata. In the Hunter region, the species grows in open woodland dominated by Narrow-leaved Ironbark E. crebra, Forest Red Gum and Black Cypress Pine Callitris endlicheri.	Low
Pterostylis saxicola	Sydney Plains Greenhood		E	E	Restricted to western Sydney between Freemans Reach in the north and Picton in the south. Most commonly found growing in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines.	Low
Syzygium paniculatum	Magenta Lilly Pilly		E	V	Grows in subtropical and littoral rainforest on sandy soils or stabilized dunes near the sea. On the south coast the Magenta Lilly Pilly occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest.	Low
Thesium australe	Austral Toadflax		V	V	Suitable habitat for this species includes grassland and grassy woodland, often in damp sites.	Low
Amphibian						
Pseudophryne australis	Red-crowned Toadlet		V		Occurs in open forests, mostly on Hawkesbury and Narrabeen Sandstones. Inhabits periodically wet drainage lines below sandstone ridges that often have shale lenses or cappings. Shelters under rocks and amongst masses of dense vegetation or thick piles of leaf litter. Breeding congregations occur in dense vegetation and debris beside ephemeral creeks and gutters. Red-crowned Toadlets have not been recorded breeding in waters that are even mildly polluted or with a pH outside the range 5.5 to 6.5.	Low
Litoria aurea	Green and Golden Bell Frog		E	V	Large populations in NSW are located around coastal and near coastal areas of the metropolitan areas of Sydney, Shoalhaven and mid north coast. It Inhabits marshes, dams and stream-sides, particularly those containing bullrushes (Typha spp.) or spikerushes (Eleocharis spp.)	Moderate

Scientific name	Common name	FM Act	BC Act	EPBC Act	Habitat	Likelihood of Occurrence
Heleioporus australiacus	Giant Burrowing Frog		V	V	Distributed through the Sydney Basin sandstone country in woodland, open woodland and heath vegetation, breeding habitat is generally soaks or pools within first or second order streams, but also 'hanging swamp' seepage lines and where small pools form from the collected water. Spend the majority of time in non-breeding habitat up to 300 m away and burrows in soil surface or leaf litter.	Low
Litoria raniformis	Southern Bell Frog		E	V	Usually found in or around permanent or ephemeral Black Box/Lignum/Nitre Goosefoot swamps, Lignum/Typha swamps and River Red Gum swamps or billabongs along floodplains and river valleys. They are also found in irrigated rice crops, particularly where there is no available natural habitat.	Low
Mixophyes balbus	Stuttering Frog		E	V	Inhabits rainforest and wet, tall open forest. Breeds in streams after summer rains and deposits eggs on rock shelves or in shallow riffles. Non-breeding habitat includes thick understorey vegetation and deep leaf litter on forest floors.	Low
Bird						
Limosa lapponica baueri	Bar-tailed Godwit			V, M	Estuaries and lagoons with large intertidal sandflats or mudflats	Low
Limosa lapponica menzbieri	Northern Siberian Bar-tailed Godwit			CE, M	Estuaries and lagoons with large intertidal sandflats or mudflats	Low
Stictonetta naevosa	Freckled Duck		V		Prefers heavily vegetated wetlands; uses more open wetlands during drought in non-breeding period.	Low
Ptilinopus superbus	Superb Fruit-Dove		V		Inhabits rainforests and similar closed forest at all altitudes.	Low
Botaurus poiciloptilus	Australasian Bittern		E	E	Inhabits temperate freshwater wetlands and occasionally estuarine reedbeds, with a preference for permanent waterbodies with tall dense vegetaion. The species prefers wetlands with dense vegetation, including sedges, rushes and reeds. Freshwater is generally preferred, although dense saltmarsh vegetation in estuaries and flooded grasslands are also used by the species.	Low
Ixobrychus flavicollis	Black Bittern		V		Occurs below 200 m above sea level and inhabit both terrestrial and estuarine wetlands, with a preference for permanent water bodies and dense vegetation. Roosts in trees or amongst dense reeds.	Low

Scientific name	Common name	FM Act	BC Act	EPBC Act	Habitat	Likelihood of Occurrence
Circus assimilis	Spotted Harrier		V		Occurs in grassy open woodland including Acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands.	Low
Haliaeetus leucogaster	White-bellied Sea-Eagle		V	M	Coastlines, estuaries, large rivers and lakes; occasionally over adjacent habitats; builds a large stick nest in a tall tree, rarely on artificial structures	Low
Hieraaetus morphnoides	Little Eagle		V		Occupies habitats rich in prey (birds, reptiles and mammals) within open eucalypt forest, woodland or open woodland. Requires tall living trees for building a large stick nest and preys on birds, reptiles and mammals and occasionally carrion.	Low
Pandion cristatus	Eastern Osprey		V	M	Requires clear estuarine and inshore marine waters and coastal rivers for foraging, and nests in tall (usually dead or dead-topped) trees in coastal habitats from open woodland to open forest, within 1-2 km of water.	Low
Falco subniger	Black Falcon		V		Core habitat is semi-arid and arid interior; uses tree-lined watercourses, isolated stands of trees and hunts over low vegetation of surrounding plains, grasslands, saltubush and blue-bus. Also hunts over wetlands and temporary waters or bore drains in arid regions	Low
Charadrius leschenaultii	Greater Sand-plover		V	V, M	Occurs in coastal areas and inhabits littoral and estuarine habitats. Prefer sheltered sandy, shelly or muddy beaches with large intertidal mudflats or sandbanks.	Low
Rostratula australis	Painted Snipe (Australian subspecies)		E	E, M	Inhabits shallow inland wetlands, either freshwater or brackish water bodies. Nests on the ground amongst tall reed-like vegetation near water, and feeds near the water's edge and on mudflats.	Low
Calidris canutus	Red Knot			E, M	Tidal mudflats, sandflats, beaches, saltmarsh, ploughed fields, flooded pasture	Low
Calidris ferruginea	Curlew Sandpiper		E	CE, M	Coastal migratory species with a NSW distribution from Hastings Point to Shoalhaven Heads. Found in open, sandy beaches with exposed sand bars and rocky outcrops. Rare use of near-coastal wetlands.	Low
Calidris tenuirostris	Great Knot		V	CE, M	Migratory shorebird distributed along entire coast of NSW. Occur on intertidal mudflats in sheltered coastal area	Low

Scientific name	Common name	FM Act	BC Act	EPBC Act	Habitat	Likelihood of Occurrence
Limicola falcinellus	Broad-billed Sandpiper		V		Migratory species. Favour estuarine mudflats, saltmarshes and reefs as feeding and roosting habitat throughout Australian distribution.	Low
Limosa limosa	Black-tailed Godwit		V	M	Estuaries and lagoons with large intertidal sandflats or mudflats.	Low
Numenius madagascariensis	Eastern Curlew			CE, M	Estuaries, tidal mudflats, sandspits, saltmarsh, mangroves.	Low
Xenus cinereus	Terek Sandpiper		V	M	Favours mudbanks and sandbanks located near mangroves, but may also be observed on rocky pools and reefs, and occasionally up to 10 km inland around brackish pools.	Low
Sternula albifrons	Little Tern		E	M	Almost exclusively coastal, preferring sheltered environments; however may occur several kilometres from the sea in harbours, inlets and rivers (with occasional offshore islands or coral cay records). Nests in small, scattered colonies in low dunes or on sandy beaches just above high tide mark near estuary mouths or adjacent to coastal lakes and islands.	Low
Callocephalon fimbriatum	Gang-gang Cockatoo		V		Occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests in winter and open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas in summer.	Low
Glossopsitta pusilla	Little Lorikeet		V		Mostly occur in dry, open eucalypt forests and woodlands. They have been recorded from both old-growth and logged forests in the eastern part of their range, and in remnant woodland patches and roadside vegetation on the western slopes. Nest in small hollows (entrance approx. 3 cm) of Eucalyptus spp. between 2 - 15 m above the ground.	Low
Lathamus discolor	Swift Parrot		E	CE	In NSW mostly occurs on the coast and south west slopes, occurring in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany (Eucalyptus robusta), Spotted Gum (Corymbia maculata), Red Bloodwood (C. gummifera), Mugga Ironbark (E. sideroxylon), and White Box (E. albens).	Low

Scientific name	Common name	FM Act	BC Act	EPBC Act	Habitat	Likelihood of Occurrence
Ninox connivens	Barking Owl		V		Occurs throughout NSW, where it inhabits dry open sclerophyll forests and woodlands, favouring dense riparian stands of eucalypts or casuarinas along watercourses or around wetlands, where there are many large trees suitable for roosting or breeding.	Low
Ninox strenua	Powerful Owl		V		Inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. They require large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. Powerful Owls nest in large tree hollows (at least 0.5 m deep), in large eucalypts (diameter at breast height of 80-240 cm) that are at least 150 years old.	Low
Tyto longimembris	Eastern Grass Owl		V		Found in areas of tall grass, including grass tussocks, in swampy areas, grassy plains, swampy heath, and in cane grass or sedges on flood plains.	Low
Anthochaera phrygia	Regent Honeyeater		CE	CE	Inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. NSW the distribution is very patchy and mainly confined to the two main breeding areas at Capertee Valley and the Bundarra-Barraba region and surrounding fragmented woodlands. Birds are also found in drier coastal woodlands and forests. The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River She-oak. These habitats have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. Key eucalypt species include Mugga Ironbark, Yellow Box, Blakely's Red Gum, White Box and Swamp Mahogany. Nectar and fruit from the mistletoes are also eaten during the breeding season.	Low
Epthianura albifrons	White-fronted Chat		V		Open damp ground, grass clumps, fencelines, heath, samphire saltmarsh, mangroves, dunes, saltbush plains.	Low
Daphoenositta chrysoptera	Varied Sittella		V		Inhabits most of mainland Australia except the treeless deserts and open grasslands. It inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland.	Low
Artamus cyanopterus cyanopterus	Dusky Woodswallow		V		The Dusky Woodswallow is found in open forests and woodlands, and may be seen along roadsides and on golf courses	Low

Scientific name	Common name	FM Act	BC Act	EPBC Act	Habitat	Likelihood of Occurrence
Petroica boodang	Scarlet Robin		V		In NSW it occupies open forests and woodlands from the coast to the inland slopes. Breeds in drier eucalypt forests and temperate woodlands, often on ridges and slopes, within an open understorey of shrubs and grasses and sometimes in open areas. Abundant logs and coarse woody debris are important structural components of its habitat.	Low
Petroica phoenicea	Flame Robin		V		Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes. Prefers clearings or areas with open understoreys. In winter, birds migrate to drier more open habitats in the lowlands (i.e. valleys below the ranges, and to the western slopes and plains).	Low
Charadrius mongolus	Lesser Sand-plover		V	E, M	Occur along the Australian coastline with highest abundance north of Shoalhaven estuary. Habitat preferences for beaches, mudflats and mangroves.	Low
Dasyornis brachypterus	Eastern Bristlebird		E	E	Habitat for central and southern populations is characterised by dense, low vegetation including heath and open woodland with a heathy understorey.	Low
Grantiella picta	Painted Honeyeater		V	V	Occurs in Eucalyptus woodland and forests, with a preference for mistletoe (Amyema spp.). Can also occur along watercourses and in farmland. Nests from spring to autumn in outer canopy of eucalypts, she-oak, paperbark and mistletoe branches.	Low
Pachyptila turtur subantarctica	Fairy Prion			V	A marine bird, found mostly in temperate and subantarctic seas. The Fairy Prion sometimes forages over continental shelves and the continental slope, but it can come close inshore in rough weather.	Low
Sternula nereis nereis	Australian Fairy Tern			V	It breeds on sheltered mainland coastlines and close islands, usually on sandy beaches above the high tide line but below where vegetation occurs. It feeds almost entirely on fish mainly by following shoals of feeding predatory fish, and is rarely found out of sight of land.	Low
Apus pacificus	Fork-tailed Swift			M	Aerial space over a variety of habitat types; feeds on insects; breeds in Asia.	Low
Calonectris leucomelas	Streaked Shearwater			M	This marine species can be found over both pelagic and inshore waters.	Low

Scientific name	Common name	FM Act	BC Act	EPBC Act	Habitat	Likelihood of Occurrence
Fish						
Epinephelus daemelii	Black Cod	V		V	Adult black cod are usually found in caves, gutters and beneath bomboras on rocky reefs. They are territorial and often occupy a particular cave for life. Small juveniles are often found in coastal rock pools, and larger juveniles around rocky shores in estuaries.	Low
Macquaria australasica	Macquarie Perch	E		E	Found in both river and lake habitats, especially the upper reaches of rivers and their tributaries.	Low
Prototroctes maraena	Australian Grayling			V	Occur in freshwater streams and rivers, especially clear gravelly streams with a moderate flow, as well as estuarine areas.	Low
Gastropod						
Meridolum corneovirens	Cumberland Plain Land Snail		E		Primarily inhabits Cumberland Plain Woodland. Lives under litter of bark, leaves and logs, or shelters in loose soil around grass clumps. Occasionally shelters under rubbish. Can dig several centimetres into soil to escape drought.	Low
Pommerhelix duralensis	Dural Land Snail			E	The majority of confirmed records are from intact remnant bushland and the species is considered unlikely to be tolerant of highly disturbed or weedy habitats. The species has been observed resting in exposed areas, such as on exposed rock or leaf litter, however it will also shelter beneath leaves, rocks and light woody debris.	Low
Mammal						
Dasyurus maculatus	Spotted-tailed Quoll		V	E	Utilises a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites.	Low
Pteropus poliocephalus	Grey-headed Flying-fox		V	V	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 commonly found in gullies, close to water, in vegetation with a dense canopy. They travel up to 50 km to forage, on the nectar and pollen of native trees, in particular Eucalyptus, Melaleuca and Banksia, and fruits of rainforest trees and vines.	Moderate

Scientific name	Common name	FM Act	BC Act	EPBC Act	Habitat	Likelihood of Occurrence
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat		V		Inhabits eucalypt rainforest, sclerophyll forest and open woodland vegetation. Availability of tree hollows is important for access to roosting sites.	Low
Mormopterus norfolkensis	Eastern Freetail-bat		V		Habitats preference includes dry eucalypt forest and coastal woodlands but also include riparian zones in rainforest and wet sclerophyll forest. Forages above forest canopy or forest edge and requires roosts including tree hollows.	Low
Falsistrellus tasmaniensis	Eastern False Pipistrelle		V		This species occupies tall, mature, wet forest and the species have been recorded roosting in stem holes in Eucalyptus and in buildings. Prefers moist habitats, with trees taller than 20 m. Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings.	Low
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat		V		Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. They form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young. This species tends to hunt in forested areas.	Low
Myotis macropus	Southern Myotis		V		This species generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. They forage over streams and pools catching insects and small fish by raking their feet across the water surface.	Low
Scoteanax rueppellii	Greater Broad-nosed Bat		V		Occurs in a variety of habitats including rainforest, dry and wet sclerophyll forest and eucalypt woodland. Large hollow bearing trees required for roosting.	Low
Chalinolobus dwyeri	Large-eared Pied Bat		V	V	Roosts in disused mine shafts, caves, overhangs and disused Fairy Martin nests for shelter and to raise young. Also potentially roost in tree hollows. Occurs in low to mid-elevation dry open forest and woodlands, preferably with extensive cliffs, caves or gullies. Pied Bat is largely restricted to the interface of sandstone escarpment (for roost habitat) and relatively fertile valleys (for foraging habitat).	Low

Scientific name	Common name	FM Act	BC Act	EPBC Act	Habitat	Likelihood of Occurrence
Dasyurus maculatus maculatus	Spotted-tail Quoll (southeastern mainland population)		V	E	Utilises a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites.	Low
Isoodon obesulus obesulus	Southern Brown Bandicoot (eastern)		E	E	Generally only found in heath or open forest with a heathy understorey on sandy or friable soils. Feed on a variety of ground-dwelling invertebrates and the fruit-bodies of hypogeous (underground-fruiting) fungi. Their searches for food often create distinctive conical holes in the soil. Males have a home range of approximately 5-20 hectares whilst females forage over smaller areas of about 2-3 hectares. Nest during the day in a shallow depression in the ground covered by leaf litter, grass or other plant material. Nests may be located under Grass trees Xanthorrhoea spp., blackberry bushes and other shrubs, or in rabbit burrows. The upper surface of the nest may be mixed with earth to waterproof the inside of the nest.	Low
Petauroides volans	Greater Glider			V	The greater glider is an arboreal marsupial, largely restricted to eucalypt forests and woodlands. It is found in highest abundance typically in taller, montane, moist eucalypt forests, with relatively old trees and abundant hollows. The greater glider favours forests with a diversity of eucalypt species, due to seasonal variation in its preferred tree species. During the day it shelters in tree hollows, with a particular selection for large hollows in large, old trees.	Low
Petrogale penicillata	Brush-tailed Rock-wallaby		E	V	This species prefers rocky habitats, including loose boulder-piles, rocky outcrops, steep rocky slopes, cliffs, gorges, isolated rock stacks and tree limbs. Preference for north-facing slopes and cliff lines. A range of vegetation types are associated with Brush-tailed Rock-wallaby habitat, including dense rainforest, wet sclerophyll forest, vine thicket, dry sclerophyll forest, and open forest.	Low

Scientific name	Common name	FM Act	BC Act	EPBC Act	Habitat	Likelihood of Occurrence
Phascolarctos cinereus	Koala		V	V	Inhabits a range of eucalypt forest and woodland communities. Adequate floristic diversity, availability of feed trees (primarily Eucalyptus tereticornis and E. viminalis) and presence of mature trees very important. Preferred food tree species vary with locality and there are quite distinct regional preferences. They are able to persist in fragmented habitats, and even survive in isolated trees across a predominantly agricultural landscape.	Low
Pseudomys novaehollandiae	New Holland Mouse			V	Inhabit open heathlands, open woodlands with a heathland understorey, and vegetated sand dunes. Nest in burrows and have a preference for deeper top soils and softer substrates to aid digging. Spends considerable time foraging above-ground for food in areas of high floristic diversity.	Low
Reptile						
Caretta caretta	Loggerhead Turtle		E	E, M	Loggerhead turtles have a worldwide tropical and subtropical distribution. In Australia, they occur in coral reefs, bays and estuaries in tropical and warm temperate waters off the coast of Queensland, Northern Territory, Western Australia and New South Wales.	Low
Chelonia mydas	Green Turtle		V	V, M	Ocean-dwelling species spending most of its life at sea. Carnivorous when young but as adults they feed only on marine plant material. Eggs laid in holes dug in beaches throughout their range. Scattered nesting records along the NSW coast.	Low
Dermochelys coriacea	Leatherback Turtle		E	E, M	Occurs in inshore and offshore marine waters. Rarely breeds in Australia, with the nearest regular nesting sites being the Solomon Islands and Malayan Archipelago. Occasional breeding records from NSW coast, including between Ballina and Lennox Head in northern NSW. Number of sightings in southern waters suggest species actively seeks temperate feeding grounds, rather than occurring only as stray vagrants.	Low

Scientific name	Common name	FM Act	BC Act	EPBC Act	Habitat	Likelihood of Occurrence
Eretmochelys imbricata	Hawksbill Turtle			V, M	Hawksbill turtles typically occur in tidal and sub-tidal coral and rocky reef habitats throughout tropical waters, extending into warm temperate areas as far south as northern New South Wales. In Australia the main feeding area extends along the east coast, including the Great Barrier Reef. Other feeding areas include Torres Strait and the archipelagos of the Northern Territory and Western Australia, possibly as far south as Shark Bay or beyond. Hawksbill turtles also feed at Christmas Island and the Cocos (Keeling) Islands.	Low
Hoplocephalus bungaroides	Broad-headed Snake		E	V	Confined to the Sydney basin within a radius of approximately 200 km of Sydney. Preferred habitat of sandstone outcrops with woodland, open woodland and/or heath vegetation. Shelters in rock crevices and under flat sandstone rocks on exposed cliff edges and tree hollows.	Low
Natator depressus	Flatback Turtle			V, M	The Flatback Turtle is found only in the tropical waters of northern Australia, Papua New Guinea and Irian Jaya and is one of only two species of sea turtle without a global distribution.	Low

Appendix D

BC Act Assessments of Significance

Appendix D BC Act Assessments of Significance

Green and Golden Bell Frog *Litoria Aurea*

The Green and Golden Bell Frog (*Litoria aurea*) (GGBF) is a dull olive to emerald green frog up to 85 mm long. The species is usually distinguished by the irregular markings on its back that range from brown to golden bronze, and by yellow and black dorsal stripes. The species is occurs mainly in coastal lowland areas within NSW and Victoria. The GGBF is listed as an endangered species under the BC Act. The *Management Plan for the Green and Golden Bell Frog Key Populations of the Parramatta River* (Department of Environment and Climate Change, 2008c) identifies the Clyde Terminal, and the Camellia peninsular/Camellia Industrial Estate/Rosehill area as containing one of the key Parramatta populations of the GGBF (the other two key Parramatta populations being located at Homebush Bay and Merrylands).

Past records of the GGBF from within the Conversion Works Area were recorded in 1999, 2000 and 2005. Two areas at the terminal were also found to contain live frogs during survey work conducted 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.

Threats to GGBF listed by OEH (OEH, 2012) include:

- Destruction of wetlands;
- Alteration of drainage patterns and stormwater runoff;
- A fungal pathogen known as Frog Chytrid Fungus;
- Predation by feral animals such as foxes;
- Herbicides and other weed control measures;
- Road mortality, where populations are already small due to other threats;
- Predation by exotic fish such as Plague Minnow; and
- Loss of suitable breeding habitat through alteration by infilling and destruction of wetlands.

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The Clyde Terminal has been identified as containing areas that have been previously used by GGBF for breeding, and that may continue to be used from time to time as breeding habitat (Department of Environment and Climate Change, 2008c).

Areas within the Conversion Project Area where the GGBF has been historically detected or where potential habitat occurs are outlined in **Table D-1**.

Table D-1 Potential and known Green and Golden Bell Frog Habitat at the Conversion Project Area

Area	GGBF Previous Records	GGBF Potential Habitat
Remnant wetlands	Four male GGBFs were heard actively calling during surveys in October 2012. One GGBF individual was recorded at this location in in 1999, and another two in 2005 (OEH, 2013a; Urban Bushland Management Consultants, 2007).	Man-made and designed to receive clean waste water from the terminal. Based on past and current records, the remnant wetland is the primary location of GGBF in the Conversion Project Area. This area was therefore used as a reference site during the October 2012 GGBF surveys.

Area	GGBF Previous Records	GGBF Potential Habitat
Tankfarm B	Two male GGBFs were heard actively calling during surveys in October 2012. There is anecdotal evidence of tadpoles (species unknown) previously occurring in the waters in the base of Tankfarm B.	Tankfarm B is one of the two tankfarms in the Conversion Project Area that retains ponded rain water because drainage appears to have been blocked by a small dense stand of *Typha orientalis* (Cumbungi). 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 not provide suitable GGBF habitat. Tankfarm B is not hydrologically connected to the remnant wetland in the north east of the Conversion 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. The mangroves and riverside floodplain forest are not impacted by the conversion works and would benefit from the improved environmental controls to be implemented as part of the Conversion Project.
Tank 52	No evidence of GGBF presence was recorded in this location during surveys in October 2012. There are no previous records of GGBFs occurring at this location (OEH, 2013a).	Tank 52 contains a very shallow ponded area with emergent vegetation dominated by the introduced (Umbrella Sedge (*Cyperus eragrostis*). 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). 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.

Area	GGBF Previous Records	GGBF Potential Habitat
Mobil Tankfarm	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. One GGBF individual was recorded at this location in 1999 (OEH, 2013a).	Tanks 201, 203 and 204 lie within a bund in the centre of the six tanks at this tankfarm. On occasions, shallow ponded water is present at this tankfarm. 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 site for refining and related activities. However visual observations and analytical sampling of the standing water within the bund do not indicate contamination (ERM, 2012a). 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 terminal.
Tankfarm E1 (including Tanks 36-41)	No evidence of GGBF presence was recorded in this location during surveys in October 2012. One individual GGBF was recorded in this location in 2000 (OEH, 2013a).	During survey work conducted in 2012, no suitable GGBF habitat was identified in Tankfarm E1.

The modification works would result in additional demolition activities at the following locations:

- LPG gantries;
- Redundant LPG spheres (V137 and V140);
- MTS 33 kV substation;
- Tank 106 (slops tank); and
- State Office Building.

The first four of these areas contain virtually no vegetation with the exception of a small stand of planted Casuarinas at the LPG gantries. As such these sites do not represent any recognisable breeding or foraging habitat for this species. Modification works in these locations would not affect the life cycle of this species in any recognisable manner.

The State Office Building includes surrounding landscaping in which anecdotal Bionet records of GGBF have been located. These records are considered to be somewhat suspect on the basis that they do not appear to represent any actual specific detections of this species in this location. Despite this the site was assessed for habitat value. This assessment determined that the site does not constitute breeding habitat due to the lack of permanent standing fresh water. The potential for the suite to be considered foraging habitat is considered to be low based upon the heavily maintained nature of the landscaping and the separation from the main population in the wetland area.

The modification works would not directly affect any breeding habitat for this species, which is considered to be limited to the wetland area to the northeast of the Site.

The sections of the terminal most commonly used as GGBF habitat (i.e. the remnant wetlands) are unlikely to be affected by the modification works. As such, it is unlikely that important breeding habitat of the species would be removed, or that access to breeding habitats would be substantially reduced as part of the Project, putting the species at risk of extinction.

b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

- ***i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or***
- ***ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.***

Not applicable.

d) In relation to the habitat of a threatened species, population or ecological community:

- ***i. the extent to which habitat is likely to be removed or modified as a result of the action proposed; and***
- ***ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and***
- ***iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.***

i. The project would involve modification works to demolish redundant infrastructure and buildings within the site. As outlined above, the potential for any of these areas to be considered habitat for this species is deemed to be low. The proponent maintains their commitment to conserving and enhancing that remnant wetland habitat to the northeast of the site so as to continue to provide secure habitat for this species into the future.

ii. 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 terminal are known to be the primary location of GGBF at the site. It is therefore most likely that the dispersion of GGBF within the terminal is centred on the remnant wetlands in the north-east, and takes place throughout select sections of the eastern half of the site on occasion. The modification works would remove redundant industrial infrastructure within the terminal, as well as the State Office Building. As outlined above, these areas are not considered viable habitat for this species and as such their removal would not fragment or isolate their habitat in any recognisable sense.

iii. The modification works would remove redundant industrial infrastructure within the terminal, as well as the State Office Building. As outlined above, these areas are not considered viable or important habitat for this species.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

The remnant wetlands are the only location that can be considered to be viable habitat for the GGBF within the broader terminal area. These remnant wetlands would not be affected, either directly or indirectly, as a result of the modification works. The proponent would continue to preserve and enhance this habitat through protection and rehabilitation mechanisms as outlined in the original development application.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

As part of the initial development application, the proponent has prepared 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. The CEMP GGBF sub-plan is has been 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).

The mitigation measures incorporated into the project by virtue of the original development application would therefore be consistent with the draft recovery plan for GGBF in NSW (DEC, 2005).

g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Of the 21 key threatening processes listed under the EPBC Act, the following are relevant to the location, the proposed modification works and the species:

- Infection of amphibians with chytrid fungus resulting in chytridiomycosis
- Land clearance

The modification works have some potential for contributing to these key threatening processes.

The proponent has committed to abiding by *The Frog Hygiene Protocol* (DECC, 2008b) to prevent the spread of Frog Chytrid Fungus. This includes the application of hygiene measures on site demolition activities.

The listing of the 'land clearance' key threatening process refers to the clearing of '*Native vegetation, [which] is defined as vegetation in which native species constitute more than 70% of the plant cover, or other vegetation containing populations of species listed under the EPBC Act*'.

The modification works would, in the broadest sense, result in land clearing occurring on site. This would however only be associated with the planted, exotic or common urban-adapted species present in and around the terminal. The main area of impact would be associated with the land immediately around the State Office Building, which is made up exclusively of landscaped vegetation. As established above, this area is not considered to be habitat for GGBF, nor is it comprised of more than 70% native species. Therefore, none of the land subject to the modification works would meet these criteria and as such this KTP is not considered to apply to this project.

On these basis the modification works are not considered likely to exacerbate either of these relevant key threatening processes.

Conclusion

The modification works would affect areas of vegetation that are either currently heavily cleared, or primarily comprised of exotic or common-native species. The main area of extant vegetation, around the State Office Building, is not considered likely to constitute core foraging habitat for GGBF on the basis of the vegetation composition and structure, as well as the physical separation and intervening activity (active driveways and terminal infrastructure) between it and the known primary habitat area to the northeast. Despite the known importance of individual GGBF populations within the Sydney basin the modification works are considered unlikely to result in a significant impact upon GGBF on this location.

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Grey-headed Flying Fox *Petaurus poliocephalus*

The Grey-headed Flying Fox *Petaurus poliocephalus* is a large bat up to 29 cm long with a wingspan of up to 1 m. Its body is covered in dark grey fur, with the fur on the neck being a lighter grey and the head and collar having a russet colour. It also has leg fur extending to the ankle, which helps distinguish it from other bats. The species occurs mainly within 200 km of the east Australia coast, extending in a continuous population between Bundaberg and the NSW-Victorian border, with other isolated populations north as far as Townsville and west as far as Adelaide. The Grey-headed Flying Fox is listed as a vulnerable species under the BC Act. There is one known record of the species occurring in the remnant wetlands within the broader terminal area. The report prepared by Eco Logical for the Conversion Project found that the Conversion Project Area did not contain important Grey-headed Flying Fox roosting habitat and that the species as unlikely to be affected directly or indirectly by the Clyde Terminal conversion. Individuals of this species may however dwell opportunistically at the terminal. The Eco Logical report indicated that there was some residual potential for the species to use the limited habitat available in the remnant wetlands, and the species could occasionally roost within the stacks at the refinery.

Threats to Grey-headed Flying Fox listed by OEH (OEH, 2013) include:

- Loss of foraging habitat;
- Loss of disturbance of roosting sites;
- Unregulated shooting;
- Electrocution on powerlines, entanglement in netting and on barbed wire;
- Competition with Black Flying-foxes;
- Negative public attitude and conflict with humans;
- Impacts from climate change; and
- Disease.

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

The modification works would result in additional demolition activities at the following locations:

- LPG gantries;
- Redundant LPG spheres (V137 and V140);
- MTS 33 kV substation;
- Tank 106 (slops tank); and
- State Office Building.

The first four of these areas contain virtually no vegetation with the exception of a small stand of planted Casuarinas at the LPG gantries. As such these sites do not represent any recognisable breeding or foraging habitat for this species. Modification works in these locations would not affect the life cycle of this species an in any recognisable manner.

The State Office Building includes surrounding landscaping, some of which is reasonably mature. Some of this vegetation, particularly large flowering trees such as eucalypts, may provide opportunistic roosting or foraging habitat for this species. The overall amount of such habitat provided in this area is however considered minimal in the context of the broader resources available in the surrounding area, including fruiting and flowering trees within residential properties throughout the Sydney basin.

Whilst the proponent aims to preserve a degree of vegetation within the grounds of the State Office Building during demolition the loss of the entirety of this location is highly unlikely to result in an effect upon the lifecycle of this species such that any viable local population is likely to be placed as risk of extinction.

b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

- ***iii. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or***
- ***iv. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.***

Not applicable.

d) In relation to the habitat of a threatened species, population or ecological community:

- ***i. the extent to which habitat is likely to be removed or modified as a result of the action proposed; and***
- ***ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and***
- ***iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.***

i. The modification works involve demolishing redundant infrastructure and buildings within the Conversion Project Area. As outlined above, the potential for any of these areas to be considered habitat for this species is deemed to be low. The proponent maintains their commitment to conserving and enhancing that remnant wetland habitat to the northeast of the terminal so as to continue to provide secure habitat for this species into the future

ii. The species is known to have the potential to disperse widely and through airborne movement. There are no specific corridors of movement for the Grey-headed Flying Fox throughout the terminal and beyond, though it is anecdotally noted that dispersion does occur along waterways, particularly when leaving roost sites. The modification works would remove redundant industrial infrastructure, as well as the State Office Building. The removal of this infrastructure would not place any barriers to movement or remove and ‘stepping stones’ that are likely to be important to the species local and regional dispersion and foraging patterns.

iii. As outlined above, the modification works would affect areas either completely devoid of habitat for this species, or with only marginal value (such as the State Office Building) The remnant wetlands at the terminal provide superior habitat values for many species including Grey-headed Flying Fox, and these wetlands would not be affected on either directly or indirectly by the modification works.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

The remnant wetlands and large Fig tree are the only habitat that can be considered to provide potentially significant habitat for the Grey-headed Flying Fox at the terminal. This habitat is not considered critical for the species. Nevertheless the habitat values of this remnant wetland would not be affected either directly or indirectly as a result of the modification works. The proponent would preserve and enhance this remnant wetland through ongoing protection and rehabilitation measures.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

There is no threat abatement plan relevant to this species. OEH has however listed 31 priority actions to promote the recovery of threatened species and the abatement of key threatening processes in relation to Grey-headed Flying Fox (OEH, 2013). The essence of these priority actions is captured by the following activities recommended to assist the species (OEH, 2013):

- Protect roost sites, particularly avoid disturbance September through November;
- Identify and protect key foraging areas;
- Manage and enforce licensed shooting;
- Investigate and promote alternative non-lethal crop protection mechanisms;
- Identify powerline blackspots and implement measures to reduce deaths;
- Implement measures to reduce deaths from entanglement in netting and on barbed-wire;
- Increase public awareness/understanding about flying-foxes, and their involvement in flying-fox conservation;
- Monitor the national population's status and distribution, and
- Improve knowledge on demographics and population structure to better understand ecological requirements of the species.

The modification works would not conflict with any of the above priority actions.

g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Of the 21 key threatening processes listed under the EPBC Act, the following are relevant to the location, the proposed modification works and the species:

- Land clearance

The listing of the ‘land clearance’ key threatening process refers to the clearing of ‘*Native vegetation, [which] is defined as vegetation in which native species constitute more than 70% of the plant cover, or other vegetation containing populations of species listed under the EPBC Act’*.

The modification works would, in the broadest sense, result in land clearing occurring within the Conversion Project Area. This would however only be associated with the planted, exotic or common urban-adapted species present in and around the terminal. The main area of impact would be associated with the land immediately around the State Office Building, which is made up exclusively of landscaped vegetation. As established above, this area is not considered to be important roosting or foraging habitat for GHFF, nor is it comprised of more than 70% native species. Therefore, none of the land subject to the modification works would meet these criteria and as such this KTP is not considered to apply to this project.

On this basis the modification works are not considered likely to exacerbate relevant key threatening processes.

Conclusion

The Project would involve the demolition of redundant refinery infrastructure and buildings, including the removal of landscaping vegetation that may provide opportunistic foraging habitat for this species. Given the species’ propensity to follow flowering and fruiting resources of various plants, and their wide preference for food plants, the loss of a small amount of flowering vegetation (primarily large eucalypts) around the State Office Building is not considered to be a substantial impact to the potential foraging ability of any important populations of this species. On this basis the proposed modification works are considered unlikely to result in a significant impact upon this species.

References

Eco Logical Australia Pty Ltd, 2012. *Shell Clyde Refinery – Bats*.

OEH, 2013. *Threatened Species Profiles*. Available at: http://www.environment.nsw.gov.au/threatenedspecies/. Accessed on Accessed 20 February 2013.

Appendix E

EPBC Act Assessments of Significance

Appendix E EPBC Act Assessments of Significance

Green and Golden Bell Frog *(Litoria Aurea)* – vulnerable species

The Green and Golden Bell Frog (*Litoria aurea*) (GGBF) is a dull olive to emerald green frog up to 85 mm long. The species is usually distinguished by the irregular markings on its back that range from brown to golden bronze, and by yellow and black dorsal stripes. The species occurs mainly in coastal lowland areas within NSW and Victoria. The GGBF is listed as vulnerable under the EPBC Act. The *Management Plan for the Green and Golden Bell Frog Key Populations of the Parramatta River* (Department of Environment and Climate Change, 2008c) identifies the Clyde Terminal, and the Camellia peninsular/Camellia Industrial Estate/Rosehill area as containing one of the key Parramatta populations of the GGBF (the other two key Parramatta populations being located at Homebush Bay and Merrylands).

Past records of the GGBF from within the Conversion Project Area were recorded in 1999, 2000 and 2005. Two areas at the terminal were also found to contain live frogs during survey work conducted 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.

Threats to GGBF listed by OEH (OEH, 2012) include:

- Destruction of wetlands;
- Alteration of drainage patterns and stormwater runoff;
- A fungal pathogen known as Frog Chytrid Fungus;
- Predation by feral animals such as foxes;
- Herbicides and other weed control measures;
- Road mortality, where populations are already small due to other threats;
- Predation by exotic fish such as Plague Minnow; and
- Loss of suitable breeding habitat through alteration by infilling and destruction of wetlands.

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

i. lead to a long-term decrease in the size of an important population

The Clyde Terminal has been identified as containing areas that have been previously used by GGBF for breeding, and that may continue to be used from time to time as breeding habitat (Department of Environment and Climate Change, 2008c).

Sites within the Conversion Project Area where the GGBF has been historically detected or where potential habitat occurs are outlined in **Table E-1** below.

Table E-1 Potential and known Green and Golden Bell Frog Habitat at the Conversion Project Area

Area	GGBF Previous Records	GGBF Potential Habitat
Remnant wetlands	Four male GGBFs were heard actively calling during surveys in October 2012. One GGBF individual was recorded at this location in in 1999, and another two in 2005 (OEH, 2013a; Urban Bushland Management Consultants, 2007).	Man-made and designed to receive clean waste water from the Conversion Project Area. Based on past and current records, the remnant wetland is the primary location of GGBF on the Conversion Project Area. This area was therefore used as a reference site during the October 2012 GGBF surveys.
Tankfarm B	Two male GGBFs were heard actively calling during surveys in	Tankfarm B is one of the two tankfarms at the Conversion Project Area that retains ponded rain

Area	GGBF Previous Records	GGBF Potential Habitat
	October 2012. There is anecdotal evidence of tadpoles (species unknown) previously occurring in the waters in the base of Tankfarm B.	water because drainage appears to have been blocked by a small dense stand of *Typha orientalis* (Cumbungi). 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 not provide suitable GGBF habitat. Tankfarm B is not hydrologically connected to the remnant wetland in the north east of the Conversion 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. The mangroves and riverside floodplain forest would not be affected by the conversion works in the terminal and would benefit from the improved environmental controls to be implemented as part of the Conversion Project.
Tank 52	No evidence of GGBF presence was recorded in this location during surveys in October 2012. There are no previous records of GGBFs occurring at this location (OEH, 2013a).	Tank 52 contains a very shallow ponded area with emergent vegetation dominated by the introduced Umbrella Sedge (*Cyperus eragrostis*). 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). 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.

Area	GGBF Previous Records	GGBF Potential Habitat
Mobil Tankfarm	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. One GGBF individual was recorded at this location in 1999 (OEH, 2013a).	Tanks 201, 203 and 204 lie within a bund in the centre of the six tanks at this tankfarm. On occasions, shallow ponded water is present at this tankfarm. 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 Conversion 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). 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 Conversion Project Area.
Tankfarm E1 (including Tanks 36-41)	No evidence of GGBF presence was recorded in this location during surveys in October 2012. One individual GGBF was recorded in this location in 2000 (OEH, 2013a).	During survey work conducted in 2012, no suitable GGBF habitat was identified in Tankfarm E1.

Given that one or more GGBF have been identified at the site since 1995 at least once the site is considered an important population.

The modification works would result in additional demolition activities at the following locations:

- LPG gantries
- Redundant LPG spheres (V137 and V140)
- MTS 33 kV substation
- Tank 106 (slops tank)
- State Office Building.

The first four of these areas contain virtually no vegetation with the exception of a small stand of planted Casuarinas at the LPG gantries. As such these sites do not represent any recognisable breeding or foraging habitat for this species. Modification works in these locations would not affect the species in such a way as to lead to a decrease in the population.

The State Office Building includes surrounding landscaping in which Bionet records of GGBF have been located. These records are considered to be highly questionable on the basis that they do not appear to represent any actual specific detections of this species in this location. Despite this the location was assessed for habitat value. This assessment determined that the location does not constitute breeding habitat due to the lack of permanent standing fresh water. The potential for the location to be considered foraging habitat is considered to be low based upon the heavily maintained nature of the landscaping and the separation from the main population in the wetland area.

The modification works would not directly affect any breeding habitat for this species, which is considered to be limited to the wetland area to the northeast of the terminal.

As indicated in **Table E-1**, the sections of the Conversion Project Area most commonly used as GGBF habitat (i.e. the remnant wetlands) are unlikely to be affected by the modification works. As such, it is unlikely that the modification works would lead to a long term decline in the size of this important population.

ii. reduce the area of occupancy of an important population

The modification works involve the demolition of redundant infrastructure and buildings within the site. As outlined above, the potential for any of these areas to be considered habitat for this species is deemed to be low. The proponent maintains their commitment to conserving and enhancing that remnant wetland habitat to the northeast of the Conversion Project Area so as to continue to provide secure habitat for this species into the future.

iii. fragment an existing important population into two or more populations

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 Conversion Project Area are known to be the primary location of GGBF at the terminal. 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. The modification works would remove redundant industrial infrastructure within the terminal, as well as the State Office Building. As outlined above, these areas are not considered viable habitat for this species and as such their removal would not fragment or isolate their habitat in any recognisable sense.

iv. adversely affect habitat critical to the survival of a species

The remnant wetlands are the only location that can be considered to be viable habitat for the GGBF within the broader terminal area. These remnant wetlands would not be affected, either directly or indirectly, as a result of the modification works. The proponent would continue to preserve and enhance this habitat through protection and rehabilitation mechanisms as outlined in the original development application (SSD 5147).

The modification works would remove redundant industrial infrastructure within the Conversion Project Area, including the State Office Building. As outlined above, these areas are not considered critical or even viable habitat for this species.

v. disrupt the breeding cycle of an important population

The remnant wetlands are the only location that can be considered to be somewhat viable breeding habitat for the GGBF within the broader terminal area. These remnant wetlands would not be affected, either directly or indirectly, as a result of the modification works. The proponent would continue to preserve and enhance this habitat through protection and rehabilitation mechanisms as outlined in the original development application.

vi. modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The modification works involve demolition of redundant infrastructure and buildings within the terminal. As outlined above, the potential for any of these areas to be considered habitat for this species is deemed to be low. The proponent maintains their commitment to conserving and enhancing that remnant wetland habitat to the northeast of the Conversion Project Area so as to continue to provide secure habitat for this species into the future.

The proposal is not considered likely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

vii. result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

The 'Conservation of Green and Golden Bell frogs, Shell Site, Clyde' (2013) outlines that the remnant wetland contains a 'large population' of Gambusia (mosquito fish). These fish are known to predate on the eggs of GGBF.

The proposed modification works would not alter the presence of Gambusia in the remnant wetland area. The works would not result in any activity that is likely to introduce this or any other invasive species that are likely to be harmful to the ongoing survival of GGBF at the terminal.

viii. introduce disease that may cause the species to decline

With adherence to best practice construction techniques and ongoing management, the proposal would not introduce disease that may cause the species to decline.

ix. interfere substantially with the recovery of the species

As part of the initial development application, the proponent has prepared GGBF specific mitigation strategy, included as a sub-plan to the EMS (i.e. Biodiversity Management Plan) for the proposed Clyde Terminal conversion, in consultation with the NSW Office of Environment and Heritage. The Biodiversity Management Plan has been 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).

The mitigation measures incorporated into the Conversion Project by virtue of the original development application (SDD 5147 MOD1) would therefore be consistent with the draft recovery plan for GGBF in NSW (DEC, 2005).

Conclusion

The modification works would affect areas within the terminal that are either currently heavily cleared, or primarily comprised of exotic or common native vegetation. The area of extant vegetation, around the State Office Building is not considered likely to constitute core foraging habitat for GGBF on the basis of the vegetation composition and structure, as well as the physical separation and intervening activity (active driveways and terminal infrastructure) between this location and the known primary habitat area to the northeast. Despite the known importance of individual GGBF populations within the Sydney basin, including this subpopulation, the modification works are considered unlikely to result in a significant impact upon GGBF.

References

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Grey-headed Flying Fox *(Petaurus poliocephalus)* – vulnerable species

The Grey-headed Flying Fox *Petaurus poliocephalus* is a large bat up to 29 cm long with a wingspan of up to 1 m. Its body is covered in dark grey fur, with the fur on the neck being a lighter grey and the head and collar having a russet colour. It also has leg fur extending to the ankle, which helps distinguish it from other bats. The species occurs mainly within 200 km of the east coast of Australia, extending in a continuous population between Bundaberg and the NSW-Victorian border, with other isolated populations north as far as Townsville and west as far as Adelaide. The Grey-headed Flying Fox is listed as a vulnerable species under the EPBC Act. There is one known record of the species occurring in the remnant wetlands within the broader terminal area. The report prepared by Eco Logical for the Conversion Project found that the Conversion Project Area did not contain important Grey-headed Flying Fox roosting habitat and that the species was unlikely to be affected directly or indirectly by the Clyde Terminal conversion. Individuals of this species may however dwell opportunistically at the terminal. The Eco Logical report indicated that there was some residual potential for the species to use the limited habitat available in the remnant wetlands, and the species could occasionally roost within the stacks at the refinery.

Threats to Grey-headed Flying Fox listed by OEH (OEH, 2013) include:

- Loss of foraging habitat;
- Loss of disturbance of roosting sites;
- Unregulated shooting;
- Electrocution on powerlines, entanglement in netting and on barbed wire;
- Competition with Black Flying-foxes;
- Negative public attitude and conflict with humans;
- Impacts from climate change; and
- Disease.

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

i. lead to a long-term decrease in the size of an important population

An important population is one that necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal;
- populations that are necessary for maintaining genetic diversity; and/or
- populations that are near the limit of the species range.

Nationally important Grey-headed flying-fox camps have been identified as those that have contained ≥10,000 Grey-headed flying-foxes in more than one year in the last 10 years, or have been occupied by more than 2,500 Grey-headed flying-foxes permanently or seasonally every year for the last 10 years. A nationally important population has been deemed to be equivalent to an important population for the purposes of this assessment.

There are two GHFF populations within the general region of the Clyde Terminal. These are:

- Parramatta Park; and
- Duck River, Clyde.

The Parramatta Park population is considered nationally important due to the number of occupants. This site is located approximately 3.5 km to the northwest of the terminal.

The Duck River population is not considered nationally important as it has not exceeded the relevant thresholds for occupancy in the past 10 years. This site is located upstream on Duck River, approximately 1.5 km to the southwest (as the crow/bat flies) and is separated from the terminal by the main western railway line, the Great Western Highway and the M4 Motorway.

The modification works would result in additional demolition activities at the following locations:

- LPG gantries;
- Redundant LPG spheres (V137 and V140);
- MTS 33 kV substation;
- Tank 106 (slops tank); and
- State Office Building.

The first four of these areas contain virtually no vegetation with the exception of a small stand of planted Casuarinas at the LPG gantries. As such these sites do not represent any recognisable breeding or foraging habitat for this species. Modification works in these locations would not affect the species in such a way as to lead to a decrease in the Parramatta Park population.

The State Office Building includes surrounding landscaping, some of which is reasonably mature. Some of this vegetation, particularly large flowering trees such as eucalypts, may provide opportunistic roosting or foraging habitat for this species. The overall amount of such habitat provided in this area is however considered minimal in the context of the broader resources available in the surrounding area, including fruiting and flowering trees within residential properties throughout the Sydney basin.

Whilst the proponent aims to preserve a degree of vegetation within the grounds of the State Office Building during demolition the loss of the entirety of this location is highly unlikely to result in an effect upon the lifecycle of this species such that any important population is likely to be placed at risk of long term decline.

ii. reduce the area of occupancy of an important population

The area of occupancy for the GHFF is generally considered to be much of the Australian east coast from Hervey Bay to Melbourne.

The modification works involve the demolition of redundant infrastructure and buildings within the Conversion Project Area only. As outlined above, the potential for any of these areas to be considered important habitat for this species is deemed to be low.

The loss of vegetation, specifically around the state office building, is unlikely to reduce the area of occupancy of this species

iii. fragment an existing important population into two or more populations

The species is known to have the potential to disperse widely and through airborne movement. There are no specific corridors of movement for the Grey-headed Flying Fox throughout the terminal and beyond, though it is anecdotally noted that dispersion does occur along waterways, particularly when leaving roost sites. The modification works would remove redundant industrial infrastructure, as well as the state office building. The removal of this infrastructure would not place any barriers to movement or remove and ‘stepping stones’ that are likely to be important to the species local and regional dispersion and foraging patterns.

iv. adversely affect habitat critical to the survival of a species

There is no habitat within the terminal that would be considered critical to the survival of this species.

As outlined above, the modification works would affect areas either completely devoid of habitat for this species, or with only marginal value (such as the state office building). The remnant wetlands at the terminal provide superior habitat values for many species including Grey-headed Flying Fox, and these wetlands would not be affected either directly or indirectly by the modification works.

The modification works would remove redundant industrial infrastructure within the Conversion Project Area, including the State Office Building. As outlined above, these areas are not considered critical habitat for this species.

v. disrupt the breeding cycle of an important population

Both the Duck River and Parramatta Park GHFF camps are known to be a maternity camp, though the Duck River camp is not considered to be an important population. Even if considered as one broader population, the proposal is unlikely to disrupt breeding for this species on the basis that the modification works are of a very small scale and would adversely affect only a small degree of foraging vegetation. The degree of dependence of one or more camps upon this vegetation is considered to be very low in the context of the broader resources available in the surrounding area, including fruiting and flowering trees within residential properties throughout the Sydney basin.

vi. modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The area of occupancy for the GHFF is generally considered to be much of the Australian east coast from Hervey Bay to Melbourne.

The modification works involve the demolition of redundant infrastructure and buildings within the Conversion Project Area only. As outlined above, the potential for any of these areas to be considered important habitat for this species is deemed to be low.

The loss of vegetation, specifically around the state office building, is unlikely to adversely affect the availability of quality of habitat such that the species may be placed at risk of decline.

vii. result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

The GHFF is known to utilise a range of habitats for roosting and foraging. This includes a known reliance upon exotic vegetation within urban areas, both native and exotic.

The modification works would implement relevant hygiene protocols for personnel, vehicles and equipment to minimise the risk of introduction of weeds or other pathogens to the site. As such the modification are not likely to introduce invasive species that are likely to be harmful to the ongoing survival of GHFF within the region or more broadly.

viii. introduce disease that may cause the species to decline

With adherence to best practice construction techniques and ongoing management, the proposal would not introduce disease that may cause the species to decline.

ix. interfere substantially with the recovery of the species

There is no threat abatement plan relevant to this species. OEH has however listed 31 priority actions to promote the recovery of threatened species and the abatement of key threatening processes in relation to Grey-headed Flying Fox (OEH, 2013). The essence of these priority actions is captured by the following activities recommended to assist the species (OEH, 2013):

- Protect roost sites, particularly avoid disturbance September through November;
- Identify and protect key foraging areas;
- Manage and enforce licensed shooting;
- Investigate and promote alternative non-lethal crop protection mechanisms;
- Identify powerline blackspots and implement measures to reduce deaths;
- Implement measures to reduce deaths from entanglement in netting and on barbed-wire;
- Increase public awareness/understanding about flying-foxes, and their involvement in flying-fox conservation;
- Monitor the national population's status and distribution, and
- Improve knowledge on demographics and population structure to better understand ecological requirements of the species.

The modification works would not conflict with any of the above priority actions.

The modification works would not result in any direct impacts or adversely affect any habitat for this species such that they would interfere substantially with the recovery of this species. This is due to the broad area of occupancy for this species, the abundance of unaffected nearby alternative foraging and roosting habitat and the small degree of vegetation directly affected by the proposal.

Conclusion

The modification works would affect areas within the terminal that are either currently heavily cleared, or primarily comprised of exotic or common native vegetation. The area of extant vegetation, around the state office building is not considered likely to constitute core foraging habitat for GHFF on the basis of the vegetation composition and structure, as well as the physical separation and intervening activity (active driveways and terminal infrastructure) between this location and the closest known roost sites to the southwest and northeast. Despite the known importance of individual GHFF camps within the Sydney basin, including the nearby Parramatta Park population, the modification works are considered unlikely to result in a significant impact upon this species.

References

Eco Logical Australia Pty Ltd, 2012. *Shell Clyde Refinery – Bats*.

OEH, 2013. *Threatened Species Profiles*. Available at: http://www.environment.nsw.gov.au/threatenedspecies/. Accessed on Accessed 20 February 2013.