Pipeline SMS Report

Derrimut Fields Precinct

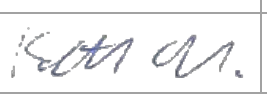
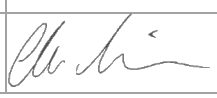
Department of Transport and Planning (Vic)

19 October 2026

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Project name	DTP Derrimut Fields Precinct Structure Plan - Safety Management Study
Document title	Pipeline SMS Report | Derrimut Fields Precinct
Project number	12697620
File name	12697620-REP-0_Pipeline SMS Report.docx

Revision	Author	Reviewer		Approved for issue		
		Name	Signature	Name	Signature	Date
A	D. Redhu T. Elms	K. Cook	* On file	L. Morrison	*On file	11/09/2026
0	D. Redhu	K. Cook		L. Morrison		19/10/2026

GHD Pty Ltd | ABN 39 008 488 373
Contact: Diya Redhu, Graduate Advisor - Risk & Assurance | GHD
180 Lonsdale Street, Level 9
Melbourne, Victoria 3000, Australia
T +61 3 8687 8000 | **F** +61 3 8732 7046 | **E** melmail@ghd.com | **ghd.com**

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Executive summary

The Department of Transport and Planning in Victoria (DTP) is leading the preparation of a Precinct Structure Plan (PSP) for the Derrimut Fields Precinct located in the City of Melton in Melbourne's western growth corridor. The precinct land use is currently agricultural (i.e. rural and semi-rural) but has been selected for industrial development. This is supported by strategic plans that identify it as a future State Significant Industrial Area. Four APA high-pressure natural gas transmission pipelines are located within or immediately adjacent to the precinct:

– Pipeline T56 Brooklyn to Ballan
– Pipeline T62 Derrimut to Sunbury
– Pipeline T112 Brooklyn to Lara
– Pipeline T118 Truganina to Plumpton

A Pipeline Safety Management Study (SMS) was conducted to assess the impact of the proposed land use change on these pipelines, with reference to *AS/NZS 2885.6:2018 Pipeline systems – High pressure, Part 6: Pipeline safety management*.

The SMS process involves a workshop with key stakeholders, including the pipeline owner. Prior to the workshop, a Preliminary Pipeline SMS Information Report [2] was prepared describing the SMS content and methodology, and providing reference information (such as pipeline documentation) for the workshop.

The SMS workshop was facilitated by GHD on 12 August 2026 with representatives from DTP, the pipeline owner APA, Melton City Council and a number of individual landowners and/or their consultants. During the workshop the team:

– Identified the land use and pipeline location classifications changes predicted for the PSP development
– Identified the changes to the threats to the pipelines arising from the proposed development
– Assessed whether the threats are still considered controlled based on the physical, procedural and design controls currently in place
– Developed recommendations regarding additional control measures, further consultation and additional information required to work towards managing the risks to the gas pipelines associated with the proposed land use changes, as provided in Table 1 overleaf

The pipeline SMS workshop was conducted relatively early in the PSP development process. GHD understands that this is in line with DTP's preference to gain an early understanding of the likely implications of pipeline SMS requirements on land use planning and to get the process started.

Not all information typically required for a land use change SMS workshop was available at the workshop. As a result:

– To manage uncertainties, recommendations were recorded where it was identified that additional information is needed to identify, understand or manage the risks
– Risk rating of the threats for changes arising from the proposed development could not be completed and ALARP assessment was not possible

The pipeline SMS register was updated after the workshop with additional information on the existing controls and existing risk ratings provided by APA.

Table 1 Pipeline SMS Workshop recommendations

ID	Recommendation	Topic
1	- Determine the typical, permitted land uses within the PSP area which would result in a Sensitive use (S) or Crowd (C) secondary location classification, which are expected to include child care centres and places of workshop (e.g. mosque) - Identify the existing processes that would trigger referrals to APA/ESV, planning requirements and/or the requirement for additional mitigations for these land uses - Consult with APA and the City of Melton to agree on whether the existing processes are sufficient or if additional requirements or mitigation measures need to be included in the PSP; this could include an exclusion zone for these land uses within the measurement distance or within the distance for the most credible threat (pipeline leak)	Overarching
2	One or more data centres are considered a likely potential land use within the PSP area. These facilities often include significant fuel storage, e.g. diesel for generators. This would introduce the risk of a fuel storage fire escalating to the pipeline or vice versa. Determine if limitations for the location of fuel storage and/or the requirement for additional controls are required within the PSP; this could include a buffer zone within the measurement distance or within the distance for the most credible threat (pipeline leak). Consultation with APA and landowners may be required as part of the decision-making.	Overarching
3	While outside the scope of this assessment, it was identified that the future Outer Metropolitan Ring (OMR) road development is likely to lead to Common Infrastructure Corridor (CIC) and/or Crowd (C) secondary location classifications. Notify the team responsible for the OMR and consult with them to determine if there are any implications of this that need to be considered in the PSP.	Overarching
14	APA to confirm what additional controls are currently in place for all threats recorded in this register and the missing current risk rankings (as full details were not provided prior to the workshop and APA experienced technical issues during the workshop).	Overarching
4	APA to confirm that the existing controls in place to manage 20T, 25T, and 30T excavator threats to the pipelines are also sufficient to manage the threats posed by larger excavators up to 90T.	External interference
5	While outside the scope of this assessment, it was identified that graders and dozers are likely to be used for construction of the Outer Metropolitan Ring (OMR). Consult with the team responsible for the OMR regarding the design and potential equipment to be used during construction to determine if there are any implications that need to be considered in the PSP.	External interference
6	Once transport modelling information and Development Services Schemes (DSS) are available, determine if there are any changes required to the Horizontal Directional Drilling threat assessment.	External interference
7	Identify, for example through the agency validation process, the assets of other authorities within the PSP area that may traverse north-south through Middle Road, e.g. branch sewers within the catchment. Based on the results, determine if there are any changes required to the Horizontal Directional Drilling threat assessment.	External interference
8	Data centres are considered a likely potential land use within the PSP area. Determine if limitations and/or the requirement for additional controls are required within the PSP to prevent data centre high voltage lines causing induced current in the pipelines.	Other threats
9	Confirm with Melbourne Water that there is no increased risk of flooding near the pipelines arising from the PSP development.	Other threats
10	Once the traffic modelling is available, in consultation with APA and AusNet, review the requirement for additional control measures for the Rockbank City Gate on the corner of Christies and Middle Roads, to prevent vehicle impacts, e.g. Armco railing.	Other threats
11	While outside the scope of this assessment, it was identified that the OMR may lead to an increased potential for vehicle impact at the Truganina Offtake City Gate (on the corner of Hopkins and Middle Roads). Communicate this information to the OMR team.	Other threats
12	In consultation with APA, determine the appropriate triggers for referral to APA for proposed developments involving the storage and handling of dangerous goods or fuel and any requirements to be captured in the PSP. This could include referral if storage is with a certain distance and/or the controls required (e.g. separation distance, instrumented controls and trips).	Other threats
13	APA noted that it is preferred that linear open space above and around the pipelines be maintained to allow access or, if this is not possible, that the pipelines remain within the frontage of industrial properties. If there were to be a loss of access there is a requirement for recoating the pipelines with associated increasing costs. DTP to determine the implications of this on the PSP.	Other threats

The workshop achieved a range of successful outcomes including:

– Informing stakeholders (including local government, landowners and their consultants) of the PSP context and the requirements of AS2885.6
– Providing stakeholders with the opportunity to share their views, provide feedback and ask questions
– Identifying uncertainties that require further investigation and/or liaison with other parties (e.g. OMR team)
– Developing an initial pipeline SMS register that
    - Provides a sound basis for early DTP planning for the Derrimut Fields PSP
    - Can be updated and refined as recommendations are closed out and the PSP progresses

The Pipeline SMS workshop is the start of the risk management process, not the end. The success of study in supporting DTP's land use planning will be dependent on the:

– Effective and timely close out of the recommendations
– Update and refinement of the Pipeline SMS register as further information becomes available and the PSP progresses
– Appropriate integration of the study findings within the PSP

This report is subject to, and must be read in conjunction with, the limitations set out in Section 1.2 and the assumptions and qualifications contained throughout the report.

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1. Introduction

The Derrimut Fields Precinct (the precinct) is located within the City of Melton, to the west of metropolitan Melbourne. The precinct is approximately 517 hectares, generally bounded by Hopkins Road to the west, Middle Road to the north, a railway line to the east, and Boundary Road to the south. Skeleton Creek traverses the precinct from north to south. Figure 1 [1] shows the location and boundaries of the precinct.

The precinct forms part of Melbourne's western growth corridor and has been identified for future urban development. The precinct contains both existing infrastructure and areas where future infrastructure is planned, including an electricity transmission line traversing the site, the Regional Rail Link along the eastern boundary and the proposed Outer Metropolitan Ring (OMR) corridor along the northern boundary.

To progress the development, a Precinct Structure Plan (PSP) is required in line with Victoria's *Precinct Structure Planning Guidelines* [3]. As part of this process, the Derrimut Fields Precinct Structure Plan: Pitching Summary Report (PSR) [4] has been developed. This work identified a range of technical studies are required for the PSP, including a pipeline Safety Management Study (SMS).

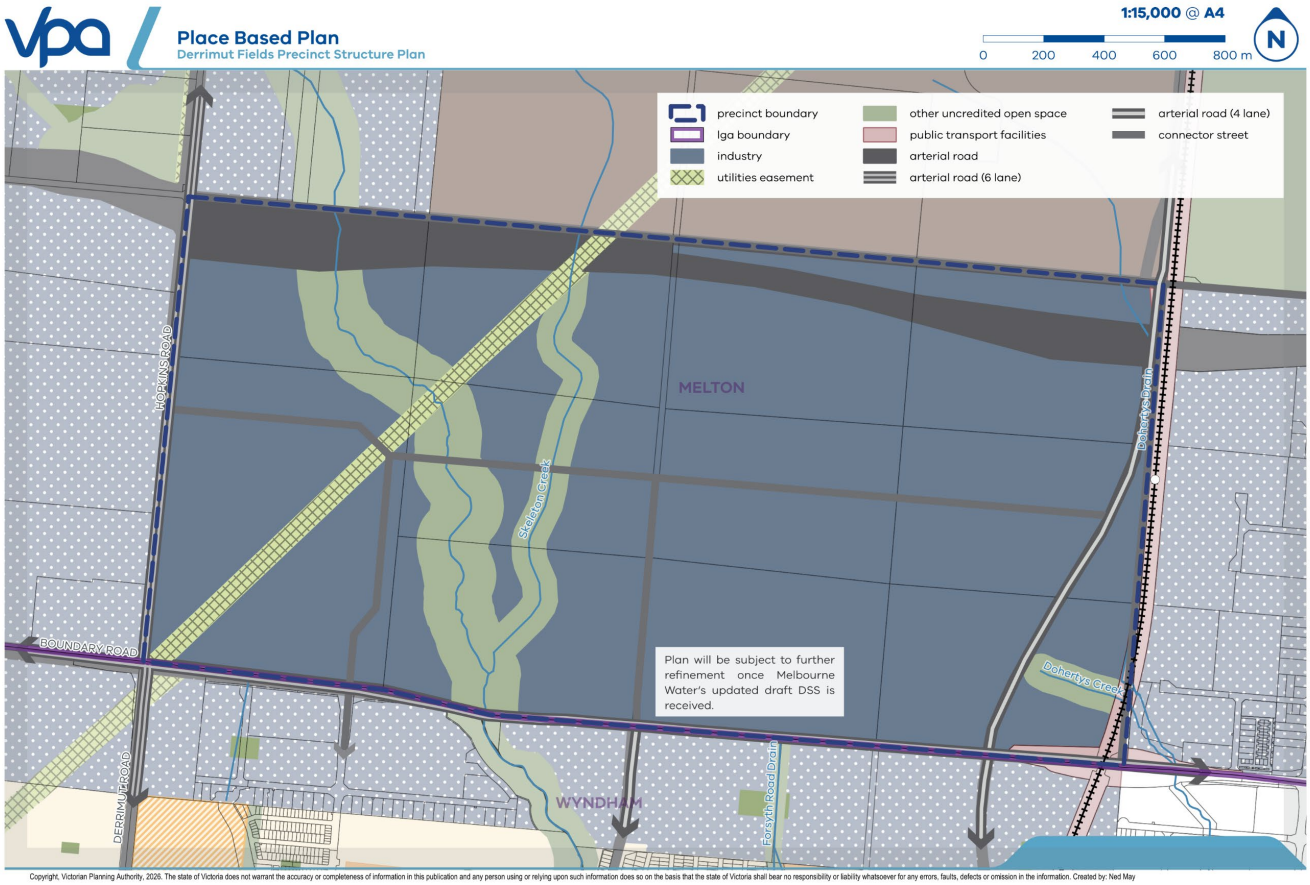


Figure 1 Derrimut Fields Place Based Plan

1.1 Purpose of this report

The purpose of this report is to document the methodology, results and recommendations of the pipeline SMS workshop conducted in August 2026 to review the impacts of the proposed land use change associated with the Derrimut Fields PSP.

1.2 Scope

The scope of work for the Derrimut Fields Precinct pipeline SMS was to conduct a half-day workshop with key stakeholders selected by the Department of Transport and Planning (DTP) to:

– Seek input from key stakeholders
– Consider risks to the gas pipelines associated with the proposed land use changes
– Identify potential actions for meeting the requirements of AS2885

The assessment considers the current pipelines within and in close proximity to the designated Derrimut Fields precinct (as listed in Section 2.1) and their existing state only; any consideration of modification or upgrade to existing pipelines and/or any future pipelines is excluded from the scope.

1.3 Limitations

Asset locations

The precise locations of some underground assets in and around the site were not provided by the asset owners in time for the workshop. Refer to Table 2 on Page 7 for further information.

Pipeline information

APA provided a selection of pipeline documentation prior to the workshop, however the following were not supplied:

– Existing Pipeline SMS registers/worksheets for the four pipelines
– Information on the procedural controls in place (pipeline integrity management plans, operating procedures, etc.)
– SMS databases (records of third-party activities undertaken in proximity to the pipelines)

APA advised that the procedural controls and relevant SMS database information would be confirmed during the workshop however, on the day, APA participants reported technical difficulties that prevented access to the documents.

As a result:

– While a draft pipeline SMS register was prepopulated with high level information prior to the workshop, the study relied on APA participants confirming the details of existing threats and protection controls during the workshop
– APA were unable to answer some questions that arose during the workshop
– The pipeline SMS register was updated to incorporate further information on the existing controls and risk ratings provided by APA after the workshop

General

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2. Context

2.1 Derrimut Fields

Derrimut Fields is located within the Melton City Council Local Government Area (LGA). The south boundary of the site is the interface between the Melton City Council LGA and the Wyndham City Council LGA.

The precinct is approximately 517 hectares in size and:

1. Has relatively flat topography, a creek and scattered trees
2. Is currently characterised as having agricultural (i.e. rural and semi-rural) land use
3. Contains 11 parcels of land, owned by five private landowners
4. Contains a number of dry-stone walls, including a Heritage Overlay (HO)

The precinct is within an Urban Growth Zone (UGZ) a designation which, as defined by the Victorian Planning Provisions [5], is used to facilitate the transition of non-urban land to urban uses in accordance with a PSP. The UGZ allows existing land uses to continue until redevelopment occurs in accordance with the approved PSP.

DTP is leading the preparation of the PSP in consultation with Melton City Council, utility service providers, and other key stakeholders. The precinct has been selected for industrial development and is supported by strategic plans that identify it as a future State Significant Industrial Area with the capacity for 7,100 new jobs. The precinct is considered favourable for industrial land use due to its location in proximity to the Western Freeway, the future Western Intermodal Freight Terminal and existing industrial areas. Development within the precinct is aimed at delivering manufacturing, warehousing, logistics, data centres and large format industrial estates.

There are four APA natural gas pipelines within or in close proximity to the precinct. Two pipelines (T56 and T112) that run east-west near Middle Road and two pipelines (T62 and T118) commence just outside the site boundary to the north-west near the intersection of Middle Road and Hopkins Road, noting these two pipelines run north:

– **Pipeline T56 (Brooklyn to Ballan)**

  This 200 millimetre (mm) diameter pipeline travels in a westerly direction from the Brooklyn Compressor Station to the Ballan Bifurcation (pipeline junction). The pipeline was commissioned in 1972.

– **Pipeline T62 (Derrimut to Sunbury)**

  This 150mm diameter pipeline travels in a northerly direction from two branch valves at the Hopkins Road and Middle Road intersection to Meter Station M045 at Sunbury City Gate. The pipeline was commissioned in 1979.

– **Pipeline T112 (Brooklyn to Lara)**

  This 500mm diameter pipeline travels in a south westerly direction from a valve on the Brooklyn BCP City Gate at Jones Road Brooklyn to the Lara South West Pipeline (SWP) City Gate. This pipeline was commissioned in 2008.

– **Pipeline T118 (Truganina to Plumpton)**

  This 500mm diameter pipeline travels in a northerly direction from three branch valves at the Hopkins Road and Middle Road intersection to the Plumpton Pressure Reduction Station (PRS). This pipeline was commissioned in 2012.

The approximate position of these pipelines within the precinct boundary is shown in Figure 2.

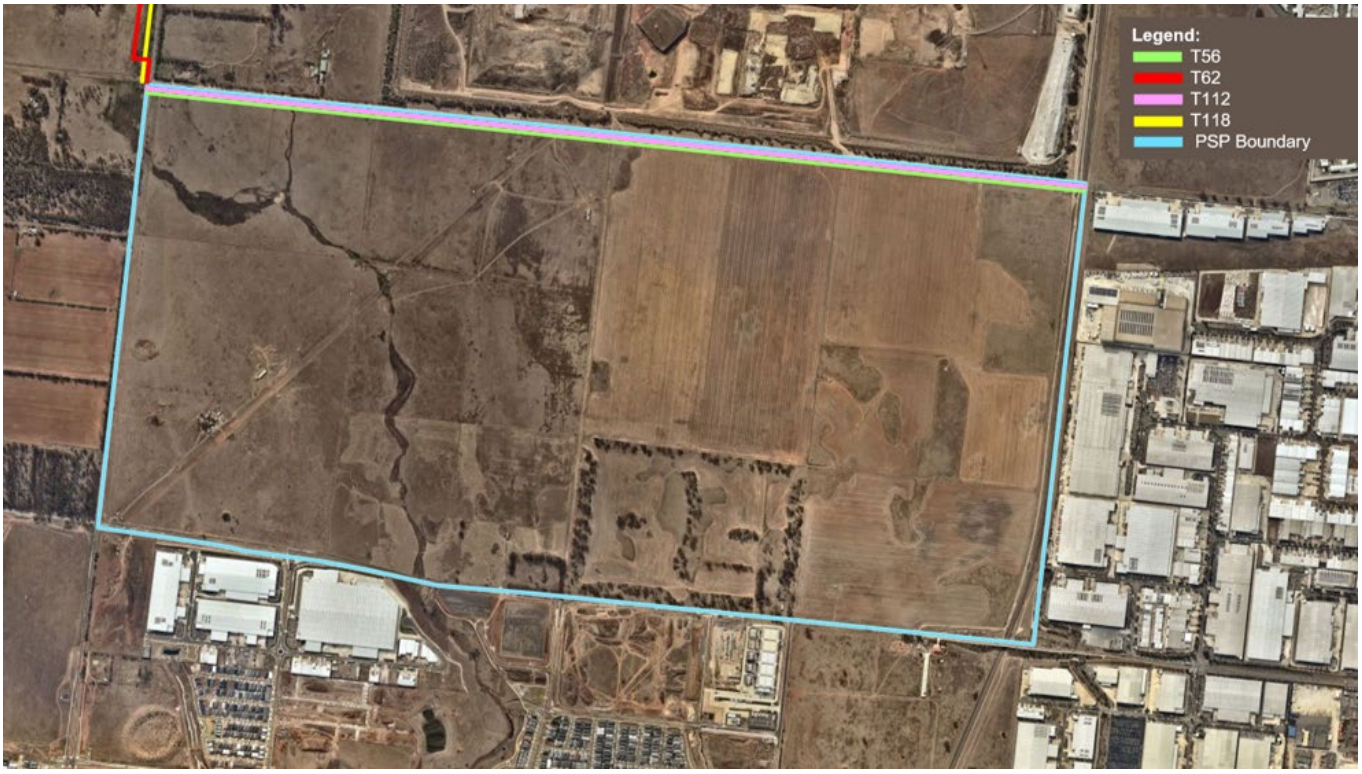


Figure 2 Approximate pipeline locations within and in proximity to the Derrimut Fields PSP boundary

Based on Before You Dig information [6], there are multiple additional asset owners with underground infrastructure in and around the site. These are listed in Table 2, along with the location if provided by the asset owner, noting some asset owners had not yet provided details at the time of the workshop.

Typical activities associated with these types of infrastructure include:

– Routine inspection
– Maintenance
– Repair
– Renewal and upgrade works

These activities can involve excavation, trenching, boring, directional drilling, pit and valve access, vegetation clearance, access track maintenance, heavy vehicle movements and craneage.

It is also noted that there are existing roads and proposed roads (e.g. the Outer Metropolitan Ring corridor) within or in proximity to the precinct. Road construction, maintenance and upgrade works associated with the change in land use may involve repeated excavation, boring, trenching, heavy vehicle movements and the use of compaction or lifting equipment.

Table 2 Summary of asset owners

Asset owner	Infrastructure	Location
Water		
Greater Western Water	Sewer	– Adjacent to Hopkins Road – South-east corner of the site – At a number of locations to the south of Boundary Road
Greater Western Water	Potable water	– Adjacent to Boundary Road
Melbourne Water Corporation	*Information pending*	– To be confirmed
Melton Shire Council	Stormwater pipes and pits	– Multiple locations on the west of the site – East of Christies Road
Power		
AusNet Transmission Group Pty Ltd	HV Transmission Lines	– Crossing the site from the south-west corner to mid site in the north
Powercor Australia (Sunshine)	High voltage cables Low voltage cables Distribution substations	– Multiple
Rail		
VicTrack Access	Rail reserve	– Adjacent to the east boundary
Telecommunications		
FibreconX Pty Ltd	FibreconX conduits	– Adjacent to three sides of site boundaries: Hopkins Road, Boundary Rd and Middle – Crossing the site in northerly direction to the east of Skeleton Creek
NBN Co VicTas	Buried cables Trenches for designed/planned cables	– Multiple
Nextgen (VIC)	Cables	– Along the west and north boundaries of the site
Optus Vic	Cables	– Along Hopkins Road
Swoop	Fibre conduit	– Along Middle Road
Telstra	Buried cable	– Multiple
Vocus (Primus VIC)	Pit and conduit	– Adjacent to the south-west site boundary
Other		
Ventia Australia	Ventia service area	– Along Hopkins Road
AusNet Gas Services	*Information pending*	– To be confirmed

2.2 Pipeline Standards and Legislation

2.2.1 Pipelines Act 2005

The Victorian *Pipelines Act 2005* [7] establishes the regulatory framework for the development, construction, operation and protection of specified pipelines in Victoria, including natural gas (petroleum) pipelines with an operating pressure greater than 1050 kPa. The protection of the public from environmental, health and safety risks resulting from these pipelines is also covered. This includes the obligation for pipeline operators to prepare and regularly review Safety Management Plans and carry out operations in accordance with their plans.

Sections of the Act to consider as part of the proposed land use changes (and associated future construction) at Derrimut Fields are listed in Table 2, noting a summary description is provided for each section in the table and the Act should be referenced for the full obligation text.

Table 3 Key sections in the Pipelines Act

Section	Title	Summary
117	Offence to obstruct operation of pipelines	Obstructing operation of the pipeline or pipeline works is not permitted
118	Digging near pipelines	Excavating, boring or opening ground within 3 metres of a pipeline without authority or suitable notice is not permitted
119	Interference with pipeline	Knowingly, recklessly or negligently breaking, damaging, opening or tampering with any pipeline is not permitted
120	Restriction on building on land near pipeline	Buildings must not be constructed directly above or within 3 metres zone above of a buried pipeline without Ministerial consent
123	Third party access to easements	Access to a pipeline easement to construct or operate another pipeline, an electric line or another facility requires pipeline owner agreement or Ministerial approval.

2.2.2 Australian Standard (AS) 2885:2018

The *AS/NZS 2885:2018 Pipeline systems – High pressure* series of standards, in six parts, establishes the requirements for onshore and submarine pipeline systems, typically steel pipelines that transport gas or liquid petroleum. This includes requirements for:

– Safe design, construction, inspection, testing, operation and maintenance
– Protection of the general public and operating personnel
– Security of supply
– Protection of the environment
– Protection of the pipeline system against accidental damage

Part 6, Pipeline safety management [8], specifies the Safety Management process for pipelines throughout the lifecycle of the pipeline. This includes coverage of the requirements where a change in land use may bring about a change in consequence and/or risk.

Location classification

A part of the SMS process is assigning a location classification / location class for the land use in the area the pipeline crosses. The Location Class can be defined as the classification of an area according to its predominant land use and density of human activity, reflecting both the threats to the pipeline system from the land usage and the consequences for the population, should the pipeline system suffer a loss of containment. For the selection of location class, the area along the pipeline route and the surrounding land uses are considered. Sections of the standard providing key information on location classification are:

– AS 2885.0 [9], Section 1.5.37, which defines location class
– AS 2885.6, Section 2, which provides detail including
    - Section 2.1 describing the process for sectioning the pipeline for the purposes of location classification

- Section 2.2 describing the determination of location classes
- Section 2.3 which defines the primary location classes
- Section 2.4 which defines the secondary location classes

There are four primary location classes to select from, and one or more secondary location classes may also apply.

Land use change

Changes in the land use within the measurement length of the pipeline may increase the likelihood or consequence of a pipeline failure [9]. The measurement length represents the distance at which an ignited rupture of the pipeline will cause at least second degree burns after 30 seconds exposure (a radiation intensity of 4.7 kW/m^2).

As a result, the standard recognises that the SMS process should be used to review the changes in risk to and from the pipeline when a land use change is anticipated.

Sections of the standard providing key information on this topic are:

– AS 2885.0 Section 1.5.34, which defines land use change
– AS 2885.6 Section 1.5.1, which states that SMS studies are required across the lifecycle of the pipeline, including in the case of land use change
– AS 2885.6 Section 5.5.2, which provides guidance on the objectives, input information and methodology required for the land use change SMS, including noting that a workshop is required

3. SMS Process

3.1 Methodology

Australian Standards Gas and Liquid Petroleum, Part 6 – Pipeline Safety Management (AS2885.6:2018) [8] defines the overall pipeline SMS process and provides a flowchart summary as shown in Figure 4 overleaf.

In the case of a land use change SMS, the workshop is comparative exercise looking at the existing situation and the anticipated changes arising from the proposed land use changes. This is achieved via the workshop steps shown in Figure 3 below. Additional detail is provided in the following sections.

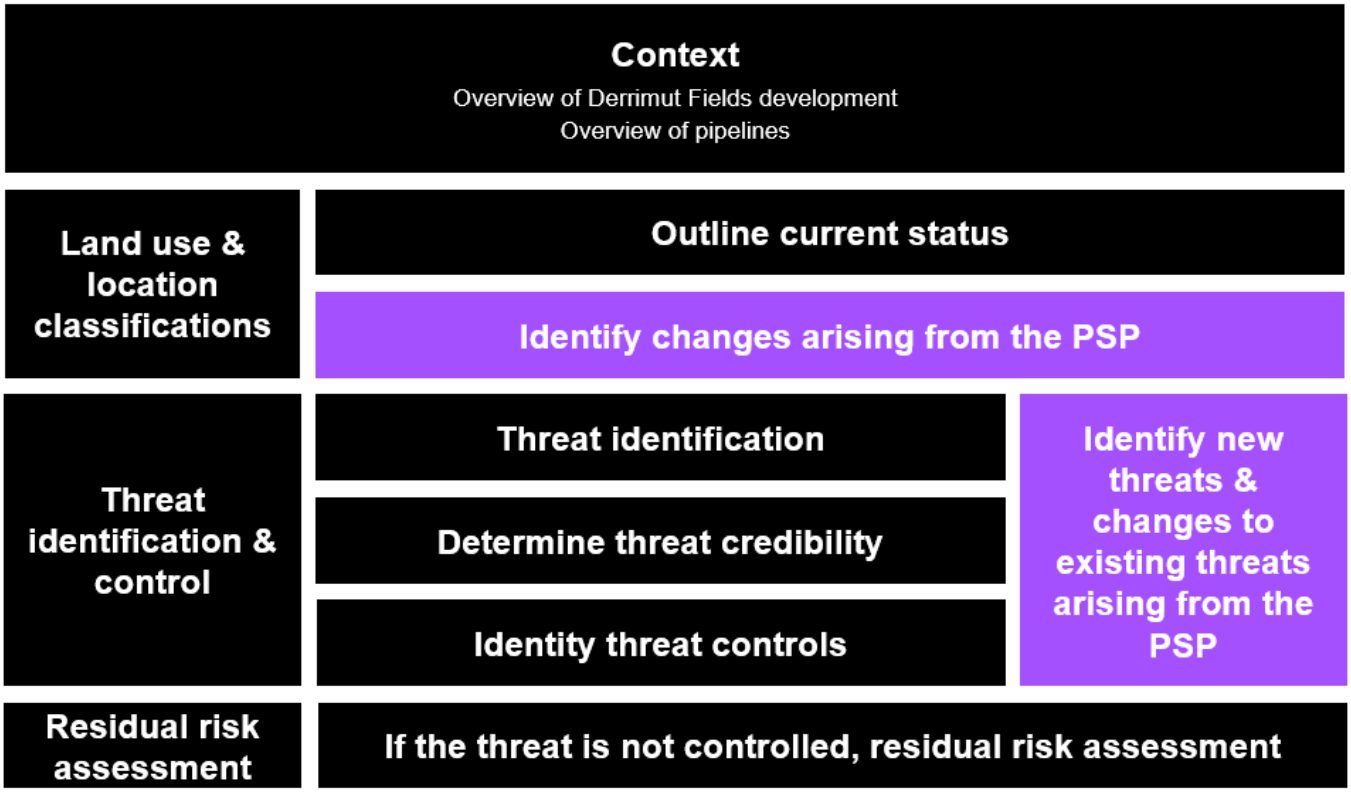


Figure 3 ***Workshop steps***

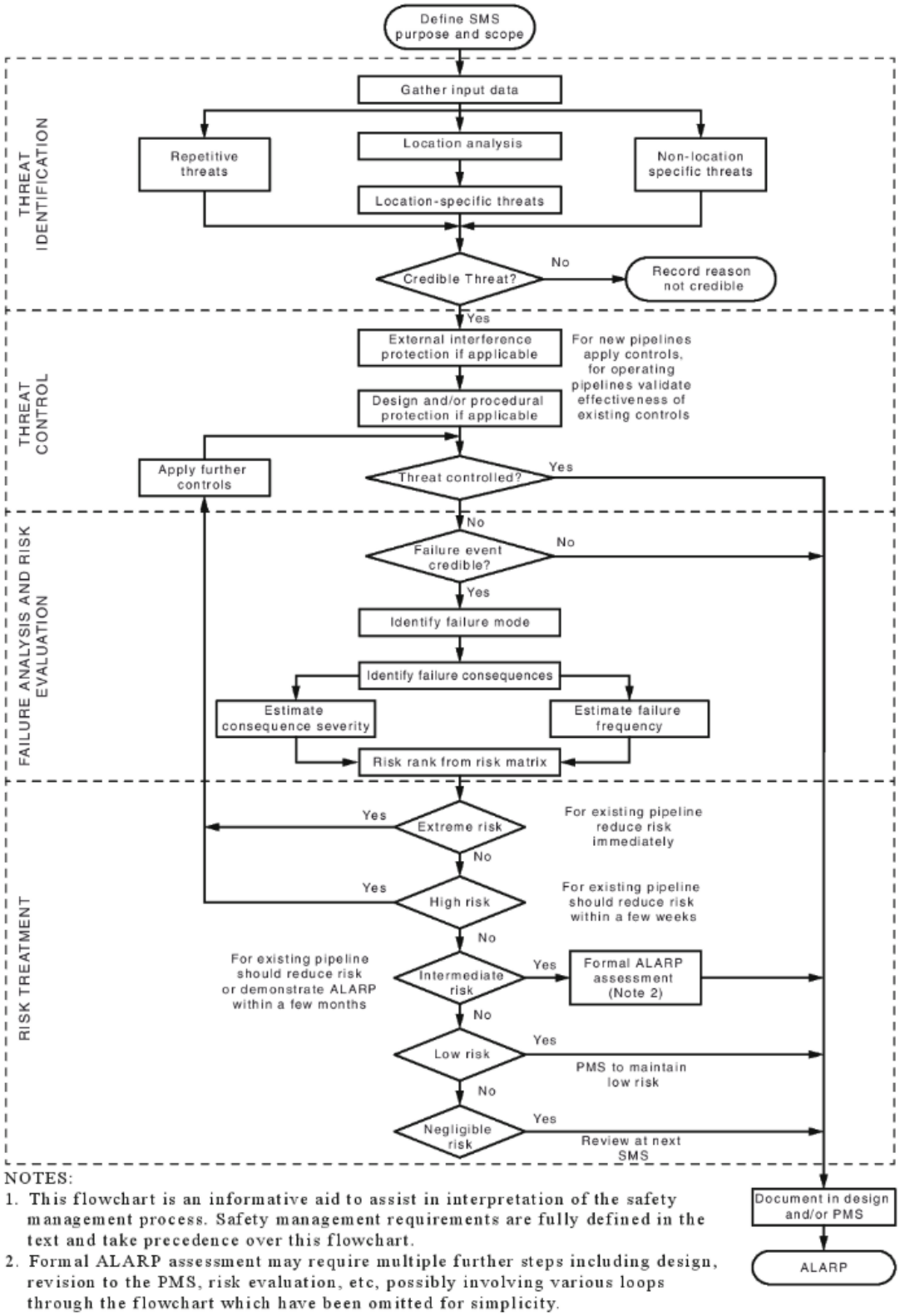


Figure 4 ***Safety management process flowchart (from Appendix A of AS2885.6)***

3.1.1 Location classification

During this step, the team determines whether the proposed land use changes are expected to lead to any changes in the pipeline location classifications, with reference to the AS 2885.6 classification descriptions provided in Appendix A.

3.1.2 Threat identification

This step aims to identify threats to the pipeline with the potential to:

– Damage the pipeline
– Cause interruption to service
– Cause release of fluid from the pipeline
– Cause harm to construction personnel, pipeline operators, the public or the environment

The focus of the process is on identifying any changes to existing threats and new threats that may be introduced by the proposed land use changes for the precinct.

The categories used as prompts during the identification process are shown in Figure 5.

Threat Sources	
External Interference	**Corrosion**
Faults in operations, maintenance and management systems	
Natural events	**Intentional Damage**
Faults in design, material of construction	**Other**

Figure 5 Threat sources

3.1.3 Threat control

Identified threats are controlled by physical and procedural controls, with the typical control categories for each displayed in Figure 6 and Figure 7 respectively. The workshop team determines if additional controls are required for any new or changed threats identified in the previous step.

Physical Controls	
Separation	**Resistance to penetration**
Burial	**Wall thickness**
Exclusion	**Barrier to penetration**
Barrier	

Figure 6 Physical controls for pipeline safety

Procedural Controls	
Liaison (with landowner, occupier, third party)	**Agreements with other entities**
Third-party awareness programs	**Planning notification zones**
One-call services	**Patrolling and surveillance**
Marking	**Remote intrusion monitoring**

Figure 7 Procedural controls for pipeline safety

3.1.4 Risk ranking and criteria

In a Pipeline SMS, qualitative risk assessment is undertaken when there is a credible threat with insufficient physical and procedural controls for the land use classification. Where a risk assessment has been performed, and the risk cannot be reduced to 'Low' or 'Negligible' action should be taken to:

– Remove the threat or apply additional controls

If this is not successful in reducing the risk to intermediate or lower, then

– Formal As Low As Reasonably Practicable (ALARP) assessment is required

The AS2885.6:2018 severity and frequency classes and Risk Matrix used for risk ranking are provided overleaf.

Based on the results, potential actions are developed if required.

Risk Criteria

The AS2885.6:2018 Risk Matrix is shown in Table 4 and the associated definitions for severity and frequency classes are shown in Table 5 and Table 6.

Table 4 AS 2885.6:2018 Risk matrix

	Catastrophic	Major	Severe	Minor	Trivial
Frequent	Extreme	Extreme	High	Intermediate	Low
Occasional	Extreme	High	Intermediate	Low	Low
Unlikely	High	High	Intermediate	Low	Negligible
Remote	High	Intermediate	Low	Negligible	Negligible
Hypothetical	Intermediate	Low	Negligible	Negligible	Negligible

Table 5 AS 2885.6:2018 Severity classes

	Severity class				
Dimension	**Catastrophic**	**Major**	**Severe**	**Minor**	**Trivial**
People	Multiple fatalities result	One or two fatalities; or several people with life-threatening injuries	Injury or illness requiring hospital treatment	Injuries requiring first aid treatment	Minimal impact on health and safety
Supply	Widespread or significant societal impact, such as complete loss of supply to a major city for an extended time (more than a few days)	Widespread societal impact such as loss of supply to a major city for a short time (hours to days) or to a localised area for a longer time	Localised societal impact or short-term supply interruption (hours)	Interruption or restriction of supply but shortfall met from other sources	No loss or restriction of pipeline supply
Environment	Impact widespread; viability of ecosystems or species affected; or permanent major changes	Major impact well outside pipeline corridor or site; or long-term severe effects; or rectification difficult	Localised impact, substantially rectified within a year or so	Impact very localised and very short-term (weeks), minimal rectification	No effect; or minor impact rectified rapidly (days) with negligible residual effect

Table 6 AS 2885.6:2018 Frequency classes

Frequency class	Frequency description
Frequent	Expected to occur once per year or more
Occasional	May occur occasionally in the life of the pipeline
Unlikely	Unlikely to occur within the life of a pipeline, but possible
Remote	Not anticipated for this pipeline at this location
Hypothetical	Theoretically possible but would only occur under extraordinary circumstances

3.2 Assumptions

The assumptions used for the Pipeline SMS study, as agreed with the workshop team, were:

– Pipelines are operated and maintained in line with their design intent and with AS 2885 requirements
– Pipelines protective systems are tested as required
– Accurate information on the design of the OMR is not yet available to the Derrimut Fields PSP team and consideration of the Outer Metropolitan Ring (OMR) road is outside the scope of this assessment; a separate pipeline SMS study will be conducted by the relevant team as part of the OMR project

3.3 Pipeline SMS register

The workshop minutes are recorded in a pipeline SMS register (MS Excel format). This is displayed on screen during the workshop to allow attendees to review the information as it is captured to confirm accuracy.

To provide a starting point for discussions, a draft pipeline SMS register was prepared prior to the workshop, prepopulated with high level information based on the APA's existing pipeline SMS report.

3.4 Reference information

The information listed in Table 7 was available for reference during the Pipeline SMS workshop.

Table 7 Input Information

Document Number/s	Rev. / Date	Title
Pipeline Route Plans		
T56-17	Rev 2	200 Brooklyn – Ballan Transmission Pipeline Route Plan
T56-18	Rev J	200 Brooklyn – Ballan Transmission Pipeline Route Plan
T62-13	Rev 2	150 Deer Park – Sunbury Transmission Pipeline Route Plan Deer Park
T112-17	Rev 1	500 Brooklyn – Lara Transmission Pipeline Route Plan
T112-18	Rev 2	500 Brooklyn – Lara Transmission Pipeline Route Plan
T118-18	Not specified	500 Truganina – Plumpton Transmission Pipeline Route Plan
Pipeline Design Information		
Extracts from APA's T56 Brooklyn to Ballan Fracture Control Plan 6/04/2026 (pp. 8, 13, 18 – 22) Extracts from APA's T62 Derrimut to Sunbury Pipeline Fracture Control Plan 2/12/2025 (pp. 8, 13, 17 – 19) Extracts from APA's Licence 266 – T112 Brooklyn to Lara Pipeline Fracture Control Plan (pp. 9, 13, 17 – 22) Extracts from APA's Licence 122 – T118 Truganina to Plumpton Pipeline Fracture Control Plan (pp. 9, 14, 18 – 21)		
Pipeline SMS Study		
320-RP-OM-0037	Rev 1.0	Report: Asset Management: Safety Management Study Report: Victorian Transmission System - Melbourne Pipelines [10]

The route plans and design information listed above and provided to participants at the workshop are shown in Appendix C, Appendix D, Appendix E and Appendix F.

4. Results

The SMS workshop was conducted on 12 August 2026 at the DTP Head Office, with additional attendees participating online via Microsoft Teams. The workshop was facilitated and recorded by independent risk professionals from GHD.

A list of attendees for the workshop is shown in Table 8. The group included sufficient disciplines, knowledge and experience to provide confidence that the results from the workshop are soundly based. Due to the nature of the PSP, in addition to the pipeline owner (APA), DTP invited multiple stakeholders associated with the site and development. This included Melton City Council, individual landowners and their respective consultants (e.g. Colliers, ESR, etc.).

Table 8 SMS workshop attendees

Name	Role	Company	In person	Online
Katrina Cook	SMS Facilitator	GHD	Y	-
Diya Redhu	SMS Scribe	GHD	Y	-
Lou Hawkins	Strategic Planning Manager	DTP	Y	-
Henry Kassay	Senior Strategic Planner	DTP	Y	-
Cindy Tran	Strategic Planner	DTP	Y	-
Fadhlan Sahid	Strategic Planner	DTP	Y	-
Tejas Deshmukh	Coordinator Strategic Planning	Melton City Council	Y	-
Hassaan Ahmad	Water & Infrastructure Engineer	DTP	-	Y
Garfield D'Costa	Senior Water & Infrastructure Engineer	DTP	-	Y
Eyal Cohen	Landowner	-	-	Y
Laura Kreet	Senior Urban Planner	Colliers	-	Y
Martein Bouwmeester	Infrastructure Project Manager	ESR	-	Y
Michael Mielczarek	Senior Urban Planner	APA	-	Y
Monica Ceckiewicz	Planner	Insight Planning Consultants	-	Y
Ka Lok Su	Pipeline Engineer	APA	-	Y
Nick Hooper	Town Planner	Taylors	-	Y
Ashikul Islam	Development Engineer	APA	-	Y
John Mathios	Civil Engineer	DPM	-	Y
Johnathon Chapman	Planning Manager	ESR	-	Y

4.1 Pipeline SMS Register

The results of the workshop were captured in the pipeline SMS register, provided in Appendix A.

In response to the pipeline information limitations described in Section 1.3, additional input on the existing controls and risk rankings was provided to DTP by APA after the workshop [11] and has been incorporated into the register.

4.2 Location classification

During the workshop, the team identified the predicted location classification changes for each pipeline based on the land use changes associated with the Derrimut Fields PSP. The results are provided in Table 8.

Table 9 Identified change in location classification as per AS2885.6:2018

Horizontal distance (m)	Current location classification from APA report [10]		Predicted location classification with development			Notes
	Primary	Secondary	Primary	Secondary		
T56 Brooklyn to Ballan						
Measurement length advised by APA = 170 m						
10.84 – 10.921	T1	I	T1	I		– No change
10.921 – 14.10	T1	-	T1	I		– For the PSP development, the team assigned a secondary location classification of I for the pipeline section along the northern boundary
T112 Brooklyn to Lara						
Measurement length advised by APA = 525 m						
10.36 – 10.855	T1	S	T1	S	I	– No change to S classification (which is due to a remand centre located to the north-east) – For the PSP development, the team assigned a secondary location classification of I for the pipeline section along the northern boundary
10.855 – 10.911	T1	S	T1	S	I	– No change to S classification (which is due to a remand centre located to the north-east) – For the PSP development, the team assigned a secondary location classification of I for the pipeline section along the northern boundary
10.36 – 13.62	T1	-	T1	-	I	– For the PSP development, the team assigned a secondary location classification of I for the pipeline section along the northern boundary
T62 Derrimut to Sunbury (named Deer Park – Sunbury on the drawing)						
Measurement length advised by APA = 150 m						
0.00 to 0.15	T1	-	T1	I	-	– For the PSP development, the team assigned a secondary location classification of I for the pipeline section from the start of the pipeline at 0.0 to the pipeline measurement length.
T118 Truganina to Plumpton						
Measurement length advised by APA = 525 m						
0.00 to 0.525	T1	-	T1	I	-	– For the PSP development, the team assigned a secondary location classification of I for the pipeline section from the start of the pipeline at 0.0 to the pipeline measurement length.

4.3 Threat identification and protection controls

The team discussed and reviewed 17 threats related to the pipelines associated with the Derrimut Fields PSP, the existing protection controls in place, and which threats are expected to be impacted by the land use change. The full results of this process can be viewed in the register in Appendix A.

4.4 Risk control and ranking

For each threat captured in the register, the team assessed if the threat is expected to remain controlled after the land use changes.

No risk ranking of the changes to threats arising from proposed development was undertaken, due to the pipeline information limitations discussed in Section 1.3.

4.5 Recommendations

A total of 14 recommendations were developed during the SMS workshop, as listed in Table 10. The recommendations are grouped by topic for ease of understanding, hence are not presented sequentially in the table.

Further context regarding the recommendations and associated threats can be found in the pipeline SMS register in Appendix B.

Table 10 SMS recommendations

ID	Recommendation
Overarching recommendations	
1	- Determine the typical, permitted land uses within the PSP area which would result in a Sensitive use (S) or Crowd (C) secondary location classification, which are expected to include child care centres and places of workshop (e.g. mosque) - Identify the existing processes that would trigger referrals to APA/ESV, planning requirements and/or the requirement for additional mitigations for these land uses - Consult with APA and the City of Melton to agree on whether the existing processes are sufficient or if additional requirements or mitigation measures need to be included in the PSP; this could include an exclusion zone for these land uses within the measurement distance or within the distance for the most credible threat (pipeline leak)
2	One or more data centres are considered a likely potential land use within the PSP area. These facilities often include significant fuel storage, e.g. diesel for generators. This would introduce the risk of a fuel storage fire escalating to the pipeline or vice versa. Determine if limitations for the location of fuel storage and/or the requirement for additional controls are required within the PSP; this could include a buffer zone within the measurement distance or within the distance for the most credible threat (pipeline leak). Consultation with APA and landowners may be required as part of the decision-making.
3	While outside the scope of this assessment, it was identified that the future Outer Metropolitan Ring (OMR) road development is likely to lead to Common Infrastructure Corridor (CIC) and/or Crowd (C) secondary location classifications. Notify the team responsible for the OMR and consult with them to determine if there are any implications of this that need to be considered in the PSP.
14	APA to confirm what additional controls are currently in place for all threats recorded in this register and the missing current risk rankings (as full details were not provided prior to the workshop and APA experienced technical issues during the workshop).
External interference recommendations	
4	APA to confirm that the existing controls in place to manage 20T, 25T, and 30T excavator threats to the pipelines are also sufficient to manage the threats posed by larger excavators up to 90T.
5	While outside the scope of this assessment, it was identified that graders and dozers are likely to be used for construction of the Outer Metropolitan Ring (OMR). Consult with the team responsible for the OMR regarding the design and potential equipment to be used during construction to determine if there are any implications that need to be considered in the PSP.
6	Once transport modelling information and Development Services Schemes (DSS) are available, determine if there are any changes required to the Horizontal Directional Drilling threat assessment.
7	Identify, for example through the agency validation process, the assets of other authorities within the PSP area that may traverse north-south through Middle Road, e.g. branch sewers within the catchment. Based on the results, determine if there are any changes required to the Horizontal Directional Drilling threat assessment.
Other threats recommendations	
8	Data centres are considered a likely potential land use within the PSP area. Determine if limitations and/or the requirement for additional controls are required within the PSP to prevent data centre high voltage lines causing induced current in the pipelines.
9	Confirm with Melbourne Water that there is no increased risk of flooding near the pipelines arising from the PSP development.

ID	Recommendation
10	Once the traffic modelling is available, in consultation with APA and AusNet, review the requirement for additional control measures for the Rockbank City Gate on the corner of Christies and Middle Roads, to prevent vehicle impacts, e.g. Armco railing.
11	While outside the scope of this assessment, it was identified that the OMR may lead to an increased potential for vehicle impact at the Truganina Offtake City Gate (on the corner of Hopkins and Middle Roads). Communicate this information to the OMR team.
12	In consultation with APA, determine the appropriate triggers for referral to APA for proposed developments involving the storage and handling of dangerous goods or fuel and any requirements to be captured in the PSP. This could include referral if storage is with a certain distance and/or the controls required (e.g. separation distance, instrumented controls and trips).
13	APA noted that it is preferred that linear open space above and around the pipelines be maintained to allow access or, if this is not possible, that the pipelines remain within the frontage of industrial properties. If there were to be a loss of access there is a requirement for recoating the pipelines with associated increasing costs. DTP to determine the implications of this on the PSP.

APA consultation

After the SMS workshop, DTP requested additional information from APA for selected recommendations to support the PSP process. APA's responses [11] are presented in Table 10 below (with minor edits for clarity).

Table 11 APA response to recommendations

ID	DTP request	APA response
1	Please confirm relevant exclusion zone/s of the pipeline, including their length, and what general outcomes are required for each zone (e.g. construction management plan.	The most critical distance to be included in the PSP would be the credible threat distance (leak/area of consequence) for each pipeline. **Brooklyn – Lara pipeline** Leak Zone = 85m either side of pipeline **Brooklyn – Ballan pipeline** Leak zone = 70m either side of pipeline (APA suggests only mapping/referencing the larger zone to avoid confusion, as the overlap will capture both these pipelines) These two leak zones will also capture the zones of the two pipelines that are located outside of the PSP area. Triggers should apply to any sensitive land uses within this area such as: – Accommodations (other than dependent persons unit and dwelling) – Aged care facilities – Childcare / family day care centres – Cinema-based entertainment facility – Prisons / corrective institutions. – Schools or other educational establishments – Hospitals – Place of assembly or worship – Higher density residential uses (greater than 50 dwellings per hectare) As well as uses which may impact the safe operation of the pipeline within the credible threat area such as – Quarrying – Service station

ID	DTP request	APA response
		– Storage of fuel and Dangerous Goods – Data centres (see reasons in response to recommendations 2, 8) A Construction Management Plan would only be required for substantial construction activities, e.g. the development of the new industrial estate within 50m of the pipeline easement. This would ensure that new services and road construction etc. would not impact the pipeline.
2	Please confirm what controls (if any) APA require in the planning scheme amendment for data centres.	Notice to APA for any data centre applications within the pipeline area of consequence (leak zone) rather than the full pipeline measurement length for data centres would be beneficial. APA would be looking to ensure that any substations/high voltage power does not impact the pipeline, as well as the storage of large volumes of fuel for backup generators.
4	APA to confirm that the existing controls in place to manage 20T, 25T, and 30T excavator threats to the pipelines are also sufficient to manage the threats posed by larger excavators up to 90T.	Confirm
8	*Refer to recommendation 2*	
12	Please confirm APA's referral requirements.	As per response to recommendation 2, trigger and referral should only be for development within the pipeline area of consequence (leak zone) rather than the full pipeline measurement length.
14	APA to confirm what additional controls are currently in place for all threats recorded in this register and the missing current risk rankings (as full details were not provided prior to the workshop and APA experienced technical issues during the workshop).	Additional control and risk ranking information marked up by APA on the Pipeline SMS register. *Note that this information has been incorporated into Appendix B, as noted in Section 4.1.*

4.6 Discussion

The pipeline SMS workshop was conducted relatively early in the PSP development process. GHD understands that this is in line with DTP's preference to gain an early understanding of the likely implications of pipeline SMS requirements on land use planning and to get the process started.

Not all information typically required for a land use change SMS workshop was available at the workshop, as noted in Section 1.3. As a result:

– To manage uncertainties, recommendations were recorded where it was identified that additional information is needed to identify, understand or manage the risks
– Risk rating of the threats for changes arising from the proposed development could not be completed and ALARP assessment was not possible

Nevertheless, the workshop achieved a number of successful outcomes including:

– Informing stakeholders (including local government, landowners and their consultants) of the PSP context and the requirements of AS2885.6
– Providing stakeholders with the opportunity to share their views, provide feedback and ask questions
– Identifying uncertainties that require further investigation and/or liaison with other parties (e.g. OMR team)
– Developing an initial pipeline SMS register that
    - Provides a sound basis for early DTP planning for the Derrimut Fields PSP
    - Can be updated and refined as recommendations are closed out and the PSP progresses

5. Conclusion

A half-day pipeline SMS workshop for the Derrimut Fields PSP was conducted on 12 August 2026 at the DTP Head Office with key stakeholders selected by the Department of Transport and Planning (DTP), including some participating online via Microsoft Teams. The work was completed with reference to AS2885.6:2018 [8] and considered threats to the four gas pipelines within and in close proximity to the Derrimut Fields precinct arising from the proposed change in land use for the Derrimut Fields PSP.

The workshop achieved a number of successful outcomes including:

– Informing stakeholders (including local government, landowners and their consultants) of the PSP context and the requirements of AS2885.6
– Providing stakeholders with the opportunity to share their views, provide feedback and ask questions
– Identifying uncertainties that require further investigation and/or liaison with other parties (e.g. OMR team)
– Developing an initial pipeline SMS register of 17 threats, that
    - Provides a sound basis for early DTP planning for the Derrimut Fields PSP
    - Can be updated and refined as recommendations are closed out and the PSP progresses

Not all information typically required for a land use change SMS workshop was available at the workshop. As a result, risk rating of the threats for changes arising from the proposed development and ALARP assessment were not undertaken.

The workshop team identified a total of 14 recommendations including:

– Threats for which the PSP may need to include limitations or require additional controls (such as data centre fuel storage)
– Recommendations relating to external interference threats and to other threats
– Recommendations relating to potential sensitive land uses within the precinct
– Areas where additional information/investigation is required to fully identify, understand or manage the risks

The Pipeline SMS workshop is the start of the risk management process, not the end. The success of study in supporting DTP's land use planning will be dependent on the:

– Effective and timely close out of the recommendations
– Update and refinement of the Pipeline SMS register as further information becomes available and the PSP progresses
– Appropriate integration of the study findings within the PSP

6. References

[1] Ned May 2026, *Place Based Plan: Derrimut Fields Precinct Structure Plan*, Victorian Planning Authority, Melbourne.

[2] GHD 2026, *Preliminary Pipeline SMS Information Report: Derrimut Fields Precinct*, rev. A, GHD, Melbourne.

[3] Victorian Planning Authority 2021, *Precinct Structure Planning Guidelines: New Communities in Victoria*, VPA, Melbourne.

[4] Victorian Planning Authority 2026, *Derrimut Fields: Precinct Structure Plan: Pitching Summary Report: May 2026*, VPA, Melbourne.

[5] The Victorian Government 2026, *Victorian Planning Provisions*, ver. 16 June 2026, The State of Victoria, Melbourne.

[6] Before You Dig Australia, Job No 53402010, equity date 11/06/2026.

[7] Parliament of Victoria 2026, *Pipelines Act 2005 (incorporating amendments as at 1 April 2026)*, Authorised Version No. 022.

[8] Standards Australia and Standards New Zealand 2018, *AS/NZS 2885.6:2018 Pipeline systems – High pressure, Part 6: Pipeline safety management (Incorporating Amendment No. 1)*, Standards Australia.

[9] Standards Australia and Standards New Zealand 2018, *AS/NZS 2885.0:2018 Pipeline systems – High pressure, Part 0: General requirements (Incorporating Amendment No. 1)*, Standards Australia.

[10] APA Group 2023, *Report: Asset Management: Safety Management Study Report: Victorian Transmission System - Melbourne Pipelines* (Document No. 320-RP-OM-0037), rev. 1.0, APA, Sydney.

[11] Email from Michael Mielczarek (APA) to Henry Kassay (DTP), *[EXTERNAL] FW: [SEC=OFFICIAL] Derrimut Fields PSP - Safety Management Study Workshop - Request for APA advice on planning controls*, sent 6/10/2026.

7. Terms & abbreviations

Term / abbreviation	Definition
ALARP	As low as reasonably practicable
APA	APA Group Gas Transmission
AS 2885.6	Australian Standard AS 2885.6:2018 *Pipeline systems – High pressure, Part 6: Pipeline safety management*
AS	Australian Standard
BCP	Brooklyn to Corio Pipeline
BYDA	Before You Dig Australia
°C	Degrees Celsius
C	Crowd, a secondary location class under AS 2885
CIC	Common Infrastructure Corridor, a secondary location class under AS 2885
CTE	Coal Tar Enamel (coating)
DN	Diamètre nominal / Nominal diameter
DTP	Victorian Department of Transport and Planning
E	Environmental, a secondary location class under AS 2885
FBE	Fusion bonded epoxy (coating)
ha	Hectare
Heritage Overlay HO	A planning control in the Victoria Planning Provisions [5] that is applied in municipal planning to conserve places and associated elements of local heritage significance and prevent development from adversely affecting them
HI	Heavy Industrial, a secondary location class under AS 2885
I	Industrial, a secondary location class under AS 2885
ILI	in-line inspection
kW/m^2	Kilowatts per square metre
LGA	Local Government Area
Location class	classification of an area according to its predominant land use and density of human activity, reflecting both the threats to the pipeline system from the land usage and the consequences for the population, should the pipeline system suffer a loss of containment.
MAOP	Maximum Allowable Operating Pressure
Measurement length	The radius of the 4.7 kW/m² radiation contour for an ignited rupture, calculated in accordance with AS/NZS AS 2885.6, applied at all locations along the pipeline.
mm	millimetre
MPa	Megapascal
NBN	National Broadband Network
OMR	Outer Metropolitan Ring
PE	Polyethylene
PRS	Pressure Reduction Station
PSP	Precinct Structure Plan
PSR	Precinct Structure Plan: Pitching Summary Report [4]
R1	Rural, a primary location class under AS 2885

Term / abbreviation	Definition
R2	Rural Residential, a primary location class under AS 2885
S	Sensitive use, a secondary location class under AS 2885
SMS	Safety Management Study
(State) Significant industrial land	Strategically located land for major industrial development, as per the Victoria Planning Provisions [5]
SWP	South West Pipeline
T1	Residential, a primary location class under AS 2885
T2	High Density, a primary location class under AS 2885
Urban Growth Zone	A planning control in the Victoria Planning Provisions [4] that is applied in municipal planning to manage the transition of non-urban land into urban land and provide for the development of land and the in accordance with a precinct structure plan
UGZ	
VPA	Victorian Planning Authority
XYZ	XYZ pipeline mapping, a technique that measures pipe centreline latitude, longitude and elevation (i.e. the X, Y and Z axes) for bending strain analysis

Appendices

Appendix A

Location Classifications

Table 12 Summary of location classes as per AS 2885.6:2018

Location class type	Location class	Description from AS 2885.6:2018
Primary location class	Rural (R1)	Land that is unused, undeveloped or is used for rural activities such as grazing, agriculture and horticulture. Rural applies where the population is distributed in isolated dwellings. Rural includes areas of land with public infrastructure serving the rural use (e.g. roads, railways, canals, utility easements).
	Rural Residential (R2)	Land that meets any of the following criteria: i. Defined in a local land planning instrument as rural residential or its equivalent. ii. Occupied by single residence blocks typically in the range 1 ha to 5 ha. iii. Rural or semi-rural areas for which the number of dwellings within the measurement length radius from any point on the pipeline does not exceed approximately 50. Land used for other purposes but with similar population density shall be assigned rural residential location class. Rural Residential includes areas of land with public infrastructure serving the rural residential use (e.g. roads, railways, canals, utility easements).
	Residential (T1)	Land that is developed for community living or is defined in a local planning instrument as residential or its equivalent. Residential applies where multiple dwellings exist in proximity to each other and dwellings are served by common public utilities. Residential includes areas of land with public infrastructure serving the residential use, e.g. roads, railways, recreational areas, camping grounds/caravan parks, suburban parks, small strip shopping centres. Residential land use may include isolated higher density areas provided they are not more than 10% of the land use within a radius of one measurement length at any point on the pipeline. Land used for other purposes but with similar population density shall be assigned Residential location class.
	High Density (T2)	Land that is developed for high density community use or is defined in a local planning instrument as high density or its equivalent. High Density applies where multi-storey development predominates or where large numbers of people congregate in the normal use of the area. High Density includes major sporting and cultural facilities, major retail and business centres (e.g. town centres, shopping malls, hotels and motels) and areas of public infrastructure serving the high-density use (e.g. roads, railways). To assist in determining the location class boundary between T1 and T2, the T2 location class contains more than approximately 50 dwellings per hectare.
Secondary location class	Sensitive use (S)	The sensitive use location class identifies land where the consequences of a failure event may be increased because it is developed for use by sectors of the community who may be unable to protect themselves from the consequences of a pipeline failure event. Sensitive uses are specifically defined in some jurisdictions, but include schools, hospitals, aged care facilities and prisons. Sensitive use location class shall be assigned to any section of the pipeline system where there is a sensitive development within a measurement length. The design requirements for High Density (T2) shall apply.
	Environmental (E)	The Environmental location class identifies locations of high environmental sensitivity to pipeline failure, including particularly areas where pipeline failure may impact on threatened ecological communities or species or where rectification of environmental damage may be difficult. Areas of high environmental sensitivity may be identified by analysis of government environmental mapping within the pipeline measurement length and, where required, may be validated by field surveys conducted by competent persons. A consequence assessment shall be undertaken, and depending on the assessed environmental severity, the requirements of R2, T1 or T2 shall be applied.
	Industrial (I)	The Industrial location class identifies land that poses a different range of threats because it is developed for manufacturing, processing, maintenance, storage or similar activities or is defined in a local land planning instrument as intended for light or general industrial use. Industrial applies where development for factories, warehouses, retail sales of vehicles and plant predominates. Industrial includes areas of land with public infrastructure serving the industrial use. The design requirements for Residential (T1) shall apply.

Location class type	Location class	Description from AS 2885.6:2018
	Heavy Industrial (HI)	Sites developed or zoned for use by heavy industry or for toxic industrial use shall be classified as Heavy Industrial. They shall be assessed individually to assess whether the industry or the surroundings include features that— i. contain unusual threats to the pipeline system; or ii. contain features that may cause a pipeline failure event to escalate either in terms of fire, or for the potential release of toxic or flammable materials. A consequence assessment shall be undertaken, and depending on the assessed severity, the requirements of R2, T1 or T2 shall be applied.
	Common Infrastructure Corridor (CIC)	Land which, because of its function, results in multiple (more than one) parallel infrastructure development within a common easement or reserve, or in easements which partially or fully overlay the pipeline easement. CIC classification includes pipelines within reserves or easements for roads, railways, powerlines, buried cables, or other pipelines. It does not include crossings, roads or tracks which are not gazetted, or where the pipeline is adjacent to but outside a road reserve.
	Crowd (C)	The crowd location class shall be applied to locations where there may be crowds or congestion leading to concentrations of population that are both intermittent and much higher than typical for the prevailing primary location class. Examples include sports fields, roads subject to serious traffic congestion, and rural community halls. Where C location class is assigned, the SMS shall examine risk to the concentration of people with consideration of the number of people, the frequency and duration of assembly, the time of day or week that people are present, and the likelihood that threats and the population concentration will occur at the same time. Controls appropriate to the level of risk shall be applied.

Appendix B

Pipeline SMS Register

Derrimut Fields Precinct Structure Plan Pipeline SMS Register

Line	Applicable pipeline/s T56	T112	T62	T118	Threat Description	Existing situation: Protection Controls - Physical	Protection Controls - Procedural	Protection Controls - Design	Credibility	Consequence Description	Current Risk Rating: Severity	Frequency	Rating	Changes arising from proposed development: Impacted by proposed change in land use?	Description of impact	Is the threat still considered controlled?	Recommendations
External Interference																	
1	Yes	Yes	Yes	Yes	**Excavators** The largest expected excavators in operation on Melbourne pipelines varies between 20T, 25T, and 30T (rock/hard ground locations and some non-High Consequence Area locations) all with general purpose teeth	- Pipeline wall thickness	- Before you dig (BYD) - Pipeline patrolling (daily) - Aerial monitoring - Liaison processes - Fracture control plans - Works on easement require approval - Pipeline Acts requirement for notification to pipeline owner for works within 3m of the pipeline - Pipeline marker posts	- Pipeline wall thickness	General purpose teeth cannot penetrate these pipelines i.e. full bore rupture not credible	-	-	-	-	Yes	Potential for larger excavators to be used for PSP area construction. Based on other developments in Victoria, this could be up to 90T if bulk earthworks are undertaken	No additional controls identified as being required.	4 APA to confirm that the existing controls in place to manage 20T, 25T, and 30T excavator threats to the pipelines are also sufficient to manage the threats posed by larger excavators up to 90T. *Note: Confirmed by APA post-workshop*
2	Yes	Yes	Yes	Yes	**Graders and dozers** used for road maintenance, construction and agricultural activities	- Depth of burial: road maintenance and construction along the pipeline does not usually require excavation to the depth of the pipeline, and agricultural grading is generally shallow - Pipeline wall thickness: based on the resistance to penetration for excavators, equipment normally fitted to these machines will not penetrate the pipeline	- Before you dig (BYD) - Pipeline patrolling (daily) - Aerial monitoring - Liaison processes	- Pipeline wall thickness	Due to depth of cover over the pipelines on the Melbourne system this threat is considered to be controlled.	-	-	-	-	Yes	Some road works (e.g. road widening or improvement to current roads) expected to be required as part of the PSP area development (prior to the Outer Metropolitan Ring (OMR) construction)	No additional controls identified as being required.	5 While outside the scope of this assessment, it was identified that graders and dozers are likely to be used for construction of the Outer Metropolitan Ring (OMR). Consult with the team responsible for the OMR regarding the design and potential equipment to be used during construction to determine if there are any implications that need to be considered in the PSP.
3	Yes	Yes	Yes	Yes	**Bulldozers fitted with rippers** may be used for agriculture (for horticultural production, root ripping, contour bank construction, etc.)	- Depth of burial - Pipeline wall thickness	- Before you dig (BYD) - Pipeline patrolling (daily) - Aerial monitoring - Liaison processes	- Pipeline wall thickness	Sightings (of bulldozers with rippers) are very rare but in consideration of the potential to rupture pipelines were considered credible.	Pipeline rupture	Major	Remote	Intermediate	Yes	Considered significantly lower likelihood that these activities will be conducted once the PSP is in place (as the PSP land will not longer be used for agriculture)	Yes	
										Pipeline leak	Major	Remote	Intermediate	Yes	Considered significantly lower likelihood that these activities will be conducted (as the PSP area will not longer be used for agriculture)	Yes	
4	Yes	Yes	Yes	Yes	**Bulldozers fitted with rippers** may be used for dam construction and maintenance activities	- Depth of burial - Pipeline wall thickness	- Before you dig (BYD) - Pipeline patrolling (daily) - Aerial monitoring - Liaison processes	- Pipeline wall thickness	Sightings (of bulldozers with rippers) are very rare but in consideration of the potential to rupture pipelines were considered credible.	Pipeline rupture	Major	Remote	Intermediate	Yes	Considered significantly lower likelihood (as the PSP does not include dams)	Yes	
										Pipeline leak	Major	Remote	Intermediate	Yes	Considered significantly lower likelihood (as the PSP does not include dams)	Yes	
5	Yes	Yes	Yes	Yes	**Bulldozers fitted with rippers** may be used for services installation in non-High Consequence Areas (non-HCA) areas of the pipeline system	- Depth of burial - Pipeline wall thickness	- Before you dig (BYD) - Pipeline patrolling (daily) - Aerial monitoring - Liaison processes - Works on easement require approval - Pipeline Act requirements for notification to pipeline owner for works within 3m of the pipeline - Pipeline marker posts	- Pipeline wall thickness	Sightings (of bulldozers with rippers) are very rare but in consideration of the potential to rupture pipelines were considered credible.	Pipeline rupture	Severe	Hypothetical	Negligible	Yes	It is expected that there will be an increase in service installation activities during construction within the PSP area.	No additional controls identified as being required. It was noted that existing subdivision referral requirements will be a control.	
6	Yes	Yes	Yes	Yes	**Vertical boring machines and augers** may be used in certain locations, such as for power pole installation, replacement or fencing and the depth of installation may exceed the depth of the pipeline	- Depth of burial - Pipeline wall thickness; The pipelines under consideration are strong enough to resist full penetration by an auger under most circumstances, and only the pilot hole would penetrate, resulting in a leak.	- Before you dig (BYD) - Pipeline patrolling - Liaison processes	- Pipeline wall thickness	Considered a credible threat to cause mechanical damage or in the worst case cause a leak	Pipeline leak	Major	Remote	Intermediate	No	No impact expected as standard power pole equipment is used across Melbourne, and this site is no different	No additional controls identified as being required.	
7	Yes	Yes	Yes	Yes	**Horizontal Directional Drilling (HDD)**	- Pipeline wall thickness	- Before you dig (BYD) - Pipeline patrolling (daily) - Aerial monitoring - Liaison processes - Works on easement require approval - Pipeline Act requirements for notification to pipeline owner for works within 3m of the pipeline - Pipeline marker posts	- Pipeline wall thickness	Resistance to penetration is not considered absolute, therefore this is considered a credible threat	It was assumed that the maximum credible hole associated with this threat is ~50 mm in diameter.	Severe	Hypothetical	Negligible	No	At this time there is insufficient information available to determine if Horizontal Directional Drilling will be required.	At this point in time, no additional controls identified as being required. It is expected that the existing controls will manage the threat if Horizontal Directional Drilling is required.	6 Once transport modelling information and Development Services Schemes (DSS) are available, determine if there are any changes required to the Horizontal Directional Drilling threat assessment. 7 Identify, for example through the agency validation process, the assets of other authorities within the PSP area that may traverse north-south through Middle Road, e.g. branch sewers within the catchment. Based on the results, determine if there are any changes required to the Horizontal Directional Drilling threat assessment.
8	Yes	Yes	Yes	Yes	**Compaction activities** during the construction of building foundation or road maintenance cause pipeline vibration	- Depth of burial	- Before you dig (BYD) - Pipeline patrolling (daily) - Aerial monitoring - Liaison processes - APA Standard conditions for works near gas transmission pipelines	- Pipeline wall thickness	Considered a credible threat based on APA's experience	Potential to exceed allowable vibration limits of the pipeline	Minor	Unlikely	Low	Yes	Expected to be an increase in compaction activities during PSP area construction due to road works (e.g. road widening, improvement to current roads)	No additional controls identified as being required.	
Other threats																	
9	Yes	Yes	Yes	Yes	**External corrosion**	N/A	- Before you dig (BYD) - Subdivision application referrals when development is within the easement - Earth Potential Rise (EPR)/Low Frequency Induction (LFI) study/report to *AS 4853 Electrical Hazards on metallic pipelines* required	- External coating - Impressed current cathodic protection system - High quality corrosion resistant paint on above ground pipe at line valves and pig launcher and receiver stations	Considered a credible threat based on APA's experience	Pipeline leak	Minor	Remote	Negligible	Yes	Possible increase in corrosion if new cathodically protected steel pipes are installed in proximity to APA pipelines, as these can cause electrolysis (stray electrical currents) New above or below ground high voltage power lines could also increase corrosion due to induced current.	At this point in time, no additional controls identified as being required.	8 Data centres are considered a likely potential land use within the PSP area. Determine if limitations and/or the requirement for additional controls are required within the PSP to prevent data centre high voltage lines causing induced current in the pipelines. *Note: Post workshop, APA provided a response to this recommendation. Refer to the Pipeline SMS report for details.*
10	Yes	Yes	Yes	Yes	**Internal corrosion**	- Pipeline wall thickness	- Routine pigging for internal inspection - Fitness for purpose reviews - Pipeline integrity dig ups	- Material selection (natural gas is not corrosive for carbon steel)	Considered a credible threat based on APA's experience	Pipeline leak	Severe	Hypothetical	Negligible	No	Potential for internal corrosion not influenced by PSP land use	Yes	
11	Yes	Yes	Yes	Yes	**Flooding** of pipeline or wash out of pipeline cover	- Depth of cover	- Checks after major weather events and repairs as required - Strain assessments on in-line inspection (ILI) to identify any areas of movement	- Pipeline wall thickness	Overland flooding washing away cover considered a potential risk	Loss of pipeline cover	Minor	Remote	Negligible	No	The team noted that the drainage infrastructure planned for the PSP area is expected to reduce the risk of flooding	Yes	9 Confirm with Melbourne Water that there is no increased risk of flooding near the pipelines arising from the PSP development.
12	Yes	Yes	Yes	Yes	**Bushfire**	- Depth of cover	- Easement vegetation management - Pipeline corridor inspections post bush fire (as required)	- Pipeline wall thickness	Considered a credible threat based on APA's experience	Fire damage to external pipe coating or third party property	Severe	Remote	Low	No	The team advised that the development (at full build) is predicted to reduce the Bushfire Attack Level rating from 'Low' to 'No' risk	Yes	

Line	Applicable pipeline/s				Threat Description	Protection Controls - Physical	Protection Controls - Procedural	Protection Controls - Design	Credibility	Consequence Description	Current Risk Rating			Impacted by proposed change in land use?	Description of impact	Is the threat still considered controlled?	Recommendations	
	T56	T112	T62	T118							Severity	Frequency	Rating					
13	Yes	Yes	Yes	Yes	**Earthquake**	N/A	- To date no evidence of damage up to 5.8 (Richter Scale) - Integrity ILI-XYZ strain assessment and detection of high strain sections - Additional pipeline corridor inspection post earthquake (as required)	- Pipeline designed to Earthquake Code	APA advised this is not an earthquake prone area	-	-	-	-	No	Development does not impact the earthquake risk	Yes		
14	Yes	Yes	Yes	Yes	**Intentional damage** The above ground sections of the pipeline and city gates are considered most at risk from this threat	- Depth of cover - Compound fencing and locked gates - Vehicle bollards around perimeter of city gates to protect equipment skids	- SCADA monitoring - Lockable valves to prevent unauthorised operation	N/A	Based on APA's experience, considered a credible threat but failure not considered possible	Buckling of pipework below ground	-	-	-	No	The PSP development is not expected to change the risk of intentional damage	Yes		
15	Yes	Yes	Yes	Yes	**Accidental damage** to pipeline e.g. vehicle impact with pipeline	- Depth of cover - Vehicle bollards around perimeter of city gates to protect equipment skids	- Site inspection	*No additional controls (see Physical controls)*	Based on APA's experience, considered a credible threat but failure not considered possible	Vehicle impact with above ground pipework causing buckled or bent pipe, leak, and/or equipment damage within the city gate station	-	-	-	Yes	Development expected to increase traffic volumes	Recommendation to be completed	10 11	Once the traffic modelling is available, in consultation with APA and AusNet, review the requirement for additional control measures for the Rockbank City Gate on the corner of Christies and Middle Roads, to prevent vehicle impacts, e.g. Armco railing. While outside the scope of this assessment, it was identified that the OMR may lead to an increased potential for vehicle impact at the Truganina Offtake City Gate (on the corner of Hopkins and Middle Roads). Communicate this information to the OMR team.
16	Yes	Yes	Yes	Yes	**Industrial fire** e.g. dangerous goods or fuel storage fire	- Depth of cover	- Easement vegetation management - Liaison processes - Post incident pipeline inspection	- Depth of cover - Pipeline wall thickness	Considered a credible threat based on APA's knowledge of past incidents but failure is not considered possible	Pipeline damage	-	-	-	Yes	Potential for fuel storage at data centres or other industrial sites Potential for industrial sites to include dangerous good storage, e.g. recycling plant	Recommendation to be completed	12	In consultation with APA, determine the appropriate triggers for referral to APA for proposed developments involving the storage and handling of dangerous goods or fuel and any requirements to be captured in the PSP. This could include referral if storage is with a certain distance and/or the controls required (e.g. separation distance, instrumented controls and trips). *Note: Post workshop, APA provided a response to this recommendation. Refer to the Pipeline SMS report for details.*
17	Yes	Yes	Yes	Yes	**Storage directly on the pipeline easement** inhibits line-of-sight between pipeline markers and limits access to pipeline for operations, maintenance and/or emergency response	N/A	- Before you dig (BYD) - Pipeline patrolling (daily) - Aerial monitoring - Pipeline corridor management - APA procedures e.g. Standard conditions for works	N/A	APA have past incident of storage over a pipeline resulting in the need to remediate the pipeline		-	-	-	Yes	APA noted that, depending on the industrial facilities constructed, there is the potential for land users to store items above the pipeline	The team determined this is largely an operational issue to be managed by APA and did not believe that impacts requiring remediation of the pipeline are a credible risk arising from the PSP	13	APA noted that it is preferred that linear open space above and around the pipelines be maintained to allow access or, if this is not possible, that the pipelines remain within the frontage of industrial properties. If there were to be a loss of access there is a requirement for recoating the pipelines with associated increasing costs. DTP to determine the implications of this on the PSP.
																	14	APA to confirm what additional controls are currently in place for all threats recorded in this register and the missing current risk rankings (as full details were not provided prior to the workshop and APA experienced technical issues during the workshop).

Appendix C

Pipeline T56 – Brooklyn to Ballan

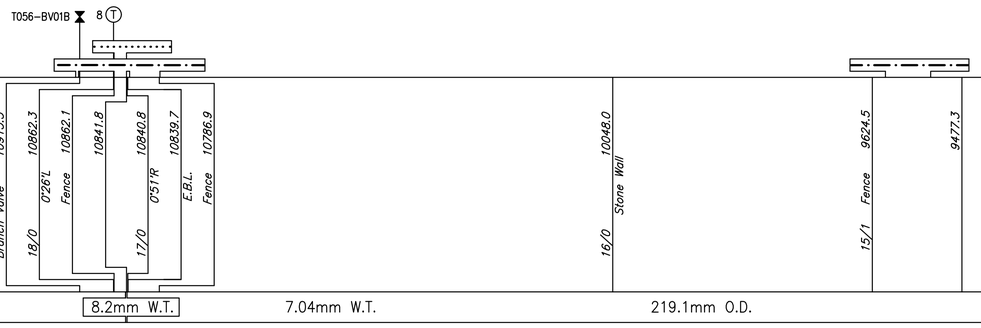
Supporting Information

EASEMENT NUMBER	T56-7-12		GOVT. ROAD / VICTRACK	T56-7-11					ROADS CORPORATION FUTURE WESTERN FREEWAY (DEER PARK BYPASS)		
PROPERTY OWNER	E. COHEN			B. & I. A. FLEIZIG & F. & A. M. AGAR							
CROWN ALLOTMENT NO.	C.P. 2 Sec.3		CHRISTIES ROAD / VICTRACK	Lot 1 TP 833828J	Lot 3 TP 833828J	Lot 4 TP 833828J	Lot 5 TP 833828J	Lot 6 TP 833828J	Lot 7 TP 833828J	Lot 8 TP 833828J	Lot 9 TP 833828J	Lot 10 TP 833828J	Lot 11 TP 833828J	Pt. C.P. 2 Sec. 4	Pt. C.P. 2 Sec. 4	
PARISH	DERRIMUT														DERRIMUT	
MUNICIPALITY	SHIRE OF MELTON															CITY OF BRIMBANK



ENVIRONMENTAL CONSTRAINTS

SPECIAL INSTALLATIONS

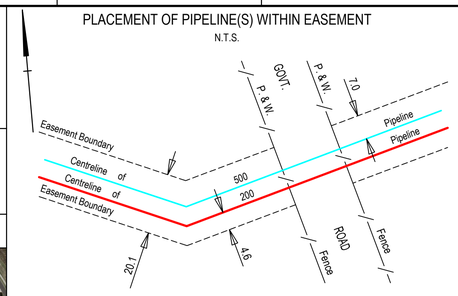


PROGRESSIVE HORIZONTAL DISTANCE	11479.2	11163.5	10915.3 to 10786.9	10048.0 to 9477.3
HORIZONTAL BENDS	Stone Wall 18/2	Branch Valve 18/0; 0°26'L Fence; 0°51'R 17/0; E.B.L. Fence	Stone Wall 16/0	Fence 15/1
PIPE O.D. & W.T.	219.1mm O.D.	8.2mm W.T.	7.04mm W.T.	219.1mm O.D. / 7.04mm W.T.
PIPELINE LOCATION CLASS	T1			T1
DATE PIPELINE LAID	OCTOBER 1972	OCTOBER 2013		OCTOBER 1972
LONGITUDINAL SECTION SHEET	T56-17-2			T56-17-1

RECORDED DRAWING

0 100 200 400 600
Full Size 1:10000 ; Half Reduction 1:20000
SCALE (m)

PLACEMENT OF PIPELINE(S) WITHIN EASEMENT
N.T.S.



LEGEND

2°31'L	LEFT HAND HORIZONTAL BEND IN DIRECTION OF PROGRESSIVE HORIZONTAL DISTANCE
2°31'R	RIGHT HAND HORIZONTAL BEND IN DIRECTION OF PROGRESSIVE HORIZONTAL DISTANCE
(ST)	STRAIN MEASURING TEST POINT
(T)	ELECTROLYSIS TEST POINT (TYPE AS SPECIFIED)
(S)	SYPHON
(A)	ANODE BED
(E)	EARTHING BED
	VALVE
	PERMANENT MARK (P.M.)
	GUNITE COATING
	CONCRETE SLABBING
	DOUBLE WRAPPED PIPE
	FENCE / CADASTRAL BOUNDARY
P8-17	REGULATOR P8-17 IN REGULATOR REGISTER

SPECIFICATION FOR 200 NB STEEL PIPELINE

PIPE:	219.1mm O.D. x 8.2mm AND 7.04mm W.T. MANUFACTURED TO API STANDARD 5L GRADE B ENDS BEVELLED FOR BUTT WELDING.
COATING:	COAL TAR ENAMEL TO CORPORATION SPECIFICATION CTE/1 OR CTE/2 (RED). INTERNAL REINFORCEMENT WITH RANDOM MESH FIBRE GLASS. EXTERNAL REINFORCEMENT TAR SATURATED 700g/m² ASBESTOS WRAP. TOTAL THICKNESS BETWEEN 2.5mm AND 4.0mm
JOINT COATING:	JOINT TRIMMED CLEANED AND PRIMED. ENAMEL APPLIED BY METHOD AS SPECIFIED BY THE CORPORATION'S PROJECT ENGINEER TO ENSURE A UNIFORM COATING.
FIELD WELDING AND BENDS:	A.S. C.B. 28 -1972 GAS PIPELINE CODE. COLD BENDS HAVE A MAXIMUM DIFFERENCE BETWEEN MAJOR AND MINOR DIAMETERS OF 2½ % OF THE DIAMETER OF THE PIPE. THE MAXIMUM DEFLECTION ALLOWABLE IN A PIPE IS 1½ % IN A LENGTH ALONG THE PIPE EQUAL TO ITS DIAMETER. RADIOGRAPHIC TESTING ON ALL WELDS.
TESTING:	HYDROSTATIC TEST TO 17871 kPa
PIPE:	(01/10/13 LAID) T056-BV01B ORIGINAL CUT OUT REPLACEMENT 219.1mm O.D. x 8.2mm W.T. MANUFACTURED TO API STANDARD 5L GRADE X52
TESTING:	TEST PRESSURE 12,750 kPa

NOTES:

1. STRAIN MEASURING TEST POINT DISCONNECTED 9-88 BY CUTTING WIRES.

OLD NUMBER 12513

REV	PROJ No	REVISION	DATE	DRW	DES	CHK	APP
2	35675	ABANDONED 80 T.P. NOTE ADDED AT CHRISTIES ROAD	29/03/17	NL	AJ	GO	RL
1	33229	80mm PIPELINE HAS BEEN ABANDONED & REPLACED WITH 100mm BRANCH	30/04/15	NL	AJ	GO	AJ
		PIPELINE. BRANCH VALVE T112-BV02 RELOCATED FROM PHD 10839.2 TO					
		PHD 10915.3& CONCRETE SLAB ADDED AT REGIONAL RAIL LINK					

REFERENCE DRGs	DRG No
REGIONAL RAIL CROSSING	T56-4-5
SITE PLAN	4554-MA-001
100 NB BRANCH VALVE T056-BV01B	T56-11-95
ROUTE PLAN	T112-17
CTM M121 & BRANCH VALVE T056-BV01B	N3-121-4
KEY PLAN	A4-80-2

FIELD BOOK
157 p.1 & 2
570 p.13
610 p.65

LEVEL DATUM

apa

A1

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	NAME	DATE
DRAWN		
DESIGNED	A.B. ROBSON	28/2/1972
VALIDATED		
ACCEPTED	R. DUNN	

SCALE: AS SHOWN

200 BROOKLYN - BALLAN TRANSMISSION PIPELINE
ROUTE PLAN

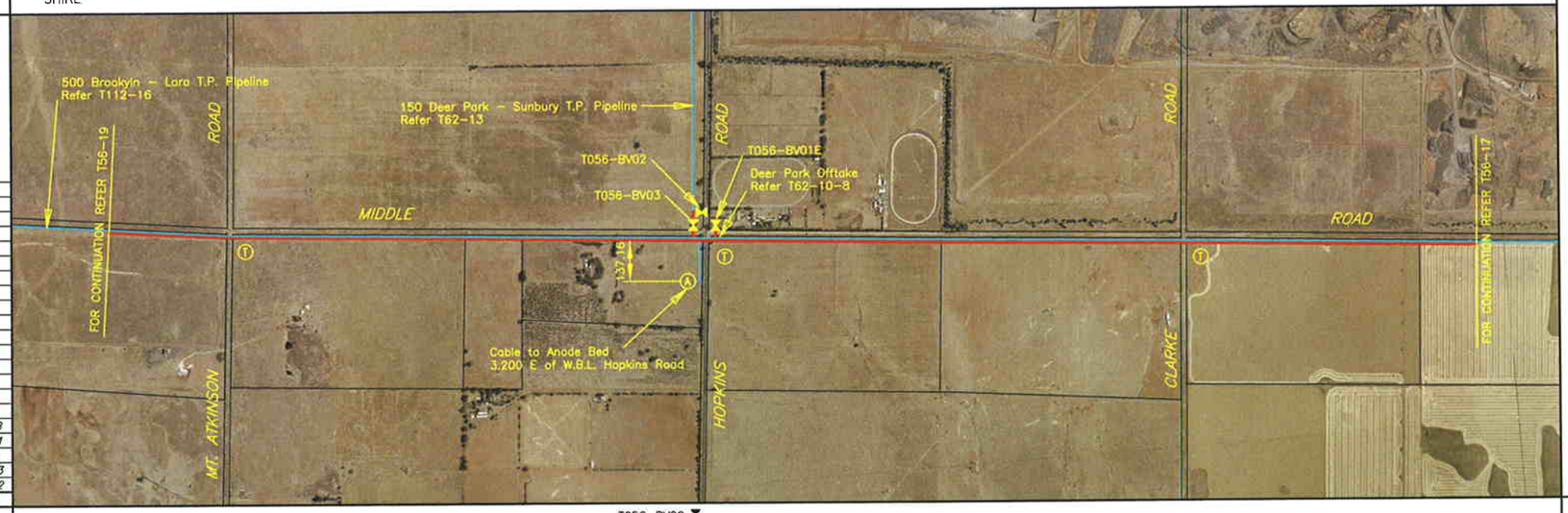
PROJECT No

DRG No: T56-17

REV: 2

R:\ Karen\Asset\T56_200 Brooklyn-Ballan TP33929 Regional Rail Link\Pipeline\T56_17 dwg Layout1 Color(PDF Writer APA General).dwg, Lee Nancy 24/03/2017 11:06:10 AM

EASEMENT NUMBER	T56-7-19	GOVT. ROAD	T56-7-18	T56-7-17	T56-7-16	T56-7-15	T56-7-14	GOVT. ROAD	T56-7-14	T56-7-14	T56-7-13	GOVT. ROAD	T56-7-12										
PROPERTY OWNER	J. WAN, Y. CHEN, L. CHEN & L. M. GU		L. SKODA	B. M. McNAUGHTON	W. E. BITANS	W. E. BITANS	MELTON SHIRE COUNCIL		MELTON SHIRE COUNCIL	W. E. BITANS	P. BATUR, V., J., M. & T. L. BULIC		E. COHEN									
CROWN ALLOTMENT NO.	2 Sec. 5	MT ATKINSON ROAD	C.P. 1 Sec. 1	Lot 1 TP 401516Q	Lot 1 PS 512501X		Road R1 PS 512501X	HOPKINS ROAD	Road R1 Reserve 1 PS 512498H	Lot 1 PS 512498H	2 Sec. 2	CLARKE ROAD	C.P. 1 Sec. 3		C.P. 2 Sec. 3							
PARISH	PYWHEITJORRK		DERRIMUT												DERRIMUT							
MUNICIPALITY	SHIRE OF MELTON																					



Route Plan	T112-18
Branch Valves T056-BV02 & T056-BV03	T62-8-1
150 Deer Park to Sunbury T.P. Pipeline	T62-13
Anode Bed Number 1	T56-9-3
Key Plan	A4-80-2
REFERENCE DRAWINGS	DRG. NO.

SPECIAL INSTALLATIONS	T11						T056-BV02 T056-BV03	T056-BV01E T10					T9										
PROGRESSIVE HORIZONTAL DISTANCE	16119.6	15719.6	15718.7	15699.3	14910.0	14716.3	14393.6	14131.1	14130.1	14100.5	14100.1	14079.9	14058.5	13292.0	12479.5	12459.4	11990.0	11699.3	11479.2				
HORIZONTAL BENDS		Stone Wall	23/0 2°08'R	E.B.L.	224/0 0°10'L	Stone Wall 22/4 Stone Wall	22/2 Stone Wall	Branch Valve	Branch Valve	22/0 0°17'R	Stone Wall	Stone Wall	Branch Valve	21/0 Stone Wall	20/0 0°8'L	Fence 19/6 Fence	19/2 Fence	Stone Wall					
PIPE CENTRELINE NO. (peg)																							
PIPE O.D. & W.T.	219.1mm O.D. 7.04mm W.T.													219.1mm O.D. 7.04mm W.T.									
DATE PIPELINE LAID	OCTOBER 1972													OCTOBER 1972									
LONGITUDINAL SECTION SHEET	T56-19-1	T56-18-2												T56-18-1						T56-17-2			

SPECIFICATION FOR 200 NB STEEL PIPELINE

PIPE: 219.1mm O.D. x 6.35mm AND 7.04mm W.T. MANUFACTURED TO API STANDARD 5L GRADE B ENDS BEVELLED FOR BUTT WELDING.

COATING: COAL TAR ENAMEL TO CORPORATION SPECIFICATION CTE/1 OR CTE/2 (RED). INTERNAL REINFORCEMENT WITH RANDOM MESH FIBRE GLASS. EXTERNAL REINFORCEMENT TAR SATURATED 700g/m² ASBESTOS WRAP. TOTAL THICKNESS BETWEEN 2.5mm AND 4.0mm

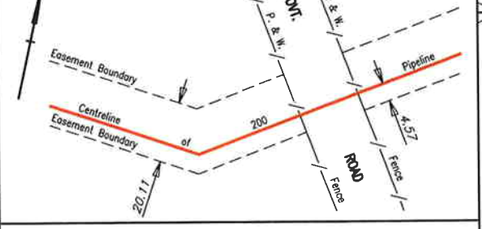
JOINT COATING: JOINT TRIMMED CLEANED AND PRIMED. ENAMEL APPLIED BY POURING METHOD AS SPECIFIED BY THE CORPORATION'S PROJECT ENGINEER TO ENSURE A UNIFORM COATING.

FIELD WELDING AND BENDS: A.S. C.B. 28 –1972 GAS PIPELINE CODE. COLD BENDS HAVE A MAXIMUM DIFFERENCE BETWEEN MAJOR AND MINOR DIAMETERS OF 2½% OF THE DIAMETER OF THE PIPE. THE MAXIMUM DEFLECTION ALLOWABLE IN A PIPE IS 1½% IN A LENGTH ALONG THE PIPE EQUAL TO ITS DIAMETER.

TESTING: RADIOGRAPHIC TESTING ON ALL WELDS. HYDROSTATIC TEST TO 17871 kPa

PLACEMENT OF PIPELINE WITHIN EASEMENT

N.T.S.



LEGEND

- 2°31'L — LEFT HAND HORIZONTAL BEND IN DIRECTION OF PROGRESSIVE HORIZONTAL DISTANCE
- 2°31'R — RIGHT HAND HORIZONTAL BEND IN DIRECTION OF PROGRESSIVE HORIZONTAL DISTANCE
- (ST) STRAIN MEASURING TEST POINT
- (T) ELECTROLYSIS TEST POINT (TYPE AS SPECIFIED)
- (S) SYPHON
- (A) ANODE BED
- (E) EARTHING BED
- VALVE
- PERMANENT MARK (P.M.)
- GUNITE COATING
- CONCRETE SLABBING
- DOUBLE WRAPPED PIPE
- FENCE / CADASTRAL BOUNDARY
- P8-17 — REGULATOR P8-17 IN REGULATOR REGISTER

200 0 200 400 600 800 1000

SCALE OF METRES

NOTES:

1. Strain measuring test point disconnected 9-88 by cutting wires.

REV	REVISION	DATE	DRN.	CKD.	APP.
J	UPDATED TO APA TITLE BLOCK, ALL PREVIOUS REVISIONS INCLUDED	AUG 07	NL		

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SHEET NO.		SCALE	AS SHOWN
LEVEL DATUM		FILENAME	T56-18
FIELD BOOK	157 p.1 & 2 570 p.13 115 p.36 & 78	DATE	28/2/1972
		DRAWN	
		CHECKED	AWC
DESIGN ENGINEER	A. B. ROBSON	APPROVING ENGINEER	R. DUNN

OLD NUMBER 12513

PROJECT

TITLE: 200 BROOKLYN – BALLAN TRANSMISSION PIPELINE ROUTE PLAN

PROJECT NO.		DRAWING NO.	REV
	R	T56-18	J

3. Pipeline Information

The pipeline Design Parameters used in the FCP are summarised in Table 4.

Table 4: Pipeline Design Parameters

Item	Description				
Licence No. / T No.	78 / T56				
Main Pipeline Location	Brooklyn to Ballan				
Section Location	Original Pipeline	Original Pipeline	Regional Railway Crossing Relocation	Deer Park Bypass Relocation	Western Ring Rd Relocation
Year Built	1973	1973	1994	2007	2013
MAOP (MPa)	7.39	7.39	7.39	7.39	7.39
Pipeline Size	DN200	DN200	DN200	DN200	DN200
Outside Diameter (mm)	219.1	219.1	219.1	219.1	219.1
Manufacture Type	ERW	ERW	ERW	ERW	HFW
Material Grade	API 5L Gr.B	API 5L Gr.B	API 5L Gr.X42	API 5L Gr.X56	API 5L Gr.X52
Pipe SMYS / UTS (MPa)	241 / 414	241 / 414	290 / 414	386 / 490	359 / 455
Wall Thicknesses (mm)	6.35	7.04	6.4	7.9	8.2
Hoop Stress at Design Pressure	128 MPa 53% SMYS	115MPa 48% SMYS	127 MPa 44% SMYS	103 MPa 27% SMYS	99 MPa 28% SMYS
Critical Defect Length (CDL)–2c	115(1)	138(1)	127(1)	242(1)	236(1)
Threshold Pressure (MPa) (85 MPa hoop stress)	4.93	5.46	4.97	6.13	6.36
Line-pipe Manufacturing Code	API 5L (Ref. 3)				
Compliance Code	AS 2885.1 : 2018 (Ref. 1)				
Max. Design Temperature (°C)	60 (Ref. 8)				
Min. Design Temperature (°C)	0 (Ref. 8)				
Hole Size for Energy Release Rate	1 GJ/s: 47 mm(2) 10 GJ/s: 147 mm(2)				
Location Class	T1,R2,/S,I,C,E (Ref. 10)(3)				

Table 5: Critical Defect Length					
Pipeline Size	**MAOP**	**Pipe Wall Thickness**	**Material Grade**	**CDL (mm)**	**80% CDL (mm)**
DN200	7.39 MPa	6.35 mm	API 5L Gr.B	115	92
DN200	7.39 MPa	7.04 mm	API 5L Gr.B	138	110
DN200	7.39 MPa	6.4 mm	API 5L Gr.X42	127	101
DN200	7.39 MPa	7.9 mm	API 5L Gr.X56	242	193
DN200	7.39 MPa	8.2 mm	API 5L Gr.X52	236	189

6.2. Fracture Initiation Toughness Requirement

An initiation toughness analysis was performed to determine the Charpy toughness requirements necessary to achieve a static axial through thickness flaw tolerance equal to 80% of the tolerable flaw length at infinite toughness.

The following equations found in AS/NZS 2885.1 define the plane-stress (Stress Intensity Factor (Kc)) required to resist fracture initiation from a through wall flaw in a pipeline and is summarised below:

The stress intensity factor (Kc) can be converted to Charpy Energy using the following relationship of AS/NZS 2885.1:

$$K_C{}^2 = 8c\frac{(\sigma_{flow})^2}{\pi}\ln.\sec\left(\frac{\pi M_T \sigma_H}{2\sigma_{flow}}\right)$$

$$C_{VN} = \frac{K_C{}^2 A_C}{EB}$$

C_{VN}	=	Chary Energy (J)
E	=	Young's Modulus in MPa
B	=	1000 (Conversion Factor)
Ac	=	Uncracked Area in a Full Size Charpy Specimen in mm (i.e. 80 mm^2)

The procedure to determine the Charpy Energy to ensure adequate resistance to fracture initiation is as follows:

- Develop a plot of Cv Energy vs. Flaw Length (2c).
- Determine the Charpy Energy that corresponds to 80% of the Charpy plateau energy required to tolerate the flaw size at infinite toughness.

In accordance with AS/NZS 2885.1, CVN tests shall be carried out at the minimum steady state operating temperature (generally it is equivalent to the minimum ground temperature at pipe depth) rounded down to the nearest 5°C. This FCP adopts the approach of using the lesser of the minimum design temperature or 0°C.

Table 9: Resistance to Penetration Summary for Maximum Excavator Type & Size Causing No Leak/Rupture

Pipe Size/ Wall Thickness / Grade	B Factor	Tooth Type			
		General Purpose (T)	Penetration (T)	Single Point Tiger (T)	Twin Tiger (T)
DN200 / 6.35mm / API 5L Gr.B	0.75	> 55	15	15	> 55
	1.3	> 55	5	5	20
DN200 / 7.04mm / API 5L Gr.B	0.75	> 55	20	20	> 55
	1.3	> 55	5	5	20
DN200 / 6.4mm / API 5L Gr.X42	0.75	> 55	20	20	> 55
	1.3	> 55	5	5	20
DN200 / 7.9mm / API 5L Gr.X56	0.75	> 55	35	35	> 55
	1.3	> 55	10	10	40
DN200 / 8.2mm / API 5L Gr.X52	0.75	> 55	35	35	> 55
	1.3	> 55	10	10	40

A series of tables (Table 10 to Table 19) were generated to demonstrate the pipeline failure mode subjected to impact by excavators for every wall thickness as well as by different Force Factor B.

In the tables below, “Resist” indicates the pipeline cannot be penetrated while “Leak” predicts the penetration resulting in a leakage and “Rupture” indicates that pipe is subject to a full bore rupture.

No rupture assessment based on excavator threat is also provided in this calculation in accordance with AS/NZS 2885.1 2018 Clause 4.9.2 (b). The result of this assessment is shown as “Pass” or “Fail” in Appendix 2.

In High Consequence Areas, where the “No Rupture” criterion is not satisfied, mitigation shall be applied in accordance with AS/NZS 2885.1.

Results from the subsequent tables shall be used in the relevant SMS document (Ref. 10) and/or ALARP assessments to ensure sufficient control measures are in place and where applicable, HCA / No Rupture design requirements (i.e. threats caused by excavators, energy release rates, etc.) are assessed and agreed such that integrity of the pipeline is not compromised.

Energy release rates are provided for all “Leak” failure modes in GJ/s. They are calculated based on the gas composition referenced in Table 7. The gas thermal properties have been accurately calculated using NIST REFPROP in accordance with AS/NZS 2885.1-2018 (Ref. 1) and API 521 (Ref. 4).

Table 10: Failure Mode Summary-B=0.75 – DN200 - WT=6.35 mm - API 5L Gr.B										
Wall Thickness	B Factor	Type of Tooth	Excavator Weight								
			5 T	10 T	15 T	20 T	25 T	30 T	35 T	40 T	55T
6.35 mm API 5L Gr.B	0.75	General purpose	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist
		Penetration Tooth	Resist	Resist	Resist	Leak 1.67	Leak 1.96	Leak 2.27	Rupture 6.89	Rupture 6.89	Rupture 6.89
		Single point Tiger	Resist	Resist	Resist	Leak 0.29	Leak 0.29	Leak 0.42	Leak 0.42	Leak 0.57	Leak 0.57
		Twin Tiger	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist

Table 11: Failure Mode Summary - B=1.3 – DN200 - WT=6.35 mm - API 5L Gr.B										
Wall Thickness	B Factor	Type of Tooth	Excavator Weight								
			5 T	10 T	15 T	20 T	25 T	30 T	35 T	40 T	55T
6.35 mm API 5L Gr.B	1.3	General purpose	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist
		Penetration Tooth	Resist	Leak 0.94	Leak 1.40	Leak 1.67	Leak 1.96	Leak 2.27	Rupture 6.89	Rupture 6.89	Rupture 6.89
		Single point Tiger	Resist	Leak 0.19	Leak 0.19	Leak 0.29	Leak 0.29	Leak 0.42	Leak 0.42	Leak 0.57	Leak 0.57
		Twin Tiger	Resist	Resist	Resist	Resist	Leak 3.35	Leak 4.18	Rupture 6.89	Rupture 6.89	Rupture 6.89

Table 12: Failure Mode Summary-B=0.75 – DN200 - WT=7.04 mm - API 5L Gr.B										
Wall Thickness	B Factor	Type of Tooth	Excavator Weight								
			5 T	10 T	15 T	20 T	25 T	30 T	35 T	40 T	55T
7.04 mm API 5L Gr.B	0.75	General purpose	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist
		Penetration Tooth	Resist	Resist	Resist	Resist	Leak 1.96	Leak 2.27	Leak 2.96	Leak 3.75	Rupture 6.89
		Single point Tiger	Resist	Resist	Resist	Resist	Leak 0.29	Leak 0.42	Leak 0.42	Leak 0.57	Leak 0.57
		Twin Tiger	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist

Table 13: Failure Mode Summary - B=1.3 – DN200 - WT=7.04 mm - API 5L Gr.B										
Wall Thickness	B Factor	Type of Tooth	Excavator Weight								
			5 T	10 T	15 T	20 T	25 T	30 T	35 T	40 T	55T
7.04 mm API 5L Gr.B	1.3	General purpose	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist
		Penetration Tooth	Resist	Leak 0.94	Leak 1.40	Leak 1.67	Leak 1.96	Leak 2.27	Leak 2.96	Leak 3.75	Rupture 6.89
		Single point Tiger	Resist	Leak 0.19	Leak 0.19	Leak 0.29	Leak 0.29	Leak 0.42	Leak 0.42	Leak 0.57	Leak 0.57
		Twin Tiger	Resist	Resist	Resist	Resist	Leak 3.35	Leak 4.18	Leak 5.60	Leak 6.67	Rupture 6.89

Table 14: Failure Mode Summary-B=0.75 – DN200 - WT=6.4 mm - API 5L Gr.X42										
Wall Thickness	B Factor	Type of Tooth	Excavator Weight								
			5 T	10 T	15 T	20 T	25 T	30 T	35 T	40 T	55T
6.4 mm API 5L Gr.X42	0.75	General purpose	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist
		Penetration Tooth	Resist	Resist	Resist	Resist	Leak 1.96	Leak 2.27	Leak 2.96	Rupture 6.89	Rupture 6.89
		Single point Tiger	Resist	Resist	Resist	Resist	Leak 0.29	Leak 0.42	Leak 0.42	Leak 0.57	Leak 0.57
		Twin Tiger	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist

Table 15: Failure Mode Summary - B=1.3 – DN200 - WT=6.4 mm - API 5L Gr.X42										
Wall Thickness	B Factor	Type of Tooth	Excavator Weight								
			5 T	10 T	15 T	20 T	25 T	30 T	35 T	40 T	55T
6.4 mm API 5L Gr.X42	1.3	General purpose	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist
		Penetration Tooth	Resist	Leak 0.94	Leak 1.40	Leak 1.67	Leak 1.96	Leak 2.27	Leak 2.96	Rupture 6.89	Rupture 6.89
		Single point Tiger	Resist	Leak 0.19	Leak 0.19	Leak 0.29	Leak 0.29	Leak 0.42	Leak 0.42	Leak 0.57	Leak 0.57
		Twin Tiger	Resist	Resist	Resist	Resist	Leak 3.35	Leak 4.18	Leak 5.60	Rupture 6.89	Rupture 6.89

Table 16: Failure Mode Summary-B=0.75 – DN200 - WT=7.9 mm - API 5L Gr.X56										
Wall Thickness	B Factor	Type of Tooth	Excavator Weight							
			5 T	10 T	15 T	20 T	25 T	30 T	35 T	40 T	55T
7.9 mm API 5L Gr.X56	0.75	General purpose	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist
		Penetration Tooth	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Leak 3.75	Leak 3.75
		Single point Tiger	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Leak 0.57	Leak 0.57
		Twin Tiger	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist

Table 17: Failure Mode Summary - B=1.3 – DN200 - WT=7.9 mm - API 5L Gr.X56										
Wall Thickness	B Factor	Type of Tooth	Excavator Weight							
			5 T	10 T	15 T	20 T	25 T	30 T	35 T	40 T	55T
7.9 mm API 5L Gr.X56	1.3	General purpose	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist
		Penetration Tooth	Resist	Resist	Leak 1.40	Leak 1.67	Leak 1.96	Leak 2.27	Leak 2.96	Leak 3.75	Leak 3.75
		Single point Tiger	Resist	Resist	Leak 0.19	Leak 0.29	Leak 0.29	Leak 0.42	Leak 0.42	Leak 0.57	Leak 0.57
		Twin Tiger	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Leak 7.23

Table 18: Failure Mode Summary-B=0.75 – DN200 - WT=8.2 mm - API 5L Gr.X52										
Wall Thickness	B Factor	Type of Tooth	Excavator Weight							
			5 T	10 T	15 T	20 T	25 T	30 T	35 T	40 T	55T
8.2 mm API 5L Gr.X52	0.75	General purpose	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist
		Penetration Tooth	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Leak 3.75	Leak 3.75
		Single point Tiger	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Leak 0.57	Leak 0.57
		Twin Tiger	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist

Table 19: Failure Mode Summary - B=1.3 – DN200 - WT=8.2 mm - API 5L Gr.X52										
Wall Thickness	B Factor	Type of Tooth	Excavator Weight							
			5 T	10 T	15 T	20 T	25 T	30 T	35 T	40 T	55T
8.2 mm API 5L Gr.X52	1.3	General purpose	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist
		Penetration Tooth	Resist	Resist	Leak 1.40	Leak 1.67	Leak 1.96	Leak 2.27	Leak 2.96	Leak 3.75	Leak 3.75
		Single point Tiger	Resist	Resist	Leak 0.19	Leak 0.29	Leak 0.29	Leak 0.42	Leak 0.42	Leak 0.57	Leak 0.57
		Twin Tiger	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Leak 7.23

9.3. Maximum Discharge Rate

AS/NZS 2885.1 requires that pipelines to be assessed against Clause 4.9.3 AS/NZS 2885.1 – Maximum Discharge Rate for High Consequence Areas. Where the existing pipeline does not comply with this clause, mitigation measures shall be applied in accordance with AS 2885.3.

As per Clause 4.9.3 of AS/NZS 2885.1, for pipeline carrying flammable gases, the maximum discharge rate shall not exceed 10 GJ/s in T1 and I or 1 GJ/s in T2, S location class. Energy release rate for HI location class depends on the appropriate design requirement (R2, T1 or T2) applied for the pipeline. The energy release rate shall be calculated for quasi-steady state conditions that exist 30 seconds after the pipeline puncture.

The hole sizes resulting in a maximum discharge rate of 10 GJ/s and 1 GJ/s are summarised Table 20 (refer to Appendix 3 for details of the calculation).

Table 20: Hole Size Resulting in 1GJ/s and 10GJ/s Energy Release Rate			
Pipeline	Energy Release Rates (GJ/S)	Hole Size (mm)	Applicable Location Classes
DN200 MAOP 7.39 MPa	1	47	T2, S
	10	147	T1, I

Appendix D ENERGY RELEASE CALCULATION RESULTS

Pipeline		Hole Size (mm)	Radiation Contour for 4.7GJ/s (mm)	Radiation Contour for 12.6GJ/s (mm)	Energy Release Rate GJ/s	Pipe Diameter (mm)	MAOP (kPa)
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70 200OD	15 T Excavator Hole Size (mm)					219.1	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	Single Point of TT	20	28	17	0.19	219.1	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	Both Points of TT	70	98	60	2.27	219.1	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	Penetration Tooth	55	77	47	1.4	219.1	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	20 T Excavator Hole Size (mm)					219.1	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	Single Point of TT	25	35	21	0.29	219.1	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	Both Points of TT	80	112	68	2.97	219.1	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	Penetration Tooth	60	84	51	1.67	219.1	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	25 T Excavator Hole Size (mm)					219.1	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	Single Point of TT	25	35	21	0.29	219.1	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	Both Points of TT	85	119	73	3.35	219.1	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	Penetration Tooth	65	91	56	1.96	219.1	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	30 T Excavator Hole Size (mm)					219.1	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	Single Point of TT	30	42	26	0.42	219.1	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	Both Points of TT	95	133	81	4.18	219.1	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	Penetration Tooth	70	98	60	2.27	219.1	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	Pilot Hole (Verticle or Horizontal Drill/Auger)	50	70	43	1.16	219.1	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	Pin Hole Size (mm)	3	4	3	0.00	219.1	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	Intermediate Hole Size (mm)	12	17	10	0.07	219.1	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	Major Hole Size (mm)	50	70	43	1.16	219.1	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	Rupture	Full Bore	171	104	7.00	219.1	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	Max. Hole size for T1 (I, etc.) Location Class (mm) (10GJ/s max. release rate)	146.96	206	126	10.00	219.1	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	Max. Hole size for T2 (S, etc.) Location Class (mm) (1GJ/s max. release rate)	46.47	65	40	1.00	219.1	7390

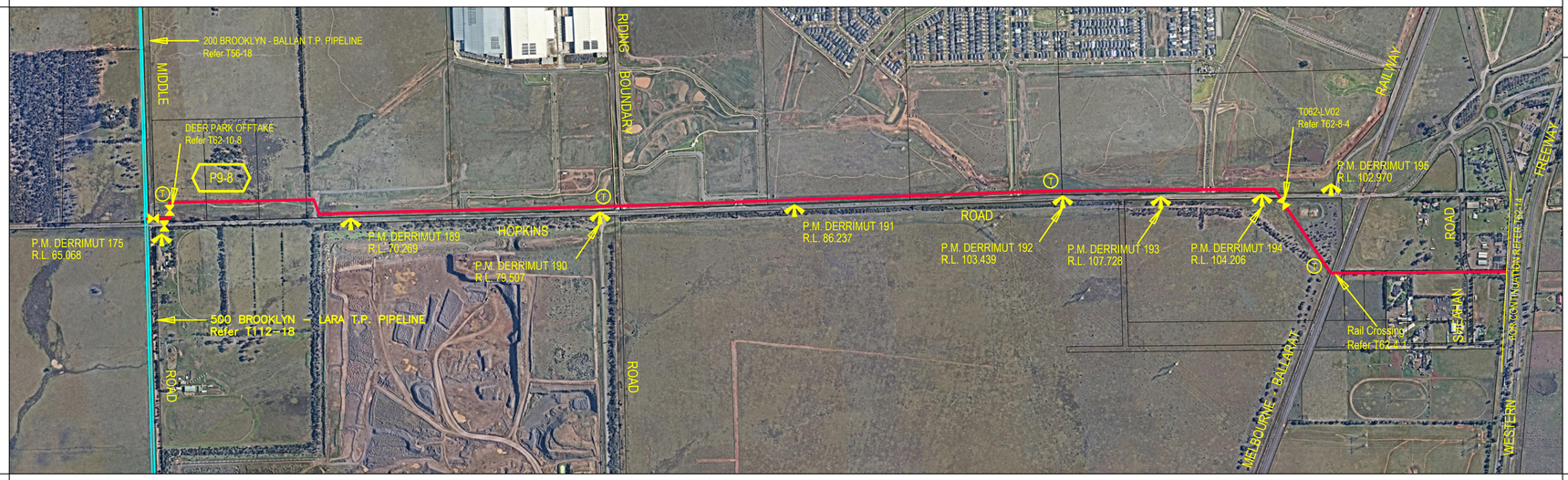
Pipeline		Hole Size (mm)	Radiation Contour for 4.7GJ/s (mm)	Radiation Contour for 12.6GJ/s (mm)	Energy Release Rate GJ/s	Pipe Diameter (mm)	MAOP (kPa)
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70 150OD	15 T Excavator Hole Size (mm)					168.3	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	Single Point of TT	20	28	17	0.19	168.3	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	Both Points of TT	70	98	60	2.27	168.3	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	Penetration Tooth	55	77	47	1.4	168.3	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	20 T Excavator Hole Size (mm)					168.3	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	Single Point of TT	25	35	21	0.29	168.3	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	Both Points of TT	80	112	68	2.97	168.3	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	Penetration Tooth	60	84	51	1.67	168.3	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	25 T Excavator Hole Size (mm)					168.3	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	Single Point of TT	25	35	21	0.29	168.3	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	Both Points of TT	85	119	73	3.35	168.3	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	Penetration Tooth	65	91	56	1.96	168.3	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	30 T Excavator Hole Size (mm)					168.3	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	Single Point of TT	30	42	26	0.42	168.3	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	Both Points of TT	95	133	81	4.19	168.3	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	Penetration Tooth	70	98	60	2.27	168.3	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	Pilot Hole (Verticle or Horizontal Drill/Auger)	50	70	43	1.16	168.3	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	Pin Hole Size (mm)	3	4	3	0.00	168.3	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	Intermediate Hole Size (mm)	12	17	10	0.07	168.3	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	Major Hole Size (mm)	50	70	43	1.16	168.3	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	Rupture	Full Bore	117	72	3.00	168.3	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	Max. Hole size for T1 (I, etc.) Location Class (mm) (10GJ/s max. release rate)	146.84	206	126	10.00	168.3	7390
Lic 78 Brooklyn Ballarat Bendigo T56 T57 T70	Max. Hole size for T2 (S, etc.) Location Class (mm) (1GJ/s max. release rate)	46.42	65	40	1.00	168.3	7390
Lic 81 Brooklyn to Corio T24	15 T Excavator Hole Size (mm)					355.6	5050
Lic 81 Brooklyn to Corio T24	Single Point of TT	20	23	14	0.12	355.6	5050
Lic 81 Brooklyn to Corio T24	Both Points of TT	70	79	48	1.47	355.6	5050
Lic 81 Brooklyn to Corio T24	Penetration Tooth	55	62	38	0.91	355.6	5050
Lic 81 Brooklyn to Corio T24	20 T Excavator Hole Size (mm)					355.6	5050

Appendix D

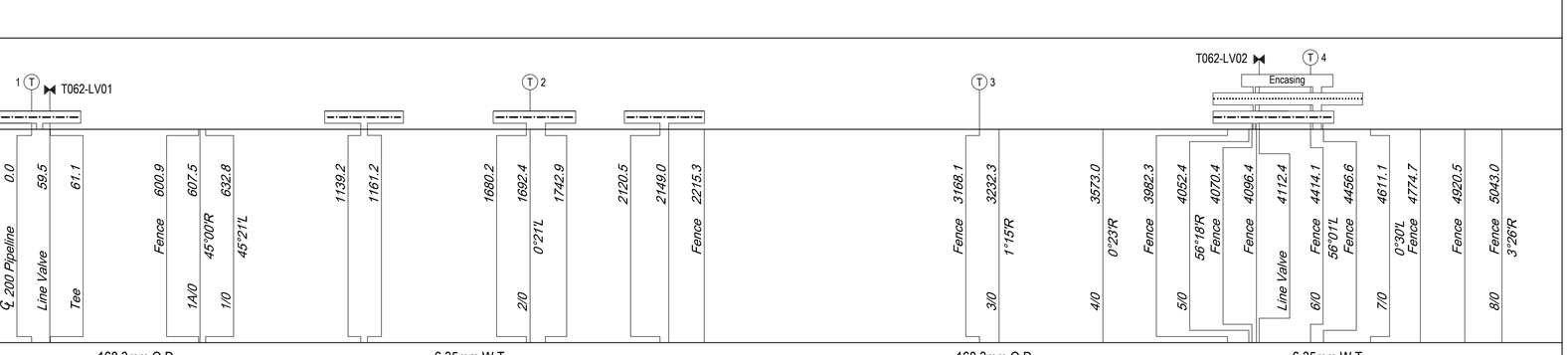
Pipeline T62 – Derrimut to Sunbury

Supporting Information

EASEMENT NUMBER	T56-7-14	GOVT. ROAD	T62-7-1	T62-7-2		GOVT. ROAD	T62-7-2			T62-7-3	GOVT. ROAD	T62-7-4	CROWN LAND	T62-7-5 T62-7-6	T62-7-7 T62-7-8	T62-7-9							
PROPERTY OWNER	R. D. HOPKINS		W. BITANS	MOUNT ATKINSON PTY. LTD.			MOUNT ATKINSON PTY. LTD.			MOUNT ATKINSON PTY. LTD.		D. D. FRASER K. L. B. POWELL		PIONEER ENT. PTY. LTD.	D. W. & J. CROCKER	A. G. & F. PACE							
CROWN ALLOTMENT NO.	2	MIDDLE ROAD	6	4	2	RIDING BOUNDARY ROAD	6	4	2	4	HOPKINS ROAD	2	MELBOURNE -BALLARAT RAILWAY	Pt. 2 Pt. 3	Pt. 2 Pt. 3	Pt. 3							
PARISH	DERRIMUT														DERRIMUT								
MUNICIPALITY	SHIRE						OF								MELTON								



ENVIRONMENTAL CONSTRAINTS	

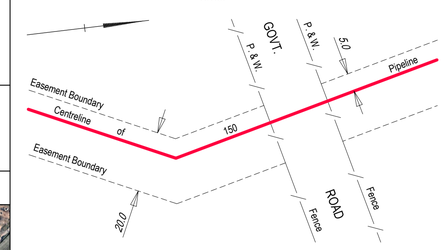


PROGRESSIVE HORIZONTAL DISTANCE HORIZONTAL BENDS PIPE CENTRELINE NO. (peg)				
PIPE O.D. & W.T.	168.3mm O.D.	6.35mm W.T.	168.3mm O.D.	6.35mm W.T.
PIPELINE LOCATION CLASS				
DATE PIPELINE LAID	MAY 1979 / DEC. 1978	JANUARY 1979	FEBRUARY 1979	JANUARY 1979 / DEC. 1978 / JAN. 1979 / FEBRUARY 1979
LONGITUDINAL SECTION SHEET	T62-13-1		T62-13-2	

0 100 200 400 600
Full Size 1:10000 ; Half Reduction 1:20000
SCALE (m)

PLACEMENT OF PIPELINE WITHIN EASEMENT

N.T.S.



LEGEND

2°31'L	LEFT HAND HORIZONTAL BEND IN DIRECTION OF PROGRESSIVE HORIZONTAL DISTANCE
2°31'R	RIGHT HAND HORIZONTAL BEND IN DIRECTION OF PROGRESSIVE HORIZONTAL DISTANCE
(T)	ELECTROLYSIS TEST POINT (TYPE AS SPECIFIED)
(A)	ANODE BED
	VALVE
	PERMANENT MARK (P.M.)
	GUNITE COATING
	CONCRETE SLABBING
	DOUBLE WRAPPED PIPE
	FENCE / CADASTRAL BOUNDARY
P9-8	REGULATOR P9-8 IN REGULATOR REGISTER

SPECIFICATION FOR 150 NB STEEL PIPELINE

PIPE:	168.3mm O.D. x 6.35mm W.T. MANUFACTURED TO API STANDARD 5L GRADE B CONTRACT No. 1744
COATING:	EXTRUDED POLYETHYLENE WITH HEAT SHRINK SLEEVES APPLIED AT JOINTS TO CORPORATION STANDARD. CONTRACT No. 1745
FIELD WELDING AND BENDS:	A.S. 1697 - 1975 AND CONTRACT No. 1749
HYDROSTATIC TESTING:	A.S. 1697 - 1975 & H.S. 1978 - 1977 MINIMUM STRENGTH TEST PRESSURE 20930 kPa MINIMUM LEAK TEST PRESSURE 8123 kPa
RE-COATING: (APRIL 2024)	CANUSA HBE 95 APPLIED FROM PHD 1139.2 - PHD 1161.2, PHD 1677.5 - PHD 1737.0 & PHD 2123.6 - PHD 2138.5. SLEEVES APPLIED AT JOINTS TO CORPORATION STANDARD.
CONCRETE SLAB:	PHD 4452.06 - PHD 4458.41. (LAID MARCH 2018) PHD 1139.2 - PHD 1161.2, PHD 1677.5 - PHD 1742.9 & PHD 2120.5 - PHD 2149.0. (LAID APRIL 2024)

NOTE:
ALL CO-ORDINATES ARE MGA 2020 ZONE 55

REV	PROJ No	REVISION	DATE	DRW	DES	CHK	APP
2		AS BUILT	26/06/24	KL		SR	GO
1	38142	AS BUILT	16/10/18	PF	DB	NL	DL
F		UPDATED TO APA TITLE BLOCK, ALL PREVIOUS REVISIONS INCLUDED	2/5/08	NL			

REFERENCE DRGs	DRG No
LINE VALVE T062-LV02	T62-8-4
DEER PARK OFFTAKE - SITE PLAN	T62-10-8
PRESSURE LIMIER	P9-8
MELBOURNE - BALLARAT RAIL CROSSING	T62-4-1
ROUTE PLAN	T112-18
ROUTE PLAN	T56-18
KEY PLAN	A4-80-2

REFERENCE DRGs	DRG No
RECOATING & CONCRETE SLABS SURVEY DATA	DSP.2373-LI-L-0001.01.xlxs
SURVEY DATA	DSP.2373-DBS-L-0001.xls

FIELD BOOK
157 p.1-45

LEVEL DATUM
A.H.D.

AS BUILT

apa

	NAME	DATE
DRAWN	B.GUPPY	1/3/79
DESIGNED		
VALIDATED		
ACCEPTED		
SCALE	AS SHOWN	
APA ID	DSP.2373-DWG-L-0013.01	
A1		

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DEER PARK SUNBURY T062

150 DEER PARK - SUNBURY TRANSMISSION PIPELINE ROUTE PLAN DEER PARK

PROJECT No	DRG No	REV
	T62-13	2

C:\APA\Working\APA_Pipelines\DSP_DeerPark_Sunbury_T062\2373_Pipeline_DSP_CAD\DWG\LT62-13.dwg Layout1 Bluebeam PDF ext3 APA General.ctb Lou Nancy 2/08/2024 1:21:07 PM

3. Pipeline Information

The pipeline Design Parameters used in the FCP are summarised in Table 4.

Table 4: Pipeline Design Parameters

Item	Description	
Licence No. / T No.	122 / T62	
Main Pipeline Location	Derrimut to Sunbury	
Section/Year Built	Derrimut to Sunbury 1979	T62-LV03 relocation
Nominal Diameter	DN150	DN150
Outside Diameter (mm)	168.3	168.3
Manufacture Type	ERW	Seamless
Wall Thicknesses (mm)	6.35	9.60(2)
Material Grade	API 5L Gr. B	ASTM A333 GRADE 6
Pipe SMYS / UTS (MPa)	241 / 414(Ref. 3)	240 / 415(Ref. 5)
MAOP (MPa)	7.39	7.39
Hoop Stress at Design Pressure	98 MPa 41% SMYS	65 MPa 27% SMYS
Critical Defect Length (CDL) –2c	140 (see Table 5)	298 (see Table 5)
Threshold Pressure (MPa) (85 MPa hoop stress)	6.41	n/a
Line-pipe Manufacturing Code	API 5L (Ref. 3)	ASME B36.10M
Compliance Code	AS 2885.1 : 2018 (Ref. 1)	AS 2885.1 : 2018 (Ref. 1)
Max. Design Temperature (°C)	60 (Ref. 7)	60 (Ref. 7)
Min. Design Temperature (°C)	0 (Ref. 7)	0 (Ref. 7)
Hole Size for Energy Release Rates	1 GJ/s: 47 mm (see Table 12) 10 GJ/s: 149 mm (see Table 12)	
Location Class	T1-R1/I (Ref. 7 & Ref. 8)	
Corrosion Allowance (mm)	Zero(1)	Zero(1)

Notes:

(1) In accordance with Pipeline Integrity Management Plan (Ref. 6), the gas transported by the VTS is a dry, sales quality natural gas and therefore the internal corrosion allowance has been assumed zero where it has not been documented. All pipelines are externally coated with a high integrity coating system, CP system is in place and pipeline is surveyed at specified intervals, therefore no design consideration for a wall thickness reduction scenario is required.

(2) In this FCP, all the assessments are carried out on the pressure design wall thickness (12.5% manufacturing tolerance has been applied).

Table 5: Critical Defect Length					
Pipeline Size	**MAOP**	**Pipe Wall Thickness**	**Material Grade**	**CDL (mm)**	**80% CDL (mm)**
DN150	7.39 MPa	6.35 mm	API 5L Gr. B	140	112
DN150	7.39 MPa	9.60 mm	ASTM A333 Gr.6	298	238

6.2. Fracture Initiation Toughness Requirement

An initiation toughness analysis was performed to determine the Charpy toughness requirements necessary to achieve a static axial through thickness flaw tolerance equal to 80% of the tolerable flaw length at infinite toughness.

The following equations found in AS/NZS 2885.1 define the plane-stress (Stress Intensity Factor (Kc)) required to resist fracture initiation from a through wall flaw in a pipeline and is summarised below:

The stress intensity factor (Kc) can be converted to Charpy Energy using the following relationship of AS/NZS 2885.1:

$$K_C^{\,2} = 8c\,\frac{(\sigma_{flow})^2}{\pi}\ln.\sec\left(\frac{\pi M_T \sigma_H}{2\sigma_{flow}}\right)$$

$$C_{VN} = \frac{K_C^{\,2} A_C}{EB}$$

C_{VN}	=	Chary Energy (J)
E	=	Young's Modulus in MPa
B	=	1000 (Conversion Factor)
Ac	=	Uncracked Area in a Full Size Charpy Specimen in mm (i.e. 80 mm^2)

The procedure to determine the Charpy Energy to ensure adequate resistance to fracture initiation is as follows:

- Develop a plot of Cv Energy vs. Flaw Length (2c).
- Determine the Charpy Energy that corresponds to 80% of the Charpy plateau energy required to tolerate the flaw size at infinite toughness.

In accordance with AS/NZS 2885.1, CVN tests shall be carried out at the minimum steady state operating temperature (generally it is equivalent to the minimum ground temperature at pipe depth) rounded down to the nearest 5°C. This FCP adopts the approach of using the lesser of the minimum design temperature or 0°C.

The Charpy values listed above are the minimum values to ensure that every pipe joint is an “arrest” pipe. This will ensure fracture arrest within a single pipe joint.

9. Special Provisions for High Consequence Areas

9.1. No Rupture Scenario

AS/NZS 2885.1 requires that each existing pipeline is assessed against Clause 4.9.2 of AS/NZS 2885.1 - No Rupture for High Consequence Areas typically found in the T2, T1, I, S, E and where applicable, HI and C location classes. Where the pipeline does not comply with this clause, mitigation shall be applied to maximise integrity of the pipeline and compliance with AS 2885.

This report only highlights the findings as per Clause 4.9.2 of AS/NZS 2885.1 and does not make recommendations or outline mitigation measures normally addressed and discussed in a SMS. Furthermore, no assumption has been made with the type and size of an excavator (credible threat) typically found in the area which has been revised in the latest SMS.

AS/NZS 2885.1 specifies that the No Rupture criteria is satisfied when either of the following conditions are met:

- The hoop stress shall not exceed 30% of the SMYS
- The largest equivalent defect length produced by the threats identified in that location shall be determined. The hoop stress at MAOP shall be such that the CDL is not less than 150% of the axial length of the largest equivalent defect.

9.2. Resistance to Penetration

Where excavators are identified as being an external interference threat, resistance to penetration against typical excavator threats are assessed in accordance with Appendix E of AS/NZS 2885.1.

The findings are summarised in Table 9 highlight the type and weight of an excavator the pipeline can resist from penetration. The B factor equal to 1.3 has been adopted within High Consequence Areas and for all other areas a B factor of 0.75 is used (refer to Appendix 2 for details of the calculation).

Table 9: Resistance to Penetration Summary for Maximum Excavator Type & Size Causing No Leak/Rupture

Pipe Size/ Wall Thickness / Grade	B Factor	Tooth Type			
		General Purpose (T)	Penetration (T)	Single Point Tiger (T)	Twin Tiger (T)
DN150 / 6.35 mm / API 5L Gr.B	0.75	> 55	15	15	> 55
	1.3	> 55	5	5	20

A series of tables (Table 10 to Table 11) were generated to demonstrate the pipeline failure mode subjected to impact by excavators for every wall thickness as well as by different Force Factor B.

In the tables below, “Resist” indicates the pipeline cannot be penetrated while “Leak” predicts the penetration resulting in a leakage and “Rupture” indicates that pipe is subject to a full bore rupture.

No rupture assessment based on excavator threat is also provided in this calculation in accordance with AS/NZS 2885.1 2018 Clause 4.9.2 (b). The result of this assessment is shown as “Pass” or “Fail” in Appendix 2.

In High Consequence Areas, where the “No Rupture” criterion is not satisfied, mitigation shall be applied in accordance with AS/NZS 2885.1.

Results from the subsequent tables shall be used in the relevant SMS document (Ref. 8) and/or ALARP assessments to ensure sufficient control measures are in place and where applicable, HCA / No Rupture design requirements (i.e. threats caused by excavators, energy release rates, etc.) are assessed and agreed such that integrity of the pipeline is not compromised.

Energy release rates are provided for all “Leak” failure modes in GJ/s. They are calculated based on the gas composition referenced in Table 7. The gas thermal properties have been accurately calculated using NIST REFPROP in accordance with AS/NZS 2885.1-2018 (Ref. 1) and API 521 (Ref. 4).

Table 10: Failure Mode Summary - B=0.75 – DN150 - WT=6.35 mm - API 5L Gr. B

Wall Thickness	B Factor	Type of Tooth	Excavator Weight								
			5 T	10 T	15 T	20 T	25 T	30 T	35 T	40 T	55T
6.35 mm API 5L Gr. B	0.75	General purpose	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist
		Penetration Tooth	Resist	Resist	Resist	Leak 1.61	Leak 1.89	Leak 2.20	Leak 2.87	Leak 3.63	Rupture 3.25
		Single point Tiger	Resist	Resist	Resist	Leak 0.28	Leak 0.28	Leak 0.40	Leak 0.40	Leak 0.55	Leak 0.55
		Twin Tiger	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist

Table 11: Failure Mode Summary-B=1.3 – DN150 - WT=6.35 mm - API 5L Gr. B

Wall Thickness	B Factor	Type of Tooth	Excavator Weight								
			5 T	10 T	15 T	20 T	25 T	30 T	35 T	40 T	55T
6.35 mm API 5L Gr. B	1.3	General purpose	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist
		Penetration Tooth	Resist	Leak 0.91	Leak 1.36	Leak 1.61	Leak 1.89	Leak 2.20	Leak 2.87	Leak 3.63	Rupture 3.25
		Single point Tiger	Resist	Leak 0.18	Leak 0.18	Leak 0.28	Leak 0.28	Leak 0.40	Leak 0.40	Leak 0.55	Leak 0.55
		Twin Tiger	Resist	Resist	Resist	Resist	Leak 3.24	Leak 4.04	Leak 5.42	Leak 6.45	Rupture 3.25

9.3. Maximum Discharge Rate

AS/NZS 2885.1 requires that pipelines to be assessed against Clause 4.9.3 AS/NZS 2885.1 – Maximum Discharge Rate for High Consequence Areas. Where the existing pipeline does not comply with this clause, mitigation measures shall be applied in accordance with AS 2885.3.

As per Clause 4.9.3 of AS/NZS 2885.1, for pipeline carrying flammable gases, the maximum discharge rate shall not exceed 10 GJ/s in T1 and I or 1 GJ/s in T2, S location class. Energy release rate for HI location class depends on the appropriate design requirement (R2, T1 or T2) applied for the pipeline. The energy release rate shall be calculated for quasi-steady state conditions that exist 30 seconds after the pipeline puncture.

The hole sizes resulting in a maximum discharge rate of 10 GJ/s and 1 GJ/s are summarised in Table 12 (refer to Appendix 3 for details of the calculation).

Table 12: Hole Size Resulting in 1GJ/s and 10GJ/s Energy Release Rate

Pipeline	Energy Release Rates (GJ/S)	Hole Size (mm)	Applicable Location Classes
DN150 MAOP 7.39 MPa	1	47	T2, S
	10	149	T1, I

10. Summary and Conclusion

10.1. Required Testings and Recommendations

The main findings, requirements and recommendations are summarised below:

- For the purpose of this FCP, the following destructive tests are required to meet the requirements of AS/NZS 2885.1. Please refer to Appendix 5 for typical pipe material certificates which demonstrate compliance to the requirements of this FCP.

Table 13: DWTT Summary

Pipe Size / Wall Thickness / Grade	Test Type	Shear Area (%)	Test Temperature (°C)
DN150 / 6.35 mm / API 5L Gr. B	DWTT	85%	0
DN150 / 9.60 mm / ASTM A333 Gr.6	DWTT	n/a	n/a

Pipeline		Hole Size (mm)	Radiation Contour for 4.7GJ/s (mm)	Radiation Contour for 12.6GJ/s (mm)	Energy Release Rate GJ/s	Pipe Diameter (mm)	MAOP (kPa)
Lic 112 Brooklyn to Qenos T120	Pin Hole Size (mm)	3	3	2	0.00	273.1	5100
Lic 112 Brooklyn to Qenos T120	Intermediate Hole Size (mm)	12	14	8	0.04	273.1	5100
Lic 112 Brooklyn to Qenos T120	Major Hole Size (mm)	50	57	35	0.76	273.1	5100
Lic 112 Brooklyn to Qenos T120	Rupture	Full Bore	169	103	7.00	273.1	5100
Lic 112 Brooklyn to Qenos T120	Max. Hole size for T1 (I, etc.) Location Class (mm) (10GJ/s max. release rate)	181.42	206	126	10.00	273.1	5100
Lic 112 Brooklyn to Qenos T120	Max. Hole size for T2 (S, etc.) Location Class (mm) (1GJ/s max. release rate)	57.37	65	40	1.00	273.1	5100
Lic 122 Derrimul to Sunbury T62 150OD	15 T Excavator Hole Size (mm)					168.3	7390
Lic 122 Derrimul to Sunbury T62	Single Point of TT	20	28	17	0.19	168.3	7390
Lic 122 Derrimul to Sunbury T62	Both Points of TT	70	98	60	2.27	168.3	7390
Lic 122 Derrimul to Sunbury T62	Penetration Tooth	55	77	47	1.4	168.3	7390
Lic 122 Derrimul to Sunbury T62	20 T Excavator Hole Size (mm)					168.3	7390
Lic 122 Derrimul to Sunbury T62	Single Point of TT	25	35	21	0.29	168.3	7390
Lic 122 Derrimul to Sunbury T62	Both Points of TT	80	112	68	2.97	168.3	7390
Lic 122 Derrimul to Sunbury T62	Penetration Tooth	60	84	51	1.67	168.3	7390
Lic 122 Derrimul to Sunbury T62	25 T Excavator Hole Size (mm)					168.3	7390
Lic 122 Derrimul to Sunbury T62	Single Point of TT	25	35	21	0.29	168.3	7390
Lic 122 Derrimul to Sunbury T62	Both Points of TT	85	119	73	3.35	168.3	7390
Lic 122 Derrimul to Sunbury T62	Penetration Tooth	65	91	56	1.96	168.3	7390
Lic 122 Derrimul to Sunbury T62	30 T Excavator Hole Size (mm)					168.3	7390
Lic 122 Derrimul to Sunbury T62	Single Point of TT	30	42	26	0.42	168.3	7390
Lic 122 Derrimul to Sunbury T62	Both Points of TT	95	133	81	4.19	168.3	7390
Lic 122 Derrimul to Sunbury T62	Penetration Tooth	70	98	60	2.27	168.3	7390
Lic 122 Derrimul to Sunbury T62	Pilot Hole (Verticle or Horizontal Drill/Auger)	50	70	43	1.16	168.3	7390
Lic 122 Derrimul to Sunbury T62	Pin Hole Size (mm)	3	4	3	0.00	168.3	7390
Lic 122 Derrimul to Sunbury T62	Intermediate Hole Size (mm)	12	17	10	0.07	168.3	7390
Lic 122 Derrimul to Sunbury T62	Major Hole Size (mm)	50	70	43	1.16	168.3	7390
Lic 122 Derrimul to Sunbury T62	Rupture	Full Bore	117	72	3.00	168.3	7390
Lic 122 Derrimul to Sunbury T62	Max. Hole size for T1 (I, etc.) Location Class (mm) (10GJ/s max. release rate)	146.96	206	126	10.00	168.3	7390

Pipeline		Hole Size (mm)	Radiation Contour for 4.7GJ/s (mm)	Radiation Contour for 12.6GJ/s (mm)	Energy Release Rate GJ/s	Pipe Diameter (mm)	MAOP (kPa)
Lic 122 Derrimul to Sunbury T62	Max. Hole size for T2 (S, etc.) Location Class (mm) (1GJ/s max. release rate)	46.49	65	40	1.00	168.3	7390
Lic 122 Derrimul to Sunbury T118 500OD	15 T Excavator Hole Size (mm)					508	10200
Lic 122 Derrimul to Sunbury T118	Single Point of TT	20	34	21	0.27	508	10200
Lic 122 Derrimul to Sunbury T118	Both Points of TT	70	118	72	3.32	508	10200
Lic 122 Derrimul to Sunbury T118	Penetration Tooth	55	93	57	2.05	508	10200
Lic 122 Derrimul to Sunbury T118	20 T Excavator Hole Size (mm)					508	10200
Lic 122 Derrimul to Sunbury T118	Single Point of TT	25	42	26	0.42	508	10200
Lic 122 Derrimul to Sunbury T118	Both Points of TT	80	135	83	4.33	508	10200
Lic 122 Derrimul to Sunbury T118	Penetration Tooth	60	102	62	2.44	508	10200
Lic 122 Derrimul to Sunbury T118	25 T Excavator Hole Size (mm)					508	10200
Lic 122 Derrimul to Sunbury T118	Single Point of TT	25	42	26	0.42	508	10200
Lic 122 Derrimul to Sunbury T118	Both Points of TT	85	144	88	4.89	508	10200
Lic 122 Derrimul to Sunbury T118	Penetration Tooth	65	110	67	2.86	508	10200
Lic 122 Derrimul to Sunbury T118	30 T Excavator Hole Size (mm)					508	10200
Lic 122 Derrimul to Sunbury T118	Single Point of TT	30	51	31	0.61	508	10200
Lic 122 Derrimul to Sunbury T118	Both Points of TT	95	161	98	6.11	508	10200
Lic 122 Derrimul to Sunbury T118	Penetration Tooth	70	118	72	3.32	508	10200
Lic 122 Derrimul to Sunbury T118	Pilot Hole (Verticle or Horizontal Drill/Auger)	50	85	52	1.69	508	10200
Lic 122 Derrimul to Sunbury T118	Pin Hole Size (mm)	3	5	3	0.01	508	10200
Lic 122 Derrimul to Sunbury T118	Intermediate Hole Size (mm)	12	20	12	0.10	508	10200
Lic 122 Derrimul to Sunbury T118	Major Hole Size (mm)	50	85	52	1.69	508	10200
Lic 122 Derrimul to Sunbury T118	Rupture	Full Bore	526	321	65.00	508	10200
Lic 122 Derrimul to Sunbury T118	Max. Hole size for T1 (I, etc.) Location Class (mm) (10GJ/s max. release rate)	121.55	206	126	10.00	508	10200
Lic 122 Derrimul to Sunbury T118	Max. Hole size for T2 (S, etc.) Location Class (mm) (1GJ/s max. release rate)	38.45	65	40	1.00	508	10200
Lic 124 Newport T64	15 T Excavator Hole Size (mm)					457	2760
Lic 124 Newport T64	Single Point of TT	20	16	10	0.06	457	2760
Lic 124 Newport T64	Both Points of TT	70	57	35	0.77	457	2760
Lic 124 Newport T64	Penetration Tooth	55	45	27	0.47	457	2760

Appendix E

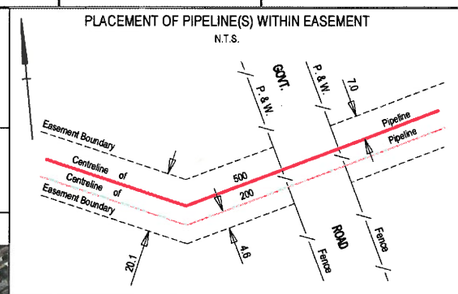
Pipeline T112 – Brooklyn to Lara

Supporting Information

EASEMENT NUMBER	T112-7-27	GOVT. ROAD / VICTRACK	T112-7-26	T112-7-25	T112-7-24	T112-7-23	T112-7-22	T112-7-21	T112-7-20	T112-7-19	T112-7-18	T112-7-17	T112-7-16	
PROPERTY OWNER	E. COHEN		F. AGAR & FAMILY PTY LTD & F. AGAR										F. AGAR & FAMILY PTY LTD & F. AGAR	ROADS CORPORATION FUTURE WESTERN FREEWAY (DEER PARK BYPASS)
CROWN ALLOTMENT NO.	C.P. 2 Sec.3	CHRISTIES ROAD / VICTRACK	Lot 1 TP 833828J	Lot 3 TP 833828J	Lot 4 TP 833828J	Lot 5 TP 833828J	Lot 6 TP 833828J	Lot 7 TP 833828J	Lot 8 TP 833828J	Lot 9 TP 833828J	Lot 10 TP 833828J	Lot 11 TP 833828J	Pt. C.P. 2 Sec. 4	Pt. C.P. 2 Sec. 4
PARISH	DERRIMUT													DERRIMUT
MUNICIPALITY	SHIRE OF MELTON													CITY OF BRIMBANK



PLACEMENT OF PIPELINE(S) WITHIN EASEMENT
N.T.S.

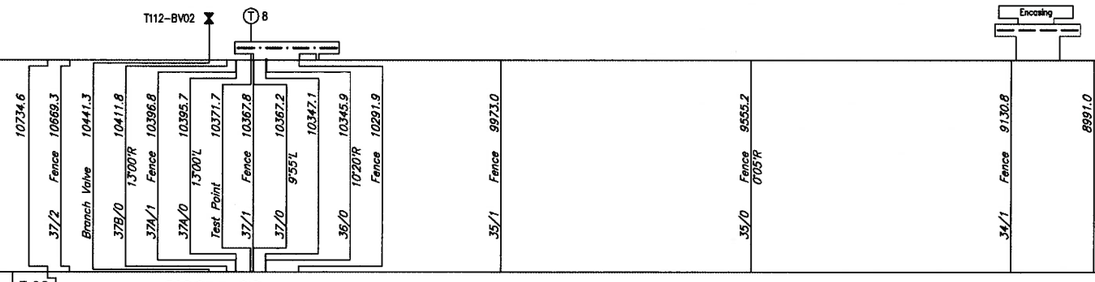


LEGEND

2°31'L	LEFT HAND HORIZONTAL BEND IN DIRECTION OF PROGRESSIVE HORIZONTAL DISTANCE
2°31'R	RIGHT HAND HORIZONTAL BEND IN DIRECTION OF PROGRESSIVE HORIZONTAL DISTANCE
M.B.	MANUFACTURED BEND 8 DIA. RAD.
(T)	ELECTROLYSIS TEST POINT (TYPE AS SPECIFIED)
(A)	ANODE BED
(E)	EARTHING BED
	ANCHOR SADDLE
	VALVE
	PERMANENT MARK (P.M.)
	CONCRETE COATING
	CONCRETE SLABBING
	FENCE / CADASTRAL BOUNDARY

ENVIRONMENTAL CONSTRAINTS

SPECIAL INSTALLATIONS



PROGRESSIVE HORIZONTAL DISTANCE	10989.0	10734.6	10669.3	10441.3	10411.8	10396.8	10395.7	10371.7	10367.8	10357.2	10347.1	10345.9	10291.9
HORIZONTAL BENDS		Fence	Branch Valve		13°00'R	Fence	13°00'L	Test Point	Fence	9°55'L		10°20'R	Fence
PIPE CENTRELINE NO. (peg)		37/2		37B/0	37A/1	37A/0		37/1	37/0		36/0		35/1

PROGRESSIVE HORIZONTAL DISTANCE	9973.0	9555.2	9130.8	8991.0
HORIZONTAL BENDS	Fence	Fence 0°05'R	Fence	
PIPE CENTRELINE NO. (peg)	35/1	35/0	34/1	

PIPE O.D. & W.T.	7.90mm W.T.	9.00	7.90	508.0mm O.D. 11.1mm W.T.
PIPELINE LOCATION CLASS	T1			T1
DATE PIPELINE LAID	MARCH 2008	OCTOBER 2013		MARCH 2008
LONGITUDINAL SECTION SHEET	T112-17-1			T112-16-1

SPECIFICATION FOR 500 NB STEEL PIPELINE

PIPE:	508.0mm O.D. x 11.1mm, 9.00mm AND 7.90mm W.T. MANUFACTURED TO API STANDARD 5L GRADE X70 CONTRACT No.
COATING:	EXTERNALLY COATED WITH DUAL LAYER F.B.E. TO 600 MICRONS INTERNALLY COATED WITH EPOXY TO 50 MICRONS CONTRACT No. WITH FIELD APPLIED HBE 95 AT JOINTS TO MINIMUM 1000 MICRONS
FIELD WELDING AND BENDS:	AS 2885.2 - 2006 AND CONTRACT No.
HYDROSTATIC TESTING:	TEST SECTION 3 (0-24191) AS 2885.5 - 2002 MAXIMUM STRENGTH TEST PRESSURE 16184 kPa MINIMUM STRENGTH TEST PRESSURE 15216 kPa MINIMUM LEAK TEST PRESSURE 14079 kPa REFER CONTRACT No.
PIPE:	T112-BV02 RELOCATED ENTIRELY. (12/13) REPLACEMENT PIPE FROM ORIGINAL PIPELINE ORDER. SAME HEAT # A3 ADJACENT PIPE. (01/11/13 LAID)
TESTING:	HYDROSTATIC TEST PRESSURE 15,300 kPa

RECORDED DRAWING

0 100 200 400 600
Full Size 1:10000 ; Half Reduction 1:20000
SCALE (m)

NOTES:

1. TEST POINTS ARE INSTALLED DIRECTLY OVER THE PIPELINE.

REV	PROJ No	REVISION	DATE	DRW	DES	CHK	APP
1	33229	BRANCH VALVE T112-BV02 RELOCATED FROM PHD 10341.3 TO PHD 10441.3	30/04/15	NL	AJ	GO	AJ
		& CONCRETE SLAB ADDED AT REGIONAL RAIL LINK					

REFERENCE DRGs	DRG No
REGIONAL RAIL CROSSING	T112-4-2
HOT TAP SPLIT TEE	T112-11-149
SITE PLAN	4554-MA-002
ROUTE PLAN	T56-17
BRANCH VALVE T112-BV02	T112-11-60
CADASTRAL FIELDNOTES	T112-11-25
KEY PLAN	A4-80-2

FIELD BOOK
608 p.27-31
610 p.66

LEVEL DATUM
A.H.D.

A1

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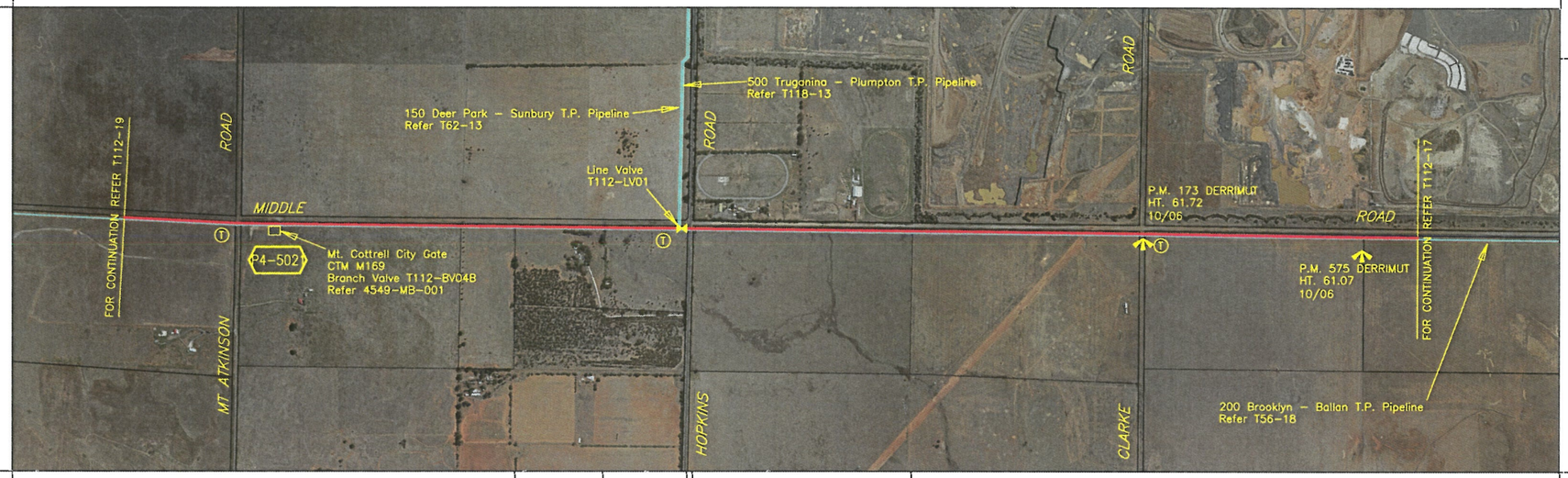
	NAME	DATE
DRAWN	N. LOW	02/08/08
DESIGNED	P.V.W	
VALIDATED		
ACCEPTED	C. BONAR	
SCALE	AS SHOWN	

500 BROOKLYN - LARA TRANSMISSION PIPELINE
ROUTE PLAN

PROJECT No	DRG No	REV
	T112-17	1

R:\corp\Asset\T112_500Brooklyn-Lara\5229_Bacons Rail Level\5229_Pipeline\T112-17.dwg Layout: Cal-PIPE Writer APA Central dgn_lib: Nancy 30/07/2018 2:26:38 PM

EASEMENT NUMBER	T112-7-37	GOVT. ROAD	T112-7-36	T112-7-35	T112-7-34	T112-7-33	GOVT. ROAD	T112-7-32	T112-7-31	T112-7-30	T112-7-29	GOVT. ROAD	T112-7-28	T112-7-27
PROPERTY OWNER	J. WAN, Y. CHEN, L. CHEN & L. M. GU		L. SKODA	B. M. McNAUGHTON	W. E. BITANS	MELTON SHIRE COUNCIL		MELTON SHIRE COUNCIL		W. E. BITANS	P. BATUR, V., J., M. & T. L. BULIC		E. COHEN	E. COHEN
CROWN ALLOTMENT NO.	2	MT ATKINSON ROAD	C.P. 1	Lot 1	Lot 1	Road R1	HOPKINS ROAD	Road R1 Reserve 1		Lot 1	2	CLARKE ROAD	C.P. 1	C.P. 2
PARISH	Sec. 5 PYWHEITJORRK		Sec. 1 DERRIMUT	TP 401516Q	PS 512501X	PS 512501X		PS 512498H		PS 512498H	Sec. 2		Sec. 3	Sec. 3 DERRIMUT
MUNICIPALITY	SHIRE							OF						MELTON



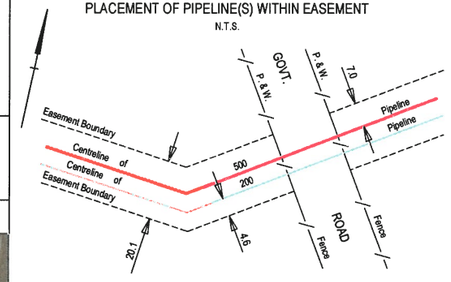
ENVIRONMENTAL CONSTRAINTS		DRY STONE WALL	DRY STONE WALL	DRY STONE WALL			DRY STONE WALL						
SPECIAL INSTALLATIONS		T11 T112-BV04B				T112-LV01 T10					T9		
PROGRESSIVE HORIZONTAL DISTANCE	15622.8	15229.7	15225.0	15205.1	15076.9	14416.9	14223.5	13900.3	13707.7	13627.0	13624.1	13619.4	13612.0
HORIZONTAL BENDS		Test Point	Fence 2°17'R	Fence	Branch Valve	0°09'L Fence	Fence	Fence		Line Valve	Test Point	5°30'R	6°00'L
PIPE CENTRELINE NO. (peg)		43/0	42/2			42/0	41/3	41/1			41A/0	41/0	40/2
PIPE O.D. & W.T.	7.9mm W.T.	11.1	508.0mm O.D.			7.9mm W.T.			11.1	508.0mm O.D.			
PIPELINE LOCATION CLASS	T1												
DATE PIPELINE LAID	FEBRUARY 2008												
LONGITUDINAL SECTION SHEET	T112-18-2					T112-18-1							

ENVIRONMENTAL CONSTRAINTS													
SPECIAL INSTALLATIONS													
PROGRESSIVE HORIZONTAL DISTANCE	13585.7	13500.3	13161.7	12796.4	11985.1	11965.0	11964.0	11495.8	11231.8	11176.9	10999.0		
HORIZONTAL BENDS	Fence	Fence	Fence	Fence 0°09'R	Fence 0°08'L	Fence	Test Point	Fence	0°01'R	Fence			
PIPE CENTRELINE NO. (peg)	40/2	40/1	40/0		39/0	38/2		38/1	38/0	37/3			
PIPE O.D. & W.T.				7.9mm W.T.	11.1			7.9mm W.T.					
PIPELINE LOCATION CLASS	T1												
DATE PIPELINE LAID	FEBRUARY 2008				MARCH 2008								
LONGITUDINAL SECTION SHEET	T112-18-1				T112-17-1								

RECORDED DRAWING

0 100 200 400 600
Full Size 1:10000 ; Half Reduction 1:20000
SCALE (m)

PLACEMENT OF PIPELINE(S) WITHIN EASEMENT
N.T.S.



LEGEND

2°31'L	LEFT HAND HORIZONTAL BEND IN DIRECTION OF PROGRESSIVE HORIZONTAL DISTANCE
2°31'R	RIGHT HAND HORIZONTAL BEND IN DIRECTION OF PROGRESSIVE HORIZONTAL DISTANCE
M.B.	MANUFACTURED BEND 8 DIA. RAD.
T	ELECTROLYSIS TEST POINT (TYPE AS SPECIFIED)
A	ANODE BED
E	EARTHING BED
	ANCHOR SADDLE
	VALVE
	PERMANENT MARK (P.M.)
	CONCRETE COATING
	CONCRETE SLABBING
	FENCE / CADASTRAL BOUNDARY
P8-17	REGULATOR P8-17 IN REGULATOR REGISTER

SPECIFICATION FOR 500 NB STEEL PIPELINE

PIPE:	508.0mm O.D. x 11.1mm AND 7.9mm W.T. MANUFACTURED TO API STANDARD 5L GRADE X70 CONTRACT No.
COATING:	EXTERNALLY COATED WITH DUAL LAYER F.B.E. TO 600 MICRONS INTERNALLY COATED WITH EPOXY TO 50 MICRONS CONTRACT No. WITH FIELD APPLIED HBE 95 AT JOINTS TO MINIMUM 1000 MICRONS
FIELD WELDING AND BENDS:	AS 2885.2 - 2006 AND CONTRACT No.
HYDROSTATIC TESTING:	TEST SECTION 3 (0-24191) AS 2885.5 - 2002 MAXIMUM STRENGTH TEST PRESSURE 16184 kPa MINIMUM STRENGTH TEST PRESSURE 15216 kPa MINIMUM LEAK TEST PRESSURE 14079 kPa REFER CONTRACT No.

NOTES:

1. TEST POINTS ARE INSTALLED DIRECTLY OVER THE PIPELINE.

REV	PROJ No	REVISION	DATE	DRW	DES	CHK	APP
2	34148	MT. COTTRELL CITY GATE CTM M169 & BRANCH VALVE T112-BV04B ADDED	05/08/16	NL	SO	GO	RL
1	33229	CONC. SLAB ADDED	30/04/15	NL	AJ	GO	AJ

REFERENCE DRGs	DRG No
MT COTTRELL M169 - PSC	4549-PA-001
BRANCH VALVE T112-BV04B	T112-11-151
CTM M169	4549-MB-001
ROUTE PLAN (150)	T62-13
ROUTE PLAN (200)	T56-18
CADASTRAL FIELDNOTES	T112-11-25 & 26
KEY PLAN	A4-80-2

FIELD BOOK
608 p.31 - 41
610 p.74 & 75

LEVEL DATUM
A.H.D.

A1

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	NAME	DATE
DRAWN	N. LOW	02/08/08
DESIGNED	P.V.W	
VALIDATED		
ACCEPTED	C. BONAR	

SCALE: AS SHOWN

500 BROOKLYN - LARA TRANSMISSION PIPELINE
ROUTE PLAN

PROJECT No	DRG No	REV
	T112-18	2

R:\corp\cad\T112-500 Brooklyn-Lara\0229_Revised Rte Lay\P-Prelim\T112-18.dwg Layout: LOM PIPE Water APA General.ctb Low, Marcus 10/05/2016 8:30:10 AM

3. Pipeline Information

The pipeline Design Parameters used in the FCP are summarised in Table 4.

Table 4: Pipeline Design Parameters

Item	Description				
Licence No. / T No.	266 / T112				
Pipeline Name and Location	Brooklyn to Lara				
Year Built	2008				
Nominal Diameter	DN500	DN500	DN500	DN500	DN500
Outside Diameter (mm)	508	508	508	508	508
MAOP (MPa)	10.2	10.2	10.2	10.2	10.2
Line Pipe Material	API 5L X70	API 5L X70	API 5L X70	API 5L X70	API 5L X70
Pipe Manufacturing Type	ERW	ERW	ERW	ERW	ERW
Pipe SMYS / UTS (MPa)	483 / 565	483 / 565	483 / 565	483 / 565	483 / 565
Wall Thicknesses (mm)	7.9	9.0	10.8	11.1	12.7
Hoop Stress at Design Pressure	328 MPa 68% SMYS	288 MPa 60% SMYS	240 MPa 50% SMYS	233 MPa 48% SMYS	204 MPa 42% SMYS
Threshold Pressure (MPa) (85 MPa hoop stress)	2.64	3.01	3.61	3.71	4.25
Location Class	R1/R2/T1 / I , S(Ref. 8)				
Critical Defect Length (CDL)– 2c	See Table.5				
Line-pipe Manufacturing Code	API 5L (Ref. 3)				
Compliance Code	AS 2885.1 : 2018 (Ref. 1)				
Max. Design Temperature (°C)	60				
Min. Design Temperature (°C)	-10				
Corrosion Allowance (mm)	Zero				

3.1. Available Test Results

This FCP provides minimum requirements in order to meet AS/NZS 2885.1. Refer to Appendix.5 for material test properties demonstrating compliance to this FCP.

Table 5: Critical Defect Length					
Pipeline Size	**MAOP**	**Pipe Wall Thickness**	**Material Grade**	**CDL (mm)**	**80% CDL (mm)**
DN500	10.2 MPa	7.9 mm	API 5L X70	101	81
DN500	10.2 MPa	9.0 mm	API 5L X70	132	106
DN500	10.2 MPa	10.8 mm	API 5L X70	186	149
DN500	10.2 MPa	11.1 mm	API 5L X70	195	156
DN500	10.2 MPa	12.7 mm	API 5L X70	248	198

6.2. Fracture Initiation Toughness Requirement

An initiation toughness analysis was performed to determine the Charpy toughness requirements necessary to achieve a static axial through thickness flaw tolerance equal to 80% of the tolerable flaw length at infinite toughness.

The following equations found in AS/NZS 2885.1 define the plane-stress (Stress Intensity Factor (Kc)) required to resist fracture initiation from a through wall flaw in a pipeline and is summarised below:

The stress intensity factor (Kc) can be converted to Charpy Energy using the following relationship of AS/NZS 2885.1:

$$K_C^{\,2} = 8c\,\frac{(\sigma_{flow})^2}{\pi}\ln.\sec\left(\frac{\pi M_T \sigma_H}{2\sigma_{flow}}\right)$$

$$C_{VN} = \frac{K_C^{\,2} A_C}{EB}$$

C_{VN} = Chary Energy (J)

E = Young's Modulus in MPa

B = 1000 (Conversion Factor)

Ac = Uncracked Area in a Full Size Charpy Specimen in mm (i.e. 80 mm^2)

The procedure to determine the Charpy Energy to ensure adequate resistance to fracture initiation is as follows:

- Develop a plot of Cv Energy vs. Flaw Length (2c).
- Determine the Charpy Energy that corresponds to 80% of the Charpy plateau energy required to tolerate the flaw size at infinite toughness.

In accordance with AS/NZS 2885.1, CVN tests shall be carried out at the minimum steady state operating temperature (generally it is equivalent to the minimum ground temperature at pipe depth) rounded down to the nearest 5°C. This FCP adopts the approach of using the lesser of the minimum design temperature or 0°C.

There are no pressure let-down facilities on the pipelines under this FCP.

9. Special Provisions for High Consequence Areas

9.1. No Rupture Scenario

AS/NZS 2885.1 requires that each existing pipeline is assessed against Clause 4.9.2 of AS/NZS 2885.1 - No Rupture for High Consequence Areas typically found in the T2, T1, I, S, E and where applicable, HI and C location classes. Where the pipeline does not comply with this clause, mitigation shall be applied to maximise integrity of the pipeline and compliance with AS 2885.

This report only highlights the findings as per Clause 4.9.2 of AS/NZS 2885.1 and does not make recommendations or outline mitigation measures normally addressed and discussed in a SMS. Furthermore, no assumption has been made with the type and size of an excavator (credible threat) typically found in the area which has been revised in the latest SMS.

AS/NZS 2885.1 specifies that the No Rupture criteria is satisfied when either of the following conditions are met:

- The hoop stress shall not exceed 30% of the SMYS
- The largest equivalent defect length produced by the threats identified in that location shall be determined. The hoop stress at MAOP shall be such that the CDL is not less than 150% of the axial length of the largest equivalent defect.

9.2. Resistance to Penetration

Where excavators are identified as being an external interference threat, resistance to penetration against typical excavator threats are assessed in accordance with Appendix E of AS/NZS 2885.1.

The findings are summarised in Table.9 highlight the type and weight of an excavator the pipeline can resist from penetration. The B factor equal to 1.3 has been adopted within High Consequence Areas and for all other areas a B factor of 0.75 is used (refer to APPENDIX 1 - for details of the calculation).

Table 9: Resistance to Penetration Summary for Maximum Excavator Type & Size Causing No Leak/Rupture

Pipe Size/ Wall Thickness / Grade	B Factor	Tooth Type			
		General Purpose (T)	Penetration (T)	Single Point Tiger (T)	Twin Tiger (T)
DN500 / 7.9 mm / API 5L X70	0.75	> 55	40	40	> 55
	1.3	> 55	15	15	40
DN500 / 9.0 mm / API 5L X70	0.75	> 55	> 55	> 55	> 55
	1.3	> 55	15	15	> 55
DN500 / 10.8 mm / API 5L X70	0.75	> 55	> 55	> 55	> 55
	1.3	> 55	25	25	> 55
DN500 / 11.1 mm / API 5L X70	0.75	> 55	> 55	> 55	> 55
	1.3	> 55	25	25	> 55

Table 9: Resistance to Penetration Summary for Maximum Excavator Type & Size Causing No Leak/Rupture					
Pipe Size/ Wall Thickness / Grade	**B Factor**	**Tooth Type**			
		General Purpose (T)	**Penetration (T)**	**Single Point Tiger (T)**	**Twin Tiger (T)**
DN500 / 12.7 mm / API 5L X70	0.75	> 55	> 55	> 55	> 55
	1.3	> 55	40	40	> 55

A series of tables (Tables 10 to 19) were generated to demonstrate the pipeline failure mode subjected to impact by excavators for every wall thickness as well as by different Force Factor B.

In the tables below, “Resist” indicates the pipeline cannot be penetrated while “Leak” predicts the penetration resulting in a leakage and “Rupture” indicates that pipe is subject to a full bore rupture.

No rupture assessment based on excavator threat is also provided in this calculation in accordance with AS/NZS 2885.1 2018 Clause 4.9.2 (b). The result of this assessment is shown as “Pass” or “Fail” in APPENDIX 1 - .

In High Consequence Areas, where the “No Rupture” criterion is not satisfied, mitigation shall be applied in accordance with AS/NZS 2885.1.

Results from the subsequent tables shall be used in the relevant SMS document (Ref. 8) and/or ALARP assessments to ensure sufficient control measures are in place and where applicable, HCA / No Rupture design requirements (i.e. threats caused by excavators, energy release rates, etc.) are assessed and agreed such that integrity of the pipeline is not compromised.

Energy release rates are provided for all “Leak” failure modes in GJ/s. They are calculated based on the gas composition referenced in Table 7. The gas thermal properties have been accurately calculated using NIST REFPROP in accordance with AS/NZS 2885.1-2018 (Ref. 1) and API 521 (Ref. 4).

Table 10: Failure Mode Summary - B=0.75 – DN500 - WT=7.9 mm - API 5L X70										
Wall Thickness	**B Factor**	**Type of Tooth**	**Excavator Weight**							
			5 T	**10 T**	**15 T**	**20 T**	**25 T**	**30 T**	**35 T**	**40 T**	**55T**
7.9 mm API 5L X70	0.75	General purpose	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist
		Penetration Tooth	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Rupture 65.33
		Single point Tiger	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Leak 0.83
		Twin Tiger	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist

Table 11: Failure Mode Summary-B=1.3 – DN500 - WT=7.9 mm - API 5L X70										
Wall Thickness	B Factor	Type of Tooth	Excavator Weight								
			5 T	10 T	15 T	20 T	25 T	30 T	35 T	40 T	55T
7.9 mm API 5L X70	1.3	General purpose	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist
		Penetration Tooth	Resist	Resist	Resist	Leak 2.44	Leak 2.86	Rupture 65.33	Rupture 65.33	Rupture 65.33	Rupture 65.33
		Single point Tiger	Resist	Resist	Resist	Leak 0.42	Leak 0.42	Leak 0.61	Leak 0.61	Leak 0.83	Leak 0.83
		Twin Tiger	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Rupture 65.33

Table 12: Failure Mode Summary - B=0.75 – DN500 - WT=9.0 mm - API 5L X70										
Wall Thickness	B Factor	Type of Tooth	Excavator Weight								
			5 T	10 T	15 T	20 T	25 T	30 T	35 T	40 T	55T
9.0 mm API 5L X70	0.75	General purpose	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist
		Penetration Tooth	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist
		Single point Tiger	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist
		Twin Tiger	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist

Table 13: Failure Mode Summary - B=1.3 – DN500 - WT=9.0 mm - API 5L X70										
Wall Thickness	B Factor	Type of Tooth	Excavator Weight								
			5 T	10 T	15 T	20 T	25 T	30 T	35 T	40 T	55T
9.0 mm API 5L X70	1.3	General purpose	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist
		Penetration Tooth	Resist	Resist	Resist	Leak 2.44	Leak 2.86	Leak 3.32	Leak 4.33	Rupture 65.33	Rupture 65.33
		Single point Tiger	Resist	Resist	Resist	Leak 0.42	Leak 0.42	Leak 0.61	Leak 0.61	Leak 0.83	Leak 0.83
		Twin Tiger	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist

Table 14: Failure Mode Summary - B=0.75 – DN500 - WT=10.8 mm - API 5L X70										
Wall Thickness	B Factor	Type of Tooth	Excavator Weight								
			5 T	10 T	15 T	20 T	25 T	30 T	35 T	40 T	55T
10.8 mm API 5L X70	0.75	General purpose	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist
		Penetration Tooth	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist
		Single point Tiger	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist
		Twin Tiger	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist

Table 15: Failure Mode Summary - B=1.3 – DN500 - WT=10.8 mm - API 5L X70										
Wall Thickness	B Factor	Type of Tooth	Excavator Weight								
			5 T	10 T	15 T	20 T	25 T	30 T	35 T	40 T	55T
10.8 mm API 5L X70	1.3	General purpose	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist
		Penetration Tooth	Resist	Resist	Resist	Resist	Resist	Leak 3.32	Leak 4.33	Leak 5.48	Leak 5.48
		Single point Tiger	Resist	Resist	Resist	Resist	Resist	Leak 0.61	Leak 0.61	Leak 0.83	Leak 0.83
		Twin Tiger	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist

Table 16: Failure Mode Summary - B=0.75 – DN500 - WT=11.1 mm - API 5L X70										
Wall Thickness	B Factor	Type of Tooth	Excavator Weight								
			5 T	10 T	15 T	20 T	25 T	30 T	35 T	40 T	55T
11.1 mm API 5L X70	0.75	General purpose	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist
		Penetration Tooth	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist
		Single point Tiger	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist
		Twin Tiger	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist

Table 17: Failure Mode Summary - B=1.3 – DN500 - WT=11.1 mm - API 5L X70										
Wall Thickness	B Factor	Type of Tooth	Excavator Weight							
			5 T	10 T	15 T	20 T	25 T	30 T	35 T	40 T	55T
11.1 mm API 5L X70	1.3	General purpose	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist
		Penetration Tooth	Resist	Resist	Resist	Resist	Resist	Leak 3.32	Leak 4.33	Leak 5.48	Leak 5.48
		Single point Tiger	Resist	Resist	Resist	Resist	Resist	Leak 0.61	Leak 0.61	Leak 0.83	Leak 0.83
		Twin Tiger	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist

Table 18: Failure Mode Summary - B=0.75 – DN500 - WT=12.7 mm - API 5L X70										
Wall Thickness	B Factor	Type of Tooth	Excavator Weight							
			5 T	10 T	15 T	20 T	25 T	30 T	35 T	40 T	55T
12.7 mm API 5L X70	0.75	General purpose	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist
		Penetration Tooth	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist
		Single point Tiger	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist
		Twin Tiger	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist

Table 19: Failure Mode Summary - B=1.3 – DN500 - WT=12.7 mm - API 5L X70										
Wall Thickness	B Factor	Type of Tooth	Excavator Weight							
			5 T	10 T	15 T	20 T	25 T	30 T	35 T	40 T	55T
12.7 mm API 5L X70	1.3	General purpose	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist
		Penetration Tooth	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Leak 5.48
		Single point Tiger	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Leak 0.83
		Twin Tiger	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist

9.3. Maximum Discharge Rate

AS/NZS 2885.1 requires that pipelines to be assessed against Clause 4.9.3 AS/NZS 2885.1 – Maximum Discharge Rate for High Consequence Areas. Where the existing pipeline does not comply with this clause, mitigation measures shall be applied in accordance with AS 2885.3.

As per Clause 4.9.3 of AS/NZS 2885.1, for pipeline carrying flammable gases, the maximum discharge rate shall not exceed 10 GJ/s in T1 and I or 1 GJ/s in T2, S location class. Energy release rate for HI location class depends on the appropriate design requirement (R2, T1 or T2) applied for the pipeline. The energy release rate shall be calculated for quasi-steady state conditions that exist 30 seconds after the pipeline puncture.

The hole sizes resulting in a maximum discharge rate of 10 GJ/s and 1 GJ/s are summarised in 20 (refer to APPENDIX 2 - for details of the calculation).

Table 20: Hole Size Resulting in 1GJ/s and 10GJ/s Energy Release Rate

Pipeline	Energy Release Rates (GJ/S)	Hole Size (mm)	Applicable Location Classes
MAOP 10.2 MPa (All Sizes and wall thicknesses)	1	38	T2, S
	10	121	T1, I

Pipeline		Hole Size (mm)	Radiation Contour for 4.7GJ/s (mm)	Radiation Contour for 12.6GJ/s (mm)	Energy Release Rate GJ/s	Pipe Diameter (mm)	MAOP (kPa)
Lic 253 Supply to Snowy Hydro Power Station Laverton North T110	Both Points of TT	85	144	88	4.89	355.6	10200
Lic 253 Supply to Snowy Hydro Power Station Laverton North T110	Penetration Tooth	65	110	67	2.86	355.6	10200
Lic 253 Supply to Snowy Hydro Power Station Laverton North T110	30 T Excavator Hole Size (mm)					355.6	10200
Lic 253 Supply to Snowy Hydro Power Station Laverton North T110	Single Point of TT	30	51	31	0.61	355.6	10200
Lic 253 Supply to Snowy Hydro Power Station Laverton North T110	Both Points of TT	95	161	98	6.11	355.6	10200
Lic 253 Supply to Snowy Hydro Power Station Laverton North T110	Penetration Tooth	70	118	72	3.32	355.6	10200
Lic 253 Supply to Snowy Hydro Power Station Laverton North T110	Pilot Hole (Verticle or Horizontal Drill/Auger)	50	85	52	1.69	355.6	10200
Lic 253 Supply to Snowy Hydro Power Station Laverton North T110	Pin Hole Size (mm)	3	5	3	0.01	355.6	10200
Lic 253 Supply to Snowy Hydro Power Station Laverton North T110	Intermediate Hole Size (mm)	12	20	12	0.10	355.6	10200
Lic 253 Supply to Snowy Hydro Power Station Laverton North T110	Major Hole Size (mm)	50	85	52	1.69	355.6	10200
Lic 253 Supply to Snowy Hydro Power Station Laverton North T110	Rupture	Full Bore	350	214	29.00	355.6	10200
Lic 253 Supply to Snowy Hydro Power Station Laverton North T110	Max. Hole size for T1 (I, etc.) Location Class (mm) (10GJ/s max. release rate)	121.55	206	126	10.00	355.6	10200
Lic 253 Supply to Snowy Hydro Power Station Laverton North T110	Max. Hole size for T2 (S, etc.) Location Class (mm) (1GJ/s max. release rate)	38.44	65	40	1.00	355.6	10200
Lic 266 Brooklyn to Lara T112	15 T Excavator Hole Size (mm)					508	10200
Lic 266 Brooklyn to Lara T112	Single Point of TT	20	34	21	0.27	508	10200
Lic 266 Brooklyn to Lara T112	Both Points of TT	70	118	72	3.32	508	10200
Lic 266 Brooklyn to Lara T112	Penetration Tooth	55	93	57	2.05	508	10200
Lic 266 Brooklyn to Lara T112	20 T Excavator Hole Size (mm)					508	10200

Pipeline		Hole Size (mm)	Radiation Contour for 4.7GJ/s (mm)	Radiation Contour for 12.6GJ/s (mm)	Energy Release Rate GJ/s	Pipe Diameter (mm)	MAOP (kPa)
Lic 266 Brooklyn to Lara T112	Single Point of TT	25	42	26	0.42	508	10200
Lic 266 Brooklyn to Lara T112	Both Points of TT	80	135	83	4.33	508	10200
Lic 266 Brooklyn to Lara T112	Penetration Tooth	60	102	62	2.44	508	10200
Lic 266 Brooklyn to Lara T112	25 T Excavator Hole Size (mm)					508	10200
Lic 266 Brooklyn to Lara T112	Single Point of TT	25	42	26	0.42	508	10200
Lic 266 Brooklyn to Lara T112	Both Points of TT	85	144	88	4.89	508	10200
Lic 266 Brooklyn to Lara T112	Penetration Tooth	65	110	67	2.86	508	10200
Lic 266 Brooklyn to Lara T112	30 T Excavator Hole Size (mm)					508	10200
Lic 266 Brooklyn to Lara T112	Single Point of TT	30	51	31	0.61	508	10200
Lic 266 Brooklyn to Lara T112	Both Points of TT	95	161	98	6.11	508	10200
Lic 266 Brooklyn to Lara T112	Penetration Tooth	70	118	72	3.32	508	10200
Lic 266 Brooklyn to Lara T112	Pilot Hole (Verticle or Horizontal Drill/Auger)	50	85	52	1.69	508	10200
Lic 266 Brooklyn to Lara T112	Pin Hole Size (mm)	3	5	3	0.01	508	10200
Lic 266 Brooklyn to Lara T112	Intermediate Hole Size (mm)	12	20	12	0.10	508	10200
Lic 266 Brooklyn to Lara T112	Major Hole Size (mm)	50	85	52	1.69	508	10200
Lic 266 Brooklyn to Lara T112	Rupture	Full Bore	350	214	29.00	508	10200
Lic 266 Brooklyn to Lara T112	Max. Hole size for T1 (I, etc.) Location Class (mm) (10GJ/s max. release rate)	121.55	206	126	10.00	508	10200
Lic 266 Brooklyn to Lara T112	Max. Hole size for T2 (S, etc.) Location Class (mm) (1GJ/s max. release rate)	38.44	65	40	1.00	508	10200

Appendix F

Pipeline T118 – Truganina to Plumpton

Supporting Information

EASEMENT NUMBER			GOVT. ROAD	T118-7-1	T118-7-2 T62-7-1	T118-7-3	T118-7-4 T62-7-2		GOVT. ROAD	T118-7-5 T62-7-2			T118-7-6 T62-7-3		GOVT. ROAD	T118-7-7 T62-7-4		VICTORIAN RAILWAYS CORPORATION					
PROPERTY OWNER				W. E. BITTANS			BRD GROUP PTY. LTD.			BRD GROUP PTY. LTD.			BRD GROUP PTY. LTD.			BORAL RESOURCES (VIC.) PTY. LTD.						
CROWN ALLOTMENT NO.			MIDDLE ROAD	Lot 9	Lot 8	Lot 7	Lot 3	Lot 1	RIDING BOUNDARY ROAD	Lot 9	Lot 7	Lot 5	Lot 4		HOPKINS ROAD	Pt. Lot 12		FOOTSCRAY & BACCHUS MARSH RAILWAY					
PARISH				PS 512497K DERRIMUT			TP 828625D	TP 828625D		TP 828625D	TP 828625D	TP 828625D	TP 747009C			TP 709345A DERRIMUT							
MUNICIPALITY			SHIRE OF MELTON																				



Truganina Offtake – Site Plan	5562-MB-001
Truganina B.L.P. Offtake – Site Plan	T118-10-4
Route Plan (500)	T112-18
Route Plan (200)	T56-16
Route Plan (150)	T62-13
Railway Crossing	T118-4-1
Key Plan	A4-80-2
REFERENCE DRAWINGS	DRG. NO.

ENVIRONMENT																							
SPECIAL INSTALLATIONS			E ZINC RIBBON				T2					E T3 ZINC RIBBON	ZINC RIBBON			T4 Conc. Encasing Pipe							
PROGRESSIVE HORIZONTAL DISTANCE			0.0	123.5	311.2	498.8	502.4	527.9		1590.5	2113.4		3067.4	3130.4	3471.1	3946.4	3956.7	3982.8	4308.4	4309.1	4352.2		
HORIZONTAL BENDS			HDWM Fence	Fence	Fence	Fence	45°00'R M.B.	45°21'L M.B.		0°27'L	Fence		1°15'R		0°23'R	56°18'R M.B.	Fence	Fence	56°02'L M.B.	Fence	Fence		
PIPE CENTRELINE NO. (peg)			0/0	0/1	0/2	0/3	1/0	2/0		3/0	3/3		4/0		5/0	6/0	6/1	6/2	7/0	7/1	7/2		
PIPE O.D. & W.T.			508.0mm O.D.				11.1mm W.T.				508.0mm O.D.				11.1mm W.T.								
PIPELINE LOCATION CLASS			T1				R1															T1	
DATE PIPELINE LAID			APRIL 2012								APRIL 2012					MAY 2012						JUNE 2012	
LONGITUDINAL SECTION SHEET			T118-13-1													T118-13-2							

SPECIFICATION FOR 500 NB STEEL PIPELINE

PIPE: 508.0mm O.D. x 7.9mm and 11.1mm W.T. MANUFACTURED TO API STANDARD 5L GRADE X70 CONTRACT No. SPLP-CT-P-001

COATING: EXTERNALLY COATED WITH DUAL LAYER F.B.E. TO 600 MICRONS. INTERNALLY COATED WITH EPOXY TO 50 MICRONS. CONTRACT No. SPLP-CT-P-001 WITH FIELD APPLIED APA APPROVED EPOXY AT JOINTS TO MINIMUM 1000 MICRONS.

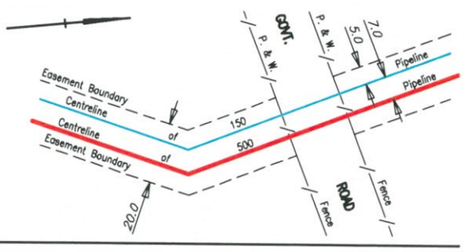
FIELD WELDING AND BENDS: AS 2885.2 – 2007

HYDROSTATIC TESTING: AS 2885.5 – 2006

MAXIMUM STRENGTH TEST PRESSURE	13500 kPa
MINIMUM STRENGTH TEST PRESSURE	13082 kPa
MINIMUM LEAK TEST PRESSURE	11229 kPa

PLACEMENT OF PIPELINE(S) WITHIN EASEMENT

N.T.S.



LEGEND

2°31'L	LEFT HAND HORIZONTAL BEND IN DIRECTION OF PROGRESSIVE HORIZONTAL DISTANCE
2°31'R	RIGHT HAND HORIZONTAL BEND IN DIRECTION OF PROGRESSIVE HORIZONTAL DISTANCE
M.B.	MANUFACTURED BEND 8 DIA. RAD.
T	ELECTROLYSIS TEST POINT (TYPE AS SPECIFIED)
A	ANODE BED
E	EARTHING BED
	ANCHOR SADDLE
	VALVE
	PERMANENT MARK (P.M.)
	CONCRETE COATING
	CONCRETE SLABBING
	FENCE / CADASTRAL BOUNDARY

200 0 200 400 600 800 1000

SCALE OF METRES

NOTES:

1. Progressive Horizontal Distances are M.G.A. Horizontal Distances

REV	REVISION	DATE	DRN.	CKD.	APP.

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APA Group	SHEET NO.	SCALE	AS SHOWN
	LEVEL DATUM A.H.D.	FILENAME	T118-13
	FIELD BOOK	DATE	14/8/12
		DRAWN	MH
		CHECKED	RC
	DESIGN ENGINEER	APPROVING ENGINEER	FRF

PROJECT: SUNBURY PIPELINE LOOPING PROJECT

TITLE: 500 TRUGANINA – PLUMPTON TRANSMISSION PIPELINE ROUTE PLAN

PROJECT NO. | R | DRAWING NO. T118-13 | REV

3. Pipeline Information

The pipeline Design Parameters used in the FCP are summarised in Table 4.

Table 4: Pipeline Design Parameters

Item	Description	
Licence No. / T No.	122 / T118	
Pipeline Name and Location	Truganina to Plumpton	
Year Built	2012	
Nominal Diameter	DN500	DN500
Outside Diameter (mm)	508	508
MAOP (MPa)	10.2	10.2
Line Pipe Material	API 5L X70	API 5L X70
Pipe Manufacturing Type	ERW	ERW
Pipe SMYS / UTS (MPa)	485 / 570	485 / 570
Wall Thicknesses (mm)	7.9	11.1
Hoop Stress at Design Pressure	328 MPa 68% SMYS	233 MPa 48% SMYS
Critical Defect Length (CDL)– 2c (mm)	101(1)	195(1)
Threshold Pressure (MPa) (85 MPa hoop stress)	2.64	3.71
Location Class	T1 (Ref. 8)	
Line-pipe Manufacturing Code	API 5L (Ref. 3)	
Compliance Code	AS 2885.1 : 2018 (Ref. 1)	
Max. Design Temperature (°C)	60	
Min. Design Temperature (°C)	-10	
Hole Size for Energy Release Rate (mm)	1 GJ/s: 38(2) 10 GJ/s: 121(2)	
Corrosion Allowance (mm)	Zero	

Notes:
(1) CDL is in accordance with Table 5.
(2) Energy release rates are in accordance with Table 14.
(3) Location class has been imported from the SMS report at the time of writing this FCP.
(4) In accordance with Pipeline Integrity Management Plan (Ref. 9), the gas transported by the VTS is a dry, sales quality natural gas and therefore the internal corrosion allowance has been assumed zero where it has not been documented. All pipelines are externally coated with a high integrity coating system, CP system is in place and pipeline is surveyed at specified intervals, therefore no design consideration for a wall thickness reduction scenario is required.

Table 5: Critical Defect Length					
Pipeline Size	**MAOP**	**Pipe Wall Thickness**	**Material Grade**	**CDL (mm)**	**80% CDL (mm)**
DN500	10.2 MPa	7.9 mm	API 5L X70	101	81
DN500	10.2 MPa	11.1 mm	API 5L X70	195	156

6.2. Fracture Initiation Toughness Requirement

An initiation toughness analysis was performed to determine the Charpy toughness requirements necessary to achieve a static axial through thickness flaw tolerance equal to 80% of the tolerable flaw length at infinite toughness.

The following equations found in AS/NZS 2885.1 define the plane-stress (Stress Intensity Factor (Kc)) required to resist fracture initiation from a through wall flaw in a pipeline and is summarised below:

The stress intensity factor (Kc) can be converted to Charpy Energy using the following relationship of AS/NZS 2885.1:

$$K_C^{\,2} = 8c\,\frac{(\sigma_{flow})^2}{\pi}\ln.\sec\left(\frac{\pi M_T \sigma_H}{2\sigma_{flow}}\right)$$

$$C_{VN} = \frac{K_C^{\,2} A_C}{EB}$$

C_{VN} = Chary Energy (J)

E = Young's Modulus in MPa

B = 1000 (Conversion Factor)

Ac = Uncracked Area in a Full Size Charpy Specimen in mm (i.e. 80 mm^2)

The procedure to determine the Charpy Energy to ensure adequate resistance to fracture initiation is as follows:

- Develop a plot of Cv Energy vs. Flaw Length (2c).
- Determine the Charpy Energy that corresponds to 80% of the Charpy plateau energy required to tolerate the flaw size at infinite toughness.

In accordance with AS/NZS 2885.1, CVN tests shall be carried out at the minimum steady state operating temperature (generally it is equivalent to the minimum ground temperature at pipe depth) rounded down to the nearest 5°C. This FCP adopts the approach of using the lesser of the minimum design temperature or 0°C.

There are no pressure let-down facilities on the pipelines under this FCP.

9. Special Provisions for High Consequence Areas

9.1. No Rupture Scenario

AS/NZS 2885.1 requires that each existing pipeline is assessed against Clause 4.9.2 of AS/NZS 2885.1 - No Rupture for High Consequence Areas typically found in the T2, T1, I, S, E and where applicable, HI and C location classes. Where the pipeline does not comply with this clause, mitigation shall be applied to maximise integrity of the pipeline and compliance with AS 2885.

This report only highlights the findings as per Clause 4.9.2 of AS/NZS 2885.1 and does not make recommendations or outline mitigation measures normally addressed and discussed in a SMS. Furthermore, no assumption has been made with the type and size of an excavator (credible threat) typically found in the area which has been revised in the latest SMS.

AS/NZS 2885.1 specifies that the No Rupture criteria is satisfied when either of the following conditions are met:

- The hoop stress shall not exceed 30% of the SMYS
- The largest equivalent defect length produced by the threats identified in that location shall be determined. The hoop stress at MAOP shall be such that the CDL is not less than 150% of the axial length of the largest equivalent defect.

9.2. Resistance to Penetration

Where excavators are identified as being an external interference threat, resistance to penetration against typical excavator threats are assessed in accordance with Appendix E of AS/NZS 2885.1.

The findings are summarised in Table.9 highlight the type and weight of an excavator the pipeline can resist from penetration. The B factor equal to 1.3 has been adopted within High Consequence Areas and for all other areas a B factor of 0.75 is used (refer to APPENDIX 1 - for details of the calculation).

Table 9: Resistance to Penetration Summary for Maximum Excavator Type & Size Causing No Leak/Rupture

Pipe Size/ Wall Thickness / Grade	B Factor	Tooth Type			
		General Purpose (T)	Penetration (T)	Single Point Tiger (T)	Twin Tiger (T)
DN500 / 7.9 mm / API 5L X70	0.75	> 55	40	40	> 55
	1.3	> 55	15	15	40
DN500 / 11.1 mm / API 5L X70	0.75	> 55	> 55	> 55	> 55
	1.3	> 55	25	25	> 55

A series of tables (Tables 10 to 13) were generated to demonstrate the pipeline failure mode subjected to impact by excavators for every wall thickness as well as by different Force Factor B.

In the tables below, “Resist” indicates the pipeline cannot be penetrated while “Leak” predicts the penetration resulting in a leakage and “Rupture” indicates that pipe is subject to a full bore rupture.

No rupture assessment based on excavator threat is also provided in this calculation in accordance with AS/NZS 2885.1 2018 Clause 4.9.2 (b). The result of this assessment is shown as “Pass” or “Fail” in APPENDIX 1 - .

In High Consequence Areas, where the “No Rupture” criterion is not satisfied, mitigation shall be applied in accordance with AS/NZS 2885.1.

Results from the subsequent tables shall be used in the relevant SMS document (Ref. 8) and/or ALARP assessments to ensure sufficient control measures are in place and where applicable, HCA / No Rupture design requirements (i.e. threats caused by excavators, energy release rates, etc.) are assessed and agreed such that integrity of the pipeline is not compromised.

Energy release rates are provided for all “Leak” failure modes in GJ/s. They are calculated based on the gas composition referenced in Table 7. The gas thermal properties have been accurately calculated using NIST REFPROP in accordance with AS/NZS 2885.1-2018 (Ref. 1) and API 521 (Ref. 4).

Table 10: Failure Mode Summary - B=0.75 – DN500 - WT=7.9 mm - API 5L X70

Wall Thickness	B Factor	Type of Tooth	Excavator Weight								
			5 T	10 T	15 T	20 T	25 T	30 T	35 T	40 T	55T
7.9 mm API 5L X70	0.75	General purpose	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist
		Penetration Tooth	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Rupture 65.33
		Single point Tiger	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Leak 0.83
		Twin Tiger	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist

Table 11: Failure Mode Summary-B=1.3 – DN500 - WT=7.9 mm - API 5L X70

Wall Thickness	B Factor	Type of Tooth	Excavator Weight								
			5 T	10 T	15 T	20 T	25 T	30 T	35 T	40 T	55T
7.9 mm API 5L X70	1.3	General purpose	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist
		Penetration Tooth	Resist	Resist	Resist	Leak 2.44	Leak 2.86	Rupture 65.33	Rupture 65.33	Rupture 65.33	Rupture 65.33
		Single point Tiger	Resist	Resist	Resist	Leak 0.42	Leak 0.42	Leak 0.61	Leak 0.61	Leak 0.83	Leak 0.83
		Twin Tiger	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Rupture 65.33

Table 12: Failure Mode Summary - B=0.75 – DN500 - WT=11.1 mm - API 5L X70										
Wall Thickness	B Factor	Type of Tooth	Excavator Weight							
			5 T	10 T	15 T	20 T	25 T	30 T	35 T	40 T	55T
11.1 mm API 5L X70	0.75	General purpose	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist
		Penetration Tooth	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist
		Single point Tiger	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist
		Twin Tiger	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist

Table 13: Failure Mode Summary - B=1.3 – DN500 - WT=11.1 mm - API 5L X70										
Wall Thickness	B Factor	Type of Tooth	Excavator Weight							
			5 T	10 T	15 T	20 T	25 T	30 T	35 T	40 T	55T
11.1 mm API 5L X70	1.3	General purpose	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist
		Penetration Tooth	Resist	Resist	Resist	Resist	Resist	Leak 3.32	Leak 4.33	Leak 5.48	Leak 5.48
		Single point Tiger	Resist	Resist	Resist	Resist	Resist	Leak 0.61	Leak 0.61	Leak 0.83	Leak 0.83
		Twin Tiger	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist	Resist

9.3. Maximum Discharge Rate

AS/NZS 2885.1 requires that pipelines to be assessed against Clause 4.9.3 AS/NZS 2885.1 – Maximum Discharge Rate for High Consequence Areas. Where the existing pipeline does not comply with this clause, mitigation measures shall be applied in accordance with AS 2885.3.

As per Clause 4.9.3 of AS/NZS 2885.1, for pipeline carrying flammable gases, the maximum discharge rate shall not exceed 10 GJ/s in T1 and I or 1 GJ/s in T2, S location class. Energy release rate for HI location class depends on the appropriate design requirement (R2, T1 or T2) applied for the pipeline. The energy release rate shall be calculated for quasi-steady state conditions that exist 30 seconds after the pipeline puncture.

The hole sizes resulting in a maximum discharge rate of 10 GJ/s and 1 GJ/s are summarised in 20 (refer to APPENDIX 2 - for details of the calculation).

Table 14: Hole Size Resulting in 1GJ/s and 10GJ/s Energy Release Rate			
Pipeline	**Energy Release Rates (GJ/S)**	**Hole Size (mm)**	**Applicable Location Classes**
MAOP 10.2 MPa (All Sizes and wall thicknesses)	1	38	T2, S
	10	121	T1, I

Pipeline		Hole Size (mm)	Radiation Contour for 4.7GJ/s (mm)	Radiation Contour for 12.6GJ/s (mm)	Energy Release Rate GJ/s	Pipe Diameter (mm)	MAOP (kPa)
Lic 122 Derrimul to Sunbury T62	Max. Hole size for T2 (S, etc.) Location Class (mm) (1GJ/s max. release rate)	46.49	65	40	1.00	168.3	7390
Lic 122 Derrimul to Sunbury T118 500OD	15 T Excavator Hole Size (mm)					508	10200
Lic 122 Derrimul to Sunbury T118	Single Point of TT	20	34	21	0.27	508	10200
Lic 122 Derrimul to Sunbury T118	Both Points of TT	70	118	72	3.32	508	10200
Lic 122 Derrimul to Sunbury T118	Penetration Tooth	55	93	57	2.05	508	10200
Lic 122 Derrimul to Sunbury T118	20 T Excavator Hole Size (mm)					508	10200
Lic 122 Derrimul to Sunbury T118	Single Point of TT	25	42	26	0.42	508	10200
Lic 122 Derrimul to Sunbury T118	Both Points of TT	80	135	83	4.33	508	10200
Lic 122 Derrimul to Sunbury T118	Penetration Tooth	60	102	62	2.44	508	10200
Lic 122 Derrimul to Sunbury T118	25 T Excavator Hole Size (mm)					508	10200
Lic 122 Derrimul to Sunbury T118	Single Point of TT	25	42	26	0.42	508	10200
Lic 122 Derrimul to Sunbury T118	Both Points of TT	85	144	88	4.89	508	10200
Lic 122 Derrimul to Sunbury T118	Penetration Tooth	65	110	67	2.86	508	10200
Lic 122 Derrimul to Sunbury T118	30 T Excavator Hole Size (mm)					508	10200
Lic 122 Derrimul to Sunbury T118	Single Point of TT	30	51	31	0.61	508	10200
Lic 122 Derrimul to Sunbury T118	Both Points of TT	95	161	98	6.11	508	10200
Lic 122 Derrimul to Sunbury T118	Penetration Tooth	70	118	72	3.32	508	10200
Lic 122 Derrimul to Sunbury T118	Pilot Hole (Verticle or Horizontal Drill/Auger)	50	85	52	1.69	508	10200
Lic 122 Derrimul to Sunbury T118	Pin Hole Size (mm)	3	5	3	0.01	508	10200
Lic 122 Derrimul to Sunbury T118	Intermediate Hole Size (mm)	12	20	12	0.10	508	10200
Lic 122 Derrimul to Sunbury T118	Major Hole Size (mm)	50	85	52	1.69	508	10200
Lic 122 Derrimul to Sunbury T118	Rupture	Full Bore	526	321	65.00	508	10200
Lic 122 Derrimul to Sunbury T118	Max. Hole size for T1 (I, etc.) Location Class (mm) (10GJ/s max. release rate)	121.55	206	126	10.00	508	10200
Lic 122 Derrimul to Sunbury T118	Max. Hole size for T2 (S, etc.) Location Class (mm) (1GJ/s max. release rate)	38.45	65	40	1.00	508	10200
Lic 124 Newport T64	15 T Excavator Hole Size (mm)					457	2760
Lic 124 Newport T64	Single Point of TT	20	16	10	0.06	457	2760
Lic 124 Newport T64	Both Points of TT	70	57	35	0.77	457	2760
Lic 124 Newport T64	Penetration Tooth	55	45	27	0.47	457	2760


GHD