Appendix N

Preliminary Risk Assessment – Pipeline Safety

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Katherine to Gove - Gas Pipeline

Preliminary AS2885 Risk Assessment Report

201001-00367-00-SR-REP-0001

29 April 2013

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SYNOPSIS

This report represents the findings of the Katherine to Gove Gas Pipeline Preliminary AS2885 Risk Assessment Report completed on 1st February 2013 for the Pre-Feasibility phase of the Project. The report provides a summary of the study and findings and the methodology used.

Disclaimer

KATHERINE TO GOVE GAS PIPELINE – PRELIMINARY AS2885 RISK ASSESSMENT REPORT							
Rev	**Description**	**Originator**	**Reviewer**	**WorleyParsons Approval**	**Date**	**Client Approval**	**Date**
A	Issued for review	H Howard	J Thompson	A Wood	8-Feb-13		
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1 EXECUTIVE SUMMARY

This report represents the findings of the a preliminary Risk Assessment undertaken for the Katherine to Gove Gas Pipeline (KGGP), in line with the requirements stipulated by AS 2885.1-2012, undertaken on the 1st February 2013.

This Preliminary Risk Assessment has been carried out to ensure that the route and pipeline design parameters did not involve any risks which could not be made acceptable by either design or procedural measures. It is not to be considered to be a definitive AS2885.1 Risk Assessment for the final pipeline design but it may be used to build on during the Feasibility and Execution Phases of the project.

Given the diverseness of pipelines, common engineered mitigation measures typically applied to above ground equipment (such as fire and gas detection, automated blowdown etc.) are often impractical to apply along the pipeline route. Given the reduced capacity to mitigate an event and the potential consequences of a major pipeline release, should the pipeline be compromised, a significant amount of hazard identification centres on prevention of a release (through a detailed threat identification assessment).

With transporting gas over approximately 603 km, there are many variations in the location classes and types through which the pipeline passes. The intention of the methodology outlined in AS 2885 is to ensure that all possible threats at the different location classes and types are identified, evaluated and managed at all stages over the life of the pipeline.

The location analysis has noted a series of features along the pipeline route and has identified threats associated with each feature. Where possible, risk has been minimised through route selection. Each threat has been systematically assessed against the Rio Tinto risk matrix and risk mitigation methods identified. Where risks were classified as Class III or higher, recommendations have been raised which will require addressing in the Feasibility Phase of the project.

A preliminary threat and location analysis for the pipeline has been undertaken (based on initial work undertaken for TTP [Ref. 3]). Each threat was reviewed for applicability to the KGGP pipeline, and current proposed control measures identified. Above ground stations were also reviewed.

45 threats were assessed. No Class IV risks were identified from the risk assessment, with proposed control and mitigation measures reducing the Residual Risk of threats and hazards to at least Class III risks. In addition, 42 recommendations were raised for further action.

2 INTRODUCTION

2.1 Objective

The Aim of this workshop was to:

- Review the previously identified hazards and risks along the pipeline which were documented as part of the TTP project [Ref. 3]. Each threat was confirm if they were deemed relevant or changed required;
- Identify any additional Pipeline threats that require risk assessment; and
- Review the above ground equipment and compressor station hazards, and document these accordingly.

2.2 Background

Pacific Aluminium (a business unit of Rio Tinto) owns and operates a bauxite mine and alumina refinery at Gove, 650 kilometres (km) east of Darwin in north east Arnhem Land, Northern Territory. The Gove mine and refinery produce high grade alumina which is then shipped to other locations for smelting and further processing.

Power and steam for the Gove Refinery and mining operations are currently generated from imported fuel oil. In order to reduce fuel oil consumption and improve operating costs at the Refinery, it is proposed to provide the facility with natural gas as an alternative fuel source. The lower cost natural gas will help underpin the long term operating viability of the Refinery.

The Katherine to Gove Gas Pipeline (KGGP) is proposed to deliver natural gas from the existing NT Amadeus Gas Pipeline at a point approximately 20 km south of Katherine, to the Gove Refinery. The KGGP would be a high pressure, steel pipeline approximately 603 km long with a nominal diameter of 300mm and a design operating life of 50 years. It will also include above ground facilities at specific locations along the route such as metering facilities, scraper stations, mainline valves and a compressor station. The supplied gas from the Amadeus Pipeline is sales quality so no additional processing of gas would be required.

The pipeline would be constructed within a 30 m wide construction corridor and would include supporting infrastructure such as temporary work camps and equipment access tracks to facilitate construction activities.

2.3 Abbreviations

The following is a list of abbreviations used in this report:

Table 2-1 – List of Abbreviations

Abbreviation	Description/Meaning
ALARP	As Low as Reasonably Practical
AS	Australian Standard
BOD	Basis of Design
DBYD	Dial Before You Dig
DN	Diameter Nominal
DP	Differential Pressure
EPA	Environmental Protection Agency
GLDS	Gas Let-down Station
ICCP	Impressed Current Cathodic Protection
KGGP	Katherine to Gove Gas Pipeline
MAOP	Maximum Allowable Operating Pressure
MOP	Maximum Operating Pressure
NT	Northern Territory
OD	Outside Diameter
PacAl	Pacific Aluminium
PCV	Pressure Control Valve
PSV	Pressure Safety Valve
SIMOP(s)	Simultaneous Operation(s)
SMS	Safety Management Study
TTP	Trans Territory Pipeline
WP	WorleyParsons Services Pty Ltd

3 RISK ASSESSMENT PROCESS

The KGGP Risk Assessment was completed by assessing the pipeline for both location specific threats and general threats to the pipeline, their likelihood of occurrence and their effect if they were to occur. The effects from worst scenario cases of failure were considered with respect to:

- Safety of the public
- Safety of employees and contractors
- Environmental impact
- Economic loss

Risk mitigation methods to be employed were also assessed on the basis of reducing risk to ALARP (As Low As Reasonably Practicable) in accordance with Australian Standard 2885.1 requirements, and the Pacific Aluminium specified requirements.

3.1 Methodology

The methodology for this Risk Assessment was based on AS2885.1 which in itself calls on methodologies outlined in AS/NZS ISO 31000: 2009 Risk Management Standards.

The study was conducted in the following stages:

1. Threat Identification

In accordance to AS2885.1 identification shall be made of the threats which could result in hazardous events affecting the station or causing release of natural gas from the station with consequent effects on the environment or the community. The systematic identification of all inherent threats was made taking an "all risks" approach, identifying all hazards and mishaps without regard to their nature, cause, severity or likelihood.

2. Identify existing controls

For each threat, all technical, procedural and other measures in place or to be undertaken to reduce or mitigate the risk as far as reasonably practicable shall be identified and documented in the workshop Minutes.

3. Estimate Consequences

For each of the postulated threats, the severity of the consequences shall be estimated.

4. Estimate Frequency

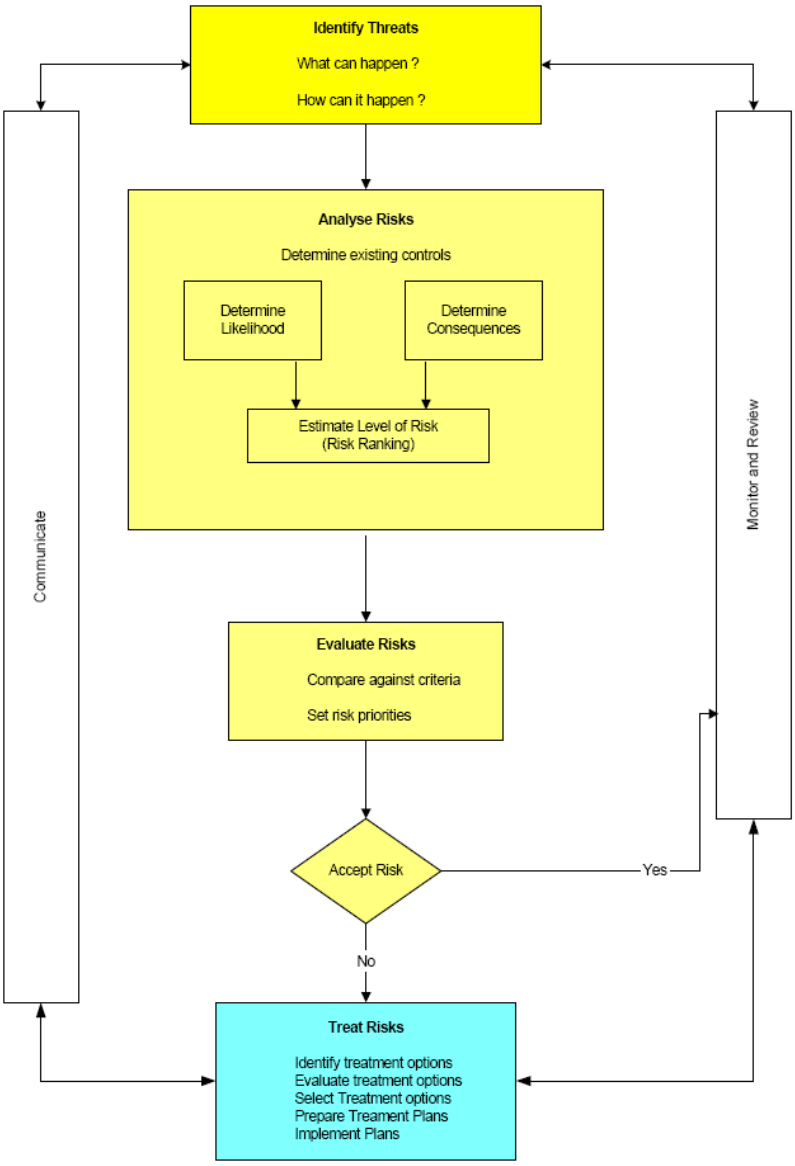
For each of the postulated threat, the frequency of the initiating event or cause shall be estimated. The contribution of existing protective mechanisms (human, equipment and procedural) shall be considered in assigning the frequency of occurrence of the hazardous incident.

5. Establish Risk Ranking

The current risk score and description are then assigned using the Risk Matrix shown in Figure 3-1.

In summary the current risk is the risk of the top level event when all existing protection has failed at its expected probability of failure on demand.

An overview of the process is outlined in below.



3.2 Risk Criteria

As advised by Pacific Aluminium, all identified threats shall be assessed against the following risk matrix in line with Rio Tinto Threat Risk Scheme given in Figure 3-1. Each risk shall then be managed (throughout the Feasibility and Execution Phases) in accordance with Rio Tinto Risk Management Response requirements.

In addition, AS2885.1-2012 provides guidance on Risk Treatment plans for hazards identified within the Pipeline risk assessment. This guidance is given in Figure 3-2, and shall be used in parallel with the Rio Tinto Risk management requirements.

Figure 3-1 Rio Tinto Threat Risk Scheme

	Most serious consequence				
	Very Low	Low	Moderate	High	Very High
Almost Certain	Class II	Class III	Class IV	Class IV	Class IV
Likely	Class II	Class III	Class III	Class IV	Class IV
Possible	Class I	Class II	Class III	Class IV	Class IV
Unlikely	Class I	Class I	Class II	Class III	Class IV
Rare	Class I	Class I	Class II	Class III	Class III

Figure 3-2 Rio Tinto Risk Reduction Requirements

General Rio Tinto Risk Reduction Requirements		AS2885.1-2012 Pipeline Risk Reduction Requirements (As per Appendix F of the Standard)	
Risk Class	**Risk Management Requirements**	**Equivalent Risk Rank**	**Risk treatment Guidelines**
Class I	Risks that are below the risk acceptance threshold and do not require active management.	**Low / Negligible**	Determine the management plan for the threat to prevent occurrence and to monitor changes that could affect the classification. Review at the Next Review Interval.
Class II	Risks that lie on the risk acceptance threshold and require active monitoring.	**Intermediate**	Repeat threat identification and risk evaluation processes to verify and, where possible, quantify the risk estimation. Where the risk rank is confirmed to be 'intermediate' (Class II), modify further physical, engineering or procedural control measures if possible to reduce the risk 'Low' (Class I) Where the risk rank cannot be reduced to 'low' or 'negligible', action shall be taken to: (a) remove threats, reduce frequencies and/or reduce severity of consequences to the extent practicable; and (b) demonstrate ALARP.
Class III	Risks that exceed the risk acceptance threshold and require proactive management.	**High**	Modification to the threat, the frequency or the consequences is required by further physical, engineering or procedural control measures so that the risk rank is reduced to 'intermediate' (Class II) or lower. Where the risk rank cannot be reduced to, action shall be taken to: (a) remove threats, reduce frequencies and/or reduce severity of consequences to the extent practicable; and (b) demonstrate ALARP.
Class IV	Risks that significantly exceed the risk acceptance threshold and need urgent and immediate attention.	**Extreme**	Modification to the threat, the frequency or the consequences is required by further physical or engineering control measures so that the risk rank is reduced to 'intermediate' or (Class II) lower.

4 PIPELINE DESCRIPTION

4.1 Pipeline Design

The DN300 ANSI Class 900# pipeline is a welded steel pipeline, which will be operated in accordance with Australian Standard AS 2885- 2012.

The pipeline, as currently selected, shall be constructed from API 5L – X70 pipe and operated at an MAOP of 15.3MPag. Flanges and other connection will be minimised, where practicable, particularly in above ground stations. Standard pipe wall thickness shall be 6.7mm, with heavy walled pipe (7.6mm) being used in high risk locations, as detailed within the next section [Ref. 4]. A fracture control plan will be drafted in the Feasibility stage of the design. Note: pipe thickness shall also be confirmed within the Feasibility Phase.

4.2 Coating and Cathodic Protection

All line pipe shall be externally coated with a high integrity factory applied coating (dual layer Fusion Bonded Epoxy) coating in accordance with project specifications [Ref. 4].

The coating is the primary corrosion protection, with additional cathodic protection providing secondary protection at any coating defects.

4.3 Cover

The minimum depth of cover for the KGGP pipeline will be in accordance with AS2885.1-2012 and is increased in areas where the potential for a release, or the potential consequences of a release, are likely to be higher.

- R1 – Remote Rural: 750mm
- R2 – Rural Residential: 750mm
- T1 – Residential: 900mm.

Cover will be increased to a minimum of 2000mm below Rivers and Water Courses, 2000mm below the Railway Lines and 1200mm at Road Crossings. In addition heavy walled pipe shall be installed in these locations.

4.4 Valve Stations

A number of above ground stations are planned along the pipeline route as shown in Table 4-1

Table 4-1 KGGP Above Ground Stations

Location	Station Description	Surrounding Land Use	Key Point (KP)	Distance from Previous Station (km)
Amadeus PL Crossing Point	Amadeus Tie-in - Scraper Station	Mainly Rural, Adelaide to Darwin Railway Line Nearby	0	0
King River	King River Compressor - Scraper Station	Rural – Natural bushland	25	25
Mainoru	MLV	Rural – Natural bushland	193	168
Annie Creek	MLV - Scraper Station	Rural – Natural bushland	298	105
Numbulwar Road	MLV	Rural – Natural bushland	462	164
Giddy River	MLV - Pressure Regulating Facility	Rural – Natural bushland	580	118
Nhulunbuy	MLV	Rural - Residential	596	16

The valve station at Giddy River will be fitted with a pressure reduction valve to decrease the line pressure at the Gove end of the pipeline. All stations will be fitted with telemetry and instrumentation so it can be monitored and controlled from the pipeline control room.

The valve spacing's comply with the requirements of AS 2885 and provide for good control over the pipeline.

4.4.1 Procedures And Plans

The pipeline will be maintained and operated in accordance with a set of operating, maintenance and repair procedures. These will be developed into a set of safety, operating and emergency response plans, which will take account of proper operation of the pipeline including environmental issues.

4.4.2 Gas Description

The gas transported in the pipeline will be non-toxic industrial quality natural gas. It is expected to have low water dewpoint and non-corrosive, thus providing corrosion protection to the internal surface of the pipeline.

Emissions of gas will be kept to a minimum, with the pipeline having high integrity from leakage and only minimal venting of gas taking place during operations.

5 RISK IDENTIFICATION

The AS 2885.1–2012 Risk Assessment Methodology was used for risk identification and evaluation.

5.1 Location Analysis Discussion

The location analysis was performed along the pipeline from a desktop analysis. The location classification for the majority of the pipeline route (KP0- KP591) was R1 – Broad Rural. On approach to Gove (KP591-KP593), the location class is upgraded to R2, with rural residential and corresponding public infrastructure is located beside the pipeline. As the pipeline approaches the PacAl Gove Refinery (KP593-KP603), the location classification is T1 Residential, with residential and public infrastructure serving the residential use being located within the measurement length (this will be verified within the Feasibility Phase of the project).

5.1.1 Measurement Length

The measurement length is the area of influence examined during the risk assessment, which defines the Primary Location Class, and is used to determine the secondary location class.

The measurement length is defined as the radius of the 4.7 kW/m^2 radiation, caused by a jet fire resulting from a full bore rupture of the pipeline. Appendix Y of AS2885 provides the radiation contours for full bore ruptures of gas pipelines for various pipe sizes and gas pressures. Based on Figure Y1 (AS2885), the following measurement length has been used for this assessment.

Pressure	Pipe Diameter	Distance to 4.7kW/m^2 (Measurement Length)	Distance to 12.6kW/m^2
15.3kPag	DN300	375	240

5.2 Threat Analysis

The threat analysis was performed with two focuses: one focus on location specific threats and the second on general threats found to apply in many locations along the pipeline length. See Appendix 1 for the detailed threat analysis.

Location specific threats are tabulated in Appendix 1.

6 THE ASSESSMENT TEAM

The Safety Management Study was undertaken by a team of people, with a variety of relevant backgrounds. It is good practice to include in the assessment team people with a variety of technical expertise, and both operational and managerial roles. This multi-disciplinary team based approach is used to increase the understanding about the nature of hazards and risks within the workplace.

The team assembled for the Safety Management Study Process conducted on 1 February 2013 at 333 Collins St Melbourne and by teleconference and shared PC desktops with other members of the Team in Brisbane and Darwin. Table 6-1 lists the names of those attendees.

Table 6-1 – List of Workshop Participants

First Name	Last Name	Title	Company
Jaime	Thompson	Senior S&R Engineer	WorleyParsons
Florence	Bout	Process Engineer	WorleyParsons
Hugh	Howard	AS 2885 Risk Facilitator	WorleyParsons
Peter	Cox	Vice President - Pipelines	WorleyParsons
Andrew	Wood	Project Manager	WorleyParsons
Grant	Armstrong	Deputy Director KGGP	WorleyParsons
Allison	Hanly	Environmental Engineer	WorleyParsons
Andrew	Buick	Principal Environmental Consultant - Approvals	Eco Logical Australia Pty Ltd
Grant	Eudey	Principle Engineer - PMO	RioTinto (PacAl)

7 KEY FINDINGS

7.1 Third Party Interference (TPI)

The highest risks identified for the pipeline were with respect to Third Party Interference. The following third party activities were identified has having a Class III level of risk:

- Farming activities (deep ripping, fence posting)
- Public Developments and Maintenance (road and drain maintenance)
- Mining Development (including exploration drilling and blasting)
- Road / Highway Maintenance

Numerous recommendations were raised for consideration within the Feasibility and Execution Phases of the project. These included:

- Further threat identification – to investigate the need for extra physical protection measures, including:
    - Liaison with land owners and freehold land owners to get a more comprehensive idea on common activities taking place (potentially around the new pipeline); and
    - Establish mining lease locations along the pipeline and liaise with lease holders to determine the level of threat to the pipe from mining activities, including the use of chemicals which could impact the corrosion protection of the pipeline.
- Further procedural measures, including
    - The need for a Dial before You Dig System to be implemented; and
    - An increased in patrolling level around easily accessible routes of the pipe – particularly those at Gove and Katharine areas.

Private and Rural development in Rural (R1) areas along the pipeline route and potential, future residential developments around Gove were assessed as having a slightly lower level of risk (Class II), as domestic services are generally not installed at a depth witch could impact equipment. It was determined that penetration resistance calculations – to be undertaken within the Feasibility Phase of the project, would provide the project with additional information on the likelihood of these activities having an impact on the pipe.

7.2 Earthquake Damage

The KGGP passes through eleven (11) areas which have the potential to be impacted by forces associated with an earthquake. It was identified that material properties of the pipeline can be selected to ensure ductility of the pipe (i.e. plastic deformation rather than brittle fracture). This will be investigated further in the Feasibility Phase of the project

It was noted that the Amadeus Pipeline at Tennant Creek was buckled by an earthquake in 1988, and although no loss of containment occurred, the pipeline needed to be shutdown to undertake repairs on the damaged section. Though this instance of damage is not in the immediate vicinity of the KGGP, it does provide support the need to ensure that any potential seismically active zones are assessed and proper design considerations are taken. A more detailed assessment of fault lines and seismic activity will be completed during the Feasibility Phase.

7.3 Pipeline Over-Pressurization

Over-pressurisation of the pipeline could potentially occur at the compressor station and at the Gove GLDS inlet, if proposed safeguards failed. The preliminary nature of the design at the compressor station did not provide adequate detail on overpressure control strategy at this stage of the project. It was recognised that further deign development and HAZOP in the Feasibility Phase of the Project would significantly reduce this risk.

7.4 Excessive Vehicular Loading

Vehicle loading on the pipeline at roads, water and rail crossings are well known and managed via increased wall thickness, or increased depth of cover. It was recognised however, that some sections of the pipeline may be subject to vehicle loads on standard sections of the pipeline (with standard depth of cover and pipe wall thickness). There is some inherent stress resistance of the pipe, based on the standard burial depth and pipe wall thickness. Stress calculations – to be undertaken within the Feasibility Phase of the project, would provide the project with additional information on the capable loading on the pipe, in which stress along unprotected sections of the pipe can be assessed).

7.5 Escalation

Upon approach to the PacAl Alumina Refinery (at KP600 onwards); the pipeline is buried with a minimum depth of cover 900mm. The Pipeline route is to the north of the facility, and avoids equipment as far as practicable. A small section of the pipe, once inside the facility fence line, will be above ground. In order to prevent event escalation to, or from the pipeline and the PacAl Refinery, the pipeline shall be fully welded up to the GLDS, and shall be of heavy walled construction. The above ground portion of the pipeline is within the Refinery fence line, which is considered a controlled zone. However, it is recognized that a loss of containment from the pipeline could potentially impact the PacAl Alumina Refinery, and further investigation of this scenario is required

7.6 Erosion And Sediment Control

Removal of topsoil during construction could result in erosion above or around the pipeline, which could in turn affect the depth of cover. This issue is particularly exacerbated by the Northern Territory wet season, which could result in some wash away of cover, and also environmental damage. Consequences associated with this risk were Low; however the high likelihood of occurrence has resulted in a Class III risk ranking. It was recommended that previous pipeline experience in NT be reviewed to ensure adequacy of identified safeguards and mitigation measures

7.7 Loss Of Containment (LOC) – Compressor Station

Accidental releases associated with equipment failure can potentially lead to a Fire / Explosion at the compressor station. Note: other known loss of containment events at the compressor station are associated with maintenance vents and emergency blowdown / overpressure vents. Both of these scenarios are controlled events, and have standard protection measures in place to ensure the safety of personnel.

A number of protection measures have been put in place at the compressor station to protect both the plant, and any person who may be at the station when the loss of containment occurs. The compressors at the facility shall be provided with some form of shelter, either a pre-engineered rigid metal framed building, or an open weather proof shelter (open on all four sides) – the decision for either is predominantly based on noise requirements, however both have the potential to cause some level of explosion, and this needs to be investigated in the Feasibility Phase of the project.

7.8 Loss of Containment (LOC) – Gove GLDS

A loss of containment at Gove was identified as a potential Class III risk, particularly given the potential to overpressure downstream equipment should the control valve at the GLDS fail. An Instrumented overpressure protection system is to be provided at this location, although it was noted that the need, and the ability to fit PSVs and associated pipes and vents within the Refinery, was to be investigated further within the Feasibility Phase.

7.9 Chemicals – Gove GLDS

Caustic and Alumina fallout at Gove has the potential to be released and damage equipment. No aluminium instrumentation has been specified for the project design phase, and additional requirements for managing Alumina fallout are to be identified within the Feasibility Phase.

7.10 Emergency Evacuation

Given the remote location of above ground equipment, the requirements for emergency evacuation need to be considered in line with the environment and diverseness of equipment. The location of the King River Compressor station has been selected to be within close proximity and access from Katherine. It was recognised that additional consultation with the current operators of the NT pipeline should be considered regarding current practices for evacuation from remote locations. Additional facilities, such as designated helicopter landing areas, communication requirements etc. shall be considered and implemented into the design.

7.11 Bush Fires

Given the location and placing of above ground station, bush fires near equipment is a common and expected threat. It is anticipated that stations will have a sufficient cleared and gravel area around all above ground equipment, and no combustible material is expected to be stored on any site. There was a need to review the safe buffer distance between equipment and bush to ensure adequate separation.

8 CONCLUSIONS

A Preliminary AS2885.1 Pipeline Risk Assessment and HAZID for the KGGP Project was undertaken in on the 1st Feb 2013, where each identified threat or high level hazard was reviewed, proposed control measures identified, and risk assessed.

In line with Rio Tinto requirements for risk management, all hazards were assessed for further risk reduction, with specific focus in ensuring further actions were in place to reduce high level risks.

The workshop identified no risks as Class IV, with seventeen risks as classified as Class III.

All Intermediate risks, Class II and Class III, were reviewed, and 42 recommendations were raised for further risk reduction within the stage of the project.

The full list of recommendations is presented in Appendix 3.

These will be assigned to appropriate personnel for closeout within the Feasibility and Execute Phases of the project. Full context for each recommendation may be found by looking at Appendix 2.

9 REFERENCES

1. AS 2885.1-2007, Pipelines - Gas and Liquid Petroleum

2. AS/NZS ISO 31000: 2009 Risk Management Standard

3. Trans Territory Pipeline, Appendix E Trans Territory Pipeline - Preliminary Risk Assessment in Accordance with AS2885 for the Trans Territory Pipeline prepared by OSD Energy Services– Draft Environmental Impact Statement, November 2004

4. Katherine-Gove Gas Pipeline, Process Basis Of Design, 201001-00367-00-PR-BOD-0001

Appendix 1 Location Specific Threat Analysis – Katherine to Nhulunbuy (15.3 MPag)

Location	Primary Location Class	Secondary	Predominant Land Use	Environmental Description	Threat Analysis
All	KP0 – 591: R1	CIC & W	Natural Bushland	Some cleared for grazing and cropping. Number of water way crossings. Pipeline follows the Central Arnham Rd in some sections	Third Party Interference: - Private development (incl. fencing, access roads, installation of new services, erection of structures such as sheds, gardening/landscaping) (most likely between KP 0 – KP 591) - Rural Development (incl. deep ripping, fencing, dams, sheds, contour banks) - New Residential Developments(incl. building of houses, garages, sheds, decks, landscaping, driveways, footpaths, installation of new services, power poles, roads, table drains, commercial centres (most likely around Gove) - Farming activity (Grazing, Cropping, Deep ripping or blade ploughing, Post hole digging for fencing) Corrosion Electrical Induction – Lighting Natural Forces: Flooding, Earthquake, Bush Fires, Cyclones and strong winds Excessing Vehicle loading (at locations other than roads) Sabotage and Vandalism Erosion and sediment control Failure of control and protective equipment Inadequate or incomplete maintenance - deterioration and subsequent failure of equipment
	KP591 – 593: R2	CIC & I	Rural Residential on approach to Gove	Pipeline runs beside PacAl Conveyor belt and other services High voltage power lines KP 591 to KP 593 (CIC)	
	KP593 – 603: T1	CIC, I, & HI	Residential – housing estates, general industrial estates and heavy industrial facilities within measurement length	Pipeline runs beside PacAl Conveyor belt and other services High voltage power lines KP 591 to KP 593 (CIC) Gove industrial estate within measurement length at KP594- KP595 YBE Facility within measurement length at KP599 Housing estate within measurement length KP 600	

Location	Primary Location Class	Secondary	Predominant Land Use	Environmental Description	Threat Analysis
KP 0	R1	CIC	Natural Bushland	Railway Crossing	Pipe stress Train derailment at the Darwin to Adelaide railway crossing
KP0	R1		Natural Bushland	Scraper Station	Loss of containment - Release of flammable gas resulting in Fire / explosion Flaring / venting Cyclones and strong winds Bush fire near above ground equipment and compressor station Hunting activities Sabotage and vandalism Escalation
KP 6	RI	W	Natural Bushland	Chinaman Creek Crossing	Erosion of cover - Water ways in low (relatively flat) to medium undulating locations, no major erosion of soil expected Environmental damage from pipeline construction at creek crossings
KP25	R1	HI	Natural Bushland	Compressor Station	Loss of containment - Release of flammable gas resulting in Fire / explosion Hazardous Chemicals – releases to the environment, combustibles Flaring / venting Cyclones and strong winds Bush fire near above ground equipment and compressor station Hunting activities Sabotage and vandalism Escalation
KP 26	RI	CIC	Natural Bushland	Stuart Highway Crossing	Stress to pipeline, causing cracking or stress fractures
KP 29-30	RI	W	Natural Bushland	King River & Roper Creek Water Crossings	Erosion of cover - Water ways in low (relatively flat) to medium undulating locations, no major erosion of soil expected Environmental damage from pipeline construction at creek crossings

Location	Primary Location Class	Secondary	Predominant Land Use	Environmental Description	Threat Analysis
KP 29-32	RI	CIC	Natural Bushland	Two “back” Road crossings	Stress to pipeline, causing cracking or stress fractures
KP 41	RI	CIC	Natural Bushland	Central Arnhem Road crossing	
KP48-49	RI	W	Natural Bushland	Maranboy Creek Crossing	Erosion of cover - Water ways in low (relatively flat) to medium undulating locations, no major erosion of soil expected Environmental damage from pipeline construction at creek crossings
KP 57, 61, 62	RI	W, S	Natural Bushland	Breswick Creek Crossing High value habitat – particularly with respect to proximity to Gouldian Finch breeding and feeding sites	
KP 74, 79	RI	CIC	Natural Bushland	Back Road crossings	Stress to pipeline, causing cracking or stress fractures
KP 84	RI	W	Natural Bushland	Water House Creek Crossing	Erosion of cover - Water ways in low (relatively flat) to medium undulating locations, no major erosion of soil expected Environmental damage from pipeline construction at creek crossings
KP 85 - 87	RI	CIC	Natural Bushland	Breswick back road crossings	Stress to pipeline, causing cracking or stress fractures
KP 93	RI	CIC	Natural Bushland	Road crossing	
KP 95-113	RI	W	Natural Bushland	Chambers River Creek Crossings	Water ways in undulating areas - possible erosion of soil High level of maintenance required at river crossings Environmental damage from pipeline construction at creek crossings
KP 101 & 104	RI	W	Natural Bushland	Chambers River Crossings	
KP 121-132	RI	W	Natural Bushland	Morok Creek Crossing	
KP 125-160	R1	N/A	Natural Bushland	Possible low depth mining activity	Mining Development (incl. exploration drilling, seismic surveying, blasting, crossing of the pipeline with heavy equipment, test excavations, new roads
KP 135	RI	W	Natural Bushland	Bukalorkmi Creek Crossing	Water ways in undulating areas - possible erosion of soil High level of maintenance required at river crossings Environmental damage from pipeline construction at creek crossings
KP 145	RI	CIC	Natural Bushland	Road crossing	Stress to pipeline, causing cracking or stress fractures
KP 149-153	RI	W	Natural Bushland	Velkerri Creek Crossing	Water ways in undulating areas - possible erosion of soil

Location	Primary Location Class	Secondary	Predominant Land Use	Environmental Description	Threat Analysis
KP159	RI	W	Natural Bushland	Maiwok Creek Crossing	High level of maintenance required at river crossings Environmental damage from pipeline construction at creek crossings
KP 161 - 185	R1	N/A	Natural Bushland	Possible low depth mining activity	Mining Development (incl. exploration drilling, seismic surveying, blasting, crossing of the pipeline with heavy equipment, test excavations, new roads
KP165-169	RI	W	Natural Bushland	Multiple channels of Flying Fox Creek	Water ways in undulating areas - possible erosion of soil High level of maintenance required at river crossings Environmental damage from pipeline construction at creek crossings
KP169 - 176	RI	W	Natural Bushland	Derim Derim Creek Crossing	
KP 193	R1		Natural Bushland	MLV Station	Loss of containment - Release of flammable gas resulting in Fire / explosion Flaring / venting Cyclones and strong winds Bush fire near above ground equipment and compressor station Hunting activities Sabotage and vandalism
KP 195	RI	CIC	Natural Bushland	Central Arnhem Road crossing	Stress to pipeline, causing cracking or stress fractures
KP197-198	RI	W	Natural Bushland	Ouibobikwi Creek Crossing	Water ways in undulating areas - possible erosion of soil High level of maintenance required at river crossings Environmental damage from pipeline construction at creek crossings
KP204	RI	W	Natural Bushland	Krabakuk Creek Crossing	
KP210	RI	W	Natural Bushland	Mainoru River Crossing	
KP211-214	RI	W	Natural Bushland	Multiple channels of Mainoru River	
KP 230	RI	W	Natural Bushland	Horse Creek Crossing	
KP 252	RI	CIC	Natural Bushland	Road crossing	Stress to pipeline, causing cracking or stress fractures

Location	Primary Location Class	Secondary	Predominant Land Use	Environmental Description	Threat Analysis
KP259	RI	W	Natural Bushland	Wilton River Crossing	Water ways in undulating areas - possible erosion of soil High level of maintenance required at river crossings Environmental damage from pipeline construction at creek crossings
KP 298	R1		Natural Bushland	MLV & Scraper Stations	Loss of containment - Release of flammable gas resulting in Fire / explosion Flaring / venting Cyclones and strong winds Bush fire near above ground equipment and compressor station Hunting activities Sabotage and vandalism
KP298, 300, 302, 304	RI	W	Natural Bushland	Annie Creek Crossing	Erosion of cover - Water ways in low (relatively flat) to medium undulating locations, no major erosion of soil expected Environmental damage from pipeline construction at creek crossings
KP360	RI	W	Natural Bushland	Goyder river Crossing	
KP398	RI	CIC	Natural Bushland	Central Arnhem Road crossing	Stress to pipeline, causing cracking or stress fractures
KP419	RI	W	Natural Bushland	Badalngarrmirri Creek Crossing	Erosion of cover - Water ways in low (relatively flat) to medium undulating locations, no major erosion of soil expected Environmental damage from pipeline construction at creek crossings
KP 424	R1	CIC	Natural Bushland	Central Arnhem Road crossing Pipeline within measurement length for 20km	Stress to pipeline, causing cracking or stress fractures Third party interference - Public development and maintenance (incl. Road and table drain maintenance, maintenance of public facilities, such as power, lighting poles , water, sewage, telecommunication cable and fibre optic, overhead and underground power, gas and oil pipelines, and drains. Road maintenance (heavy machinery)
KP429	RI	CIC	Natural Bushland	Central Arnhem Road crossing	Stress to pipeline, causing cracking or stress fractures

Location	Primary Location Class	Secondary	Predominant Land Use	Environmental Description	Threat Analysis
KP430	RI	W	Natural Bushland	Dubuwamirri Creek Crossing	Erosion of cover - Water ways in low (relatively flat) to medium undulating locations, no major erosion of soil expected Environmental damage from pipeline construction at creek crossings
KP432	RI	CIC	Natural Bushland	Central Arnhem Road crossing	Stress to pipeline, causing cracking or stress fractures
KP439,	RI	W	Natural Bushland	Buckingham River Crossing	Erosion of cover - Water ways in low (relatively flat) to medium undulating locations, no major erosion of soil expected Environmental damage from pipeline construction at creek crossings
KP443	RI	CIC	Natural Bushland	Central Arnhem Road crossing	Stress to pipeline, causing cracking or stress fractures
KP444	RI	W	Natural Bushland	Buckingham River Crossing	Erosion of cover - Water ways in low (relatively flat) to medium undulating locations, no major erosion of soil expected Environmental damage from pipeline construction at creek crossings
KP456	RI	CIC	Natural Bushland	Gapuwiyak Road crossing	Stress to pipeline, causing cracking or stress fractures
KP462	R1		Natural Bushland	MLV Station	Loss of containment - Release of flammable gas resulting in Fire / explosion Flaring / venting Cyclones and strong winds Bush fire near above ground equipment and compressor station Hunting activities Sabotage and vandalism
KP463	RI	W	Natural Bushland	Habgood River Crossing	Erosion of cover - Water ways in low (relatively flat) to medium undulating locations, no major erosion of soil expected Environmental damage from pipeline construction at creek crossings
KP469, 471, 475, 477	RI	W	Natural Bushland	Habgood River Crossing	
KP488	RI	W	Natural Bushland	Richard River Crossing	
KP548	RI	CIC	Natural Bushland	Central Arnhem Road crossing	Stress to pipeline, causing cracking or stress fractures
KP 496, 498, 501	RI	W	Natural Bushland	Goromuru River Crossing	Erosion of cover - Water ways in low (relatively flat) to medium undulating locations, no major erosion of soil expected

Location	Primary Location Class	Secondary	Predominant Land Use	Environmental Description	Threat Analysis
KP512	RI	W	Natural Bushland	Boggy Creek Crossing	Environmental damage from pipeline construction at creek crossings
KP540	RI	W	Natural Bushland	Cato River Crossing	
KP 547 - 554	R1	CIC	Natural Bushland	Central Arnhem Road within measurement length	Third party interference Public development and maintenance (incl. Road and table drain maintenance, maintenance of public facilities, such as power, lighting poles , water, sewage, telecommunication cable and fibre optic, overhead and underground power, gas and oil pipelines, and drains. Road maintenance (heavy machinery)
KP555	RI	W	Natural Bushland	Wonga Creek Crossing	Erosion of cover - Water ways in low (relatively flat) to medium undulating locations, no major erosion of soil expected Environmental damage from pipeline construction at creek crossings
KP572	RI	W	Natural Bushland	Giddy River Crossing	
KP575	RI	CIC	Natural Bushland	Central Arnhem Road crossing	Stress to pipeline, causing cracking or stress fractures
KP 580	R1		Natural Bushland	MLV pressure Regulating	Loss of containment - Release of flammable gas resulting in Fire / explosion Flaring / venting Cyclones and strong winds Bush fire near above ground equipment and compressor station Hunting activities Sabotage and vandalism
KP581	RI	W	Natural Bushland	Latram River Crossing	Erosion of cover - Water ways in low (relatively flat) to medium undulating locations, no major erosion of soil expected Environmental damage from pipeline construction at creek crossings
KP 591 - 594	R2	CIC, I	Rural Residential on approach to Gove	High Voltage Power Lines	Power lines parallel to the pipeline capable of inducing an electrical voltage in the pipeline.
KP594	T1	CIC,	Natural Bushland	Road crossing	Stress to pipeline, causing cracking or stress fractures

Location	Primary Location Class	Secondary	Predominant Land Use	Environmental Description	Threat Analysis
KP594 – KP603	R2/T1	CIC, I & HI	Rural Residential on approach to Gove, Residential at Gove – housing estates and industrial estates within measurement length	Gove Industrial, YBE & PacAL within measurement length	Third party interference - Public development and maintenance (incl. Road and table drain maintenance, maintenance of public facilities, such as power, lighting poles , water, sewage, telecommunication cable and fibre optic, overhead and underground power, gas and oil pipelines, and drains. Road maintenance (heavy machinery)
KP 594 - 603	T1	CIC, I, HI	Residential – housing estates, general industrial estates and heavy industrial facilities within measurement length	High Voltage Power Lines	Power lines parallel to the pipeline capable of inducing an electrical voltage in the pipeline
KP 596	R2	CIC ,	Rural Residential on approach to Gove	MLV Station	Loss of containment - Release of flammable gas resulting in Fire / explosion Flaring / venting Cyclones and strong winds Bush fire near above ground equipment and compressor station Hunting activities Sabotage and vandalism
KP598-599	T1	CIC,	Natural Bushland	YBE Access Road crossings	Stress to pipeline, causing cracking or stress fractures
KP600-601	T1	CIC, HI	Natural Bushland	Melville Bay Road crossing	
KP 603	T1	CIC, HI	Residential – housing estates, general industrial estates and heavy industrial facilities within measurement length	GLDS – scraper station	Loss of containment - Release of flammable gas resulting in Fire / explosion Flaring / venting Cyclones and strong winds Bush fire near above ground equipment and compressor station Hunting activities Sabotage and vandalism

Location	Primary Location Class	Secondary	Predominant Land Use	Environmental Description	Threat Analysis
KP601-603	T1	CIC, HI	Residential – housing estates, general industrial estates and heavy industrial facilities within measurement length	Pipeline runs Parallel to PacAl Facilities	Escalation of pipe to / from PacAl Facilities

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Location Along Pipeline	Guide Word	ID.	Threat Details Leading to Loss of Containment	Existing Mitigation Measures		Ranking (in light of existing protection measures)			Recommended Action
				Physical Mitigation	Physical Mitigation	Frequency	Consequence	Risk Ranking	
General (Across the entire pipeline)	Corrosion	1	External corrosion - The external surface of the pipeline is installed in a corrosive environment - The pipeline will be operating in the pressure range of up to 80% SMYS - Stress corrosion cracking of the pipeline steel can take place at this pressure, particularly as the steel will be subjected to cyclic pressures	- The pipe will be coated with dual layer epoxy as the primary corrosion protection - Cathodic protection - Given the type of coating, stress corrosion cracking is considered unlikely.	- Procedures will ensure that the pipeline cathodic protection levels are maintained to protect the pipeline from all types of corrosion	Rare	Moderate	Class II	1. External corrosion mitigation to be formally addressed in detail and closed out in the Corrosion Study (which will be completed in the Feasibility Phase of the project)
		2	Internal Corrosion Note: internal lining is not expected to deter corrosion - as corrosion may still occur at welded joints	- The flowing gas has low sulphur and low water dewpoint. These gas qualities protect the pipe internals from corrosion - Continuous, gas measurement at start of pipeline will measure flow and monitor composition	- Base Assumption: Gas quality is being maintained upstream	Rare	Low	Class 1	2. PacAl to confirm with APA the control measures in place to maintain gas specification 3. Corrosion Study to assess the issue of internal corrosion due to off spec gas - and determine if an additional corrosion allowance or mitigation measures are required
Rural Areas of the pipeline KP 0 - KP591 Location Class: R1	Third party / external Interference	3	Private Development - - fencing - access roads - installation of new services (i.e. gas, phone, sewerage, drainage) - erection of structures such as sheds - gardening/landscaping	- Domestic services are generally not installed at great depth or using equipment which could impact on the integrity of the pipeline - Separation by Burial - Pipeline is buried with a minimum depth of cover of 750 mm in R1 locations - Standard pipe wall thickness offers some resistance to penetration from equipment - Heavy Walled pipe installed at known roads - Clear right-of-way	- Signage shall be clearly visible in both directions and located at both sides creeks, rivers and roads - Signage with spacing of less than 500 m - Aerial and drive by Patrolling (route accessible by 4WD in the dry season) - Landholder and other utility liaison - Marker Tape in road reserves	Unlikely	Moderate	Class II	
		4	Rural Development - deep ripping - fencing - dams - sheds - contour banks - installation of fibre optic - Leading to possible fatality.	- Separation by Burial - Pipeline is buried with a minimum depth of cover of 750 mm in R1 locations - Standard pipe wall thickness offers some resistance to penetration from equipment - Heavy Walled pipe installed at known roads - Clear right-of-way	- Signage shall be clearly visible in both directions and located at both sides creeks, rivers and roads - Signage with spacing of less than 500 m - Aerial and drive by Patrolling (route accessible by 4WD in the dry season) - Marker Tape in road reserves - Liaison with rural landholders will reduce the risk from third party activity	Rare	High	Class III	9. Penetration resistance calculations to be undertaken in the Feasibility Phase of the project

Location Along Pipeline	Guide Word	ID.	Threat Details Leading to Loss of Containment	Existing Mitigation Measures		Ranking (in light of existing protection measures)			Recommended Action
				Physical Mitigation	Physical Mitigation	Frequency	Consequence	Risk Ranking	
General Location Class: -KP0591: R1 (CIC & W) -KP591593: R2 (CIC & I) KP593603: T1 (CIC, I, & HI) Note: New Residential Development is most likely around Gove	Third party / external Interference	**5**	New Residential Developments - Building of houses - Building of garages, sheds, decks - Landscaping - Driveways and footpaths - Installation of new services (i.e. gas, phone, water, sewage, drainage, electricity, etc.) - Power poles and lighting poles - Roads and table drains - Commercial centres	- Location of the pipeline is away from any densely populated area - Pipeline route is well away from farm buildings - No private building structures were within 600 m of the pipeline in R1 Location (note: Private homes and business are within measurement length from KP593 onwards) - Separation by Burial - Pipeline is buried with a minimum depth of cover of 750 mm in R1, 900 mm in T1, & 1,200 mm below known roads - Standard pipe wall thickness offers some resistance to penetration from equipment - Heavy wall pipe, to satisfy the requirements for "no rupture pipe", in all T1 location Class - Clear right-of-way	- Signage shall be clearly visible in both directions and located at both sides creeks, rivers and roads - Signage with spacing of less than 500 m - Aerial and drive by Patrolling (route accessible by 4WD in the dry season) - Landholder and other utility liaison - Marker Tape in road reserves and in T1 Locations	Unlikely	Moderate	Class II	4. Town council zone plans shall be reviewed to determine if a higher location class is required on approach to Gove 5. Determine if a Dial before You Dig system is required to be set up, or if there is an existing system which can be informed particularly where the pipeline approaches Gove
		6	Farming activities - Grazing - Cropping - Deep ripping or blade ploughing - Post hole digging for fencing	- Cropping activity should generally be limited to ploughing of the soil to a maximum depth of 300 mm - Deep ripping or blade ploughing is not anticipated along the pipeline route - Post hole digging for fencing is likely to be the highest farming threat to the pipeline - Location of the pipeline is away from any densely populated area - Pipeline route is well away from farm buildings - - No private building structures were within 600 m of the pipeline in R1 Location (note: Private homes and business are within measurement length from KP593 onwards) - Separation by Burial - Pipeline is buried with a minimum depth of cover of 750 mm in R1, 900mm in T1, & 1,200 mm below known roads - Standard pipe wall thickness offers some resistance to penetration from equipment - Heavy wall pipe, to satisfy the requirements for "no rupture pipe", in all T1 location Class - Clear right-of-way	- Signage shall be clearly visible in both directions and located at both sides creeks, rivers and roads - Signage with spacing of less than 500 m - Aerial and drive by Patrolling (route accessible by 4WD in the dry season) - Land agreements will be entered into with landholders to limit their activities to non-threatening activity on the pipeline ROW	Possible	Moderate	Class III	10. Liaison with agricultural Stations along the pipeline route, and freehold land holders shall be undertaken to identify the level of activity at each location and determine if any additional protection measures are required

Location Along Pipeline	Guide Word	ID.	Threat Details Leading to Loss of Containment	Existing Mitigation Measures		Ranking (in light of existing protection measures)			Recommended Action
				Physical Mitigation	Physical Mitigation	Frequency	Consequence	Risk Ranking	
General (Across the entire pipeline)	Third Party / External Interference	**7**	Public Developments and Maintenance - Road and table drain maintenance (typically utilising 14 G grader or equivalent for resurfacing) - Maintenance of public facilities, such as power and lighting poles - Maintenance of public services (water, sewage, telecommunication cable and fibre optic, overhead and underground power, gas and oil pipelines, and drains) - Installation of new services (water, sewage, telecommunication cable and fibre optic, overhead and underground power, gas and oil pipelines, and drains)	- Location of the pipeline is away from any densely populated area - Separation by Burial - Pipeline is buried with a minimum depth of cover of 750 mm in R1, 900mm in T1 - Standard pipe wall thickness offers some resistance to penetration from equipment - Heavy wall pipe, to satisfy the requirements for "no rupture pipe", in all T1 location Class - Increased depth of cover to 1200 mm, and heavy walled pipe installed below all roads - Clear right-of-way	- Signage shall be clearly visible in both directions and located at both sides creeks, rivers and roads - Signage with spacing of less than 500 m - Aerial and drive by Patrolling (route accessible by 4WD in the dry season) - Landholder and other utility liaison - Marker Tape in road reserves and in T1 Locations	Unlikely	High	Class III	6. Establish increased patrolling plan around easily accessible routes of the pipe and above ground stations (i.e. at Gove and Katharine areas)
General (Across the entire pipeline)	Third party / external Interference	**8**	Mining Development - Exploration drilling - Seismic surveying - Blasting - Crossing of the pipeline with heavy equipment - Test excavations - New roads	- Separation by Burial - Pipeline is buried with a minimum depth of cover of 750 mm in R1, 900mm in T1 - Standard pipe wall thickness offers some resistance to penetration from equipment - Heavy wall pipe, to satisfy the requirements for "no rupture pipe", in all T1 location Class - Increased depth of cover to 1200 mm, and heavy walled pipe installed below all roads - Clear right-of-way	- Signage shall be clearly visible in both directions and located at both sides creeks, rivers and roads - Signage with spacing of less than 500 m - Aerial and drive by Patrolling (route accessible by 4WD in the dry season) - Landholder and other utility liaison - Liaison with Mining Companies - Regular pipeline route inspections will provide an important measure to minimise the risk	Unlikely	High	Class III	7. Establish where the mining leases are along the pipeline and determine the additional physical and procedural mitigation measures (including liaison) required 8. Identify any chemicals being used by 3rd party mining companies which could impact the corrosion coating on the pipeline

Location Along Pipeline	Guide Word	ID.	Threat Details Leading to Loss of Containment	Existing Mitigation Measures		Ranking (in light of existing protection measures)			Recommended Action
				Physical Mitigation	Physical Mitigation	Frequency	Consequence	Risk Ranking	
General (Across the entire pipeline)	Road maintenance	**9**	Third Party Interference - Heavy machinery maintaining and restoring roads impacts pipeline	- Most road crossings are in Rural - Low populated Areas - Separation by Burial -Pipeline is buried with a minimum depth of cover of 750 mm in R1, 900mm in T1 - Standard pipe wall thickness offers some resistance to penetration from equipment - Increased depth of cover to 1200 mm, and heavy walled pipe installed below all roads, offering increased resistance to penetration at high risk areas - Clear right-of-way - Concrete slabbing will be installed in table drains	- Signage shall be clearly visible in both directions and located at both sides creeks, rivers and roads - Signage with spacing of less than 500 m - Aerial and drive by Patrolling (route accessible by 4WD in the dry season) - Liaison with other utility providers to educate them on the pipeline's location will be conducted for the life of the pipeline - Marker Tape in road reserves	Unlikely	High	Class III	
General (Across the entire pipeline)	Natural Events	**10**	Electrical Induction caused by Lightning - Lightning striking the pipeline is capable of inducing significant voltages into the pipeline. - No other high structures adjacent to the pipeline to attract lightning away from the pipeline.	- Pipeline is buried (Note: there are existing cases of underground pipeline being impacted by lightning) - Minimal above ground equipment - Adequate earthing and surge protection at gate station -		Unlikely	Moderate	Class II	11. Review the requirements for additional lightning protection for all pipeline equipment
		11	Flooding, leading to: - Erosion of cover - Floatation of pipe Note: Wash away areas (location where the cover of the pipeline is lost) are expected along the pipeline route after the wet seasons - this could lead to increase in corrosion in some locations.	- Pipeline shall be buried at least 2,000 mm below rivers and watercourses - Compressor stations and other above ground facilities will be located on higher areas not subject to flooding - In areas where pipeline flotation could occur, the pipe will have weight coating or some other means to provide negative buoyancy - River movement will be investigated, and additional depth of cover will be added to cover the migrating rivers - Concrete coating on some water crossings may be provided	- Aerial Patrol the pipeline during the Wet season	Unlikely	Moderate	Class II	

Location Along Pipeline	Guide Word	ID.	Threat Details Leading to Loss of Containment	Existing Mitigation Measures		Ranking (in light of existing protection measures)			Recommended Action
				Physical Mitigation	Physical Mitigation	Frequency	Consequence	Risk Ranking	
General (Across the entire pipeline)	Natural Events	**12**	Earthquake Note: Pipeline passes through areas that have a 90% chance that a ground acceleration coefficient will not be exceeded in the next 50 years of 0.065 around Katherine, to areas as low as 0.045 around Gove. Damage to buildings generally starts to occur at a ground coefficient level of 0.05. Surrounding soil creates substantial damping for pipelines and tends to provide some protection. Pipelines with good weld integrity tend to survive minor earthquakes undamaged. Note: a pipeline at Tennant Creek was buckled by an earthquake in 1988. No loss of containment occurred, however required shutdown of the pipeline to undertake repairs. Tennant creek has a ground acceleration coefficient of 0.1) Shaking of land around the pipe can also result in floatation.	- Separation by Burial - Standard pipe wall thickness offers some resistance - Known active fault crossings along the pipe line route shall be designed with shallow trenches to allow pipeline movement - Note: the main factors affecting the ability of a pipeline to withstand the effects of an earthquake are wall thickness, good weld integrity and corrosion prevention		Possible	Moderate	Class III	12. Material properties of the pipeline to be investigated to ensure ductility of pipeline (i.e. plastic deformation rather than brittle fracture) in any seismic zones identified
		13	Bush Fire Over Pipeline	- Separation by burial - No escalation is expected to buried pipe - Small section of the pipe is above ground on approach to the Gove PacAl Facility. This is within a controlled zone and is a low bush fire risk		Rare	Very Low	Class 1	
General (Across the entire pipeline)		**14**	Erosion and sediment control Environmental damage during construction, resulting in additional erosion to the pipeline during the operational life of the pipeline	- Pipeline ROW shall be a narrow strip and ground disturbance and vegetation clearing shall be minimised in the ROW - Topsoil containing seeds shall be stripped off and stored on the edge of the pipeline row prior to construction taking place. Following pipeline construction this topsoil will be re-spread across the row, to encourage natural vegetation to restore and rebind the soil - Erosion berms shall be constructed to ensure discharge runoff water does not lead to erosion or sedimentation - Addition of rocks at bank reinstatement assists in the prevention of erosion	- -Erosion control structures shall be routinely inspected and maintained during the life of the pipeline to ensure they remain effective	Likely	Low	Class III	13. Look at previous experience in NT to ensure adequacy of safeguards and mitigation measures for erosion and sediment control

Location Along Pipeline	Guide Word	ID.	Threat Details Leading to Loss of Containment	Existing Mitigation Measures		Ranking (in light of existing protection measures)			Recommended Action
				Physical Mitigation	Physical Mitigation	Frequency	Consequence	Risk Ranking	
General (Across the entire pipeline)	Intentional Damage	**15**	Deliberate vandalism: - Removal of Signage - Shooting of instrumentation and Signage	- Remote location of pipeline - Above ground facilities have been limited to only those that are necessary - The facilities will be fenced and have clear warning signs - Buildings will be alarmed to indicate unauthorised access - Separation by Burial -Pipeline is buried with a minimum depth of cover of 750 mm in R1, 900mm in T1 - Standard pipe wall thickness offers some resistance to penetration from equipment	- Aerial and drive by Patrolling (route accessible by 4WD in the dry season)	Unlikely	Low	Class 1	
General (Across the entire pipeline)	Operation and Maintenance	**16**	Failure of control systems leading to over pressurisation of pipeline - source of overpressure is the compressor station - overpressure at Gove where pipeline pressure is reduced	- The pipeline inlet control pressures will be designed in accordance with as 2885 with two levels of overpressure control - Pressure reduction stations will also have duty/standby configuration to protect downstream systems - High pressure trips are provided at the compressor station and at Gove GLDS - MAOP of pipeline is 15.3 MPag for the entire length of the pipe (even after pressure let down at Giddy River) - All systems will be fail safe - Satellite based control system monitoring the pipeline		Rare	High	Class III	15. HAZOP in next stage of the project will address the issue of pipeline overpressure in detail
		17	Inadequate or incomplete maintenance resulting in deterioration and subsequent failure of equipment Note: Access to some locations along the pipeline may be limited in the Wet Season Unplanned repair or maintenance during the wet season could impact production	- The pipeline will be operated in accordance with as 2885.3 which requires the implementation of a suite of operating, maintenance and repair procedures and the use of competent and properly trained operations personnel - Loss of access to the pipeline during the wet season may be counter acted by a reduced operating pressure and other means Note: King River Compressor Station has all weather access	- Aerial and drive by Patrolling (route accessible by 4WD in the dry season)	Rare	Moderate	Class II	

Location Along Pipeline	Guide Word	ID.	Threat Details Leading to Loss of Containment	Existing Mitigation Measures		Ranking (in light of existing protection measures)			Recommended Action
				Physical Mitigation	Physical Mitigation	Frequency	Consequence	Risk Ranking	
General (Across the entire pipeline)	Other Threats	**18**	Excessive vehicular load above pipe (not at existing road crossings)	- Separation by Burial - Pipeline is buried with a minimum depth of cover of 750 mm in R1, 900mm in T1 - Vehicles are likely to be 4WD, though some heavier equipment may be possible - Standard pipe wall thickness offers some resistance to stress from 4WD - Heavy wall pipe, to satisfy the requirements for "no rupture pipe", in all T1 location Class - Increased depth of cover to 1200 mm, and heavy walled pipe installed below all roads - Clear right-of-way	- Aerial and drive by Patrolling (route accessible by 4WD in the dry season) likely to identify any new tracks over the pipeline - Landholder and other utility liaison	Unlikely	High	Class III	16. Stress calculations to be undertaken to determine the potential load capabilities of standard walled pipe at a minimum depth of 900mm
		19	Use of company access road near the pipeline being used by the public - effecting the stability of landforms near the pipeline and additional erosion	- Arnhem Highway provides right of way access; most vehicles are expected to travel on the main highway - Separation by Burial - Pipeline is buried with a minimum depth of cover of 750 mm in R1, 900mm in T1 - Vehicles are likely to be 4WD, though some heavier equipment may be possible - Standard pipe wall thickness offers some resistance to stress from 4WD - Heavy wall pipe, to satisfy the requirements for "no rupture pipe", in all T1 location Class - Increased depth of cover to 1200 mm, and heavy walled pipe installed below all roads - Clear right-of-way	- Aerial and drive by Patrolling (route accessible by 4WD in the dry season) - Landholder and other utility liaison	Possible	Low	Class II	14. Patrolling procedures will need to include the need to periodically review the company Access Track quality, to ensure that there is not excessive erosion of cover on/near the pipeline
High Voltage Power Lines -KP 591-603 Location Class: T1(CIC, I & HI)	Electrical Induction	**20**	Electrical Induction Power lines parallel to the pipeline are capable of inducing an electrical voltage in the pipeline. (Note: Gove industrial Estate is within measurement length at KP594KP603) Power lines can also effect the adequacy of corrosion protection	- Separation by Burial - Pipeline is buried with a minimum depth of cover of 750 mm in R1, 900mm in T1 - Adequate earthing and surge protection at Gate Station		Unlikely	Moderate	Class II	17. Design techniques need to be reviewed to protect equipment and personnel and to dissipate energy away safely in the event of a lightning strike to the pipeline or above ground equipment. 18. Adequacy of corrosion protection needs to be reviewed in location close to power lines

Location Along Pipeline	Guide Word	ID.	Threat Details Leading to Loss of Containment	Existing Mitigation Measures		Ranking (in light of existing protection measures)			Recommended Action
				Physical Mitigation	Physical Mitigation	Frequency	Consequence	Risk Ranking	
PacAl Alumina Refinery, Gove Operations Location Class: T1(CIC, I & HI)	Escalation	21	Risk of escalation to/ or from the Alumina Refinery	- Separation by Burial - Pipeline is buried with a minimum depth of cover 900mm in T1 - Small section of the pipe is above ground on approach to the Gove PacAl Facility. This is within a controlled zone and is a low bush fire risk - Above ground Pipeline is fully welded until the GLDS - Pipeline route is to the north of the facility, and avoids equipment as far as practicable - Additional isolation is provided at 15km from the PacAl Facility		Rare	High	Class III	19. Review the Gove plant hazards and risks to determine the likelihood of escalation to/of the pipe
General (Across the entire pipeline)	Slugs	22	Liquid in the Pipeline as a result of: - composition changes - cold temperatures - liquid dropout (at the GLDS) - low pipeline levels - collection of liquids (in particular at water crossings)	- Upstream compressor station - King River Compressor station will remove additional liquid, with liquid collection/separation prior to compression - Filter coalescer is provided at the GLDS - Gas composition		Rare	Moderate	Class II	20. Ensure there are no low points in the pipeline for liquids to accumulate, without adequate provision to manage the accumulation of fluid 21. Retrieve some data from APA with respect to the history of liquids in their line (pigging/compositional changes)
General (all above ground equipment)	Manned Operation	23	Noise from above ground equipment (valves, compressors etc.) - Heath issue for personnel and the public	- Remote location of above ground equipment - Above ground facilities have been limited to only those that are necessary. - The facilities will be fenced to prevent unlawful access - Receptors are being identified, and noise will be managed accordingly	- Hearing protection will be required if necessary	Possible	Very Low	Class 1	32. Further work on Noise is required once noise sensitive receptors have been identified
		24	Emergency Evacuation Remote location of above ground equipment makes it difficult to evacuate injured personnel	- King river compressor station is close to Katherine with all year access		Unlikely	High	Class III	33. Operators of the NT pipeline to be consulted on current practice for evacuation from remote locations. Additional facilities, such as helicopter landing areas, communication requirements etc. shall be considered and implemented into the design.

Location Along Pipeline	Guide Word	ID.	Threat Details Leading to Loss of Containment	Existing Mitigation Measures		Ranking (in light of existing protection measures)			Recommended Action
				Physical Mitigation	Physical Mitigation	Frequency	Consequence	Risk Ranking	
General (all above ground equipment)	Third Party Interference	25	Hunting Activities - The use of firearms near the pipeline will only present a threat to the pipeline at the facilities where there is above ground high-pressure pipe work	- Remote location of pipeline - Above ground facilities have been limited to only those that are necessary - The facilities will be fenced and have clear warning signs - Buildings will be alarmed to indicate unauthorised access - Separation by Burial -Pipeline is buried with a minimum depth of cover of 750 mm in R1, 900mm in T1 - Standard pipe wall thickness offers some resistance to penetration from equipment	- -Landholders will be advised of the risk and asked to limit hunting activities in the immediate vicinity of the facilities - Aerial and drive by Patrolling (route accessible by 4WD in the dry season)	Unlikely	Moderate	Class II	35. Limit the use of gauges, or shield critical equipment from view at above ground facilities 36. Landholder/community liaison shall specifically cover hunting and risks to pipeline
General (all above ground equipment)	3. Natural Hazards	26	Cyclones and strong winds - Scraper stations will have some above ground pipe work - Smaller valve at a station could be broken off causing a smaller leak. This is likely to cause a small jet fire at worst. - Note: main line valves will be buried and not subject to cyclone damage	- Pipe work is resistant to damage by impact from natural materials as the pipe steel will have a design factor of at least 0.67 - All facilities will be fenced providing protection against wind driven debris (except for extra high velocity wind) - Control buildings (small) and compressor buildings shall be built to the northern territory building code to withstand the effects of cyclones and strong winds - Most facilities and stations will be located more than 100 km from the coast where cyclone based events are diminished		Unlikely	Moderate	Class II	
			Bush fire near above ground equipment and compressor station	- Stations and above ground equipment will be cleared and gravelled - No combustible material will be kept within proximity to above ground equipment	- Annual Maintenance - Bush fire management plan	Possible	Moderate	Class III	39. Review the need for a buffer distance between above ground equipment and cleared area (for a LOC or other ignition sources) for bush fire prevention 40. Review the landscape management around cleared / disturbed areas and include provisions for graveling around above ground equipment

Location Along Pipeline	Guide Word	ID.	Threat Details Leading to Loss of Containment	Existing Mitigation Measures		Ranking (in light of existing protection measures)			Recommended Action
				Physical Mitigation	Physical Mitigation	Frequency	Consequence	Risk Ranking	
King River Compressor Station	High Pressure at Compressor Station	27	Over pressurisation of the pipe above MAOP at compressor station - leading to loss of containment	- Overpressure protection will be provided in the design, through use of PSVs - Pressure trips and isolation shall occur if high high pressure is reached - Compressors will be provided with a Recycle function - Emergency Shutdown and Isolation will occur if the above control measures fail	- Maintenance and operational procedures will insure equipment operates as required	Rare	Moderate	Class II	41. HAZOP in next stage of the project will address the issue of overpressure at the Compressor Station
		28	Over pressurising the NT pipeline	- Check valves are the only current provision in design - APA Tie in facility will have some pressure protection		Rare	High	Class III	24. Feasibility Phase of project to consider additional protection against pressurising the NT pipeline 29. Need to review the pressure protection at the APA pipeline 42. HAZOP in next stage of the project will address the issue of overpressure at the NT Pipeline
King River Compressor Station	Loss of Containment at Compressor Station	29	Accidental Releases - Equipment failure potentially leading to a release and subsequent Fire / Explosion leading to significant equipment damage If the compressor station is manned at the time of the event, a single fatality may be possible.	- Facility siting limits the potential offsite effects (i.e. low risk to the public) - Plant Layout shall limit the potential for manned buildings to be impacted by events - Appropriately Rate equipment will reduce the likelihood of ignition - Gas and fire detection - Inventory minimisation through ESD and Blowdown - Isolation of the pipeline from the compressor station to prevent escalation		Unlikely	High	Class III	30. Ventilation (natural or forced) at compressors to be investigated further based on design in order to eliminate, or prevent significant explosion on site
		30	Known releases through - maintenance vents - compressor seal gas vents - pigging vents - Low volume environmental releases, no significant hazard to personnel	- Manual vents to atmosphere are only small volume releases of gas - Vents are elevated and provided with appropriate hazards area rating - Ignition sources around vents are eliminated	- Known releases are a manual operation, undertaken via procedural controls	Possible	Very Low	Class 1	

Location Along Pipeline	Guide Word	ID.	Threat Details Leading to Loss of Containment	Existing Mitigation Measures		Ranking (in light of existing protection measures)			Recommended Action
				Physical Mitigation	Physical Mitigation	Frequency	Consequence	Risk Ranking	
King River Compressor Station	Loss of Containment at Compressor Station	31	High pressure emergency venting/Blowdown at compressor station, as a result : - blocked outlet - compressor trip failure - Initiation of ESD (via process or F&G system) Emergency venting can often occur without notice, and high levels of radiant heat can be experienced if ignition occurs	- Facility siting limits the potential offsite effects (i.e. low risk to the public) - Plant Layout shall include an appropriate sizes exclusion zone - Vent stack sizing shall reduce the potential for ignition of flammable gases - Vent stack sizing shall take into account the elimination of radiant heat, in the event the flammable gasses are ignited		Rare	Moderate	Class II	31. Criteria for radiation for both manual venting of MLV's and at the compressor station need to be established in the Feasibility Phase of the Project
Gove GLDS (within PacAl Facility)	High Pressure at GLDS	32	High pressure at Gove - resulting in - overpressure of gas in the Gove PacAL facility - Potential damage to burners	- Instrumented overpressure protection is currently provided for in the design of the GLDS - Upstream pipeline is rated to MAOP across the entire length - GLDS is within a restricted area of the plant (limited area for PSV vents at Gove)		Rare	High	Class III	23. Additional PSVs at gate let down stations to be investigated in Feasibility Phase
Gove GLDS (within PacAl Facility)	Loss Of Containment at GLDS	33	Equipment failure potentially leading to a release and subsequent Fire / leading to significant equipment damage, and potential escalation to the PacAl facility	- GLDS is within a cleared and restricted area of the plant (limited area for PSV vents at Gove) - Isolation is provided at the GLDS and the MLV station 15km upstream - GLDS is separation from PacAl Facility equipment by >100m - GLDS is separated front he property boundary by approximately 60m - Bollards will be provided to prevent collision (depending on access requirements) - Gas and Fire Detection		Rare	High	Class III	19. Review the Gove plant hazards and risks to determine the likelihood of escalation to/of the pipe

Location Along Pipeline	Guide Word	ID.	Threat Details Leading to Loss of Containment	Existing Mitigation Measures		Ranking (in light of existing protection measures)			Recommended Action
				Physical Mitigation	Physical Mitigation	Frequency	Consequence	Risk Ranking	
Gove GLDS (within PacAl Facility)	Loss of Containment at GLDS	34	Manual venting at Gove Should ignition occur during venting, high levels of radiant heat can be experienced	- GLDS siting limits the potential offsite effects (i.e. at the property boundary) - Layout includes sufficient distance between the GLDS and other equipment - GLDS is within a cleared and restricted area of the plant (limited area for PSV vents at Gove) - Vent stack sizing shall reduce the potential for ignition of flammable gases - Vent stack sizing shall take into account the limitation of radiant heat, in the event the flammable gasses are ignited - Radiation criteria has been assigned to limit exposure to the public (note the location of the GLDS is approximately 200m from a public beach) - Ignition sources around vents are eliminated or controlled (hazardous area rated)		Rare	Moderate	Class II	
Gove GLDS (within PacAl Facility)	Environment at Gove	35	Odorant requirements unknown			Unlikely	Low	Class 1	34. Check the requirement for odorant or the presence of odorant in the pipeline
		36	Caustic - Dissolving aluminium	- Carbon steel instrument and equipment		Unlikely	Low	Class 1	28. No aluminium instrumentation to be used in above ground equipment
		37	Alumina Fallout - impacting critical instrumentation, leading to a loss of control of instrumented system			Possible	Moderate	Class III	25. Review the siting of critical equipment with respect to Alumina fallout 26. Review the hazards at Gove PacAL facility for risk of dust explosion impacting the Gove facilities and above ground piping 27. Review the need for increased maintenance and sparing levels of equipment to be considered for above ground equipment at Gove
			Coastal tropical areas (salt) leading to increase corrosion (approach to Gove - GLDS and MLV station 15km from the facility)			Possible	Low	Class II	38. Above ground coating selection shall ensure that it is adequate for the environment at Gove

Location Along Pipeline	Guide Word	ID.	Threat Details Leading to Loss of Containment	Existing Mitigation Measures		Ranking (in light of existing protection measures)			Recommended Action
				Physical Mitigation	Physical Mitigation	Frequency	Consequence	Risk Ranking	
Pipeline Main Line Valve and Scraper Stations	Loss of Containment	38	Equipment failure potentially leading to a release and subsequent Fire / leading to significant equipment damage.	- Facility siting limits the potential offsite effects (i.e. low risk to the public) - Plant Layout shall limit the potential for escalation of events (i.e. bush fires) - Appropriately Rated equipment will reduce the likelihood of ignition - Gas and fire detection		Rare	Moderate	Class II	
		39	High pressure venting - pipeline de pressurising	- MLV Vents are a manual, controlled operation - MLV siting limits the potential offsite effects (i.e. low risk to the public) - Vent stack sizing shall reduce the potential for ignition of flammable gases - Vent stack sizing shall take into account the limitation of radiant heat, in the event the flammable gasses are ignited - Layout shall include sufficient exclusion zones to protect personnel and vegetation from radiant heat - Ignition sources around vents are eliminated or controlled (hazardous area rated)	- Known releases are a manual operation, undertaken via procedural controls	Rare	Moderate	Class II	31. Criteria for radiation for both manual venting of MLV's and at the compressor station need to be established in the Feasibility Phase of the project.
	Chemicals	40	Elemental sulphur accumulating at the gate station - particularly downstream of pressure reduction stations	- Two pressure cuts in the pipe are likely to reduce the likelihood of this occurring		Rare	Low	Class 1	37. Confirm the likelihood of elemental sulphur to occur across the PRS
Road Crossings	Third Party / External Interference	41	Stress to pipeline, causing cracking or stress fractures	- Location of the pipeline is away from any densely populated area - Separation by Burial - Pipeline is buried with a minimum depth of cover of 750 mm in R1, 900mm in T1, & 1,200 mm below known roads - Heavy wall pipe provided at road crossings - Heavy wall pipe, to satisfy the requirements for "no rupture pipe", in all T1 location Class - Clear right-of-way	- Aerial and drive by Patrolling (route accessible by 4WD in the dry season)	Unlikely	Moderate	Class II	YES

Location Along Pipeline	Guide Word	ID.	Threat Details Leading to Loss of Containment	Existing Mitigation Measures		Ranking (in light of existing protection measures)			Recommended Action
				Physical Mitigation	Physical Mitigation	Frequency	Consequence	Risk Ranking	
All Water Crossings Location Class: R1 (W)	Natural Events	42	Erosion of cover at Water ways in flood areas and undulating areas	- -Separation by Burial - Pipeline is buried with a minimum depth of cover of 2,000 mm below creeks and rivers - Pipeline ROW shall be maintained during the life of the pipeline to ensure cover is not reduced - -Erosion berms, water breaks and trench breakers shall be constructed to ensure discharge runoff water does not lead to erosion or sedimentation - Addition of rocks at bank reinstatement assists in the prevention of erosion - Directional drilling shall be used at major waterways to prevent disturbing of top soils during construction	- Aerial and drive by Patrolling (route accessible by 4WD in the dry season) - Inspection of all waterways will occur after each wet season - Landholder liaison	Likely	Very Low	Class II	
		43	General risk - across the pipeline Erosion of cover in undulating land	- Separation by Burial - Pipeline is buried with a minimum depth of cover of 750 mm in R1 - Pipeline ROW shall be maintained during the life of the pipeline to ensure cover is not reduced - Design incorporates water breaks, berms, trench breakers - Compaction post construction and vegetation replaced - Directional drilling shall be used at major waterways to prevent disturbing of top soils during construction	- Aerial and drive by Patrolling (route accessible by 4WD in the dry season) - Landholder liaison	Unlikely	Low	Class 1	
		44	Large growth of trees near waterways	- No large trees growing over the pipeline - A narrow ROW will be cleared and maintained	- Patrolling - Biannual inspection of pipeline and facilities	Unlikely	Low	Class 1	
KP0 Darwin to Adelaide Railway Line Location Class: R1 (CIC)	Vehicular loading road crossings	45	Pipe stress Train derailment at the Darwin to Adelaide railway crossing	- Separation by Burial - Pipeline is buried with a minimum depth of cover of 2000mm below top of rail - Heavy wall pipe thickness at rail reserve - The pipeline crossing of the Darwin to Adelaide railway is in a remote, straight section of track unlikely to cause a train derailment	- Railway authority liaison for additional protections (i.e. casing of crossings)	Rare	Moderate	Class II	22. Corrosion protection study to investigate any issues associated with the railway activities

Appendix 3 SMS Recommendations

Recommended Action	Thread identification referenced ID.
1. External corrosion mitigation to be formally addressed in detail and closed out in the Corrosion Study (which will be completed as an engineering deliverable in the Feasibility Phase of the project)	1
2. PacAl to confirm with APA the control measures in place to maintain gas specification	2
3. Corrosion Study to assess the issue of internal corrosion due to off spec gas - and determine if an additional corrosion allowance or mitigation measures are required	2
4. Nhulunbuy council zoning plans shall be reviewed to determine if a higher location class is required on approach to Gove	5
5. Determine if a Dial before You Dig system is required to be set up, or if there is an existing system which can be informed particularly where the pipeline approaches Gove	5
6. Establish increased patrolling plan around easily accessible routes of the pipe and above ground stations (i.e. at Gove and Katharine areas)	7
7. Identify any mining leases along the pipeline and determine the additional physical and procedural mitigation measures (including liaison) required	8
8. Identify any chemicals being used by 3rd party mining companies which could impact the corrosion coating on the pipeline	8
9. Penetration resistance calculations to be undertaken in the next Feasibility Phase of the project	4
10. Liaison with agricultural stations and landowners along the pipeline route shall be undertaken to identify the level of activity at each location and determine if any additional protection measures are required	6
11. Review the requirements for additional lightning protection for all pipeline equipment	10
12. Material properties of the pipeline to be investigated to ensure ductility of pipeline (i.e. plastic deformation rather than brittle fracture) in any seismic zones identified	12
13. Look at previous experience in NT to ensure adequacy of safeguards and mitigation measures for erosion and sediment control	14
14. Patrolling procedures will need to include the need to periodically review the company Access Track quality, to ensure that there is not excessive erosion of cover on/near the pipeline	19

Recommended Action	Thread identification referenced ID.
15. HAZOP in next stage of the project will address the issue of pipeline overpressure in detail	16
16. Stress calculations to be undertaken to determine the potential load capabilities of standard walled pipe at a minimum depth of 900mm	18
17. Design techniques need to be reviewed to protect equipment and personnel and to dissipate energy away safely in the event of a lightning strike to the pipeline or above ground equipment	20
18. Adequacy of corrosion protection needs to be reviewed in location close to power lines	20
19. Review the Gove plant hazards and risks to determine the likelihood of escalation to/of the pipe	21. 33
20. Ensure there are no low points in the pipeline for liquids to accumulate, without adequate provision to manage the accumulation of fluid	22
21. Retrieve some data from APA with respect to the history of liquids in their line (pigging/compositional changes)	22
22. Corrosion protection study to investigate any issues associated with the railway activities	45
23. Additional PSVs at gate let down stations to be investigated in Feasibility Phase	32
24. Feasibility Phase of the project to consider additional protection against pressurising the NT pipeline	28
25. Review the siting of critical equipment with respect to alumina fallout	37
26. Review the hazards at Gove Alumina Refinery for risk of dust explosion impacting the Gove facilities and above ground piping	37
27. Review the need for increased maintenance and sparing levels of equipment to be considered for above ground equipment at Gove	37
28. No aluminium instrumentation to be used in above ground equipment	36
29. Need to review the pressure protection at the APA pipeline	28
30. Ventilation (natural or forced) at compressors to be investigated further based on design in order to eliminate, or prevent significant explosion on site.	29
31. Criteria for radiation for both manual venting of MLV's and at the compressor station need to be established in the Feasibility Phase of the Project.	31, 39

Recommended Action	Thread identification referenced ID.
32. Further work on Noise is required once noise sensitive receptors have been identified	23
33. Operators of the NT pipeline to be consulted on current practice for evacuation from remote locations. Additional facilities, such as helicopter landing areas, communication requirements etc. shall be considered and implemented into the design	24
34. Check the requirement for odorant or the presence of odorant in the pipeline	35
35. Limit the use of gauges, or shield critical equipment from view at above ground facilities	25
36. Landholder/community liaison shall specifically cover hunting and risks to pipeline	25
37. Confirm the likelihood of elemental sulphur to occur across the PRS	40
38. Above ground coating selection shall ensure that it is adequate for the environment at Gove	37
39. Review the need for a buffer distance between above ground equipment and cleared area (for a LOC or other ignition sources) for bush fire prevention	25
40. Review the landscape management around cleared / disturbed areas and include provisions for graveling around above ground equipment	25
41. HAZOP in next stage of the project will address the issue of overpressure at the Compressor Station	27
42. HAZOP in next stage of the project will address the issue of overpressure at the NT Pipeline	28