TECHNICALLY SUPERIOR
RISK MANAGEMENT

AECOM

Kurnell Terminal SSD-5544 MOD 7
Appendix F Preliminary Hazard Analysis

Release 6, 13 May 2025

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1 EXECUTIVE SUMMARY

AECOM Australia Pty Ltd (AECOM) (on behalf of Ampol Australia Petroleum Pty Ltd) engaged R4Risk to perform a Preliminary Hazard Analysis (PHA) on the proposed modification to State Significant Development application reference 5544 (SSD-5554) for the Kurnell Terminal ('the Site'). The proposed modification would include the consolidation of operational infrastructure into the existing and operational bulk liquid fuel terminal. The role of the PHA is to evaluate the tolerability of the risk to the surrounding land uses and environment.

The objective of the PHA was to:

- Provide an assessment of the hazards and risks associated with the proposed modification; and
- Evaluate the calculated risk levels against the land-use planning criteria for off-site risk.

The risk associated with the proposed modification was assessed semi-quantitatively. A hazard identification (HAZID) workshop and risk assessment was conducted. The intent of the workshop was to identify the hazards and assess the risks associated with the proposed modification.

The key findings from the PHA are as follows:

- No hazardous events were identified that could impact off-site populations at a consequence level exceeding the dangerous dose to human health or the environment
- The proposed modification complies with the fatality, injury, societal risk, property damage and accident propagation risk criteria outlined in the New South Wales Department of Planning Hazardous Industry Planning Advisory Paper No. 4 (HIPAP 4)
- The hazardous events identified for the proposed modification would have a tolerable risk, provided that the identified mitigation measures are implemented during the detailed design stage.

2 ACRONYMS AND GLOSSARY

2.1 ACRONYMS

ACS	Asbestos-contaminated soil
AECOM	AECOM Australia Pty Ltd
Ampol	Ampol Australia Petroleum Pty Ltd
AQMP	Air quality management plan
ASC NEPM	National Environment Protection (Assessment of Site Contamination) Measure
ASS	Acid sulfate soils
CEMP	Construction Environmental Management Plan
DG	Dangerous goods
DPHI	Department of Planning, Housing, and Industry
EP&A Act	Environmental Planning & Assessment Act 1979 [1]
EP&A Regulation	Environmental Planning and Assessment Regulation 2021 [2]
FWS	Firewater systems
GWMP	Groundwater Management Plan
HAZDEM	The Hazard and Risk Analysis of the Proposed Caltex Kurnell Refinery Demolition Works [3]
HAZID	Hazard identification
HIPAP 4	New South Wales Department of Planning Hazardous Industry Planning Advisory Paper No. 4 [4]
kPa	Kilopascal
kW/m^2	Kilowatt per square metre
LOC	Loss of containment
NSW	New South Wales
OSD	Onsite detention
OSOM	Oversize and overmass (vehicles)
OWS	Oily water sewer
PHA	Preliminary hazard analysis
PULP	Premium Unleaded Petrol
QRA	Quantitative risk assessment
RAP	Conceptual Remedial Action Plan
SPULP	Super Premium Unleaded Petrol
SSD	State Significant Development
ULP	Unleaded Petrol
WHSMP	Work Health and Safety Management Plan

2.2 GLOSSARY

the approved project	The original conversion project and subsequent demolition and other projects through which the Kurnell Refinery was converted to the Kurnell Terminal as approved under SSD-5544 and subsequent other modifications. The approved project was divided into two phases: • Converting infrastructure to allow the Site to operate as a terminal and shutdown the refinery (the conversion works); and • Demolition and removal of redundant infrastructure (the demolition works).
the conversion works	The project/works associated with the original SSD-5544 application.
Consequence	The impact and severity associated with an event in terms of toxic doses, fire or explosion, etc. (i.e. the potential effects of a hazardous event).
the demolition works	The works predominantly associated with Mod 1 of SSD-5544.
Hazard	A physical situation with the potential for human injury, damage to property, damage to the environment or some combination of these.
Hazardous Event	The event associated with a failure leading to a consequence.
Likelihood	The frequency of an event occurring, based on the number of historical events that have occurred at similar facilities.
the Modification Report	The report prepared to assess the proposed modification.
Project Area	The location within the Site that the works would occur.
the proposed modification	The relocation of operational infrastructure within the boundaries of the Site, and the removal of non-operational infrastructure. Remediation and grading works would also be undertaken.
Risk	The combination of likelihood and consequence, the chance of an event happening that can cause specific consequences.
the Site	Kurnell Terminal on the southern side of Botany Bay, in Kurnell, NSW.
SSD-5544	State Significant Development (SSD) application reference 5544.
Zones	Following a review of their landholdings at Kurnell to understand future use opportunities, Ampol have split the Site into various zones, as defined below and shown in Figure 1: • Zone 1: The area that continues to be used as an operational fuel terminal • Zone 1A: The Eastern Right of Way, in use by the operational fuel terminal • Zone 2: The former refinery process areas, now largely vacant • Zone 3: The Former Caltex Lubrication Oil Refinery, now largely vacant • Zones 4 and 5: Undeveloped land containing extensive native vegetation.

3 INTRODUCTION

3.1 BACKGROUND

The Kurnell Terminal ('the Site') is located on the southern side of Botany Bay, in Kurnell, New South Wales (NSW) (Figure 1). In 2012, Ampol Australia Petroleum Pty Ltd (Ampol) announced that the oil refinery and fuel terminal would be converted to a finished product terminal (the 'approved project'), ceasing refinery operations in 2014.

Development consent was received to complete the approved project under State Significant Development (SSD) application reference 5544 (SSD-5544). Ampol has modified SSD-5544 six times to complete the conversion and demolition works.

Currently, the operational infrastructure is primarily located in the northern part of the Site (Zones 1 and 1A, as shown in Figure 1). Other parts of Ampol's landholdings at Kurnell include largely vacant areas of previously developed land (Zones 2 and 3) and areas of undeveloped land containing extensive native vegetation (Zones 4 and 5).

To support future land use opportunities, Ampol intends to consolidate operational infrastructure, remove redundant assets, and undertake remediation and grading. Completion of these works (the 'proposed modification') would continue the safe and reliable operation of the Kurnell Terminal whilst preparing the Site for future uses. The location within the Site that these works would occur is referred to as the 'Project Area.'

A Modification Report has been prepared to support a modification application to SSD-5544. This Preliminary Hazards Analysis (PHA) is one of a number of technical documents that form part of the Modification Report. In line with the requirements of Section 4.55 of the Environmental Planning & Assessment Act 1979 (EP&A Act), the Modification Report provides the information required by Section 100 of the Environmental Planning and Assessment Regulation 2021 (EP&A Regulation).

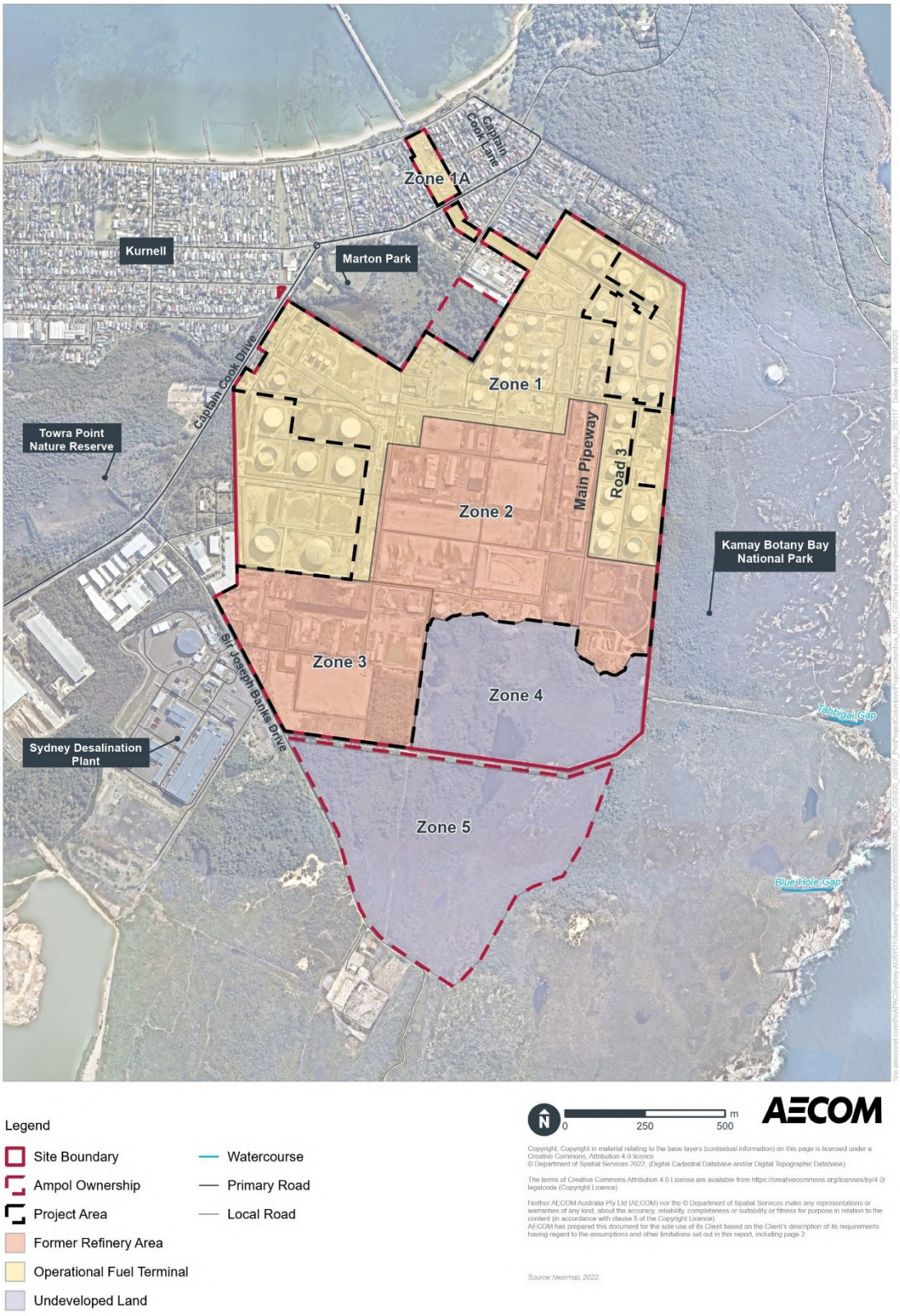


Figure 1: Ampol Kurnell Terminal (the Site)

3.2 PRELIMINARY HAZARD ANALYSIS

The role of the PHA is to evaluate the tolerability of the risk to the surrounding land uses and environment. The objective was to:

- Provide an assessment of the hazards and risks associated with the proposed modification; and
- Evaluate the calculated risk levels against the land-use planning criteria for off-site risk.

The risk associated with the proposed modification was assessed semi-quantitatively. A hazard identification (HAZID) workshop and risk assessment was conducted. The intent of the workshop was to identify the hazards and assess the risks associated with the proposed modification.

To assess the tolerability of the off-site risk exposure to the surrounding land uses, the following risk criteria were considered:

- Individual risk of fatality
- Individual risk of injury
- Societal risk
- Risk of property damage and accident propagation.

Additionally, the risk to the biophysical environment as a direct result of the storage and handling of hazardous materials was assessed.

4 THE PROPOSED MODIFICATION

4.1 KEY ELEMENTS OF THE PROPOSED MODIFICATION

To support the continued safe and reliable operation of the Site and to facilitate the future use of the Site, the proposed modification works involve:

- **Stage 1 – Preparation works:** Preparing the Project Area for proposed modification works.
- Stage 2 – Removal, relocation and/or augmentation of infrastructure, including:
  - Relocation and/or augmentation of firewater systems (FWS) and oily water sewer (OWS) systems and construction of new operational facilities, including replacement warehouses
  - Decommissioning and removal of non-operational assets, redundant structures and electrical assets.
- **Stage 3 – Remediation:** Addressing legacy contamination, including asbestos-contaminated soil (ACS).
- **Stage 4 – Grading:** Landforming the Project Area following removal of infrastructure and ground remediation activities and preparing Zones 2 and 3 for future use.
- **Stage 5 – Demobilisation:** Demobilisation of construction and remediation equipment.

These stages may occur sequentially or concurrently, depending on site requirements.

A summary of project elements requiring modification and how they relate to the approved project is provided in Table 1. The proposed modification works would be undertaken within the Project Area shown on Figure 2. All activities would adhere to the Kurnell Terminal permit to work system to ensure compliance with environmental and safety protocols.

Once the modification works are complete, the Site would continue to operate as described in the approval documentation for the approved project and would be consistent with the development consent for SSD-5544.

In line with Figure 2, relocated equipment would operate in their new locations.

Table 1: Project Summary

Stage	Element	Approved Project	Modified Project
Stage 1	Project Area	Project Area delineation	• Prepare the Project Area for the proposed modification works required under Stages 2, 3 and 4 and exclude other parts of the Site from proposed modification works.
Stage 2	Oily water sewer (OWS)	Maintain location in Zones 2 and 3	• Divert surface water runoff from potentially contaminated areas in Zone 2 to Zone 1 via new OWS interception pits/ lines until Stage 3 remediation is complete. • Divert potential leachate from ACS Containment Cell in Zone 2 to Zone 1 OWS system. • Remove all redundant OWS infrastructure.
	Firewater systems (FWS)	Maintain location in Zone 2 and 3	• Augment or remove FWS infrastructure from Zones 2 and 3. • If removed from Zone 2, augment existing FWS in Zone 1 with a new firewater tank and pipework to service the terminal infrastructure. • Locate the new firewater tank and pumphouse within the FWS Relocation Area (specific siting selected during detailed design).
	Electrical assets	Maintain location in Zone 2 and 3	• Remove redundant electrical assets in Zones 2 and 3, including five substations.
	Structures	Maintain location in Zone 2 and 3	• Demolish structures in Zones 2 and 3 • Construct new 'fit for purpose' warehouse and Oil Spill Equipment Storeroom within Zone 1. • Construct new storage shed in Zone 1A.
Stage 3	Remediation	Removal of ACS from pipeways and containment onsite	• Remediate land in Zones 2 and 3 as necessary. • Remediate land in Zone 1 where infrastructure is relocated and/ or augmented as necessary. • Conduct remediation to a commercial/ industrial land use under the ASC NEPM (NEPM, 2013).
Stage 4	OWS	Maintain location in Zones 2 and 3	• Disconnect and remove remaining underground OWS lines from Zones 2 and 3, except for lines connecting to the ACS Containment Cell. • Install a new pump adjacent to the ACS Containment Cell. Two site options have been identified (specific siting selected during detailed design).
Stage 4	Grading	Grading following demolition of structures and removal of infrastructure across the Site and relevant Project Areas	• Construct new onsite detention (OSD) basins in Zone 3 to attenuate runoff and maintain pre-construction surface water flow rates. • Grade Zone 2 following Stage 2 and Stage 3 activities to manage stormwater and prepare for future land uses. • Grade Zones 1 and 3 as necessary.
Stage 5	Demobilisation	Demobilisation of construction equipment.	• Demobilisation of construction and remediation equipment.

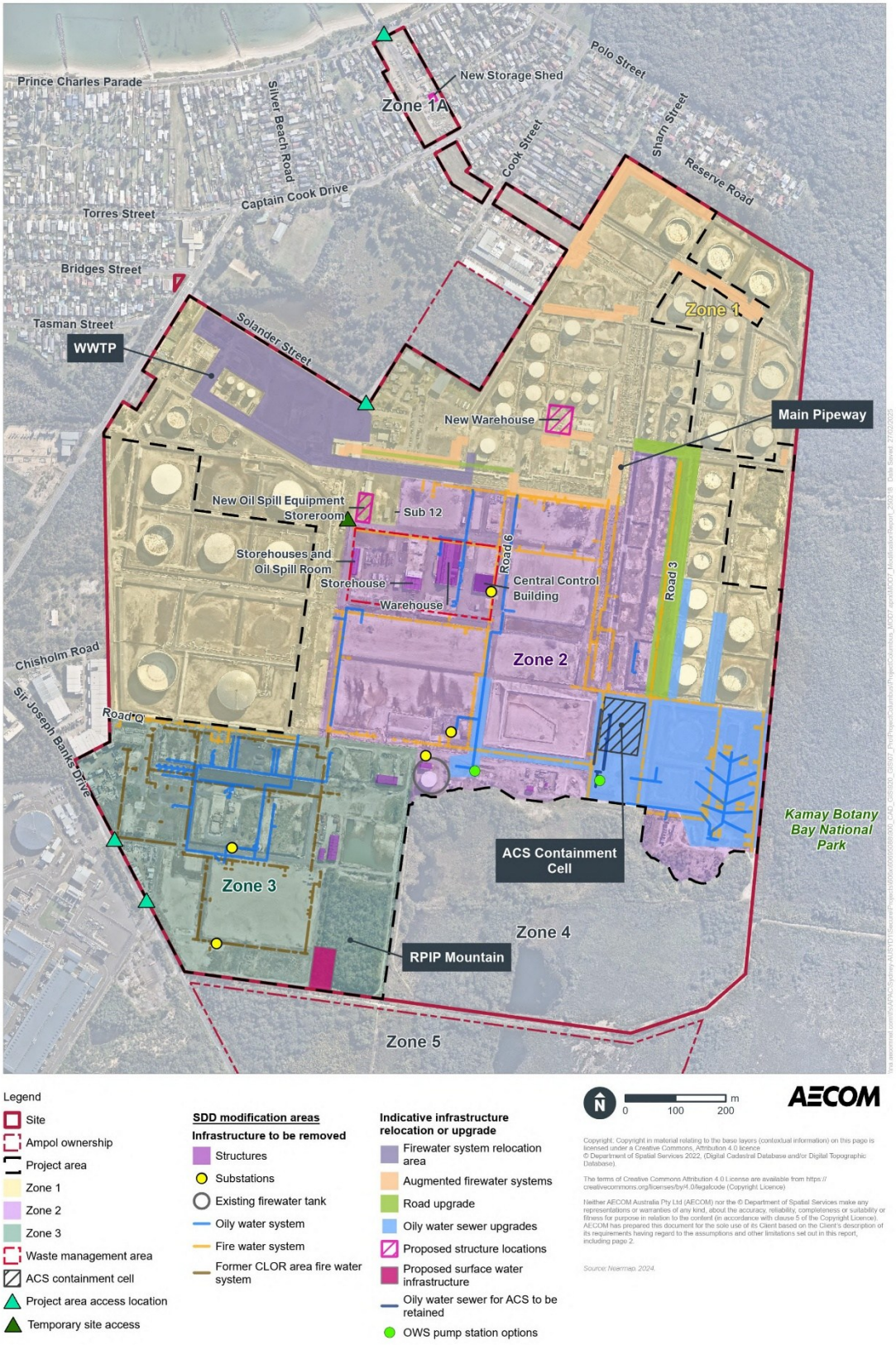


Figure 2: The Proposed Modification

4.2 CONSTRUCTION EQUIPMENT AND TIMELINE

Works are planned to commence in August 2025 and would continue for about 12 months for infrastructure removal scopes and up to four years for remediation works in accordance with the schedule in Table 2.

In line with Condition C18 of SSD-5544, construction works would comply with following hours:

- Monday to Sunday – 7am to 10pm.

High noise generating construction works, including works within the Eastern Right of Way (Zone 1A), would be confined to less sensitive times of the day and not undertaken on Sundays, public holidays, or outside of the hours 7am and 6pm Monday to Saturday (in line with Condition C19).

Construction works outside of the work hours identified above would only be undertaken in the following circumstances (in line with Condition C20):

- Works that are inaudible at nearest sensitive land receivers
- Works that are consistent with Ampol's existing maintenance procedures and are in accordance with EPL 837
- Works agreed to in writing by the EPA or DPHI
- For the delivery of materials required outside these hours by the NSW Police Force or other authorities for safety reasons
- Where it is required in an emergency to avoid the loss of lives, property and/ or to prevent environmental harm.

Plant and equipment that would be used to deliver the modification works is shown in Table 3.

Table 2: Proposed Modification Program

Stage	Timeframe
Stage 1 – Preparation works	August 2025
Stage 2 – Removal and/or relocation of infrastructure[1]	August 2025 – August 2026
Stage 3 – Remediation	August 2025 – July 2029
Stage 4 – Grading	Zone 2: August 2026 – December 2026 Zone 3: Up to July 2029
Stage 5 – Demobilisation	September 2026 (for all works except remediation)

Table 3: Indicative Plant and Equipment

Plant / Equipment	Maximum number required per day (Stage 1 and 2)	Maximum number required per day (Stage 3, 4 and 5)
Front end loader	6	6
20 t excavator	6	6
Dump truck	6	6
Grader (up to 7 m blade)	-	4
Large crane (60 t)	4	-
Elevated work platform	6	-
Franna crane (30 t)	6	-
Cement truck	6	-
Bobcat	6	2
Water cart	6	6

[1] Construction in Zone 1A expected to last 3 months.

Plant / Equipment	Maximum number required per day (Stage 1 and 2)	Maximum number required per day (Stage 3, 4 and 5)
Concrete crusher	2	-
Telehandler	6	-
Truck and dog (offsite disposal)	6	6
Truck and dog (imported fill)	-	12
Generator	2	2
Biopiling blower	-	8

4.3 OTHER RELEVANT ELEMENTS OF THE PROPOSED MODIFICATION OPERATIONAL ACTIVITIES

The FWS would be relocated within the FWS Relocation Area in Zone 1, including a new firewater tank and pipework to allow it to service the terminal infrastructure, with specific siting selected during detailed design.

For the purpose of assessment in this PHA, two indicative locations have been considered for the relocation of the FWS, which have been selected based on optioneering completed in the concept design phase in consultation with key stakeholders, including Firewater and Process Safety Subject Matter Experts. The location of each option is shown Figure 3.

Operation and maintenance of the relocated FWS would be consistent with existing operations. The FWS would include three diesel engines used to operate FWS pumps housed within an enclosed area.

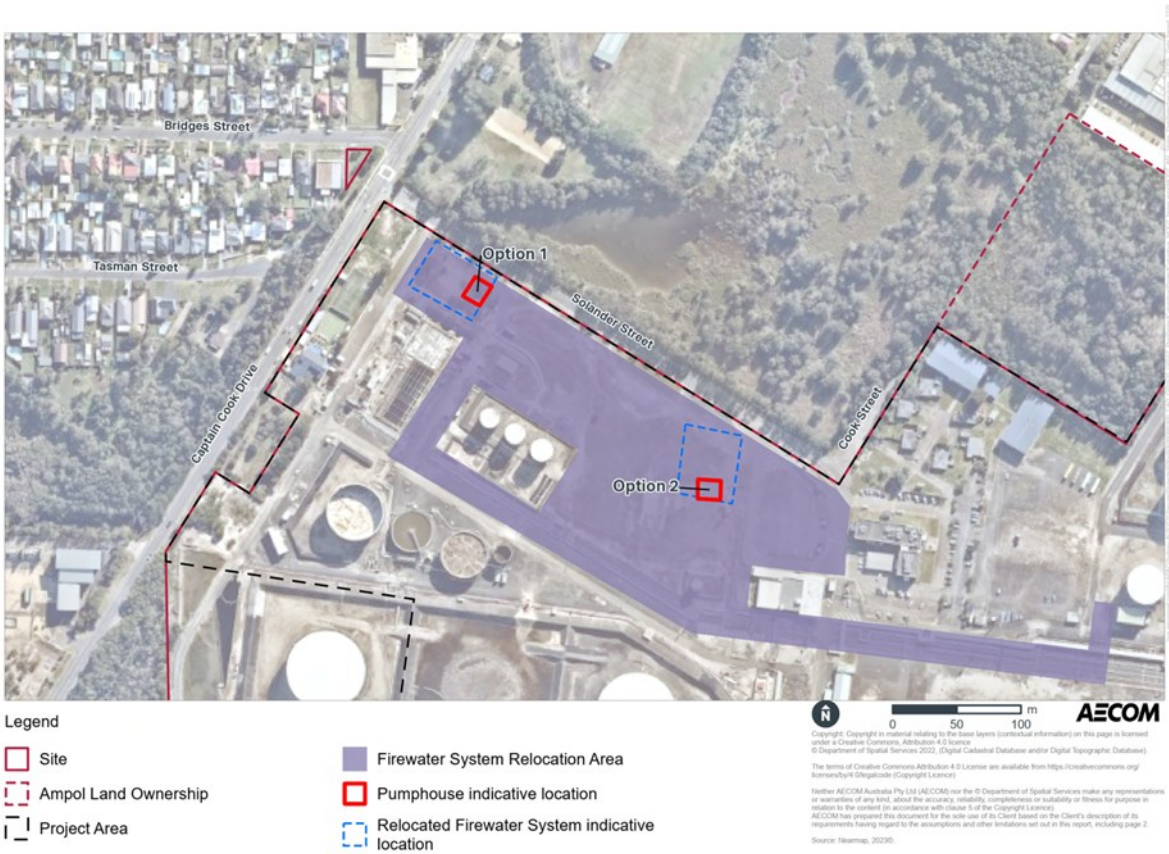


Figure 3: Relocated FWS – Indicative Locations

5 METHODOLOGY

5.1 OVERVIEW

This section presents a summary of the PHA methodology applied to this assessment. The assessment follows the approach described in the New South Wales (NSW) Department of Planning and Environment (now Department of Planning, Housing, and Industry; DPHI) Guideline "Multi-level Risk Assessment" [5]. The tolerability of the risk was assessed using the risk criteria specified in Hazardous Industry Planning Advisory Paper No. 4 (HIPAP 4) [4].

A HAZID workshop was held on 22 August 2024. The intent of the workshop was to identify and assess the hazards that may be introduced to the Site as a result of the proposed modification. Details of the workshop methodology, attendance and minutes are provided in Annexure A.

This section presents a summary of the methodology applied to the proposed modification. The key steps are as follows:

- Hazard Identification
- Hazard Screening
- Risk Assessment
- Risk Evaluation
- Risk Tolerability Assessment
- Management of Impacts.

These are summarised in the following sections.

5.2 HAZARD IDENTIFICATION

The hazard identification process was conducted as a workshop and involved a systematic review of potential hazards associated with the proposed modification. Attendees included representatives from Ampol, AECOM and Arriscar with relevant knowledge of the proposed modification, existing infrastructure and terminal operations. Hazards with the potential for significant impacts on the surrounding land uses (i.e. off-site consequences) were identified. For the purposes of the PHA, 'off-site' was defined as beyond the Project Area.

The following impact types were considered when assessing off-site consequences:

- Impacts to human health
- Impacts to the environment.

The analysis did not include consideration of occupational exposures to onsite workers (e.g. slips, trips, strains). Existing hazards associated with the operations of the terminal (e.g. exposure of construction workers to fires or benzene vapour during tank degassing) were also excluded from the analysis. The risks associated with these hazards would be managed through suitable safe systems of work, in accordance with existing site controls (e.g. permit to work), as covered by a Work Health and Safety Management Plan (WHSMP).

A preliminary screening of hazardous chemicals stored and handled at the Site was conducted. The hazard screening considered the quantity stored, properties of the hazardous chemicals and the potential consequence types to determine which chemicals have the potential to pose significant off-site impacts.

The hazard identification was conducted with reference to previous risk assessments for the Site. These included:

- Kurnell Terminal - Quantitative Risk Assessment (QRA) ("the QRA") [6]
- The Hazard and Risk Analysis of the Proposed Caltex Kurnell Refinery Demolition Works ("the HAZDEM") [3].

The QRA completed in 2021 for the Kurnell Terminal operations was reviewed to establish a baseline of the risks associated with existing hazards.

The HAZDEM conducted for the approved demolition works (SSD-5544 MOD-1) was used to identify risks associated with undertaking construction works. The HAZDEM identified possible events that may impact public safety and the biophysical environment.

5.3 RISK ANALYSIS

The risk analysis involved the following steps:

- Risk Evaluation
- Risk Tolerability Assessment
- Management of Impacts.

The Multi-Level Risk Assessment Guidelines [5] provide guidance on the suitable level of risk analysis for land use planning, as replicated in Table 4.

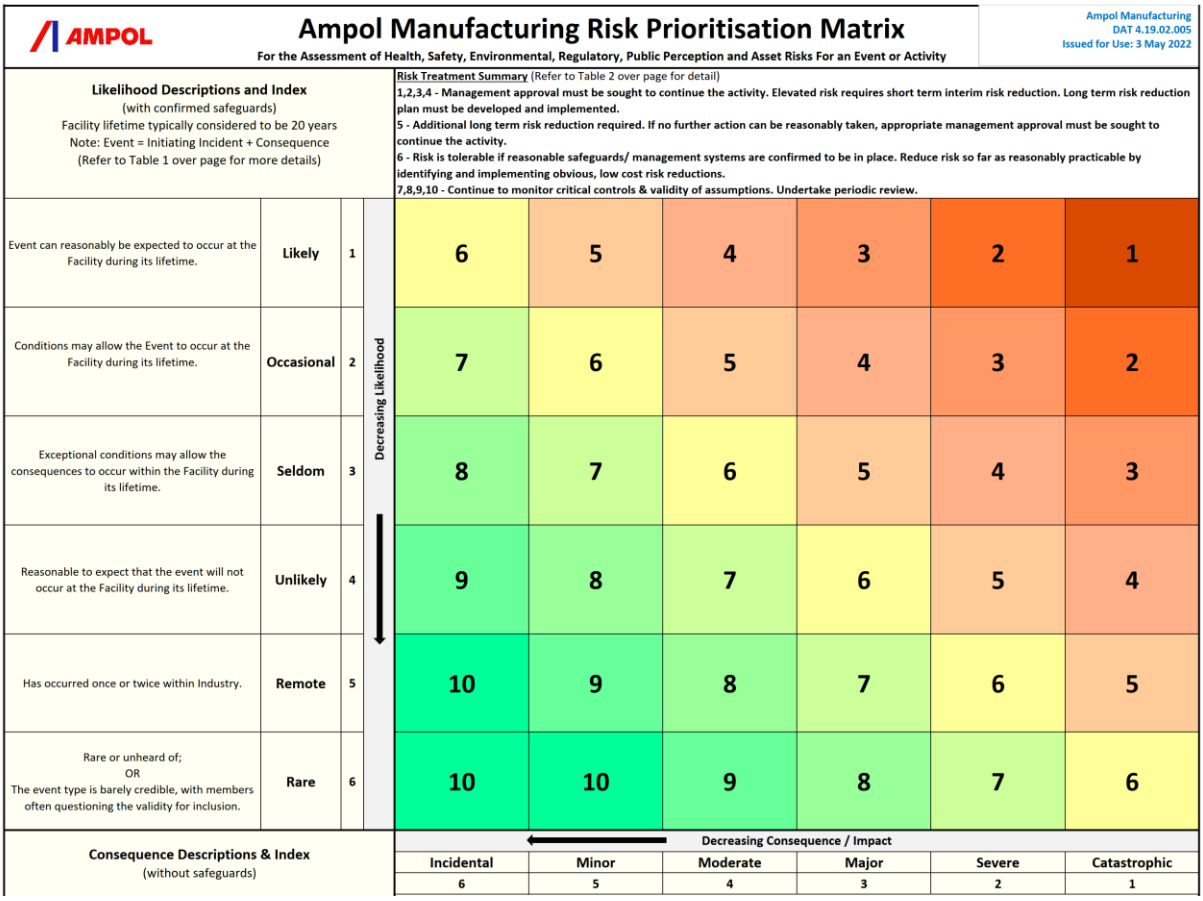
Table 4: Risk Analysis Levels [5]

Analysis Level	Analysis Type	Risk Requirement	Justification for Use
Level 1	Qualitative	Significant, no serious potential for harm	Societal risk is in the negligible zone, and there are no potential accidents with significant off-site consequences.
Level 2	Partially quantitative	Medium potential for harm	The frequency of risk contributors having off-site consequences is relatively low.
Level 3	Quantitative	High potential for harm	Required where there are significant off-site risk contributors, and a level 2 assessment is unable to demonstrate that the risk criteria would be met.

A Level 2 analysis was deemed appropriate for the PHA based on the outcomes of the QRA (i.e. the risk results), which indicate that the frequency of risk contributors having off-site consequences is relatively low. In this Level 2 analysis, the likelihood and consequence severity of each hazardous event were evaluated to identify events with significant off-site impacts (e.g. off-site fatality potential).

The risk (i.e. the likelihood and consequence severity) associated with hazardous events assessed as having the potential for significant off-site impacts was then quantified to allow for comparison with the risk tolerability criteria. Where a Level 2 analysis is unable to demonstrate that the risk criteria would be met, a Level 3 analysis (requiring quantitative assessment) would be considered. Following the assessment, Level 2 analysis was deemed appropriate for the potential hazardous events.

The Ampol risk matrix was used to assess the safety and environmental risk of identified hazardous events. This risk matrix is presented in Figure 4.



Ampol Manufacturing Risk Prioritisation Matrix

For the Assessment of Health, Safety, Environmental, Regulatory, Public Perception and Asset Risks For an Event or Activity

Ampol Manufacturing
DAT 4.19.02.005
Issued for Use: 3 May 2022

Likelihood Descriptions and Index
(with confirmed safeguards)
Facility lifetime typically considered to be 20 years
Note: Event = Initiating Incident + Consequence
(Refer to Table 1 over page for more details)

Risk Treatment Summary (Refer to Table 2 over page for detail)
1,2,3,4 - Management approval must be sought to continue the activity. Elevated risk requires short term interim risk reduction. Long term risk reduction plan must be developed and implemented.
5 - Additional long term risk reduction required. If no further action can be reasonably taken, appropriate management approval must be sought to continue the activity.
6 - Risk is tolerable if reasonable safeguards/ management systems are confirmed to be in place. Reduce risk so far as reasonably practicable by identifying and implementing obvious, low cost risk reductions.
7,8,9,10 - Continue to monitor critical controls & validity of assumptions. Undertake periodic review.

			Decreasing Likelihood	Incidental (6)	Minor (5)	Moderate (4)	Major (3)	Severe (2)	Catastrophic (1)
Event can reasonably be expected to occur at the Facility during its lifetime.	Likely	1		6	5	4	3	2	1
Conditions may allow the Event to occur at the Facility during its lifetime.	Occasional	2		7	6	5	4	3	2
Exceptional conditions may allow the consequences to occur within the Facility during its lifetime.	Seldom	3		8	7	6	5	4	3
Reasonable to expect that the event will not occur at the Facility during its lifetime.	Unlikely	4		9	8	7	6	5	4
Has occurred once or twice within Industry.	Remote	5		10	9	8	7	6	5
Rare or unheard of; OR The event type is barely credible, with members often questioning the validity for inclusion.	Rare	6		10	10	9	8	7	6

Consequence Descriptions & Index
(without safeguards)

Decreasing Consequence / Impact

Figure 4: Ampol Risk Matrix [7]

The safety and environmental consequences associated with each hazardous event were identified. Where relevant, the QRA was consulted to define the extent of potential impacts of these events. The potential consequence severity was assessed using the Ampol risk matrix consequence criteria, reproduced in Table 5. A significant impact was specified as a severity of *Major* or higher.

For hazards which have a consequence rating of *Major* or higher, the residual likelihood was assessed to determine the resulting risk level. The likelihood rating was based on the nominated consequence severity occurring and was assessed with safeguards in place (i.e. residual likelihood). The Ampol risk matrix likelihood criteria is reproduced in Table 6. Quantitative frequencies were aligned to each likelihood rating to allow for the quantitative assessment of process safety risks.

The resulting risk level was determined by plotting each hazardous event on the risk matrix, using the intersection of the assigned consequence severity and likelihood categories. The risk rating (i.e. residual risk) considered the risk reduction of the inherent design controls and proposed site risk controls.

The risk rating was used to assess the tolerability of identified risks and to determine whether further risk reduction actions should be taken (refer to Table 7). Hazards assessed as having off-site impacts with a risk rating between 7 and 10 were assessed as tolerable (i.e. offsite fatality at a likelihood of 5×10^{-7} per year or less). Hazards assessed as having off-site impacts with a risk rating between 1 and 6, were directly compared to HIPAP 4 risk criteria (refer to Section 6) to assess tolerability.

Where the risk was assessed as intolerable or additional measures were identified that could reduce the risk of an identified hazard, these were recorded.

Table 5: Consequence Severity

Rating	Safety		Environmental
	Workforce	Public	
1 - Catastrophic	Multiple fatalities (>50)	Multiple fatalities (>10)	Impacts such as persistent reduction in ecosystem function on a landscape scale or significant disruption of a sensitive species.
2 - Severe	Multiple fatalities (5-50)	Multiple fatalities (1-10)	Impacts such as significant, widespread and persistent changes in habitat, species or environmental media (e.g. widespread habitat degradation).
3 - Major	Fatalities (1-4)	One or more severe injuries including permanently disabling injuries.	Impacts such as localized but irreversible habitat loss or widespread, long-term effects on habitat, species or environmental media.
4 - Moderate	One or more severe injuries including permanently disabling injuries.	One or more injuries, not severe.	Impacts such as localized, long term degradation of sensitive habitat or widespread, short term impacts to habitat, species or Environmental media.
5 - Minor	One or more injuries, not severe.	One or more minor injuries such as a first-aid.	Impacts such as localized or short term effects on habitat, species or environmental media.
6 - Incidental	Minor injury such as a first aid.	No impact	Spill/release with no harm to community or the environment.

Table 6: Likelihood Criteria

Ampol Risk Matrix Rating	Ampol Risk Matrix Qualitative Descriptor	SSD-5544 Mod 7 Quantitative Frequency
1 - Likely	Event can reasonably be expected to occur at the Site during its lifetime.	5×10^{-2} per year (i.e. one in twenty per year)
2 - Occasional	Conditions may allow the Event to occur at the Site during its lifetime.	5×10^{-3} per year (i.e. 5 in a thousand per year)
3 - Seldom	Exceptional conditions may allow the consequences to occur within the Site during its lifetime.	5×10^{-4} per year (i.e. 500 in a million per year)
4 - Unlikely	Reasonable to expect that the event will not occur at the Site during its lifetime.	5×10^{-5} per year (i.e. 50 in a million per year)
5 - Remote	Has occurred once or twice within Industry.	5×10^{-6} per year (i.e. 5 in a million per year)
6 - Rare	The event type is barely credible, with members often questioning the validity for inclusion.	5×10^{-7} per year (i.e. half in one million per year)

Table 7: Risk Rating Definitions

Risk Rating	Definition
7-10	Broadly acceptable risk
6	Acceptable if demonstrated that the risk is reduced so far as is reasonably practicable
5	Tolerable only if it is demonstrated that no further risk reduction is practicable. Further risk analysis may be required (e.g. quantitative analysis)
1-4	Intolerable. Risk reduction actions must be applied to reduce risk to a tolerable level

6 RISK CRITERIA

6.1 INDIVIDUAL RISK – FATALITY

The individual fatality risk criteria used are those specified in HIPAP 4 [4]. These are as follows:

- Hospitals, schools, child-care facilities and old age housing developments (i.e. "sensitive locations") should not be exposed to individual fatality risk levels in excess of half in one million per year (0.5×10^{-6} per year)
- Residential developments and places of continuous occupancy, such as hotels and tourist resorts, should not be exposed to individual fatality risk levels in excess of one in a million per year (1×10^{-6} per year)
- Commercial developments, including offices, retail centres, warehouses with showrooms, restaurants and entertainment centres, should not be exposed to individual fatality risk levels in excess of five in a million per year (5×10^{-6} per year)
- Sporting complexes and active open space areas should not be exposed to individual fatality risk levels in excess of ten in a million per year (10×10^{-6} per year)
- Individual fatality risk levels for industrial sites at levels of 50 in a million per year (50×10^{-6} per year) should, as a target, be contained within the site's boundaries where applicable.

These criteria have been developed based on the principle that if the risk from a potentially hazardous installation is less than most risks being experienced by the community (e.g. voluntary risks, transportation risks), then that risk may be tolerated. This principle is consistent with the basis of international risk criteria adopted by most authorities.

The criterion for residential areas is demonstrably very low in relation to the background risk. It is considered conservative, as it assumed an individual is present and exposed for 24 hours per day, 365 days per year.

6.2 INDIVIDUAL RISK – INJURY

HIPAP 4 also outlines risk criteria for effects that may cause injury to people but will not necessarily cause fatality. The injury risk criteria are separated based on the different effect types, i.e.:

- Heat radiation
- Explosion overpressure
- Toxic exposure.

The individual risk of injury criteria described in HIPAP 4 that are applicable to proposed hazardous developments are as follows:

- Heat flux radiation at residential and sensitive use areas should not exceed 4.7 kilowatt per square metre (kW/m^2) at a frequency of more than 50×10^{-6} per year.
- Explosion overpressure at residential and sensitive use areas should not exceed 7 kilopascal (kPa) at frequencies of more than 50×10^{-6} per year.
- Toxic concentrations at residential and sensitive use areas should not exceed a level which would be seriously injurious to sensitive members of the community following a relatively short period of exposure at a maximum frequency of 10×10^{-6} per year.

6.3 SOCIETAL RISK CRITERIA

The NSW DPHI has adopted indicative criteria to assess the off-site societal risk. The criteria take into account the fact that society is particularly intolerant of accidents, which although infrequent, have the potential to cause multiple fatalities. The criteria are presented on the "F-N" graph in Figure 5. The criteria define three risk regions as follows [4]:

- Intolerable: Above the "intolerable" line, the activity is considered undesirable, even if individual risk criteria are met.
- ALARP ("as low as reasonable practicable"): Within the ALARP region, the emphasis should be on reducing risk as far as possible towards the "negligible" line (i.e. ensuring that risks

have been reduced to as low as reasonably practicable). Provided other quantitative and qualitative criteria of HIPAP 4 are met, the risks from the activity may be considered tolerable within the ALARP region as long as all “reasonably practical” risk reduction measures have been implemented.

- Negligible: Below the “negligible” line, the societal risk is not considered significant, provided other individual risk criteria are met.

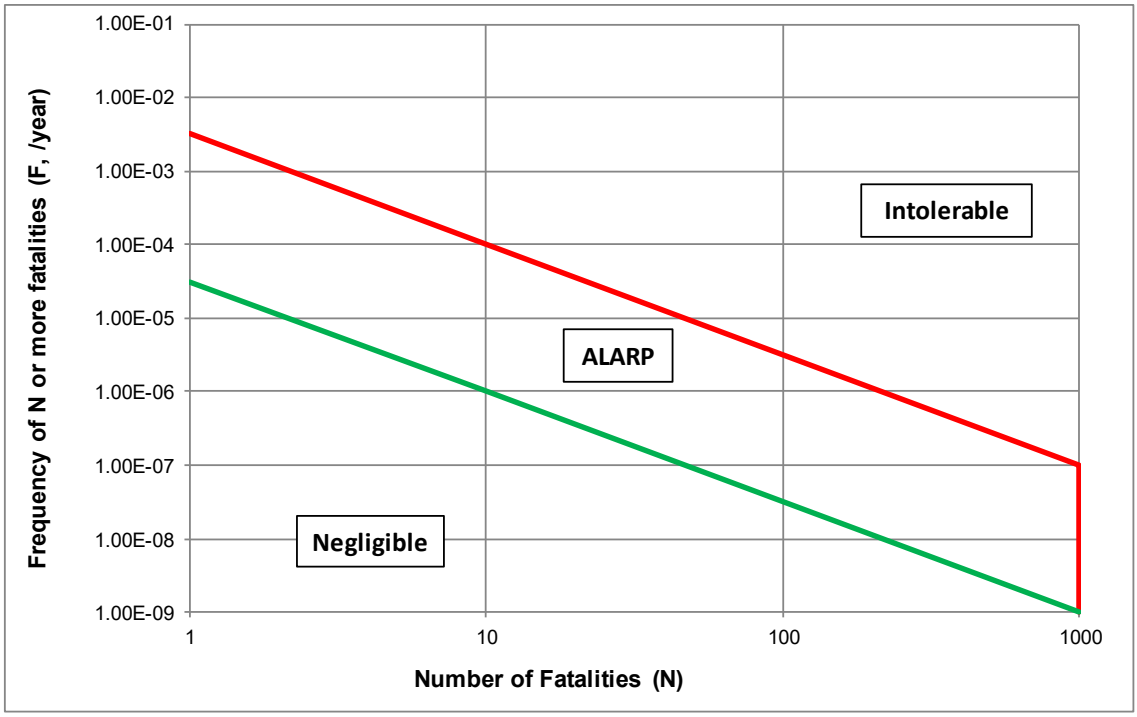


Figure 5: Indicative Societal Risk Criteria [4]

6.4 RISK OF PROPERTY DAMAGE AND ACCIDENT PROPAGATION

HIPAP 4 sets risk criteria that reflect the potential for property damage and accident propagation. Assessment against the criteria provides an indication of the risk that an accident at the facility may cause damage to buildings and/or propagate to involve neighbouring industrial operations, causing further hazardous incidents, i.e. the so-called 'domino effect'. HIPAP 4 sets the following criteria for risk of damage to property and accident propagation:

- Heat flux radiation at neighbouring potentially hazardous installations, or at land zoned to accommodate such installations, should not exceed a risk of 50 x 10^{-6} per year for the 23 kW/m^2 heat flux level.
- Explosion overpressure at neighbouring potentially hazardous installations, at land zoned to accommodate such installations or at nearest public buildings should not exceed a risk of 50 x 10^{-6} per year for the 14 kPa explosion overpressure level.

7 HAZARD IDENTIFICATION

The hazard identification was conducted as described in Section 5.2. The potential hazards and impacts (consequences) were collated from the HAZID workshop (refer to Annexure A).

Hazards were identified for the following stages associated with the proposed modification:

- Construction
- Operation.

The following sections describe the hazards identified for the proposed modification.

7.1 PRELIMINARY HAZARD SCREENING

Hazardous materials stored at the facility were reviewed to determine those which have the potential for significant off-site safety impacts. The hazardous materials stored and handled at the Site are flammable and combustible liquids (i.e. hydrocarbons). These are:

- Gasoline (i.e. Unleaded Petrol (ULP) / Premium Unleaded Petrol (PULP) / Super Premium Unleaded Petrol (SPULP))
- Jet Fuel
- Diesel
- Slop (a mixture of gasoline, jet fuel and diesel with some water).

The most common consequence outcomes associated with the storage, handling and transportation of flammable or combustible materials are fire and explosions.

7.2 HAZARD IDENTIFICATION

A HAZID workshop was carried out to review of the proposed modification to identify hazards associated with the construction and ongoing operation of the modification (refer to Annexure A).

The identified hazards were assessed to determine if risk evaluation was required to verify the tolerability of the risk. Risk evaluation was not considered for the following:

- Hazards with onsite impacts only
- Hazards with impacts already being managed through the implementation of a mitigation plan (e.g. a traffic management plan).

Hazards with only onsite impacts were excluded from further analysis, as these are not the focus of land-use planning. During the proposed modification construction work, all work would be undertaken in accordance with existing site controls (e.g. permit to work). These would be detailed in the applicable WHSMP.

Mitigation plans (e.g. a traffic management plan) would be developed for the proposed modification works to ensure appropriate controls are implemented for identified hazardous events. It is assumed the risk of hazardous events would be reduced to a tolerable level through the implementation of these mitigation plans. Therefore, these hazardous events were excluded from further analysis. Other mitigation plans proposed as part of the proposed modification can be found in Section 8 (Revised management and mitigation measures) of the Modification Report, and Appendix B (Revised mitigation measures table).

7.2.1 Construction

Construction hazards were identified in the HAZID workshop. Additionally, hazards identified as part of the previous HAZDEM were reviewed and included where relevant. The hazards identified as having potential impacts on people or the environment are summarised in Table 8. Hazards that were recommended for further risk evaluation are also indicated in Table 8.

The majority of the proposed modification works would be carried out in Zones 2 and 3. Some works, including relocation and augmentation of the FWS, road upgrades, and construction of new buildings, would be undertaken in Zone 1 and 1A, which would continue to be part of the operational terminal. Works in Zones 2 and 3 are not anticipated to cause any interactions with hazardous materials (i.e. gasoline, jet fuel, diesel and slop). The only hazardous event identified with the potential to impact on hydrocarbon operations during the construction were proposed capping works near pipeways in Zone 2 that house live hydrocarbon lines (i.e. Hazard 9 in Table 8).

Table 8: Construction Hazards

ID	Hazardous Event	Cause	Consequence	Consequence Category	Comment	Further Risk Evaluation Required?
1	Security breach	Alternate site access required for works	Unauthorised access, security breach	Workforce Safety	Onsite impacts only. WHSMP would reduce risk to a tolerable level.	No
2	Traffic/vehicle impacts	Trucks and vehicles required for works	Increase to traffic in the Project Area, vehicle accident, potential onsite injury	Workforce Safety	Onsite impacts only. Traffic management plan and WHSMP would reduce risk to a tolerable level.	No
3	Release of domestic sewage	Removal of domestic sewerage as part of building demolition	Potential exposure of workers to raw sewage	Workforce Safety	Onsite impacts only. WHSMP would reduce risk to a tolerable level.	No
4	Worker exposure to contaminated materials	Demolition of contaminated materials (e.g. asbestos in underground firewater pipes)	Potential exposure of workers to contamination	Workforce Safety	Onsite impacts only. Conceptual Remedial Action Plan (RAP), Construction Environmental Management Plan (CEMP), Contamination Management Plan, Acid Sulphate Soils Management Plan and WHSMP would reduce risk to a tolerable level.	No
5	Worker exposure to contaminated soil or water	Contaminated soil/water in excavation areas	Potential exposure of workers to contamination	Workforce Safety	Onsite impacts only. RAP, CEMP, Contamination Management Plan, Acid Sulphate Soils Management Plan, Groundwater Management Plan (GWMP) and WHSMP would reduce risk to a tolerable level.	No

ID	Hazardous Event	Cause	Consequence	Consequence Category	Comment	Further Risk Evaluation Required?
6	Worker exposure to hazardous ground gases	Contaminated ground gases in excavation areas	Potential exposure of workers to ground gases and potential for ingress of hazardous ground gases into structures. Potential for toxic or explosive atmospheres within structure. Fire, explosion, toxic impacts.	Workforce Safety	Onsite impacts only. RAP, CEMP, Contamination Management Plan, GWMP and WHSMP would reduce risk to a tolerable level.	No
7	Interaction with underground services (cables and/or oily water sewer)	Installation of underground town main supply line to the firewater tank	Worker interaction with underground services, electric shock, potential onsite fatality	Workforce Safety	Onsite impacts only. WHSMP would reduce risk to a tolerable level.	No
8	Worker electric shock	Unidentified live cables during demolition	Worker electric shock, potential onsite fatality	Workforce Safety	Onsite impacts only. WHSMP would reduce risk to a tolerable level.	No
9	Loss of containment (LOC) of hydrocarbons	Capping in Zone 2 along pipeways containing live hydrocarbon pipes Augmentation of existing FWS pipework in Zone 1 in the vicinity of live hydrocarbon pipes	Impact to hydrocarbon pipes, LOC of hydrocarbon, ignition, pool fire, potential onsite fatality	Safety	Onsite and off-site potential impact WHSMP would reduce risk to a tolerable level.	Yes
10	Increased dust production	Dust from demolition, construction and excavation activities (e.g. during remediation and grading)	Excess dust to surrounding environment	Environmental	Air quality management plan would reduce risk to a tolerable level.	No

ID	Hazardous Event	Cause	Consequence	Consequence Category	Comment	Further Risk Evaluation Required?
11	Excess odour	Odour produced by remediation activities (e.g. proximity of biopiles to community)	Odour impact to community	Environmental	Air quality management plan would reduce risk to a tolerable level.	No

7.2.2 Operation

The proposed modification does not include any changes to the storage or handling of the hazardous materials. Additionally, it does not include the introduction of any new hazardous materials. No new hazardous events related to hazardous materials were identified following completion of the proposed modification.

No change to the hazards associated with the external impacts (e.g. bushfires, flooding, airplane impacts) was identified. The risk was assessed to be as per the current level.

Hazards were identified which could inhibit the fire system from responding as designed to a fire (i.e. impairment of an existing control). These hazards were expected to be appropriately managed as part of the fire system detailed design and do not directly pose a hazard to people or the environment. Additionally, an addendum to the Site's current Fire Safety Study [8] was developed to address the proposed changes to the operations and fire systems associated with the proposed modification. This addendum is provided in Annexure B.

The hazards identified as having potential impacts on people or the environment are summarised in Table 9. Hazards that were recommended for further risk evaluation are also indicated in Table 9.

Table 9: Operational Hazards

ID	Hazardous Event	Cause	Consequence	Consequence Category	Comment	Risk Evaluation Required?
12	Exhaust gases exposure	Exhaust gases from relocated diesel fire pumps	Exhaust gases discharged to community areas	Environmental	Design measures to minimise risks to people during detailed design	No
13	Excess noise	Noise from relocated diesel fire pumps	Excess noise in community areas	Environmental	Design measures to minimise risks to people during detailed design	No
14	Vehicle accident	Impaired visibility for drivers due to sun position when driving along Solander Street from new firewater tank (indicative locations Option 1 and 2)	Vehicle accident, injury	Public Safety	Two indicative locations have been considered for the relocation of the FWS (and tank). Option 1 is closer to Solander Street. Issue is specific to Solander Street.	Yes
15	Escalation of fires	Exceeding the dangerous goods (DG) storage capacity within the New Warehouse	Incident escalation (fire) within New Warehouse if required DG storage arrangements are not adhered to (e.g. quantities, segregation, separation)	Workforce Safety	New Warehouse detailed design would ensure it is fit for purpose. Ongoing use of the warehouse to be managed via operating procedures / manifest.	No
16	Overflow of OWS	Power loss to the new OWS pump	Loss of new OWS pump, overflow of OWS emergency storage, and release to environment	Environmental	OWS detailed design would include access for tanker vacuum truck to pump out of emergency storage	No
17	Overflow of OWS	Tie in point of the proposed OWS is adjacent to the 400-series tanks' floating-roof water drain point	High demand on the OWS system may cause a restriction at the new tie in point, leading to overflow of OWS emergency storage, and release to environment	Environmental	OWS detailed design would include access for tanker vacuum truck to enable the pump out of the emergency storage. In addition, in the case of high flows, the 400-series tanks' floating-roof water drain would be given preference.	No

8 RISK ASSESSMENT

8.1 RISK EVALUATION

A summary of the hazardous events with potential off-site impacts and the associated residual risk rating is presented in Table 10. For full details of the assessment, refer to Annexure A.

Table 10: Summary of Hazardous Events with Potential Off-site Risk

ID	Hazardous Event	Consequence Category	Consequence Severity	Likelihood Rating	Risk Rating
9	LOC of hydrocarbons	Public Safety	3	4	6
13	Vehicle accident	Public Safety	3	3	5

8.2 RISK TOLERABILITY ASSESSMENT

Hazardous events were identified which could have the following consequence impacts:

- Public Safety
- Workforce Safety
- Environmental.

Two hazardous events were identified, which may have the potential to result in a public safety consequence. These are:

- LOC of hydrocarbons
- Vehicle accident.

An LOC of hydrocarbons following damage to live hydrocarbon pipework may occur due to work being carried out within the vicinity of the pipework (e.g. damage by mobile equipment). A release of hydrocarbons would be contained within the site and could result in a localised pool fire if ignited. A localised pool fire was assessed as having the potential for onsite fatality or off-site injury, depending on the location of the release. The risk rating for this hazard was assessed as 6. At this risk level, the risk is considered tolerable only if it is demonstrated that risk is reduced 'so far as is reasonably practicable'. The risk of this event is already present at the site during current operations (e.g. maintenance work on piping) and is managed through suitable safe systems of work in accordance with the Site's WHSMP. These existing controls include measures such as permit to work systems and exclusion zones to ensure the work is carried out with appropriate precautions to reduce the risk to a tolerable level.

A vehicle accident may occur due to impaired visibility for drivers of vehicles heading west along Solander Street, due to the sun position reflecting from the proposed new firewater tank. This hazard was based on site experience and was relevant only to Solander Street (based on the direction of the road). The risk rating for this hazard was assessed as 5. At this level, the risk is tolerable only if it is demonstrated that no further risk reduction is practicable. One mitigation measure identified for this hazard was to implement landscaping treatments or equivalent around the new firewater tank to reduce driving hazards from impaired visibility. Following the implementation of this, the risk would be reduced further to a tolerable level.

All other safety hazards identified were assessed as having impacts to workforce safety only. Workforce safety is not the focus of land use planning and would be managed through an appropriate WHSMP.

Of the environmental hazards identified, either their consequences were contained within the Site, or mitigation plans would be implemented to either limit the consequence or reduce the frequency of these events. The risk of hazards managed through mitigation plans are expected to be at a tolerable level, provided that the appropriate mitigation plans are implemented.

9 MANAGEMENT OF IMPACTS

Mitigation measures to manage potential safety and environmental impacts of the proposed modification are outlined in Table 11. Relevant, additional, and/or modified environmental safeguards and management measures to those presented in the approved SSD-5544 are shown in **bold** and deleted measures, or parts of measures, have been ~~struck out~~.

Table 11: Mitigation Measures

Item	Mitigation Measure	Hazardous Event
A3	~~Caltex~~ **Ampol** would ensure that the ~~Project~~ contractor **for the proposed modification** prepares and implements a Construction Environmental Management Plan (CEMP) ~~for the conversion works and a Demolition Environmental Management Plan (DEMP) for the demolition works (inclusive of the ACS Modification works, Tank 101 demolition works)~~ to manage ~~any Project~~ **potential construction phase** impacts. This would be reviewed and approved by a ~~Caltex~~ **Ampol** Environmental Management Representative (EMR). Elements of these plans may be shared as required.	• Hazard 4: Worker exposure to contaminated materials • Hazard 5: Worker exposure to contaminated soil or water • Hazard 6: Worker exposure to hazardous ground gases
B1	A program of routine testing, inspection and maintenance would be developed for each new piece of equipment or function of instrumentation to be added to the preventative maintenance program already established for existing plant and equipment.	• Firewater System Modifications
B2	The recommendations of the Fire Safety Study and **SSD-5544 MOD-7 Fire Safety Study Addendum, as appended to the PHA (Appendix G) of the MOD-7 Modification Report),** would be implemented for the design and operation of the terminal.	• Firewater System Modifications
B11	**Ampol would continue to implement onsite safety processes and procedures and update the relevant existing Work Health and Safety Management Plan (WHSMP) to include the proposed modification as required.** Procedures would include training staff for the safe use and handling of hazardous/ flammable/ contaminated materials, use of relevant safety equipment, and incident reporting and response processes.	• Hazard 3: Release of domestic sewage • Hazard 4: Worker exposure to contaminated materials • Hazard 5: Worker exposure to contaminated soil or water • Hazard 6: Worker exposure to hazardous ground gases • Hazard 7: Interaction with underground services (cables and/or oily water sewer) • Hazard 8: Worker electric shock
B12	**The SSD-5544 MOD-7 HAZID Workshop Recommendations, as appended to the PHA (Appendix G of the MOD-7 Modification Report), would be implemented for the design and operation of MOD-7 infrastructure.**	• Firewater System Modifications • Hazard 14: Vehicle accident • Hazard 15: Escalation of fires • Hazard 16: Overflow of OWS • Hazard 17: Overflow of OWS
C9	If Acid Sulfate Soils (ASS) are encountered during construction or the ACS Modification works, an ASS Management Plan **(ASSMP)** would be prepared in accordance with the ASS Manual (ASS Management Advisory Committee 1998).	• Hazard 4: Worker exposure to contaminated materials • Hazard 5: Worker exposure to contaminated soil or water

Item	Mitigation Measure	Hazardous Event
C10	A Groundwater Management Plan (GWMP) would be developed and included within the CEMP. This plan would outline the measures that would be used to manage the testing, dewatering, storage, movement and treatment of any groundwater intercepted during the construction phase. Measures would include: • Measures for the dewatering, storage, movement and treatment of groundwater encountered in excavations. Dewatered groundwater would be collected and sent to the on-site Wastewater Treatment Plant in accordance with the established Site wastewater management procedures, unless it is tested and is of suitable quality to be directed to stormwater • The use of appropriate drip trays and interception techniques for any construction specific liquids stored on the Site • Bunding of any fuel or chemical storage area at the construction Site • Regular inspection of construction equipment to ensure any leaks are minimised and rectified • Management of vehicles leaving the Site to reduce soil on roads, production of dust and the introduction of contamination to the groundwater and/or stormwater system • Appropriate and timely disposal of any contaminated soil, water or waste generated during construction • ~~Regular inspection of erosion control structures and bunded areas~~ • Regular inspection and testing of containment areas~~, drainage lines and process pipe work~~ • A plan for corrective action should an unexpected **find** ~~increase in contaminants of potential concern (COPC)~~ be observed ~~in the groundwater monitoring~~ **during the proposed modification**. • **Management and monitoring of dewatering activities adjacent to Marton Park and the wetlands in Zone 4** • **Management and monitoring of groundwater quality should in-situ treatment of groundwater be warranted.**	• Hazard 4: Worker exposure to contaminated materials • Hazard 5: Worker exposure to contaminated soil or water • Hazard 6: Worker exposure to hazardous ground gases
C33	**The Conceptual Remediation Action Plan (RAP) would be implemented, which would include:** **a. Data gap investigations within the Project Area** **b. Preparation of one or more Detailed RAP(s).** **The Detailed RAP(s) would be prepared in accordance with NSW EPA Contaminated Land Guidelines for Consultants Reporting on Contaminated Sites (NSW EPA, 2020) and be reviewed by the Site Auditor.**	• Hazard 4: Worker exposure to contaminated materials • Hazard 5: Worker exposure to contaminated soil or water • Hazard 6: Worker exposure to hazardous ground gases

Item	Mitigation Measure	Hazardous Event
G17	**Equipment associated with the relocated firewater system must be sufficiently treated so that operational noise levels do not exceed the criteria defined in Condition of Consent C17 of SSD -5544. Maintenance and testing activities associated with the firewater system would be conducted during standard daytime hours only** • **Monday to Saturday – 7am to 6pm** • **Sunday – 8am to 6pm**	• Hazard 13: Excess noise
H18	Real-time dust monitoring would be undertaking during the operation of the concrete crusher. Details of this monitoring (and associated response actions) would be incorporated into the **Air Quality Management Plan** (AQMP) for the **construction** ~~demolition~~ works.	• Hazard 10: Increased dust production • Hazard 11: Excess odour
I2	A **Construction** Traffic Management Plan **(CTMP)** would be developed for the construction~~/ demolition~~ phase. The Traffic Management Plan would comply with all relevant Regulations and By-Laws and in particular address safe access and egress to the public road network. The ~~Transport Management Plan~~ **CTMP** would include: • Hours of permitted vehicle activity • Designated routes for construction ~~and demolition~~ traffic and defined access points to the Site ~~and demolition works area~~ • Duration of works • Permitted ~~demolition~~ vehicle types • Designated areas within the Site and **MOD-7 Project Area** ~~demolition works area~~ for truck turning movements, parking, loading and unloading to allow heavy vehicles to enter and leave the Site and **MOD-7 Project Area** in a forward direction • Sequence for implementing traffic management measures should these be required • Procedures and/or principles for construction and demolition vehicle speed limits and the safe operation of construction and demolition vehicles • Coordination of off-site heavy vehicle movements from the ~~demolition works and ACS Modification works~~ **Site** to help ensure that heavy vehicle movements do not exceed ~~60~~ **136** movements per day~~.~~ • **Outline plan for the movement of OSOM vehicles accessing the Site, including routes, appropriate construction hours for deliveries, road closures, and permit requirements.**	• Hazard 2: Traffic/ vehicle impacts

10 REFERENCES

1 NSW Legislation, “Environmental Planning and Assessment Act 1979”, 1 July 2024.

2 NSW Legislation, “Environmental Planning and Assessment Regulation 2021”, 2 August 2024.

3 Planager, “Hazard and Risk Analysis of the Proposed Caltex Kurnell Refinery Demolition Works” Document Number: URS\26-B388, Revision 0, 4 November 2014.

4 New South Wales Government, Department of Planning, “Hazardous Industry Planning Advisory Paper No. 4, Risk Criteria for Land Use Safety Planning”, January 2011 (HIPAP 4).

5 State of New South Wales, Department of Planning, “Assessment Guideline – Multi-level Risk Assessment”, May 2011.

6 R4Risk, “Ampol Australia Petroleum Pty Ltd, Kurnell Terminal Quantitative Risk Assessment”, Release 1, 9 September 2021, R4Risk Ref. 104-66.

7 Ampol, “Ampol Manufacturing Risk Prioritisation Matrix”, DAT 4.19.02.005, 3 May 2022.

8 R4Risk, “Ampol Australia Petroleum Pty Ltd, Kurnell Terminal - Fire Safety Study”, R4Risk Ref. 104-67, Release 1, 17 September 2021.

ANNEXURE A: HAZID WORKSHOP

TECHNICALLY SUPERIOR
RISK MANAGEMENT

AECOM

Ampol Kurnell Terminal SSD-5544 MOD 7 HAZID Workshop

Release 2, 21 February 2025

R4Risk Ref.: 222-06

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DOCUMENT CONTROL

Document	Ampol Kurnell Terminal SSD-5544 MOD 7 HAZID Workshop
Client	AECOM
Project Manager	Samara Smith
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Release	Issue Date	Reviewed	Approved	R4Risk Ref.	Comments
A	9-Sep-2024	L. Dreher	L. Dreher	222-06	Issue for comment
1	1-Oct-2024	L. Dreher	L. Dreher	222-06	Updated following client comment
2	21-Feb-2025	L. Dreher	L. Dreher	222-06	Issued to Client

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1 EXECUTIVE SUMMARY

A Modification Report is being prepared to support the application for changes to State Significant Development (SSD) application reference 5544, Modification 7 (SSD-5544 MOD 7) for Ampol Australia Petroleum Pty Ltd (Ampol). As part of this process, a Hazard Identification (HAZID) workshop was conducted for AECOM Australia Pty Ltd (AECOM) on the 22 August 2024.

The scope of the workshop was to review and identify process safety and environmental hazards introduced by SSD-5544 MOD 7 (the 'proposed modification').

The HAZID identified 15 recommendations. This report details the methodology and results of the study.

2 ACRONYMS

AECOM	AECOM Australia Pty Ltd
Ampol	Ampol Australia Petroleum Pty Ltd
HAZID	Hazard identification
OWS	Oily water sewer
SSD	State Significant Development
SSD-5544 MOD 7	State Significant Development application reference 5544, Modification 7

3 INTRODUCTION

A Modification Report is being prepared to support the application for changes to State Significant Development (SSD) application reference 5544, Modification 7 (SSD-5544 MOD 7) for Ampol Australia Petroleum Pty Ltd (Ampol). As part of this process, AECOM Australia Pty Ltd (AECOM) engaged R4Risk to facilitate a Hazard Identification (HAZID) workshop to identify potential hazards associated with SSD-5544 MOD 7 (the 'proposed modification').

3.1 SCOPE

The scope of the workshop was to review and identify process safety and environmental hazards introduced by SSD-5544 MOD 7. That is, to identify the incremental risk associated with the proposed modification.

The HAZID scope excluded all other types of hazards including:

- Occupational health and safety
- Compliance & Regulatory
- Reputational
- Financial
- Operational / Business Interruptions.

3.2 HAZID OBJECTIVES

The objectives of the HAZID were to:

- Review the proposed works for SSD-5544 MOD 7
- Document the potential hazards and corresponding causes and mitigation measures
- Identify additional mitigation or elimination measures to reduce the potential for the identified hazard
- Enable clear communication of the hazards and associated actions developed from the HAZID.

4 METHODOLOGY

4.1 GENERAL

The HAZID study involved a multidisciplinary team that systematically and rigorously reviewed the proposed modification to identify potential hazards that may pose a risk to health, safety and operations. The presence of a multidisciplinary team is essential to identify and evaluate hazards comprehensively.

The methodology comprised of a structured examination of the proposed modification. The proposed works were divided into manageable segments (or “nodes”) and the HAZID guide words were then used to prompt the team to identify potential hazards. The HAZID minutes were recorded using the “PHA-Pro” software program.

The guide words used in the study were as follows:

- Site Location
- Natural disasters
- Transport & Logistics
- Infrastructure
- Site security
- Utility Systems
- Brownfield Facilities Modifications
- Hazardous Material
- Inventory
- Operating Envelopes
- Breakdown of plant services
- Fire, Explosion and Toxic Hazards
- Asset Integrity / Equipment Failure
- Layout
- Operability & Maintenance Hazards
- Equipment Compliance
- New Technology
- Constructability
- Discharge to Air
- Discharge to Water
- Discharge to Land/Soil
- Environmental Noise
- Water Management
- Biodiversity Management
- Land Management
- Waste Management
- Sustainability Management
- Cultural Heritage Management
- Community & Societal Issues.

Once a credible hazard was identified, the potential consequences of the hazard were listed, assuming no safeguards. For undesirable consequences, the potential causes were determined and the existing safeguards identified.

For hazards with the potential for significant off-site impacts (i.e. severe injuries to the public or irreversible/long-term effects to the environment), a team judgement was made on the potential consequence severity using the Ampol Risk Matrix consequence criteria. The consequence descriptions and associated severities are reproduced in Table 1. The residual likelihood of the event (i.e. with the existing safeguards in place) was assessed. The likelihood rating was based on the Ampol Risk Matrix likelihood criteria, with quantitative frequencies assigned to each rating to allow for the assessment of process safety risks. These are summarised in Table 2.

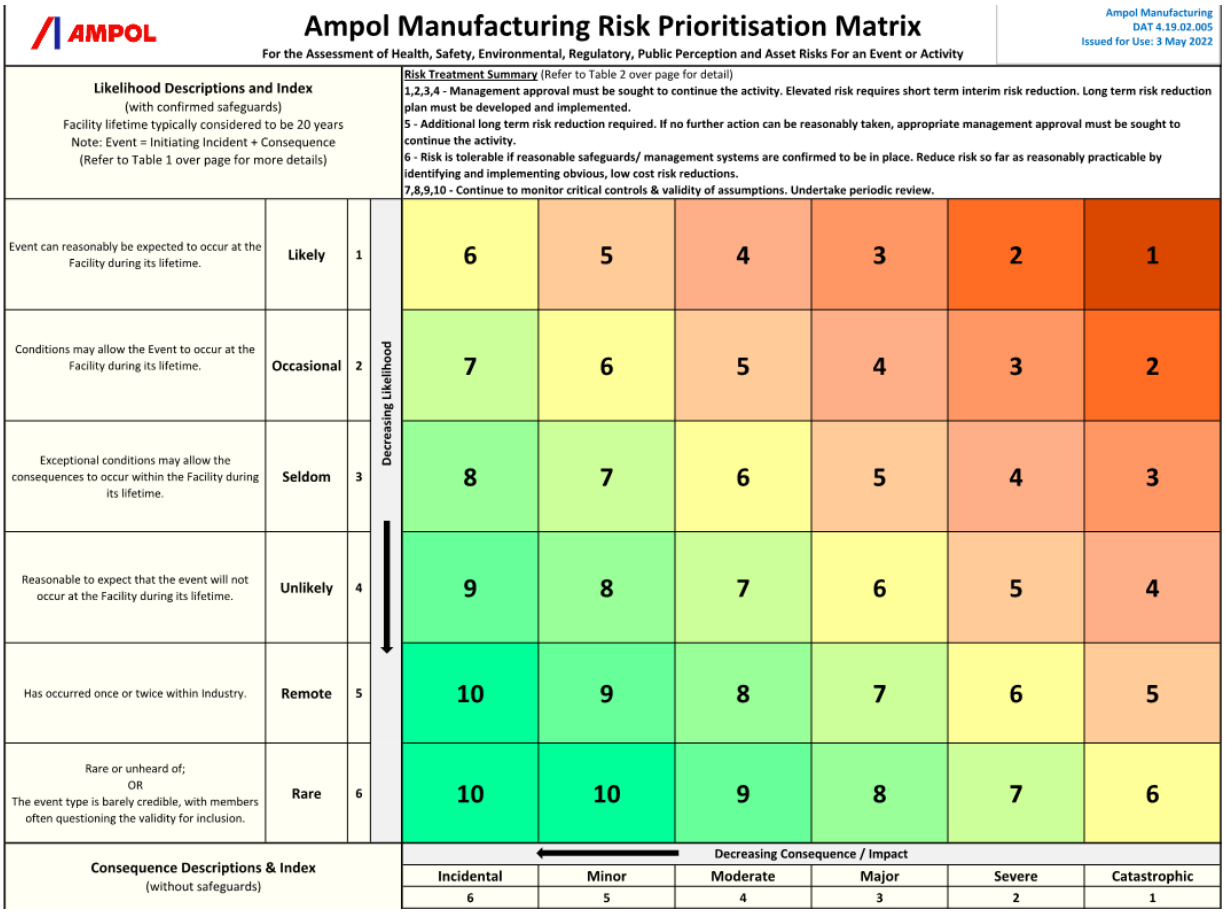
The resulting risk level was then assessed using the Ampol Risk Matrix (refer to Figure 1). The risk rating (i.e. residual risk) considers the risk reduction of the existing safeguards. The team raised recommendations for further mitigation measures or improvements in cases where the existing mitigation measures were considered inadequate.

Table 1: Consequence Severity

Rating	Safety		Environmental
	Workforce	Public	
Incidental	Minor injury such as a first-aid.	No impact	Spill/release with no harm to community or the environment.
Minor	One or more injuries, not severe.	One or more minor injuries such as a first-aid.	Impacts such as localized or short-term effects on habitat, species or environmental media.
Moderate	One or more severe injuries including permanently disabling injuries.	One or more injuries, not severe.	Impacts such as localized, long-term degradation of sensitive habitat or widespread, short-term impacts to habitat, species or Environmental media.
Major	Fatalities (1-4)	One or more severe injuries including permanently disabling injuries.	Impacts such as localized but irreversible habitat loss or widespread, long-term effects on habitat, species or environmental media.
Severe	Multiple fatalities (5-50)	Multiple fatalities (1-10)	Impacts such as significant, widespread and persistent changes in habitat, species or environmental media (e.g. widespread habitat degradation).
Catastrophic	Multiple fatalities (>50)	Multiple fatalities (>10)	Impacts such as persistent reduction in ecosystem function on a landscape scale or significant disruption of a sensitive species.

Table 2: Likelihood Criteria

Ampol Risk Matrix Rating	Ampol Risk Matrix Qualitative Descriptor	SSD-5544 MOD 7 Quantitative Frequency
Likely	Event can reasonably be expected to occur at the Site during its lifetime.	5×10^{-2} per year (i.e. 5 in a hundred per year)
Occasional	Conditions may allow the Event to occur at the Site during its lifetime.	5×10^{-3} per year (i.e. 5 in a thousand per year)
Seldom	Exceptional conditions may allow the consequences to occur within the Site during its lifetime.	5×10^{-4} per year (i.e. 5 in ten thousand per year)
Unlikely	Reasonable to expect that the event will not occur at the Site during its lifetime.	5×10^{-5} per year (i.e. 5 in a hundred thousand per year)
Remote	Has occurred once or twice within Industry.	5×10^{-6} per year (i.e. 5 in a million per year)
Rare	The event type is barely credible, with members often questioning the validity for inclusion.	5×10^{-7} per year (i.e. 5 in ten million per year)



Ampol Manufacturing Risk Prioritisation Matrix

For the Assessment of Health, Safety, Environmental, Regulatory, Public Perception and Asset Risks For an Event or Activity

Ampol Manufacturing
DAT 4.19.02.005
Issued for Use: 3 May 2022

Likelihood Descriptions and Index
(with confirmed safeguards)
Facility lifetime typically considered to be 20 years
Note: Event = Initiating Incident + Consequence
(Refer to Table 1 over page for more details)

Risk Treatment Summary (Refer to Table 2 over page for detail)
1,2,3,4 - Management approval must be sought to continue the activity. Elevated risk requires short term interim risk reduction. Long term risk reduction plan must be developed and implemented.
5 - Additional long term risk reduction required. If no further action can be reasonably taken, appropriate management approval must be sought to continue the activity.
6 - Risk is tolerable if reasonable safeguards/ management systems are confirmed to be in place. Reduce risk so far as reasonably practicable by identifying and implementing obvious, low cost risk reductions.
7,8,9,10 - Continue to monitor critical controls & validity of assumptions. Undertake periodic review.

			Decreasing Likelihood	Incidental (6)	Minor (5)	Moderate (4)	Major (3)	Severe (2)	Catastrophic (1)
Event can reasonably be expected to occur at the Facility during its lifetime.	Likely	1		6	5	4	3	2	1
Conditions may allow the Event to occur at the Facility during its lifetime.	Occasional	2		7	6	5	4	3	2
Exceptional conditions may allow the consequences to occur within the Facility during its lifetime.	Seldom	3		8	7	6	5	4	3
Reasonable to expect that the event will not occur at the Facility during its lifetime.	Unlikely	4		9	8	7	6	5	4
Has occurred once or twice within Industry.	Remote	5		10	9	8	7	6	5
Rare or unheard of; OR The event type is barely credible, with members often questioning the validity for inclusion.	Rare	6		10	10	9	8	7	6

Consequence Descriptions & Index
(without safeguards)

Decreasing Consequence / Impact

Figure 1: Ampol Risk Matrix [1]

4.2 INFORMATION USED IN THE STUDY

Table 3 lists the drawings and documentation available for the HAZID.

Table 3: HAZID Reference Material

Drawing / Document No.	Title	Revision	Date
MOD7_ModificationReport_240819b	Figure 4-1: Proposed Modification	-	-
60695088-GEN-DRG-0001	Ampol Kurnell Fire Water System Site Layout with Bund Fire Heat Radius	A	02-Aug 2024
-	Scope of Work for Architectural Services - Warehouse and Storage Facilities	A	11-July 2024
60695088-SHT-AMP-WW-0001	Oily Water Sewer System DN250 Rising Main and Pumping Station Cover Sheet and Drawing List	1	01-Aug 2024
60695088-SHT-AMP-WW-0002	Oily Water Sewer System DN250 Rising Main and Pumping Station General Notes and Legend	1	01-Aug 2024
60695088-SHT-AMP-WW-0003	Oily Water Sewer System DN250 Rising Main and Pumping Station Option 1 - Plan and LS - Sheet 1 Of 3	1	01-Aug 2024
60695088-SHT-AMP-WW-0004	Oily Water Sewer System DN250 Rising Main and Pumping Station Option 1 - Plan and LS - Sheet 2 Of 3	1	01-Aug 2024
60695088-SHT-AMP-WW-0005	Oily Water Sewer System DN250 Rising Main and Pumping Station Option 1 - Plan and LS - Sheet 3 Of 3	1	01-Aug 2024
60695088-SHT-AMP-WW-0006	Oily Water Sewer System DN300 Gravity Main and Pumping Station Option 1 - Plan And LS	1	01-Aug 2024

Drawing / Document No.	Title	Revision	Date
60695088-SHT-AMP-WW-0007	Oily Water Sewer System DN250 Rising Main and Pumping Station Option 2 - Plan and LS - Sheet 1 Of 2	1	01-Aug 2024
60695088-SHT-AMP-WW-0008	Oily Water Sewer System DN250 Rising Main and Pumping Station Option 2 - Plan and LS - Sheet 2 Of	1	01-Aug 2024
60695088-SHT-AMP-WW-0009	Oily Water Sewer System DN300 Gravity Main and Pumping Station Option 2 - Plan And LS	1	01-Aug 2024
60695088-SHT-AMP-WW-0010	Oily Water Sewer System DN250 Rising Main and Pumping Station P&ID Arrangement	1	01-Aug 2024
60695088-SHT-AMP-WW-0011	Oily Water Sewer System DN250 Rising Main and Pumping Station Discharge Connection Details	1	01-Aug 2024
60695088-SHT-AMP-WW-0012	Oily Water Sewer System DN250 Rising Main and Pumping Station Pump Station - General Arrangement	1	01-Aug 2024
F3_MOD7_Excavation_240530_RAPc	Figure F3: Remediation Plan	-	-
F4_MOD7_Capping_240530_RAPb	Figure F4: Capping Design	-	-

4.3 NODE LISTING

Table 4 lists the nodes reviewed. Each corresponds to an element of the proposed modification. Details of each element and proposed changes can be found in Section 4 (Description of the proposed modification) of the Modification Report.

Table 4: HAZID Study Nodes

Node Number	Node Title
1	Project Area
2	Fire water systems
3	Electrical assets
4	Structures
5	Oily water sewer (OWS)
6	Remediation / Grading

5 HAZID TEAM MEMBERS

The HAZID workshop involved a multidisciplinary team with knowledge of the Ampol Kurnell Terminal SSD-5544 MOD 7. The HAZID workshop was conducted on 22 August 2024. Table 5 lists the HAZID team members.

Table 5: HAZID Team Members

Name	HAZID Role	Position	Company
Aidin Riyazi	Firewater System	Project Manager	Ampol
Bradley Gittoes	Electrical	EIS Team Lead	Ampol
Damien Davidson	Remediation	Remediation	Ampol
Daniel Pepyat	Oily Water	Project Manager	Ampol
David Peninton	Construction	Construction	Ampol
David Wang	Process Safety	Process Safety	Ampol
Geraldine Bourgarel	Project Sponsor	Head of Property	Ampol
Keiran Fleming	Project Manager	National Development & Transaction Manager Fuels and Infrastructure	Ampol
Scott Mayes	Operations and Maintenance	Maintenance	Ampol
Alireza Noursadeghi[1]	Firewater System	Principal Mechanical Engineer	AECOM
Sally Stevenson	Project Manager	Associate Director – Environment	AECOM
Suzy Carden-Noad	Environment Project Manager	Senior Environmental Planner	AECOM
Gordon Treadwell	Process Safety	Principal Consultant	Arriscar
Lachlan Dreher	HAZID Facilitator	Senior Principal Risk Engineer	R4Risk
Samara Smith	Technical Scribe	Senior Risk Engineer	R4Risk

[1] Attended meeting virtually

6 RESULTS / FINDINGS

The HAZID identified 15 recommendations from the 6 nodes reviewed. The minutes of the study are included in Attachment A, with a summary list of the recommendations provided in Table 6.

The scope of the workshop was to identify the incremental risk associated with the proposed modification. Therefore, where a hazard was identified that was assessed to be equivalent to the hazards for the current operations, "no issues of concern" was recorded.

Similarly, where hazards to the biophysical environment were identified that are already included as part of proposed mitigation plans, these were not documented and "no issues of concern" was recorded. Where environmental hazards were identified that may not be included in the proposed mitigation plans, these were documented, and recommendations recorded to ensure the hazard is appropriately managed in the associated mitigation plans.

To ensure that hazards identified in this study are eliminated and/or reduced as a result of implementing these study recommendations, a system should be implemented to ensure that the recommendations are completed and that the action taken meets the intent of the recommendation.

Table 6: Summary of Recommendations

No.	Recommendation	Place(s) Used
1	Review the design for the booster connections at the new fire pumps. Ensure that suitable hardstand is available. Also ensure that suitable access is available for fire brigade vehicles, considering existing/planned infrastructure in the area (e.g. flood mitigation infrastructure).	Causes: 2.3.1
2	Fire Safety Study Addendum to be prepared. This will assess whether the firewater supply can meet the minimum requirements.	Causes: 2.12.1
3	Compliance of firewater system design with AS 2419.1 will be addressed as part of detailed design.	Causes: 2.13.1
4	Access to new firewater pumps for maintenance will be addressed in detailed design.	Causes: 2.15.1
5	Consider the routing of the underground town main water supply line during detailed design to minimise interactions with existing underground services.	Causes: 2.18.1
6	Consider the ability to drain the firewater tanks for maintenance as part of the detailed design.	Causes: 2.20.1
7	As part of the detailed design, implement measures to manage the noise exposure to the community from the relocated diesel firewater pumps.	Causes: 2.22.1
8	Consider landscaping treatment around the new firewater tank to reduce driving hazard from impaired visibility.	Causes: 2.29.1
9	Once the location and dimensions of the DG warehouse is confirmed, as part of the detailed design, review potential heat impacts from nearby tank fires onto the warehouse	Causes: 4.1.1
10	Ensure that, as part of the OWS detailed design, suitable vehicle access is available for tanker vacuum trucks, to enable the pump out of the OWS emergency storage.	Causes: 5.3.1, 5.7.1, 5.11.1
11	Ensure that, as part of the OWS detailed design, on high demand, the 400-series tank water draw will be given preference over the new OWS feed lines.	Causes: 5.7.1
12	Traffic management plan to be developed. This will include road and bridge limits and consideration of oversize and over-mass vehicles.	Causes: 6.3.1
13	As part of the air quality management plan, consider suitable sources of water for dust suppression trucks	Causes: 6.18.2
14	Ensure that potential hazards associated with contaminated soils (including hazardous ground gases) are assessed during construction and an appropriate treatment plan developed to ensure that no unacceptable level of residual risk remains for proposed structures.	Causes: 4.18.2
15	Ensure that as part of the permit to work procedure, exposure of workers to harmful gases from tank degassing operations are managed.	Causes: 1.12.1

7 REFERENCES

1 Ampol, “Ampol Manufacturing Risk Prioritisation Matrix”, DAT 4.19.02.005, 3 May 2022.

ATTACHMENT A: STUDY MINUTES

HAZID Study Minutes

Node	Guide Word	Cause	Consequence	Effective Safeguards	Before Risk Reduction			Remark	Recommendations
					C	L	RR		
1. Project Area	1. Site Location	1. No issues of concern identified	1. -	1. -					
	2. Natural disasters	1. No additional issues of concern identified	1. -	1. -				There is an existing bushfire risk for the Terminal. No additional hazards were identified associated with Mod 7. No change to existing bushfire risk. There is an existing flood risk for areas of the Terminal. The surface water flows will not be changed significantly by Mod 7. No change to the existing flooding risk.	
	3. Transport & Logistics	1. Alternate site access required for works	1. Unauthorised access, security breach	1. Permit to Work					
		2. Trucks and vehicles required for works	1. Increased traffic in the Terminal and on surrounding roads.	1. Traffic management plan to be developed. Includes road and bridge limits. Includes oversized and over mass					
	4. Infrastructure	1. No issues of concern identified	1. -	1. -					
	5. Site security	1. No issues of concern identified	1. -	1. -				Modification works are within the current site boundary and existing site security. No change to the current aircraft impact assessment (aircraft crash risk).	
	6. Utility Systems	1. Removal of domestic sewerage as part of building demolition	1. Potential exposure of workers to raw sewage	1. Demolition plan					
		2. Incorrect sequence of modification activities	1. Required services are not available in modification project areas. Operational issue	1. Once scope is finalised, a sequence plan will be developed prior to works					
	7. Brownfield Facilities Modifications	1. No issues of concern identified	1. -	1. -					
	8. Hazardous Material	1. No issues of concern identified	1. -	1. -					
	9. Inventory	1. No issues of concern identified	1. -	1. -					
	10. Operating Envelopes	1. No issues of concern identified	1. -	1. -					
	11. Breakdown of plant services	1. No issues of concern identified	1. -	1. -					
	12. Fire, Explosion and Toxic Hazards	1. Degassing tanks (e.g. for maintenance)	1. During tank degassing there is the potential for elevated levels of Benzene in the immediate	1. Permit to Work					15. Ensure that as part of the permit to work procedure, exposure of workers to harmful gases from tank degassing

Node	Guide Word	Cause	Consequence	Effective Safeguards	Before Risk Reduction			Remark	Recommendations
					C	L	RR		
			area of the tank. Potential for worker exposure to toxic concentrations.						operations are managed.
	13. Asset Integrity / Equipment Failure	1. No issues of concern identified	1. -	1. -					
	14. Layout	1. No issues of concern identified	1. -	1. -					
	15. Operability & Maintenance Hazards	1. No issues of concern identified	1. -	1. -					
	16. Equipment Compliance	1. No issues of concern identified	1. -	1. -					
	17. New Technology	1. No issues of concern identified	1. -	1. -					
	18. Constructability	1. No issues of concern identified	1. -	1. -					
	19. Discharge to Air	1. No issues of concern identified	1. -	1. -					
	20. Discharge to Water	1. No issues of concern identified	1. -	1. -					
	21. Discharge to Land/Soil	1. No issues of concern identified	1. -	1. -					
	22. Environmental Noise	1. No issues of concern identified	1. -	1. -					
	23. Water Management	1. No issues of concern identified	1. -	1. -					
	24. Biodiversity Management	1. No issues of concern identified	1. -	1. -					
	25. Land Management	1. No issues of concern identified	1. -	1. -					
	26. Waste Management	1. No issues of concern identified	1. -	1. -					
	27. Sustainability Management	1. No issues of concern identified	1. -	1. -					
	28. Cultural Heritage Management	1. No issues of concern identified	1. -	1. -					
	29. Community & Societal Issues	1. No issues of concern identified	1. -	1. -					
2. Fire water systems	1. Site Location	1. No issues of concern identified	1. -	1. -					
	2. Natural disasters	1. Flooding of proposed new fire pump locations (option 1 or 2)	1. Inability to operate firewater pumps during an emergency	1. There is a current project to construct flood mitigation controls. This should mitigate impacts of flooding at the locations of the new					

Node	Guide Word	Cause	Consequence	Effective Safeguards	Before Risk Reduction			Remark	Recommendations
					C	L	RR		
				firewater pumps to a level that can be designed out (e.g. by raising the pumps off the ground).					
		2. Bushfire in adjacent parkland	1. Inability to operate firewater pumps during an emergency	1. Separation distance between the proposed fire pump locations and the parkland (separated by Solander Street).					
	3. Transport & Logistics	1. Restricted access to the fire brigade booster connection	1. Inability to boost the firewater system in the case of firewater pump failure	1. None					1. Review the design for the booster connections at the new fire pumps. Ensure that suitable hardstand is available. Also ensure that suitable access is available for fire brigade vehicles, considering existing/planned infrastructure in the area (e.g. flood mitigation infrastructure).
	4. Infrastructure	1. No issues of concern identified	1. -	1. -					
	5. Site security	1. No issues of concern identified	1. -	1. -					
	6. Utility Systems	1. No issues of concern identified	1. -	1. -				All required utilities are available All duty fire pumps will be diesel-driven. The jacking pump will be electric-driven.	
	7. Brownfield Facilities Modifications	1. No issues of concern identified	1. -	1. -					
	8. Hazardous Material	1. Demolition of contaminated materials (e.g. asbestos in underground firewater pipes)	1. Potential exposure of workers to contamination	1. “Unexpected Finds” protocol					
		2. Contaminated soil/water in excavation areas	1. Potential exposure of workers to contamination	1. Permit to Work 2. Excavation works will be carried out under an excavation/remediation plan which will describe the appropriate controls to manage the hazard.					
		3. Contaminated ground gases in excavation areas	1. Potential exposure of workers to ground gases	1. Permit to Work 2. Excavation works will be carried out under an excavation/remediation plan which will describe the appropriate controls to manage the hazard.					
	9. Inventory	1. No issues of concern identified	1. -	1. -					
	10. Operating Envelopes	1. No issues of concern identified	1. -	1. -					
	11. Breakdown of plant services	1. Breakdown of firewater pump	1. Inability to operate firewater pumps during an emergency	1. Redundancy in the design of the firewater pump system				The level of redundancy in the firewater pump system design is equivalent to the existing system.	

Node	Guide Word	Cause	Consequence	Effective Safeguards	Before Risk Reduction			Remark	Recommendations
					C	L	RR		
	12. Fire, Explosion and Toxic Hazards	1. Inadequate firewater supply (e.g. makeup from towns main)	1. Inability to combat potential fires	1. None					2. Fire Safety Study Addendum to be prepared. This will assess whether the firewater supply can meet the minimum requirements.
	13. Asset Integrity / Equipment Failure	1. Partial failure of firewater hydrant main	1. Inability to combat potential fires	1. None					3. Compliance of firewater system design with AS 2419.1 will be addressed as part of detailed design.
	14. Layout	1. No issues of concern identified	1. -	1. -					
	15. Operability & Maintenance Hazards	1. Access to firewater pumps to maintain equipment	1. Inability to maintain firewater pumps	1. None					4. Access to new firewater pumps for maintenance will be addressed in detailed design.
	16. Equipment Compliance	1. No issues of concern identified	1. -	1. -					
	17. New Technology	1. No issues of concern identified	1. -	1. -					
	18. Constructability	1. Installation of underground town main supply line to the firewater tank	1. Interaction with underground services	1. None					5. Consider the routing of the underground town main water supply line during detailed design to minimise interactions with existing underground services.
	19. Discharge to Air	1. Exhaust gases from relocated diesel firewater pumps	1. Exhaust gases discharged to community areas	1. Assessed and managed as part of the air quality environmental assessment				Firewater pump locations are closer to the community. The diesel firewater pumps will have an increase exhaust discharge during start-up	
	20. Discharge to Water	1. Emptying of the firewater tank for maintenance purposes	1. Inability to drain the firewater tank for maintenance. Operational issue	1. None					6. Consider the ability to drain the firewater tanks for maintenance as part of the detailed design.
	21. Discharge to Land/Soil	1. No issues of concern identified	1. -	1. -					
	22. Environmental Noise	1. Noise from relocated diesel fire pumps	1. Excess noise in community areas	1. Assessed and managed as part of the noise environmental assessment.				The proposed locations for the firewater pumps are closer to the community and will therefore increase the noise exposure to the community.	7. As part of the detailed design, implement measures to manage the noise exposure to the community from the relocated diesel firewater pumps.
	23. Water Management	1. No issues of concern identified	1. -	1. -					
	24. Biodiversity Management	1. No issues of concern identified	1. -	1. -					
	25. Land Management	1. No issues of concern identified	1. -	1. -					
	26. Waste Management	1. No issues of concern identified	1. -	1. -					
	27. Sustainability Management	1. No issues of concern identified	1. -	1. -					
	28. Cultural Heritage Management	1. No issues of concern identified	1. -	1. -					
	29. Community &	1. Impaired visibility for	1. Vehicle accident, injury	1. None				There are two options for firewater tank	8. Consider landscaping treatment around

Node	Guide Word	Cause	Consequence	Effective Safeguards	Before Risk Reduction			Remark	Recommendations
					C	L	RR		
	Societal Issues	drivers due to the sun position when driving along Solander Street, e.g. reflections from the new firewater tank						locations. Option 1 is closer to Solander Street.	the new firewater tank to reduce driving hazard from impaired visibility.
3. Electrical assets	1. Site Location	1. No issues of concern identified	1. -	1. -					
	2. Natural disasters	1. No issues of concern identified	1. -	1. -					
	3. Transport & Logistics	1. No issues of concern identified	1. -	1. -					
	4. Infrastructure	1. No issues of concern identified	1. -	1. -					
	5. Site security	1. No issues of concern identified	1. -	1. -					
	6. Utility Systems	1. No issues of concern identified	1. -	1. -					
	7. Brownfield Facilities Modifications	1. No issues of concern identified	1. -	1. -					
	8. Hazardous Material	1. No issues of concern identified	1. -	1. -					
	9. Inventory	1. No issues of concern identified	1. -	1. -					
	10. Operating Envelopes	1. No issues of concern identified	1. -	1. -					
	11. Breakdown of plant services	1. No issues of concern identified	1. -	1. -					
	12. Fire, Explosion and Toxic Hazards	1. No issues of concern identified	1. -	1. -					
	13. Asset Integrity / Equipment Failure	1. No issues of concern identified	1. -	1. -					
	14. Layout	1. No issues of concern identified	1. -	1. -					
	15. Operability & Maintenance Hazards	1. No issues of concern identified	1. -	1. -					
	16. Equipment Compliance	1. No issues of concern identified	1. -	1. -					
	17. New Technology	1. No issues of concern identified	1. -	1. -					
	18. Constructability	1. Unidentified live cables during demolition	1. Worker electric shock, fatality	1. Underground services clearance protocols					

Node	Guide Word	Cause	Consequence	Effective Safeguards	Before Risk Reduction			Remark	Recommendations
					C	L	RR		
		2. Demolition of contaminated underground infrastructure (e.g. asbestos)	1. Potential exposure of workers to contamination	1. Unexpected finds protocol					
		3. Contaminated soil/water in excavation areas	1. Potential exposure of workers to contamination	1. Permit to Work 2. Excavation works will be carried out under an excavation/remediation plan which will determine appropriate controls to manage the hazard					
		4. Contaminated ground gases in excavation areas	1. Potential exposure of workers to ground gases	1. Permit to Work 2. Excavation works will be carried out under an excavation/remediation plan which will determine appropriate controls to manage the hazard					
	19. Discharge to Air	1. No issues of concern identified	1. -	1. -					
	20. Discharge to Water	1. No issues of concern identified	1. -	1. -					
	21. Discharge to Land/Soil	1. No issues of concern identified	1. -	1. -					
	22. Environmental Noise	1. No issues of concern identified	1. -	1. -					
	23. Water Management	1. No issues of concern identified	1. -	1. -					
	24. Biodiversity Management	1. No issues of concern identified	1. -	1. -					
	25. Land Management	1. No issues of concern identified	1. -	1. -					
	26. Waste Management	1. No issues of concern identified	1. -	1. -					
	27. Sustainability Management	1. No issues of concern identified	1. -	1. -					
	28. Cultural Heritage Management	1. No issues of concern identified	1. -	1. -					
	29. Community & Societal Issues	1. No issues of concern identified	1. -	1. -					
4. Structures	1. Site Location	1. Proximity of New Warehouse storing DGs to the bulk storage tanks	1. Potential restriction of future uses of adjacent bulk storage tanks. Operational issue	1. Return to service of these tanks would be conducted under an MOC. Issues such as interactions would be considered at this time				The tanks that are located near the proposed New Warehouse location are currently cleaned and parked (i.e. empty).	9. Once the location and dimensions of the DG warehouse is confirmed, as part of the detailed design, review potential heat impacts from nearby tank fires onto the warehouse
	2. Natural disasters	1. No issues of concern identified	1. -	1. -					
	3. Transport & Logistics	1. Truck access to warehouse along Road K	1. Inability to transport material to/from DG warehouse using	1. Road K is to be upgraded to allow for two-way traffic					

Node	Guide Word	Cause	Consequence	Effective Safeguards	Before Risk Reduction			Remark	Recommendations
					C	L	RR		
			trucks. Operational issue	2. Traffic management plan consider truck access					
	4. Infrastructure	1. No issues of concern identified	1. -	1. -					
	5. Site security	1. No issues of concern identified	1. -	1. -					
	6. Utility Systems	1. No issues of concern identified	1. -	1. -					
	7. Brownfield Facilities Modifications	1. No issues of concern identified	1. -	1. -					
	8. Hazardous Material	1. No issues of concern identified	1. -	1. -					
	9. Inventory	1. Exceeding the dangerous goods (DG) storage capacity within the New Warehouse	1. Incident escalation of DG warehouse fire if required storage arrangements are not adhered to (e.g. quantities, segregation, separation etc.)	1. As part of its detailed design process, it will be ensured that the New Warehouse is 'fit for purpose' to cater for the types and quantities of materials to be stored					
	10. Operating Envelopes	1. No issues of concern identified	1. -	1. -					
	11. Breakdown of plant services	1. No issues of concern identified	1. -	1. -					
	12. Fire, Explosion and Toxic Hazards	1. No issues of concern identified	1. -	1. -					
	13. Asset Integrity / Equipment Failure	1. No issues of concern identified	1. -	1. -					
	14. Layout	1. No issues of concern identified	1. -	1. -					
	15. Operability & Maintenance Hazards	1. No issues of concern identified	1. -	1. -					
	16. Equipment Compliance	1. No issues of concern identified	1. -	1. -					
	17. New Technology	1. No issues of concern identified	1. -	1. -					
	18. Constructability	1. Contaminated soil/water in excavation areas	1. Potential exposure of workers to contamination	1. Permit to Work 2. Excavation works will be carried out under an excavation/remediation plan which will determine appropriate controls to manage the hazard					
		2. Contaminated ground gases in excavation areas	1. Potential exposure of workers to hazardous ground gases	1. Permit to Work 2. Excavation works will be carried out under an excavation/remediation					14. Ensure that potential hazards associated with contaminated soils (including hazardous ground gases) are

Node	Guide Word	Cause	Consequence	Effective Safeguards	Before Risk Reduction			Remark	Recommendations
					C	L	RR		
			2. Potential for ingress of hazardous ground gases into structures. Potential for toxic or explosive atmospheres within structure. Fire, explosion, toxic impacts.	plan which will determine appropriate controls to manage the hazard					assessed during construction and an appropriate treatment plan developed to ensure that no unacceptable level of residual risk remains for proposed structures.
	19. Discharge to Air	1. No issues of concern identified	1. -	1. -					
	20. Discharge to Water	1. No issues of concern identified	1. -	1. -					
	21. Discharge to Land/Soil	1. No issues of concern identified	1. -	1. -					
	22. Environmental Noise	1. No issues of concern identified	1. -	1. -					
	23. Water Management	1. No issues of concern identified	1. -	1. -					
	24. Biodiversity Management	1. No issues of concern identified	1. -	1. -					
	25. Land Management	1. No issues of concern identified	1. -	1. -					
	26. Waste Management	1. No issues of concern identified	1. -	1. -					
	27. Sustainability Management	1. No issues of concern identified	1. -	1. -					
	28. Cultural Heritage Management	1. No issues of concern identified	1. -	1. -					
	29. Community & Societal Issues	1. No issues of concern identified	1. -	1. -					
5. Oily water sewer (OWS)	1. Site Location	1. No issues of concern identified	1. -	1. -					
	2. Natural disasters	1. No issues of concern identified	1. -	1. -					
	3. Transport & Logistics	1. Inadequate access for tanker vacuum truck to pump out the OWS emergency storage	1. If access to the OWS emergency storage is restricted, this may lead to an overflow of OWS in the case of a downstream failure, resulting in a release to the environment	1. None				Pump station location could be in a future third party area	10. Ensure that, as part of the OWS detailed design, suitable vehicle access is available for tanker vacuum trucks, to enable the pump out of the OWS emergency storage.
	4. Infrastructure	1. No issues of concern identified	1. -	1. -					
	5. Site security	1. No issues of concern identified	1. -	1. -					
	6. Utility Systems	1. No issues of concern identified	1. -	1. -					
	7. Brownfield Facilities	1. Tie in point of the proposed OWS is adjacent to the	1. High demand on the OWS system may cause a restriction	1. OWS system hydraulics and the emergency storage capacity will be					10. Ensure that, as part of the OWS detailed design, suitable vehicle access

Node	Guide Word	Cause	Consequence	Effective Safeguards	Before Risk Reduction			Remark	Recommendations
					C	L	RR		
	Modifications	400-series tanks' floating-roof water drain point	at the new tie in point, leading to overflow of OWS emergency storage, and a release to the environment	considered as part of detailed design					is available for tanker vacuum trucks, to enable the pump out of the OWS emergency storage. 11. Ensure that, as part of the OWS detailed design, on high demand, the 400-series tank water draw will be given preference over the new OWS feed lines.
	8. Hazardous Material	1. No issues of concern	1. -	1. -				The feed areas for the new OWS pit are not expected to contain hydrocarbons	
		2. Demolition of contaminated underground infrastructure	1. Potential exposure of workers to contamination	1. Unexpected finds protocol 2. Planned as part of remediation protocols					
		3. Contaminated ground gases in excavation areas	1. Potential exposure of workers to ground gases	1. Excavation/remediation plans will determine appropriate controls 2. Permit to work					
	9. Inventory	1. No issues of concern identified	1. -	1. -					
	10. Operating Envelopes	1. No issues of concern identified	1. -	1. -					
	11. Breakdown of plant services	1. Power loss	1. Loss of OWS pump	1. Suitable access to enable a vacuum truck to be utilised to pump out OWS emergency storage 2. Provision to connect to generator, if required					10. Ensure that, as part of the OWS detailed design, suitable vehicle access is available for tanker vacuum trucks, to enable the pump out of the OWS emergency storage.
	12. Fire, Explosion and Toxic Hazards	1. No issues of concern identified	1. -	1. -				The feed areas for the new OWS pit are not expected to contain hydrocarbons	
	13. Asset Integrity / Equipment Failure	1. No issues of concern identified	1. -	1. -					
	14. Layout	1. No issues of concern identified	1. -	1. -					
	15. Operability & Maintenance Hazards	1. No issues of concern identified	1. -	1. -					
	16. Equipment Compliance	1. No issues of concern identified	1. -	1. -					
	17. New Technology	1. No issues of concern identified	1. -	1. -					
	18. Constructability	1. Contaminated soil/water in excavation areas	1. Potential exposure of workers to contamination	1. Known areas of contamination will be considered and managed as part of construction planning					
	19. Discharge to Air	1. No issues of concern identified	1. -	1. -					

Node	Guide Word	Cause	Consequence	Effective Safeguards	Before Risk Reduction			Remark	Recommendations
					C	L	RR		
	20. Discharge to Water	1. No issues of concern identified	1. -	1. -					
	21. Discharge to Land/Soil	1. No issues of concern identified	1. -	1. -					
	22. Environmental Noise	1. No issues of concern identified	1. -	1. -					
	23. Water Management	1. No issues of concern identified	1. -	1. -					
	24. Biodiversity Management	1. No issues of concern identified	1. -	1. -					
	25. Land Management	1. No issues of concern identified	1. -	1. -					
	26. Waste Management	1. No issues of concern identified	1. -	1. -					
	27. Sustainability Management	1. No issues of concern identified	1. -	1. -					
	28. Cultural Heritage Management	1. No issues of concern identified	1. -	1. -					
	29. Community & Societal Issues	1. No issues of concern identified	1. -	1. -					
6. Remediation and Grading	1. Site Location	1. Proximity of biopiles to community	1. Odour impact to community	1. Biopiles are to be located in an area that is away from the community and in areas that have previously been used for remediation works.				Biopiles would be present during construction only (Stage 3 – Remediation). Once the soil is remediated to the required standard, the biopiles would be deconstructed and the soil would be reused on-site as backfill or for capping	
	2. Natural disasters	1. No issues of concern identified	1. -	1. -					
	3. Transport & Logistics	1. Trucks and vehicles required for works	1. Increase to traffic in the Terminal and on surrounding roads	1. None					12. Traffic management plan to be developed. This will include road and bridge limits and consideration of oversize and over-mass vehicles.
	4. Infrastructure	1. No issues of concern identified	1. -	1. -					
	5. Site security	1. No issues of concern identified	1. -	1. -					
	6. Utility Systems	1. No issues of concern identified	1. -	1. -					
	7. Brownfield Facilities Modifications	1. No issues of concern identified	1. -	1. -					
	8. Hazardous Material	1. Contaminated soil/water in excavation areas	1. Potential exposure of workers to contamination	1. Asbestos management plan including exclusion zones					
	9. Inventory	1. No issues of concern identified	1. -	1. -					

Node	Guide Word	Cause	Consequence	Effective Safeguards	Before Risk Reduction			Remark	Recommendations
					C	L	RR		
	10. Operating Envelopes	1. No issues of concern identified	1. -	1. -					
	11. Breakdown of plant services	1. No issues of concern identified	1. -	1. -					
	12. Fire, Explosion and Toxic Hazards	1. Capping of pipeways with live hydrocarbon lines	1. LOC of hydrocarbon, potentially resulting in a fire and a fatality onsite	1. Permit to Work 2. Emergency response plan	Major	Unlikely	6		
		2. Activated charcoal filter hot spots	1. Activated charcoal filter hot spots, leading to ignition and fire. This is expected to result in equipment damage only.	1. Separation of charcoal filter units to limit escalation potential 2. Emergency response plan				No people will be working in the immediate area. The use of activated charcoal filters (or alternative technology) will be determined during detailed design.	
	13. Asset Integrity / Equipment Failure	1. No issues of concern identified	1. -	1. -					
	14. Layout	1. No issues of concern identified	1. -	1. -					
	15. Operability & Maintenance Hazards	1. No issues of concern identified	1. -	1. -					
	16. Equipment Compliance	1. No issues of concern identified	1. -	1. -					
	17. New Technology	1. No issues of concern identified	1. -	1. -					
	18. Constructability	1. Dewatering	1. Increased flow of water to the WWTP (operational issues)	1. WWTP can process a larger quantity of water than its current operational demand.					
		2. Dust from remediation/grading activities	1. Excess dust to surrounding environment	1. Dust suppression trucks					13. As part of the air quality management plan, consider suitable sources of water for dust suppression trucks
	19. Discharge to Air	1. No issues of concern identified	1. -	1. -					
	20. Discharge to Water	1. No issues of concern identified	1. -	1. -					
	21. Discharge to Land/Soil	1. No issues of concern identified	1. -	1. -					
	22. Environmental Noise	1. No issues of concern identified	1. -	1. -					
	23. Water Management	1. No issues of concern identified	1. -	1. -					
	24. Biodiversity Management	1. No issues of concern identified	1. -	1. -					
	25. Land Management	1. No issues of concern identified	1. -	1. -					
	26. Waste	1. No issues of concern	1. -	1. -					

Node	Guide Word	Cause	Consequence	Effective Safeguards	Before Risk Reduction			Remark	Recommendations
					C	L	RR		
	Management	identified							
	27. Sustainability Management	1. No issues of concern identified	1. -	1. -					
	28. Cultural Heritage Management	1. No issues of concern identified	1. -	1. -					
	29. Community & Societal Issues	1. No issues of concern identified	1. -	1. -					

ANNEXURE B: FIRE SAFETY STUDY ADDENDUM

TECHNICALLY SUPERIOR
RISK MANAGEMENT

AECOM

Kurnell Terminal SSD-5544 MOD 7
Fire Safety Study Addendum

Release 4, 3 March 2025

R4Risk Ref.: 222-07

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DOCUMENT CONTROL

Document	Kurnell Terminal SSD-5544 MOD 7 Fire Safety Study Addendum
Client	AECOM
Project Manager	Samara Smith
Report Author (s)	Samara Smith

Release	Issue Date	Reviewed	Approved	R4Risk Ref.	Comments
1	1-Nov-2024	L. Dreher	L. Dreher	222-07	Initial Release
2	10-Jan-2025	L. Dreher	L. Dreher	222-07	Updated following client comments
3	21-Feb-2025	L. Dreher	L. Dreher	222-07	Issued to Client
4	3-Mar-2025	L. Dreher	L. Dreher	222-07	Minor change to project boundary

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1 EXECUTIVE SUMMARY

A Modification Report has been prepared to support the modification application to State Significant Development (SSD) application reference 5544, Modification 7 (SSD-5544 MOD 7) for Ampol Australia Petroleum Pty Ltd (Ampol). As part of this process, AECOM Australia Pty Ltd (AECOM) engaged R4Risk to prepare an addendum to the Fire Safety Study (FSS) previously completed for the Kurnell Terminal ("the Terminal") in 2021 (the 2021 FSS) [1]. This document should be read in conjunction with the 2021 FSS.

This addendum addresses proposed changes to the operations and fire systems associated with SSD-5544 MOD-7 (the "proposed modification"). Refer to the Modification Report for full details. The key aspects of the proposed modification which are significant to the FSS assessment are changes to the firewater system (FWS) and the construction of a new 'fit for purpose' warehouse and Oil Spill Equipment Storeroom. The proposed FWS changes include:

- Installation of new firewater pipelines, relocated pumps, and the construction of a new 3 megalitre (ML) firewater tank and pumphouse (the "Relocated Pumphouse") in Zone 1
- Augmentation of other FWS infrastructure within Zone 1
- Augmentation or disconnection and removal of the FWS infrastructure in Zones 2 and 3.

The scope of this addendum involved the following:

- A review of the key assumptions underlying the FSS to ensure their applicability
- A review of the representative fire scenarios identified within the FSS to ensure their applicability
- A review of the firewater demands for the representative fire scenarios
- A review of the ability of the revised firewater system to satisfy those demands
- Identification of any gaps in the current systems to manage the fire hazards associated with the proposed changes to the facility (including recommendations to address those gaps, as applicable).

The FSS provides an assessment of the suitability of the existing fire systems to manage fire scenarios identified for the Terminal. Where deficiencies were identified, recommendations have been made to address them.

1.1 RECOMMENDATIONS

Recommendations were made to enable the FWS to meet the performance requirements to adequately deal with the considered fire scenarios. The recommendations arising from the study are as follows:

1 Ensure that as part of the detailed design for the proposed modification, warehouses or other stores that may be holding flammable and/or combustible materials are 'fit for purpose' and incorporate suitable controls to prevent fires and/or the escalation of fires. This should include a review of potential heat impacts from nearby tank fires onto the New Warehouse.

2 As part of the commissioning of the pumps in the Relocated Pumphouse, conduct flow tests on the firewater pumps and ensure that the pump performance is within 95% of the performance specification as per the manufacturer's pump curve.

3 Consider the implementation of OE Guidance Document requirements for firewater pumps (e.g. the provision of deluge sprinklers to protect firewater pumps) as part of the Relocated Pumphouse detailed design. This requirement is specified in the OE Guidance Document and is not an explicit requirement from the Australian Standards.

4 Review the design for the booster connections at the new Relocated Pumphouse. Ensure that a suitable hardstand and access are available for fire brigade vehicles.

5 Ensure that as part of the detailed design for the firewater system, modifications be implemented to the existing firewater system (i.e. additional lines and/or upsized lines) to enable the required hydraulic performance to be delivered.

6 Review and update emergency response documentation to reflect changes associated with the proposed modification. This includes the following:

a. Emergency Response Plan
b. Emergency Response Capability Study of Kurnell Terminal Organisation
c. Pre-Fire Plans.

2 ACRONYMS

2.1 ACRONYMS

AECOM	AECOM Australia Pty Ltd
Ampol	Ampol Australia Petroleum Pty Ltd
AS	Australian Standard
Caltex	Caltex Australia Petroleum Pty Ltd (which has been rebranded as Ampol)
DG	Dangerous goods
FSS	Fire safety study
FWS	Firewater system
HIPAP	Hazardous Industry Planning Advisory Paper
NFPA	National Fire Protection Association (United States)
OE	Operational Excellence
PIMAC	Petroleum Industry Mutual Aid Committee
PULP	Premium unleaded petrol
SPULP	Super premium unleaded petrol
T	Tank
ULP	Unleaded petrol

2.2 GLOSSARY

2021 FSS	The fire safety study report conducted for the Kurnell Terminal in 2021 [1].
Affected tanks	Tanks with potential for escalation due to flame impingement or exposure to radiant heat from a tank on fire.
Bund	Embankment or wall that forms the perimeter of a compound.
Compound	The area defined by a bund surrounding a tank or group of tanks that is capable of containing the largest release.
Cooling water	Firewater applied to tanks and other equipment to protect against radiant heat from a nearby fire.
Cooling water spray rings	A fixed system on a tank that delivers firewater to a sector of the tank, providing protection against radiant heat. The system typically consists of one or more arcs of pipes with nozzles used to direct water onto the tank roof and/or wall.
Emergency response plan	Emergency response plan refers to documents outlining the management of an emergency at the facility. Other terms for these documents include emergency plans and emergency management plans.
Firewater	Water used in the fire protection system to deliver foam and/or cooling water.
Flash point (°C)	The lowest temperature at which a substance can vaporise and form an ignitable mixture.
Foam concentrate	A concentrated liquid foaming agent, as received from the manufacturer. The foam concentrate is diluted with firewater to form the foam solution.
Foam solution	A mixture of firewater and foam concentrate.
HYENA	A software package used to perform hydraulic modelling.

OE Guidance Document	Ampol OE Guidance – Fire Safety Study, Consequence Modelling and Fires System Design Process Guidelines for Terminals & Depots – Doc. No. CD2920 [7].
Pre-fire plans	The plans summarising the potential impacts and response required (e.g. firewater, foam concentrate and equipment) for specific fire scenarios. Emergency response plans also refer to these as fire plans.
the proposed modification	The relocation of operational infrastructure within the boundaries of the Terminal, and the removal of non-operational infrastructure. Remediation and grading works would also be undertaken.
Ring main	The primary firewater loop supplying firewater to hydrants and monitors.
SSD-5544	State Significant Development (SSD) application reference 5544.
the Tank Farm	Kurnell Tank Farm
Tank on fire	The tank in which the flammable or combustible liquid is assumed to have been ignited.
the Terminal	The Kurnell Terminal, consisting of the Tank Farm, Wharf and associated pipelines and pumps.
the Wharf	Kurnell Wharf
Zones	Following a review of their landholdings at Kurnell, Ampol have split the Site into various zones, as defined below: • Zone 1: The area that continues to be used as an operational fuel terminal • Zone 1A: The Eastern Right of Way, in use by the operational fuel terminal • Zone 2: The former refinery process areas, now largely vacant • Zone 3: The Former Caltex Lubrication Oil Refinery, now largely vacant • Zones 4 and 5: Undeveloped land containing extensive native vegetation.

2.3 SYMBOLS AND UNITS

%	Percentage
°C	Degrees Celsius
kL	Kilolitres
km	Kilometres
kPa	Kilopascals
kW/m^2	Kilowatts per square metre
L	Litres
L/min	Litres per minute
$(L/min)/m^2$	Litres per minute, per square metre
m^2	Square metres
min	Minutes
ML	Megalitres
mm	Millimetres

3 SCOPE AND METHODOLOGY

3.1 SCOPE

A Modification Report has been prepared to support a modification application to State Significant Development (SSD) application reference 5544 (SSD-5544), Modification 7 (SSD-5544 MOD-7) at the Ampol Australia Petroleum Pty Ltd (Ampol) Kurnell Terminal. As part of this process, AECOM Australia Pty Ltd (AECOM) engaged R4Risk to prepare an addendum to the Fire Safety Study (FSS) previously completed for the Kurnell Terminal ("the Terminal") in 2021 ("the 2021 FSS") [1].

The main objective of the 2021 FSS was to identify potential fire hazards associated with the Terminal and assess the adequacy of the controls for those hazards. In cases where deficiencies were identified in the existing systems, recommendations were provided to address those deficiencies.

This addendum addresses proposed changes to the operations and fire systems associated with SSD-5544 MOD-7 (the "proposed modification"). This included:

- A review of the key assumptions underlying the FSS to ensure their applicability
- A review of the representative fire scenarios identified within the FSS to ensure their applicability
- A review of the firewater demands for the representative fire scenarios
- A review of the ability of the revised firewater system to satisfy those demands
- Identification of any gaps in the current systems to manage the fire hazards associated with the proposed modification.

This document should be read in conjunction with the 2021 FSS. Where it is deemed that the proposed modification poses no changes to the assessment made in the 2021 FSS, this is noted and the 2021 FSS should be consulted.

3.2 METHODOLOGY

The methodology applied in preparing this addendum was consistent with that of the 2021 FSS and the principles and objectives described in Hazardous Industry Planning Advisory Paper (HIPAP) No. 2 "Fire Safety Study Guidelines" [2]. The assessment included consideration of the requirements of relevant Australian Standards (AS), National Fire Protection Association (NFPA) Codes and Ampol's Operational Excellence (OE) Guidance Documents. These included:

- AS 1940:2017 The storage and handling of flammable and combustible liquids (AS 1940) [3]
- AS 2419.1:2021 Fire hydrant installations Part 1: System design, installation and commissioning (AS 2419.1) [4]
- NFPA 11 Standard for Low-, Medium-, and High- Expansion Foam (NFPA 11) [5]
- NFPA 25 Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems (NFPA 25) [6]
- Ampol's OE Guidance Document: Fire Safety Study, Consequence Modelling and Fires System Design Process Guidelines for Terminals & Depots ("OE Guidance Document") [7].

4 TERMINAL DESCRIPTION

4.1 OVERVIEW

Kurnell Terminal is located at the former Kurnell Refinery, on the Kurnell Peninsula within the Sutherland Shire Local Government Area. The Terminal is located approximately 15 km south of Sydney's CBD. The Terminal includes the Tank Farm and Wharf areas.

The Terminal operates on a continuous basis (i.e. 24 hours per day, 365 days per year) to receive, store and distribute bulk petroleum products, including:

- Unleaded petrol (ULP)
- Premium unleaded petrol (PULP)
- Super premium unleaded petrol (SPULP)
- Jet fuel
- Diesel.

Products are received at the berths of the Wharf and transported to the Tank Farm via underground pipelines. Received products are stored in tanks within the Tank Farm before being transferred to the Banksmeadow Terminal. The storage tanks are also used to store slop (i.e. impure fuel created by the unintentional mixing of products). Slop can be removed from the Tank Farm and transported back to the Wharf, where it is loaded into a ship to be sent away for reprocessing. A site layout of the Tank Farm is provided in Figure 1, with the tanks noted in this addendum highlighted.

Since the 2021 FSS, the operations at the Terminal are largely unchanged. The key exception to this is T-611 which has changed service from Slops (flammable liquid) to Diesel (combustible liquid).

Refer to the 2021 FSS for more detail on the Terminal's operations.

4.2 PROPOSED MODIFICATION

A summary of the layout following the proposed modification is shown in Figure 2. Refer to the Modification Report for full details. Of the changes, the following are significant to the FSS assessment:

- Construction of a new 'fit for purpose' warehouse and Oil Spill Equipment Storeroom
- Changes to the firewater system (FWS).

A new, 'fit for purpose' warehouse would be constructed to house maintenance supplies and small-scale maintenance activities currently undertaken in the existing main warehouse building. This would include the storage of small packages of dangerous good (DG) materials. A new Oil Equipment Storeroom would also be constructed.

The FWS would be relocated within the FWS Relocation Area in Zone 1 (indicated in Figure 3), including a new firewater tank and pipework to allow it to service the terminal infrastructure. The specific siting for the FWS will be selected during detailed design.

This work would include:

- Installation of new firewater pipelines, relocated pumps, and the construction of a new 3 megalitre (ML) firewater tank and pumphouse (the "Relocated Pumphouse") in Zone 1
- Augmentation of other FWS infrastructure within Zone 1
- Augmentation or disconnection and removal of the FWS infrastructure in Zones 2 and 3.

The installation of the new FWS infrastructure would involve the following:

- Excavation and remediation, where required
- Construction of new foundations for the firewater tank, pumps, and pipework
- Construction and installation of the new FWS infrastructure
- Connection of the existing and new firewater infrastructure (including the connection of pipes from the new tank to the main header).

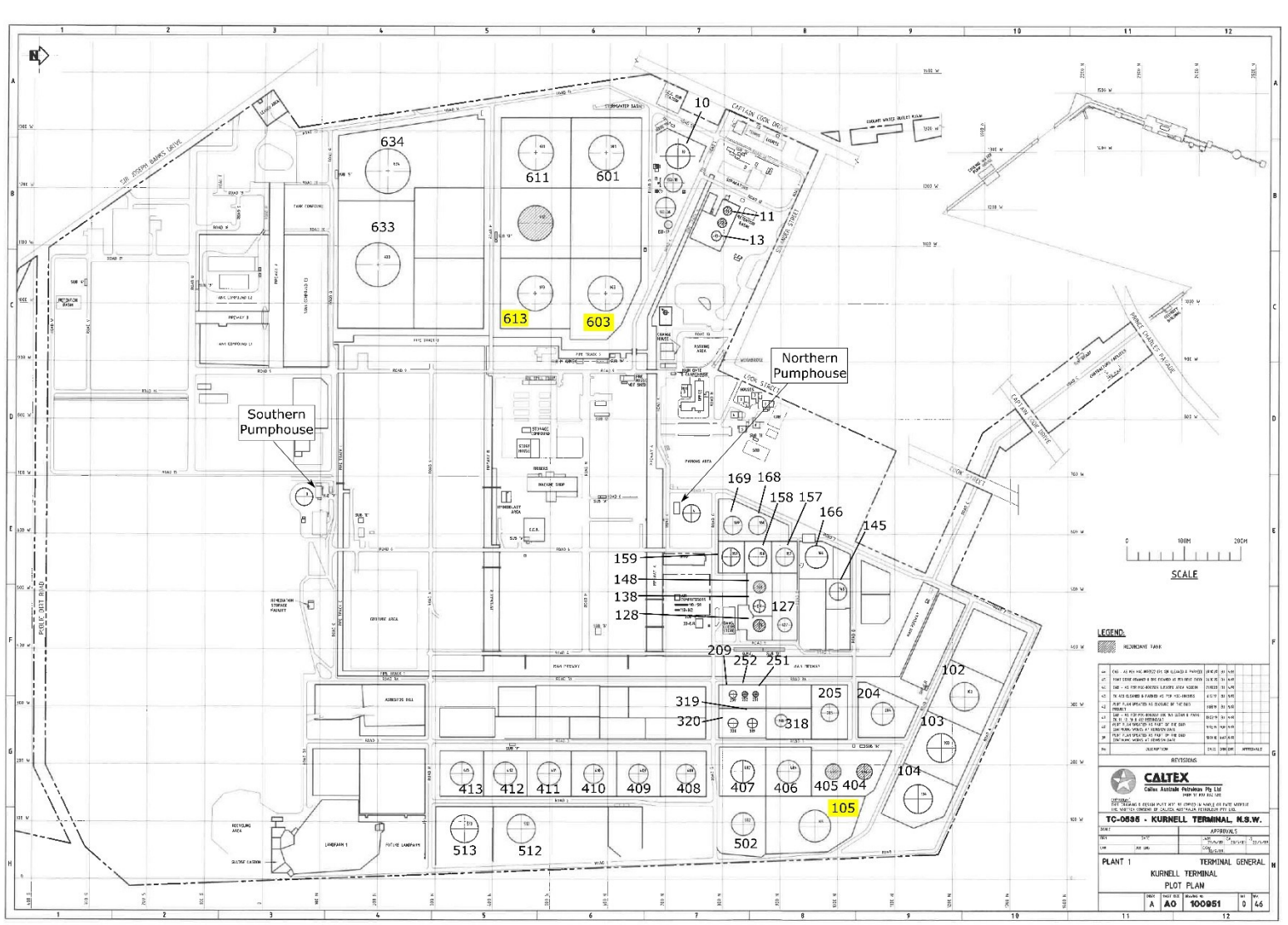

Figure 1: Site Layout – Tank Farm [8]

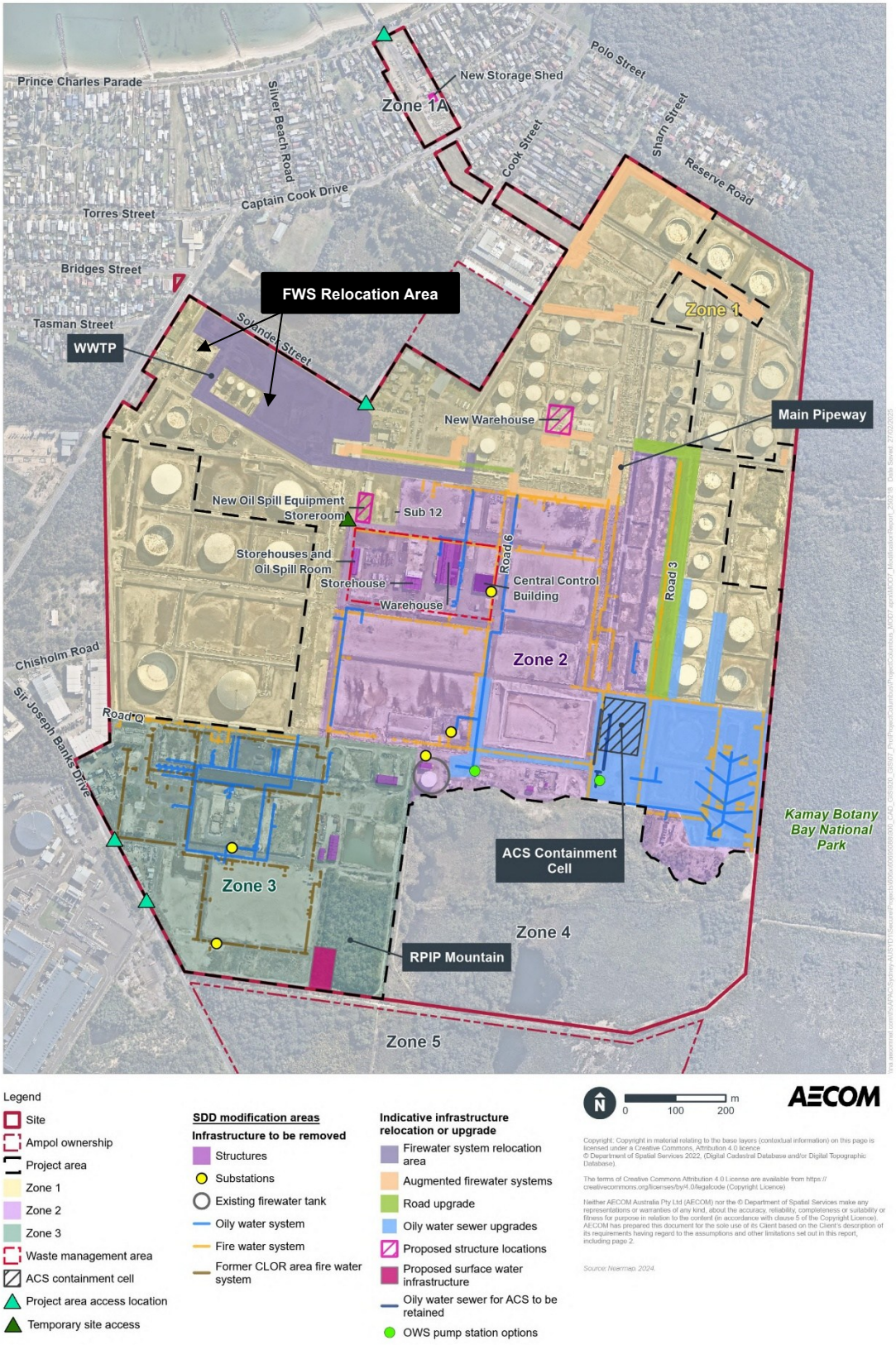

Figure 2: The Proposed Modification

Figure 3: Relocated FWS – Indicative Locations

5 HAZARDS IDENTIFIED

5.1 HAZARDOUS MATERIALS

A hazard is a physical situation with the potential to cause human injury or harm, damage to property, damage to the environment, or any combination of these. The most common hazards associated with the storage, handling or transportation of flammable materials are those with the potential for fire impacts.

The major flammable and combustible materials stored at the Terminal are:

- Gasoline (ULP / PULP / SPULP)
- Jet Fuel
- Diesel
- Slop.

5.2 POTENTIAL FIRE SCENARIOS

The fire scenarios considered within the 2021 FSS relate to the ignition of hazardous materials:

- Within a tank
- Released from a tank (contained within a compound)
- Released from a product transfer pump
- Released from a pipeline
- Released during product loading or unloading.

There are no changes to the potential fire scenarios compared to the 2021 FSS.

The New Warehouse and Oil Spill Equipment Storeroom may store small packages of flammable and/or combustible material. The design of this warehouse and detailed storage arrangements are not currently available. However, it is anticipated that this would be small capacity storage and the fires involving the package storage would be relatively small. It is anticipated that as part of the detailed design for the proposed modification, warehouses or other stores that may be holding flammable and/or combustible materials would be 'fit for purpose' and incorporate suitable controls to prevent fires and/or the escalation of fires. The fire protection requirements (i.e. firewater flow) for these scenarios would be less than the requirements for other nearby larger scenarios (i.e. tank fires). Therefore, fire scenarios involving package storage were excluded on this basis.

Recommendation

1. *Ensure that as part of the detailed design for the proposed modification, warehouses or other stores that may be holding flammable and/or combustible materials are 'fit for purpose' and incorporate suitable controls to prevent fires and/or the escalation of fires. This should include a review of potential heat impacts from nearby tank fires onto the New Warehouse.*

6 CONSEQUENCE OF INCIDENTS

The proposed modification would not result in changes to the consequence assessment presented in the 2021 FSS. The change in service of T-611 from Slops to Diesel does not make a material change to heat radiation impact distances, as these materials have similar pool fire properties (i.e. smoky flame and similar burning rates). Refer to the 2021 FSS for further details.

7 FIRE PREVENTION STRATEGIES / MEASURES

The Fire Prevention Strategies / Measures (i.e. integrity management and ignition prevention strategies) are unchanged from the 2021 FSS.

8 FIRE DETECTION AND PREVENTION

The release detection, fire detection and isolation strategies at the Terminal are unchanged from the 2021 FSS. Similarly, the fire system basis of protection is as per the 2021 FSS.

8.1 FIRE PROTECTION AND SUPPRESSION

AS 1940 requires fire protection to be provided to flammable liquid storage tanks using both foam and firewater systems. The design of the existing fire protection system was based on the maximum expected firewater and foam requirements. This addendum evaluates the foam and firewater requirements for the largest demand case only (i.e. a full-surface tank fire). This is discussed in the following sections.

8.1.1 Foam Application

There are no proposed changes to the fixed foam system. However, the Terminal plans to transition from fluorinated foam concentrate to fluorine-free foam concentrate (Solberg Versagard AS 100 3x3) for the generation of foam solution to respond to full-surface tank fires. Fluorine-free foam was used as the basis for foam application rates. This has increased the minimum foam delivery requirements, which are described in Ampol's guidance document [9].

The minimum required foam application rates for tank fires are specified in NFPA 11, with an additional allowance of 15% applied for foam delivery via fixed and semi-fixed systems to cater for the performance of fluorine-free foam, as per Ampol's guidance document [9]. For manual application (e.g. via monitors), the foam application rate specified in NFPA 11 was applied, with an additional allowance of 50% included to cater for potential losses due to wind and other factors. The foam application rates applied for tank fires are summarised in Table 1.

Table 1: Foam Application Rates – Tank Fires

Fire Scenario	Application Method	Application Rate ((L/min)/m^2)	Application Duration (minutes)	
			Flash Point <37.8°C	Flash point ≥37.8°C
Full-Surface Tank Fire	Fixed / Semi-Fixed System[1]	4.72	55	30
Full-Surface Tank Fire	Monitors[2]	10	65	50

A full set of updated foam requirements has not been calculated. However, the foam requirements for the tank fire scenarios with the largest demands (i.e. T-105, T-611 and T-613) were calculated to identify the maximum firewater demand. These demands are summarised in Table 2. The foam application method is also listed.

[1] As per Ampol guidance the foam application rate used in calculations is 4.72 (L/min)/m^2 which is approximately 15% of the application rate for fluorinated foam.

[2] As per Ampol guidance the foam application rate used in calculations is 10 (L/min)/m^2 which is approximately 50% of the application rate stated in NFPA 11.

Table 2: Foam Requirements – Full-Surface Tank Fires

Tank ID	Service	Application Method	Application Rate ((L/min)/m^2)	Duration (min)	Surface Area (m^2)	Foam Solution Required (L/min)	Foam Concentrate	
							%	Required (L)
T-105	Gasoline	Monitors	10	65	2,419	24,192	3	47,175
T-603	Jet Fuel	Fixed System	4.72	30	2,922	13,794	3	12,415
T-613	Jet Fuel	Fixed System	4.72	30	2,922	13,794	3	12,415

8.1.2 Maximum Firewater Flow Requirements

The maximum firewater flow requirements are presented for full-surface tank fires. The firewater flow requirements for full-surface tank fires allow for the simultaneous operation of:

- Cooling water to protect surrounding tanks
- Water for the foam applied to the tank on fire
- Supplementary foam streams
- Supplementary cooling water
- Water to prevent against a bushfire.

The greatest firewater demand is 31,079 L/min for a full-surface tank fire involving tank T-105. The breakdown of this demand is provided in Table 3. Sufficient infrastructure (i.e. an adequate number of monitors and supplementary hose streams) is available to satisfy the firewater requirements for the largest full-surface tank fire.

To deliver the largest firewater demand, any three of the six firewater pumps would need to be operating. With three pumps in operation, a flow of up to 36,000 L/min (i.e. 3 x 12,000 L/min) could be supplied. Given the six-pump arrangement at the Terminal, there would be sufficient firewater pump redundancy.

Refer to Section 10 for an evaluation of the proposed FWS ability to deliver the maximum firewater demand (i.e. flow and pressure).

Table 3: Maximum Firewater Requirement – Full-Surface Tank Fire at Tank T-105

Application	Firewater Requirement (L/min)
Cooling water for adjacent tanks	3,983
Water for foam applied to the tank on fire	23,466
Supplementary hydrant streams	1,800
Water for supplementary foam hose streams	553
Bushfire prevention	1,276
Total	**31,079**

8.1.3 Foam Concentrate Requirements

The foam concentrate requirement for a full-surface tank fire comprises the following:

- Concentrate for foam applied to the tank on fire
- Concentrate for supplementary foam hose streams.

The largest foam concentrate requirement is for a full-surface tank fire at tank T-105. The foam requirements for this scenario are summarised in Table 4.

Table 4: Maximum Foam Concentrate Requirement – Full-Surface Tank Fire at Tank T-105

Application	Foam Solution Requirement (L/min)	Application Duration (minutes)	Foam Concentration	Foam Concentrate Requirement (L)
Foam applied to the tank on fire	24,192	65	3%	47,175
Supplementary foam hose streams	570	30	3%	513
			Total	**47,688**

Ampol currently has a combined storage of 108,300 L of foam concentrate at the Terminal (refer to Table 5). This exceeds the maximum requirement for a full-surface tank fire (i.e. 47,688 L).

Table 5: Foam Concentrate Stocks

Foam Storage Area	Comment	Foam Concentrate (L)
Foam Pods	Five 10 kL foam pods	50,000
Foam tank – "600-series" Tank Farm	Foam Concentrate Tank (16D-9)	20,000
Fire appliances	Scania: 4,000 L Rosenbauer: 4,100 L	8,100
Foam store shed	Bulki-bins	27,000
Adjacent tank T-128 and at Separators	200 L Foam Drums	3,200
	Total	**108,300**

8.1.4 Firewater Storage Requirements

The greatest firewater storage requirement is associated with the full-surface tank fire with the greatest firewater demand. This is made up of the following:

- Cooling water to protect surrounding tanks
- Water for the foam applied to the tank on fire
- Water for supplementary foam streams
- Supplementary hydrant hose streams
- Water to prevent against a bushfire.

The maximum firewater volume requirement is 2.18 ML for a full-surface tank fire involving tank T-105 (refer to Table 6). In accordance with AS 1940, an application duration of 90 minutes was specified for cooling water application to adjacent tanks, bushfire prevention and the supplementary hydrant streams.

Table 6: Firewater Volume Requirement – Full-Surface Tank Fire at T-105

Application	Water Requirement (L/min)	Duration (min)	Volume Required (L)
Cooling water for adjacent affected tanks including wastage	3,983	90	358,510
Water for foam applied to the tank on fire	23,466	65	1,525,320
Water for supplementary foam	553	30	16,590
Supplementary hydrant hose streams	1,800	90	162,000
Bushfire prevention	1,276	90	114,840
		Total	**2,177,260**

The combined capacity of the firewater storage available at the Terminal would be 11 ML, with 8 ML available from the Northern Pumphouse and 3 ML from the new Relocated Pumphouse. This exceeds the firewater volume requirement specified by AS 1940. Make-up water would also be available to replenish a portion of the water depleted from the firewater storage tank(s).

The OE Guidance document specifies the need to provide redundancy of firewater supply. Either of the firewater storage tanks contain sufficient volume to respond to a full-surface tank fire involving tank T-105. Therefore, adequate firewater supply redundancy would be available.

8.2 VAPOUR SUPPRESSION

Vapour suppression requirements have not been calculated as these do not represent the highest firewater demand. Refer to the 2021 FSS for details of the requirements for this scenario.

9 FIRE SERVICES LAYOUT

9.1 INTRODUCTION

The Terminal is equipped with firewater and foam systems. Refer to the 2021 FSS for full details on the fire protection equipment associated with each system. The proposed changes to the FWS are described in the following sections.

9.2 FIREWATER SYSTEM

The Terminal's FWS provides coverage to the Tank Farm and Wharf operations. As per the 2021 FSS, these systems consist of:

- Two firewater storage tanks
- Six firewater pumps
- A firewater main
- Hydrants and monitors
- Cooling water spray systems.

The proposed modification includes changes to the firewater storage, firewater pumps and firewater main. However, the number of firewater tanks and pumps, and the intended operation of these systems would be as per the existing system described in the 2021 FSS.

There would be no changes to the location or number of fixed hydrants or monitors compared to what was described in the 2021 FSS as part of the proposed modification. The location and number of hydrants and monitors was assessed as adequate in the 2021 FSS. This status would be unchanged. Similarly, there are no changes to the fixed cooling water spray systems.

9.2.1 Firewater Storage

Following the proposed modification (i.e. the construction of the new firewater storage tank and disconnection and removal of the existing firewater storage tank within Zone 2), there would be two firewater storage tanks. The 8 ML capacity firewater storage tank located at the Northern Pumphouse would remain and a new firewater storage tank (3 ML capacity) would be installed at the Relocated Pumphouse.

Two firewater storage tanks provide the FWS with a redundancy of supply. The requirements of the OE Guidance Document and AS 1940, is to have two tanks each with a minimum of 50% of the total volume requirement. This ensures, that at least 50% of the demand is available when a firewater tank is taken offline (e.g. for maintenance).

The capacity of the firewater storage tanks at the Northern Pumphouse (8 ML) and the proposed capacity at the Relocated Pumphouse (3 ML) both exceed the greatest firewater storage requirement (2.18 ML, refer to Section 8.1.4). Therefore, sufficient firewater storage with suitable redundancy would be available. This configuration would meet the requirements of the OE Guidance Document and AS 1940.

9.2.2 Firewater Pumps

The firewater pumps would operate as per the existing system. Refer to the 2021 FSS for details. There would be six diesel-driven firewater pumps:

- Relocated Pumphouse:
  - Pump 16G-51
  - Pump 16G-52
  - New Pump
- Northern Pumphouse:
  - Pump 16G-53
  - Pump 16G-54
  - Pump 16G-55.

The new pump at the Relocated Pumphouse would be equivalent to the other diesel-driven firewater pumps used at the Terminal. The nominal duty flow for each pump is 12,000 L/min. In addition to these pumps, there would be two firewater utility pumps used to maintain the pressure in the firewater main at 1,200 kPa.

Heat flux of 3 kW/m^2 is the nominal access limit for emergency response personnel during a fire. The heat radiation contours representing a heat flux of 3 kW/m^2 should be considered when determining the location of critical emergency response items, such as water spray deluge valves, monitors, hydrants etc. Both Option 1 and Option 2 locations for the Relocated Pumphouse would be outside 3 kW/m^2 heat flux for all fire scenarios. Therefore, access to the Relocated Pumphouse would not be impeded in the event of a fire.

The acceptance criterion for the firewater pump's performance is that it should deliver at least 95% of the pressure per the manufacturer's curve for a given flow [6]. Pump performance was assessed in the 2021 FSS as meeting the acceptance criteria. The recent pump test results have not been reviewed as part of this addendum.

Recommendation

2. *As part of the commissioning of the pumps in the Relocated Pumphouse, conduct flow tests on the firewater pumps and ensure that the pump performance is within 95% of the performance specification as per the manufacturer's pump curve.*

To satisfy the requirements of the OE Guidance Document, deluge sprinklers should be provided to protect each firewater pump. This prevents the potential loss of a firewater pump, which may limit the ability to adequately respond to a major fire scenario. These requirements are in addition to those detailed in the relevant Australian Standards. It is recommended as part of the Relocated Pumphouse detailed design, the requirements of the OE Guidance Document are considered and implemented to satisfy these requirements.

Recommendation

3. *Consider the implementation of OE Guidance Document requirements for firewater pumps (e.g. the provision of deluge sprinklers to protect firewater pumps) as part of the Relocated Pumphouse detailed design. This requirement is specified in the OE Guidance Document and is not an explicit requirement from the Australian Standards.*

9.2.3 Firewater Main

Firewater is reticulated around the Terminal via a firewater main that supplies fixed fire equipment. It consists of a piping network covering the Tank Farm, with a section that extends along the Wharf to the Breasting Island.

As part of the proposed modification, the section of the firewater main which extends to service the area previously containing refinery infrastructure (i.e. Zone 2 and 3 in Figure 2) would be decommissioned.

Booster connections would be provided at both the Northern and Relocated Pumphouses. This enables fire appliances to pump water from the storage tanks into the firewater main, to supplement the pump performance, if required. The booster connections should be readily accessible and an appropriate hard stand provided at each location.

Recommendation

4. *Review the design for the booster connections at the new Relocated Pumphouse. Ensure that a suitable hardstand and access are available for fire brigade vehicles.*

Isolation valves are provided in the firewater main to allow continued partial operation of the system in the case of a failure in one section of the ring main, or when undergoing maintenance. AS 2419.1 outlines rules for locating ring main valves to ensure operation of the ring main. Isolation valves should be located to allow the continued use of not less than 75% of the fire hydrants, as required by AS 1940. A review against the requirements of AS 2419.1 and AS 1940 was completed on the proposed firewater piping isolation valve locations. The locations and number of isolation valves for the proposed firewater piping would satisfy these requirements.

The locations of isolation valves on the existing FWS were reviewed against the requirements of AS 2419.1 and AS 1940 in the 2021 FSS. In the 2021 FSS, several instances were identified where an insufficient number of valves are installed at locations where lines interconnect. Recommendations were made to address these items - refer to the 2021 FSS for details.

Feed lines from the firewater main extend from the Tank Farm to the Wharf. The feed lines tie-in to a network of fixed fire equipment that provides coverage to the Wharf and Breasting Island. There would be no change to this layout and its operation under the proposed modification.

9.3 FOAM SYSTEM

The Terminal plans to transition from fluorinated foam concentrate to fluorine-free foam concentrate (Solberg Versagard AS 100 3x3). This assessment has been based on the use of fluorine-free foam concentrate. The proposed modification does not include changes to the foam system. The assessment of the foam system would be unchanged from the 2021 FSS.

10 HYDRAULIC ANALYSIS

10.1 OVERVIEW

A hydraulic model of the FWS was developed for the proposed modification (i.e. “the modified FWS”) as part of the Ampol Kurnell Terminal - Hydraulic Analysis [10]. A summary of that analysis is described in this section.

The model was developed using the software HYENA [11]. The objective of the hydraulic analysis was to determine if the modified FWS would be capable of delivering the greatest firewater demand for the Terminal. Two fire scenarios were assessed:

- A full-surface tank fire on the west side of the Terminal (T-613)
- A full-surface tank fire on the east side of the Terminal (T-105).

10.2 RESULTS AND DISCUSSION

The hydraulic demand at the more remote pumphouse (assuming only one pumphouse operating) would be as follows:

- T-105 full-surface tank fire: 31,753 L/min at 2,055 kPa at the Relocated Pumphouse
- T-613 full-surface tank fire: 22,590 L/min at 1,156 kPa at the Northern Pumphouse.

The modified FWS would be able to cater to the maximum firewater demand for a full-surface tank fire on the west side of the Terminal (i.e. T-613) with three firewater pumps operating at the more remote pumphouse (i.e. the Northern Pumphouse).

The modified FWS would not be able to satisfy the maximum firewater demand for a full-surface tank fire on the west side of the Terminal (i.e. T-105). For this scenario, the required pressure at either pumphouse would significantly exceed the maximum discharge pressure of the firewater pumps. Therefore, piping modifications would be required to satisfy the firewater demand. This may involve the replacement of existing piping with larger diameter piping and/or running new lengths of piping to supplement the existing network.

A Sensitivity Case was analysed to identify a potential solution to meet the system demand. A total of 17 sections of the existing piping network (1.3 km total length) were remodelled as steel piping of a nominal diameter of 400 mm. Additionally, the diameter of sections of the proposed new delivery piping from the Relocated Pumphouse were increased. With these changes implemented, the system would be able to meet the design basis (i.e. maximum of three pumps operating at the more remote pumphouse).

It is recommended that as part of the detailed design for the FWS, modifications be implemented to the existing FWS (i.e. additional lines and/or upsized lines) to enable the required hydraulic performance to be delivered.

Recommendation

5. *Ensure that as part of the detailed design for the firewater system, modifications be implemented to the existing firewater system (i.e. additional lines and/or upsized lines) to enable the required hydraulic performance to be delivered.*

11 CONTAINMENT OF CONTAMINATED FIREWATER

The containment of contaminated firewater would be unchanged from the 2021 FSS.

12 FIRST AID FIRE PROTECTION

The first aid fire protection would be as per the 2021 FSS.

Following implementation of the proposed modification, emergency response documentation should be reviewed and updated, as needed. This includes the following:

- Emergency Response Plan
- Emergency Response Capability Study of Kurnell Terminal Organisation
- Pre-Fire Plans.

Recommendation

6. *Review and update emergency response documentation to reflect changes associated with the proposed modification. This includes the following:*

    a. *Emergency Response Plan*

    b. *Emergency Response Capability Study of Kurnell Terminal Organisation*

    c. *Pre-Fire Plans.*

13 REFERENCES

1 R4Risk, “Ampol Australia Petroleum Pty Ltd, Kurnell Terminal - Fire Safety Study”, R4Risk Ref. 104-67, Release 1, 17 September 2021.

2 New South Wales Department of Planning, “Hazardous Industry Planning Advisory Paper No. 2: Fire Safety Study Guidelines”, January 2011.

3 Australian Standard, AS 1940, “The storage and handling of flammable and combustible liquids”, Standards Australia, Sixth Edition, 2017.

4 Australian Standard, AS 2419.1, “Fire hydrant installations Part 1: System design, installation and commissioning”, Standards Australia, 2021.

5 National Fire Protection Association, NFPA 11, “Standard for Low-, Medium-, and High-Expansion Foam”, National Fire Protection Association, 2024 Edition.

6 National Fire Protection Association, NFPA 25, “Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems”, 2023 Edition.

7 Ampol Australia Petroleum Pty Ltd, “Fire Safety Study, Consequence Modelling and Fires System Design Process Guidelines for Terminals & Depots”, Version 5, Document No. CD2920, 28 February 2022.

8 Caltex Australia Petroleum Pty Ltd, “TC-535 – Kurnell Terminal, N.S.W., Plant 1, Terminal General, Kurnell Terminal, Plot Plan”, Drawing No. 100951, Rev. 46, 28 October 2020.

9 Ampol Australia Petroleum Pty Ltd, “Design Guidance for Transition to Synthetic Fluorine Free Foam at Ampol Facilities and Operations”, Document No. CD6014, Version 2, 22 December 2022.

10 R4Risk, “AECOM, Ampol Kurnell Terminal - Hydraulic Analysis”, R4Risk Ref. 222-05, Release 1, 23 September 2024.

11 ACADS-BSG, Hyena, Version 7.0.0, https://www.acadsbsg.com.au/hyena/.