- A description of the design features and measures to be incorporated into any proposed development to guard against anything more than minimal long term actual and potential environmental disturbances, particularly in respect of maintaining the natural hydrologic regime and sediment movement patterns and the identification of riparian buffers. (See note below)
- Details of the impact on water quality and remedial measures proposed to address more than minimal adverse effects.

Riparian corridors form a transition zone between terrestrial and aquatic environments and perform a range of important environmental functions. The protection or restoration of vegetated riparian areas is important to maintain or improve the geomorphic form and ecological functions of watercourses through a range of hydrologic conditions in normal seasons and also in extreme events.

Note: Recommended Riparian Corridor Widths (each side of watercourse) are:

- 10m - 1st order watercourse;
- 20m - 2nd order watercourse;
- 30m – 3rd order watercourse
- 40m – 4th order and greater watercourses.

Refer to NSW Office of Water *Guidelines for Controlled Activities– Riparian Corridors*, available at: http://www.water.nsw.gov.au/Water-Licensing/Approvals/Controlled-activities/default.aspx.

Water Management Structures/Dams

The Office of Water is responsible for the management and licensing of these structures under water legislation. If the proposal includes existing or proposed water management structures/dams, the assessment should provide information on the following:

- Date of construction (for existing structure/s).
- Details of the legal status/approval for existing structure/s.
- Details of any proposal to change the purpose of existing structure/s.
- Details if any remedial work is required to maintain the integrity of the existing structure/s.
- Clarification if the structure/s is on a watercourse.
- Details of the purpose, location and design specifications for the structure/s.
- Size and storage capacity of the structure/s.
- Calculation of the Maximum Harvestable Right Dam Capacity (MHRDC) for the site.
- Details if the structure/s is affected by flood flows.
- Details of any proposal for shared use, rights and entitlement of the structure/s.
- Details if the proposed development/subdivision has the potential to bisect the structure/s.

NSW Office of Water *Farm Dams Assessment Guide* provides details on harvestable rights and the calculation of the MHRDC. Refer to: http://www.water.nsw.gov.au/Water-Licensing/Basic-water-rights/Harvesting-runoff/Harvesting-runoff/default.aspx.

Basic Landholder Rights

The *WMA* identifies Basic Landholder Rights (BLRs) for access to water whereby landholders over an aquifer or with river or lake frontage can access water for domestic (household) purposes or to water stock without the need for a water licence (although a works approval may still be required for a bore utilising BLR). Pipeline constructions and easements may therefore affect existing BLR users and therefore all potentially affected BLR users need to be identified and the impacts quantified.

Sustainable Water Supply

Competition for water in NSW is extremely high. In areas where a Water Sharing Plan (WSP) has commenced, a long term average extraction limit has been established which constrains overall growth in extractions in an area. In these areas there are limited types of new licenses that can be issued, for example for aboriginal cultural purposes or growth in town water supplies.

Therefore in most instances new enterprises are required to enter the water market to purchase adequate water licences to meet their water demand requirements.

In areas where a WSP has not yet commenced, the NSW Government has established embargoes on applying for new licences. There are limited exemptions in some areas which need to be considered and applied for by a proponent. If an exemption does not apply, then again new enterprises need to enter the water market to purchase the required water licences. In some areas where a WSP has not yet commenced, there is still available water and the proponent may be able to apply for a new licence to account for the water taken from that water source.

The onus is on the proponent to assess which of the above is relevant and identify the potential sources of water of an appropriate reliability and quantity to meet their water supply requirements. The water supply requirements and potential water available should be identified in the EA to enable NOW to assess the viability of the water supply required. Assurances should also be made that the proponent will enter the water market as required.

Therefore the assessment is required to address the issue of provision of a sustainable water supply for any project proposal. The assessment should include Water Management Plans detailing how a sustainable water supply can be sourced and implemented. Through the implementation of BASIX, Integrated Water Cycle Management and Water Sensitive Urban Design, any proposed development should also exhibit high water use efficiency.

End Attachment A

*****

Department of Primary Industries
Office of Water

Contact: Alison Collaros
Phone: 02 6841 7416
Fax: 02 6884 0096
Email: alison.collaros@water.nsw.gov.au

GHD Pty Ltd
Level 15, 133 Castlereagh Street
SYDNEY, NSW 2000

Our ref: 80 ERM2012/0847
File No:
Your Ref:

Attention: Rima Exikanas

16 October 2012

Dear Sir/Madam

Re: Integrated Development – Browns Creek to Orange Gas Pipeline – Relocation of Gas Pipeline

Controlled Activities

The NSW Office of Water has reviewed documents associated with the above proposal and considers that an exemption applies to the controlled activity described and no controlled activity approval is required.

Under clause 40 of the Water Management (General) Regulation 2011 (copy enclosed), a network operator or pipeline licensee as **defined by this clause**, is exempt from section 91E (1) of the *Water Management Act 2000* (WM Act), in relation to controlled activities that are carried out in connection with the construction, modification, repair, maintenance or emergency work on their relevant infrastructure providing the proposed activities:

(a) are carried out in, on or under waterfront land relating to a ;river, estuary or lake (**other than** in or on the bed or banks of a river, the bed or shore of a lake, or the bed or land lying between the bed and the mean high water mark of an estuary), and

(b) do not cause any change in the course of the river, and

(c) have had the environmental impacts considered under section 111 of the *Environmental Planning and Assessment Act 1979* (or are exempt from the need for such consideration under section 110E of that Act).

This exemption is subject to any applicable requirements set by the Minister for the protection of waterfront land or any river, lake or estuary to which that land has frontage. Any relevant requirements will be published on the Office of Water's website:
www.water.nsw.gov.au Water licensing » Approvals » Controlled activities

Please note that the Minister may issue a direction in relation to a controlled activity which is having, has had, or is likely to have, an adverse effect on a water source or waterfront land and works which degrade the watercourse or waterfront land may be subject to compliance action.

NSW Office of Water advises that the works are required to be consistent with the requirements of the *Water Management Act, 2000* and if negative impacts on waterfront land occur due to the

activities, the proponent is the responsible party for any rehabilitation/remediation required by NSW Office of Water, under the *Water Management Act, 2000.*

For the purposes of the WM Act, **waterfront land** includes (i) the bed of any river together with any land within 40 metres inland of the highest bank of the river, or (ii) the bed of any lake, together with any land within 40 metres of the shore of the lake, or (iii) the bed of any estuary, together with any land within 40 metres inland of the mean high water mark of the estuary.

The Office of Water should be notified if the proposal is varied in any way that results in development extending onto waterfront land not covered by this exemption or encompassing controlled activities not covered by this exemption.

Water Licensing

Any water extracted for purposes such as dust suppression will require the relevant licence or permit under the Water Act 1912 or the Water Management Act 2000.

General Comments

1. Relevant Legislation
The assessment is required to take into account the objectives and requirements of the following legislation (administered by NSW Office of Water), as applicable:

- *Water Act 1912*
- *Water Management Act 2000 (WMA)*

2. Relevant Policies
The assessment is required to take into account the following NSW Government policies, as applicable which can be found at http://www.water.nsw.gov.au/Water-management/Law-and-Policy/default.aspx

- NSW State Rivers and Estuaries Policy
- NSW Sand and Gravel Extraction Policy for Non-Tidal Rivers
- NSW Groundwater Policy Framework Document - General
- NSW Groundwater Quantity Management Policy
- NSW Groundwater Quality Protection Policy
- NSW Groundwater Dependent Ecosystem Policy
- NSW Wetlands Management Policy
- NSW Farm Dams Policy
- NSW Weirs Policy
- NSW Aquifer Interference Policy

3. Surface Waters
NSW Office of Water is responsible for the sustainable management of rivers, estuaries, wetlands and adjacent riverine plains.

Watercourse/Riparian
The assessment is required to consider the impact of the proposal on the watercourses and associated riparian vegetation within the site and provide the following:

- Identify the sources of surface water.
- Details of stream order (using the Strahler System).
- Details of any proposed surface water extraction, including purpose, location of existing pumps, dams, diversions, cuttings and levees.

- Detailed description of any proposed development or diversion works including all construction, clearing, draining, excavation and filling.
- An evaluation of the proposed methods of excavation, construction and material placement.
- A detailed description of all potential environmental impacts of any proposed development in terms of vegetation, sediment movement, water quality and hydraulic regime.
- A description of the design features and measures to be incorporated into any proposed development to guard against long term actual and potential environmental disturbances, particularly in respect of maintaining the natural hydrological regime and sediment movement patterns and the identification of riparian buffers.
- Details of the impact on water quality and remedial measures proposed to address any possible adverse effects.

NSW Office of Water recommends a review of Departmental guidelines as mentioned earlier in relation to works in water courses and on floodplains which can be accessed at the following website:http://www.water.nsw.gov.au/Water-Licensing/Approvals/Controlled-activities/default.aspx

4.Groundwater

NSW Office of Water is responsible for the management of the groundwater resources so they can sustain environmental, social and economic uses for the people of New South Wales.

Groundwater Source

The assessment is required to identify groundwater issues and potential degradation to the groundwater source and provide the following:

- Details of the predicted highest groundwater table at the development site.
- Details of any works likely to intercept, connect with or infiltrate the groundwater sources.
- Details of any proposed groundwater extraction, including purpose, location and construction details of all proposed bores and expected annual extraction volumes.
- Describe the flow directions and rates and the physical and chemical characteristics of the groundwater source.
- Details of the predicted impacts of any final landform on the groundwater regime.
- Details of the existing groundwater users within the area (including the environment) and include details of any potential impacts on these users.
- Assessment of the quality of the groundwater for the local groundwater catchment.
- Details of how the proposed development will not potentially diminish the current quality of groundwater, both in the short and long term.
- Details on preventing groundwater pollution so that remediation is not required.
- Details on protective measures for any groundwater dependent ecosystems (GDEs).
- Details of proposed methods of the disposal of waste water and approval from the relevant authority.
- Assessment of the potential for saline intrusion of the groundwater and measures to prevent such intrusion into the groundwater aquifer.
- Details of the results of any models or predictive tools used.

Where potential impact/s are identified the assessment will need to identify limits to the level of impact and contingency measures that would remediate, reduce or manage potential impacts to the existing groundwater resource and any dependent groundwater environment or water users, including information on:

- Details of any proposed monitoring programs, including water levels and quality data.
- Reporting procedures for any monitoring program including mechanism for transfer of information.

- An assessment of any groundwater source/aquifer that may be sterilised as a consequence of the proposal.
- Identification of any nominal thresholds as to the level of impact beyond which remedial measures or contingency plans would be initiated (this may entail water level triggers or a beneficial use category).
- Description of the remedial measures or contingency plans proposed.
- Any funding assurances covering the anticipated post development maintenance cost, for example on-going groundwater monitoring for the nominated period.

Licensing

All proposed groundwater works, including bores for the purpose of investigation, extraction, dewatering, testing or monitoring must be identified in the proposal and an approval obtained from NSW Office of Water prior to their installation.

Groundwater Dependent Ecosystems

The assessment is required to identify any impacts on GDEs.

GDEs are ecosystems which have their species composition and natural ecological processes wholly or partially determined by groundwater. GDEs represent a vital component of the natural environment. GDEs can vary dramatically in how they depend on groundwater from having occasional or no apparent dependence through to being entirely dependent. GDEs occur across both the surface and subsurface landscapes ranging in area from a few metres to many kilometres. Increasingly, it is being recognised that surface and groundwaters are often interlinked and aquatic ecosystems may have a dependence on both.

Ecosystems that can depend on groundwater and that may support threatened or endangered species, communities and populations, include:

- Terrestrial vegetation that show seasonal or episodic reliance on groundwater.
- River base flow systems which are aquatic and riparian ecosystems in or adjacent to streams/rivers dependent on the input of groundwater to base flows.
- Aquifer and cave ecosystems.
- Wetlands.
- Estuarine and near-shore marine discharge ecosystems.
- Fauna which directly depend on groundwater as a source of drinking water or that live within water which provide a source.

The NSW Groundwater Dependent Ecosystem Policy provides guidance on the protection and management of GDEs. It sets out management objectives and principles to:

- Ensure the most vulnerable and valuable ecosystems are protected.
- Manage groundwater extraction within defined limits thereby providing flow sufficient to sustain ecological processes and maintain biodiversity.
- Ensure sufficient groundwater of suitable quality is available to ecosystems when needed.
- Ensure the *precautionary principle* is applied to protect GDEs, particularly the dynamics of flow and availability and the species reliant on these attributes.

5. Rehabilitation of the site

Rehabilitation of the site must ensure the stabilisation of the development area to minimise soil erosion. Soil erosion and sediment control structures must remain in place until the site is fully rehabilitated. Revegetation must emulate the native vegetation communities in the area. Refer to the Office of Water website for further guidance on vegetation management http://www.water.nsw.gov.au/Water-Licensing/Approvals/Controlled-activities/default.aspx

The Office of Water recognises that some aspects of the above requirements are generic hence if further information or clarification is required please do not hesitate to contact Alison Collaros on telephone number 02 6841 7416 or alison.collaros@water.nsw.gov.au .

Yours sincerely

Alison Collaros
Licensing Officer
NSW Office of Water
Licensing Operations North

Extract from Water Management (General) Regulation 2011

Part 3, Division 2, Subdivision 4, Clause 40: Network operators

A network operator licensed or authorised under the *Water Industry Competition Act 2006* or the *Gas Supply Act 1996*, or a licensee under the *Pipelines Act 1967* (a pipeline licensee), is exempt from section 91E (1) of the *Water Management Act 2000* in relation to the construction, modification, repair or maintenance of, or emergency work on:

(a) in the case of a network operator, the network operator's water or gas infrastructure, and
(b) in the case of a pipeline licensee, the pipeline the subject of the licence and its associated infrastructure,

being activities:

(c) that are carried out in, on or under waterfront land relating to a river, estuary or lake (other than in or on the bed or banks of a river, the bed or shore of a lake, or the bed or land lying between the bed and the mean high water mark of an estuary), and
(d) that do not cause any change in the course of the river, and
(e) the environmental impact of which has been considered under section 111 of the *Environmental Planning and Assessment Act 1979* (or is exempt from the need for such consideration under section 110E of that Act).

Rima Exikanas

From: richard.carter@dpi.nsw.gov.au
Sent: Monday, 8 October 2012 12:59 PM
To: Rima Exikanas
Subject: Re: Fw: Invitation to Comment - Brown?s Creek to Orange Natural Gas Pipeline EIS

Thank you for your request. AgNSW does not normally get involved in local planning decisions. There is no requirement in the DGRs for an Agricultural Impact Statement.

Richard J Carter | Manager Resource Planning & Development
Department of Primary Industries | Agriculture NSW | Skills & Communities
161 Kite Street | (Locked Bag 21) | Orange NSW 2800
T: 02 6391 3163 | F: 02 6391 3551 | M: 0412 820 361 | E: richard.carter@dpi.nsw.gov.au
W: www.dpi.nsw.gov.au

From: Liz Rogers/DII/NSW
To: Richard Carter/DII/NSW@NSW
Date: 08/10/2012 09:04 AM
Subject: Fw: Invitation to Comment - Brown's Creek to Orange Natural Gas Pipeline EIS
Sent by: Ruth Frater

FYI
----- Forwarded by Elizabeth Wiltshire/DII/NSW on 08/10/2012 08:56 AM -----

From: Rima Exikanas <Rima.Exikanas@ghd.com>
To: "nsw.agriculture@dpi.nsw.gov.au" <nsw.agriculture@dpi.nsw.gov.au>
Date: 05/10/2012 04:02 PM
Subject: Invitation to Comment - Brown's Creek to Orange Natural Gas Pipeline EIS

Dear Sir/Madam

East Australian Pipeline Pty Ltd is proposing to relocate a 1.8 km section of the Brown's Creek to Orange Natural Gas Pipeline around Orange Aerodrome. Please see attached letter and map. GHD is currently preparing an the environmental impact statement for the proposal and is seeking your comments and/or feedback. It would be appreciated if you could advise any issues that you feel should be addressed in the environmental impact statement by no later than Friday 19th October 2012 to me at rima.exikanas@ghd.com.

Many Thanks

Rima Exikanas
Environmental Scientist

GHD
T: +61 2 9239 7685 | F: +61 2 9239 7199 | V: 217685 | E: rima.exikanas@ghd.com
Level 15 133 Castlereagh St Sydney NSW 2000 Australia | http://www.ghd.com/
Water | Energy & Resources | Environment | Property & Buildings | Transportation

Heritage Council of New South Wales

3 Marist Place
Parramatta NSW 2150

Locked Bag 5020
Parramatta NSW 2124
DX 8225 PARRAMATTA

Telephone: 61 2 9873 8500
Facsimile: 61 2 9873 8599

heritage@heritage.nsw.gov.au
www.heritage.nsw.gov.au

Contact: Katrina Stankowski
Telephone: (02) 9873 8569
Email: Katrina.Stankowski@heritage.nsw.gov.au
File: 12/15619
Job ID No: A1146460
Your Ref: N/A

Rima Exikanas
Environmental Scientist - GHD
Level 15
133 Castlereagh Street
SYDNEY NSW 2000

Dear Ms Exikanas

RE: Review of Environmental Factors – Diversion of Brown's Creek to Orange Natural Gas Pipeline around Orange Aerodrome.

I refer to your email (received by this Branch on 8th of October 2012), requesting information regarding the NSW Heritage Council's requirements for the preparation of the above mentioned Review of Environmental Factors (REF) for the above project.

It is advised that the REF should address the following issues:

- The heritage significance of the site and any impacts the development may have upon this significance should be assessed. This assessment should include natural areas and places of Aboriginal, historic or archaeological significance. It should also include a consideration of wider heritage impacts in the area surrounding the site.

- The Heritage Council maintains the State Heritage Inventory which lists some items protected under the Heritage Act, 1977 and other statutory instruments. This register can be accessed through the Heritage Branch home page on the internet (www.heritage.nsw.gov.au).

- It should be noted that the legal standing of items listed on the State Heritage Register can also be provided by applying for a section 167 Certificate through the Heritage Branch home page.

- In addition, you should consult lists maintained by the National Trust, any heritage listed under the Australian Government's Environment Protection and Biodiversity Conservation Act 1999 and the local council in order to identify any identified items of heritage significance in the area affected by the proposal. Please be aware, however, that these lists are constantly evolving and that items with potential heritage significance may not yet be listed. Where possible refer to archaeological

zoning plans or archaeological management plans held by Local Councils.

- Non-Aboriginal heritage items within the area affected by the proposal should be identified by field survey. This should include any buildings, works, relics (including relics underwater), gardens, landscapes, views, trees or places of non-Aboriginal heritage significance. A statement of significance and an assessment of the impact of the proposal on the heritage significance of these items should be undertaken. Any policies/measures to conserve their heritage significance should be identified. This assessment should be undertaken in accordance with the guidelines in the NSW Heritage Manual. The field survey and assessment should be undertaken by a qualified practitioner/consultant with historic sites experience.

- The proposal should have regard to any impacts on places, items or relics of significance to Aboriginal people. Where it is likely that the project will impact on Aboriginal heritage, adequate community consultation should take place regarding the assessment of significance, likely impacts and management/mitigation measures.

The requirements for the preparation of EIS heritage assessments prepared by the Department of Planning may also be referred to and applied to the preparation of the REF.

The Heritage Branch would be happy to review any further documentation that may address any likely heritage impacts. If you have any further enquiries regarding this matter, please contact Katrina Stankowski on (02) 9873 8569.

Yours Sincerely

10/10/2012

Vincent Sicari
Manager
Conservation Team
Heritage Branch
Office of Environment & Heritage

As Delegate of the NSW Heritage Council

Rima Exikanas

From:	Liz Mazzer <Liz.Mazzer@environment.nsw.gov.au>
Sent:	Monday, 8 October 2012 2:44 PM
To:	Rima Exikanas
Cc:	Robert Taylor
Subject:	Brown's Creek to Orange Gas Pipeline Relocation SSD
Follow Up Flag:	Follow up
Flag Status:	Flagged

Dear Rima

RE Brown's Creek to Orange Gas Pipeline Relocation (SSI 12_5570)

I refer to your email dated 5th October inviting comments on the above proposal from the Office of Environment and Heritage (OEH). OEH has previously provided input to the Director General's Requirements and notes that these are included in the documentation you have sent.

OEH has responsibilities under the;

- *National Parks and Wildlife Act 1974* - namely the protection and care of Aboriginal objects and places, the protection and care of native flora and fauna and the protection and management of reserves; and the
- *Threatened Species Conservation Act 1995* which aims to conserve threatened species of flora and fauna, populations and ecological communities to promote their recovery and manage processes that threaten them;
- *Native Vegetation Conservation Act 2003* – ensuring compliance with the requirements of this legislation.

Based on the information provided, we have no specific comments to make on the proposal at this stage. Please note that if subsequent information indicates that these areas within the OEH's responsibility require further investigation, we may provide future input.

Should you require further information regarding issues that are the responsibility of the OEH, please contact me on 6883 5325 or liz.mazzer@environment.nsw.gov.au.

Yours sincerely

Liz Mazzer

Liz Mazzer
Conservation Planning Officer
Office of Environment and Heritage
48-52 Wingewarra St (PO Box 2111) Dubbo NSW 2830
Ph 6883 5325, fx 6884 8675

I work part-time: Monday, Wednesday and Friday

with authority states them to be the views of the Office of Environment and Heritage, NSW Department of Premier and Cabinet.

PLEASE CONSIDER THE ENVIRONMENT BEFORE PRINTING THIS EMAIL

Transport
Roads & Maritime
Services

WST12/00121

The Manager
Energy & Infrastructure Projects
NSW Department of Planning & Infrastructure
GPO Box 39
SYDNEY NSW 2001

Attention: Ms Swati Sharma

Dear Ms Sharma

Orange Aerodrome - Gas Pipeline Deviation (SSI 12_5570)Lot B DP
Environmental Assessment Requirements

Thank you for your letter dated 18 September 2012 referring SSI 12_5570 Preliminary Environmental Assessment (PEA) to Roads and Maritime Services (RMS) for comment.

The PEA has been reviewed and RMS notes the proposed pipeline deviation will not cross or be located in any classified road reserves.

RMS recommends that a traffic impact study be prepared in accordance with the methodology set out in Section 2 of the RTA Guide to Traffic Generating Developments including, but not limited to:

- Travel routes to the site for staff, contractors, construction personnel, materials and equipment during the construction phase of the development. The study should include vehicle types (including details of extended semi trailers proposed), volumes, number of movements and times of peak travel. The traffic study should also address internal traffic movements, parking facilities and address the impacts on local and classified roads during construction.

- Clarification of materials, equipment and machinery to be transported, in particular the lengths of pipes required to be transported to the site. The PEA states pipe lengths will be 12 metres (under Pipe haulage) then later states pipes will be transported in 18 metre lengths (under Stringing).

- Sight distances at affected intersections and suitability of intersections to accommodate large articulated vehicles.

- Consideration of local school bus routes and times. Haulage/transport operations relating to the proposal on local roads during school bus times should be avoided

Should you require further information please contact Andrew McIntyre on (02) 68611453.

Yours faithfully

Tony Hendry
Road Safety & Traffic Manager
Western

5 OCT 2012

Sophy Townsend

From: Sophy Townsend
Sent: Tuesday, 11 September 2012 4:50 PM
To: Peter Lansdown (InTouch)
Subject: RE: Orange Airport Expansion

CompleteRepository: 2121326
Description: Orange Airport Expansion EIS
JobNo: 21326
OperatingCentre: 21
RepoEmail: 2121326@ghd.com
RepoType: Job

Thank you Peter!

From: Peter Lansdown [mailto:Peter.Lansdown@dwe.nsw.gov.au]
Sent: Tuesday, 11 September 2012 4:47 PM
To: Sophy Townsend
Subject: Orange Airport Expansion

Sophy,
Further to our discussions on this project, I am now providing a response to the request for comments from Kel Gardiner dated 18 July 2012.

This response is from the Energy Branch of the Division of Resources and Energy, NSW Trade & Investment.

The proposed relocation of the existing Young to Lithgow natural gas pipeline will require an application for a variation to licence under section 18 of the *Pipelines Act 1967* (the Act);

- This pipeline is Pipeline Licence No 22 from Browns Creek to Orange;
- The pipeline was originally constructed in 1987 by The Pipeline Authority, a Federal Government agency;
- The pipeline became a NSW licensed pipeline in 1997 under section 12 (3) of the Act;
- The pipeline has never been subject to a Permit under the Act;
- Because of the provisions of clause 6 (1) of Schedule 1 of the Act, the Minister for Resources and Energy is unable to consider an application for a variation without the proposed relocation being considered by the Department of Planning and Infrastructure under the State Significant Infrastructure (Part 5) provisions of the *Environmental Planning and Assessment Act 1979*;
- Separately, the proponent is reminded of certain obligations of the consent authority under section 55 (1) of the *State Environmental Planning Policy (Infrastructure) 2007*; this pipeline being one of those prescribed under section 55 (2) (b) (i).

As indicated to you in discussions, Kel Gardiner's letter has apparently not been received, or registered, within NSW Trade and Investment.

However, I have passed it through to the appropriate contact person and asked that it be distributed to relevant officers within the various Departments/Divisions/Branches of NSW T & I for review and comment. I am told that these officers have been asked to comment individually to Kel directly. I have confirmed that the advice is now overdue from the originally requested date and have asked that comments be forwarded as soon as reasonably possible.

I understand that separate comments are likely to be sought from NSW Planning & Infrastructure regarding the now separately submitted Application for Approval under State Significant Infrastructure provisions of the EP&A Act for the pipeline relocation project.

Please feel free to contact me directly if you have any further queries.

Regards

Peter

Peter Lansdown | Manager Networks Performance
Resources and Energy | NSW Trade and Investment
227 Elizabeth Street | Sydney | NSW 2000
T: (02) 8281 7739 | F: (02) 8281 7452 | M: 0437 895 319
E: peter.lansdown@industry.nsw.gov.au
www.trade.nsw.gov.au

Rima Exikanas

From: Andrew Griffith <AGriffith@orange.nsw.gov.au>
Sent: Monday, 8 October 2012 9:30 AM
To: Rima Exikanas
Cc: Kel Gardiner; Robin Edwards (InTouch); Mary Baxter
Subject: RE: Invitation to Comment - Brown's Creek to Orange Natural Gas Pipeline EIS

Follow Up Flag: Follow up
Flag Status: Flagged

Rima,

Comments from Orange City Council regarding the Gas Pipeline Deviation Environmental Assessment Requirements below
Let me know if you have any queries or require further information

- Andrew

Andrew Griffith
Trainee Engineer
Orange City Council
PH: (02) 6393 8152
agriffith@orange.nsw.gov.au

From: David Waddell
Sent: Thursday, 4 October 2012 2:48 PM
To: Swati Sharma (Swati.Sharma@planning.nsw.gov.au)
Cc: Linda McFadden
Subject: Orange Aerodrome - Gas Pipeline Deviation (SSI 12_5570) Environmental Assessment Requirements.

I write on behalf of the General Manager.

Thankyou for your letter requesting comment on the Draft EARs for the above project.

From a planning perspective I consider the EARs to be sufficient to properly assess the development.

I do note however that given the aerodrome EIS itself covers off virtually all of these issues that there should be cooperation between the two projects where possible. In particular I would think there would be scope to truncate the aboriginal heritage consultation component to streamline the assessment rather than completely duplicating this. Most of the other studies in the Aerodrome EIS offer the same opportunity.

Regards

David Waddell
Director – Development Services
Orange City Council

63938261

From: Kel Gardiner
Sent: Monday, 8 October 2012 8:15 AM

ISSUE:

Canobolas Local Area Command (NSW Police Force) input into Environmental Impact Statement for proposed extension of Orange Airport.

BACKGROUND:

As per attached email I have been offered the opportunity to provide input into the environmental impact statement for the proposed expansion of Orange Airport . I have consulted Supt DRIVER and as the alternate Local Emergency Operations Officer I provide the following input.

COMMENT:

1. The proposed extension of the main runway will require the re-location of the main gas line and/or outlet to a location well away from the proposed runway extension to reduce the risk of an aerodrome accident impacting this gas line and outlet.
2. NSW Police would request any re-development of the airport should consider the expansion of the CCTV to cover the entire car park area and terminal for Crime prevention and investigative purposes.
3. NSW Police would request any re-development of the airport should consider an emergency operations room so in the case of an emergency incident at the Orange Airport a multi agency response could be co-ordinated from the airport.
4. NSW Police would request any re-development of the airport should consider developing identified marshalling areas at the Orange Airport with appropriate sealed parked areas with green lights and adequate access/egress routes for emergency vehicles and staff to be able to be directed to, to commence any emergency response which may be required at the airport.

RECOMMENDATION:

Forwarded for consideration

Peter ATKINS
Inspector
Canobolas LAC
23 July 2012

1. Local Area Commander, CANOBOLAS

Noted agree - Please Forward

Superintendent
David Driver
Commander
Canobolas LAC
28/7/12

Attachment C
Preliminary Hazard Analysis

Brown's Creek to Orange Gas Pipeline Relocation

Preliminary Hazard Analysis

November 2012

This Preliminary Hazard Analysis *("Report"):*

1. *has been prepared by GHD Pty Ltd ("GHD") for East Australian Pipeline Pty Ltd ("EAPL");*
2. *may only be used and relied on by EAPL;*
3. *must not be copied to, used by, or relied on by any person other than EAPL without the prior written consent of GHD;*
4. *may only be used for the purpose of Planning Approvals (and must not be used for any other purpose).*

GHD and its servants, employees and officers otherwise expressly disclaim responsibility to any person other than EAPL arising from or in connection with this Report.

To the maximum extent permitted by law, all implied warranties and conditions in relation to the services provided by GHD and the Report are excluded unless they are expressly stated to apply in this Report.

The services undertaken by GHD in connection with preparing this Report:

- *were limited to those specifically detailed in sections 1.2,2.3 and 2.4 of this Report;*
- *did not include site visits, or site testing, or review of detailed engineering plans.*

The opinions, conclusions and any recommendations in this Report are based on assumptions made by GHD when undertaking services and preparing the Report ("Assumptions"), including (but not limited to):

- *Preliminary design information including equipment, layout and intended plant capacity;*
- *Preliminary list of dangerous goods intended to be used on site;*
- *Preliminary site information.*

GHD expressly disclaims responsibility for any error in, or omission from, this Report arising from or in connection with any of the Assumptions being incorrect.

Subject to the paragraphs in this section of the Report, the opinions, conclusions and any recommendations in this Report are based on conditions encountered and information reviewed at the time of preparation and may be relied on until 12 months, after which time, GHD expressly disclaims responsibility for any error in, or omission from, this Report arising from or in connection with those opinions, conclusions and any recommendations.

Revision Record

Rev	Date	Reason for Issue	Responsible	Accountable
A	12/10/2012	Draft for comment	I Martin	
0	31/10/2012	Updated with comments	L. Dinh	M. Erskine
1	14/11/2012	Updated with comments	L. Dinh	M. Erskine

Table of Contents

1.0 EXECUTIVE SUMMARY

1.1 Introduction

Orange City Council is planning on an extension of Runway 11/29 as part of the proposed Orange Aerodrome Expansion. The construction and operations of these facilities would threaten the existing gas pipeline, operating between Brown's Creek and Orange. East Australian Pipeline Pty Ltd (EAPL), a wholly owned subsidiary of APA Group, is the owner operator of the pipeline and is proposing to divert the existing pipeline around the Orange Aerodrome extension. The diverted pipeline section would be approximately 1.8 km long and 400 m to the west of its existing location. It would be adjacent to the realigned Aerodrome Road and installed within a new pipeline easement.

GHD is preparing an Environmental Impact Statement for the gas pipeline deviation on behalf of EAPL. Under the Director General's Requirements (DGRs), issued 28 September 2012, an assessment of the hazards and risks associated with the proposal is to be completed as part of the EIS submission. The assessment must refer to the Department of Planning Guideline *Applying SEPP 33* (DUAP, 1994), where relevant, and include details of hazardous materials used or kept on the premises during the construction and operation phases. According to SEPP 33, the Brown's Creek to Orange Gas Pipeline Relocation proposal does not fall within the definition of a potentially hazardous industry or a hazardous storage establishment.

However, according to the NSW Department of Planning and Infrastructure, the pipeline is classified as potentially hazardous due to the hazardous nature of the material being transported, in this case natural gas. It is therefore a requirement that a Preliminary Hazard Analysis (PHA) be prepared in accordance with the requirements of Hazardous Industry Planning Advisory Paper (HIPAP) No. 6 and for the risk to be evaluated and compared with their risk criteria, as specified in Hazardous Industry Planning Advisory paper (HIPAP) No 4.

PHA's of new installations of longer pipes typically require risk work to be performed (consequence x likelihood contours) , but due to the short distance of this pipe, and the fact it is replacing an existing pipe of the same duty, it is likely the full risk assessment may not be needed. Therefore, GHD has prepared a Fire and Explosion Analysis (FEA) as part of this assessment for inclusion in the EIS in order to satisfy the likely requirement of the DGRs.

1.2 Purpose and Scope

The primary objective of the PHA is to assess whether there are any constraints with the Brown's Creek to Orange Gas Pipeline Relocation, from a safety perspective. It considers risks associated with the proposed development in terms of accidental loss scenarios and their potential for hazardous incidents.

The following approach is undertaken to conduct the assessment:

- Identification of potential hazards associated with the pipeline;
- Analysis of the safeguards to ensure they are adequate and therefore demonstrate that the operation can operate within acceptable risk levels to its surroundings;
- Consequence analysis of those hazards and their effect on people and the environment;
- Identification of risk reduction measures, if required.

1.3 Findings

The failure modes assessed in the PHA were derived from historical failures of similar pipelines. The main hazards associated with the gas pipeline were found to be associated with external interference (due to excavation by external parties) with the potential to result in a fire or explosion.

For the pipeline deviation the potential for external interference is minimised as it would be buried at a depth of 1200 mm. It would have a resistance to penetration through use of appropriate pipe thickness and marker tape would be laid 300 mm above the pipeline. The pipeline would have a 15 to 20 m wide easement and part of the pipeline would be laid within the Orange Aerodrome property boundary.

Depending on the release conditions, including the mass of material involved and how rapidly it is ignited the results may be a localised fire, such as a jet fire or a flash fire. Full bore rupture of the pipeline was considered to be non-credible and hence excluded from this study. According to APA, the pipeline diversion has been designed to meet the requirements of the 'No rupture' clause 4.7.2 in AS2885.1 [Ref 3] to satisfy the criteria applicable to the largest equivalent defect length produced by threats in the area.

Results show that the maximum distance to LFL from a 25 mm hole leak in the pipeline is 21.6 m and hence the resulting flash fire envelope would not reach any nearby residential houses.

For a medium 25 mm hole leak from the pipeline, thermal radiation effects of the resulting jet fire scenarios, would not impact on nearby residential houses. Even the 4.7 kW/m^2 thermal effect distance which corresponds to "causing pain in 15 – 20 seconds and injury after 30 seconds exposure (at least second degree burns will occur)" and is the lowest level of thermal effect listed in Table 2 would not impact the occupants of the residential houses in the vicinity.

The pipeline deviation would run through open areas and explosion of the vapour cloud formed through the release is considered highly unlikely. The consequence analysis shows that if an explosion were to occur, an overpressure of 14 kPa, which will make a house uninhabitable and badly cracked, would not reach nearby homes.

The proposed development does not increase in any significant way the risk of potential releases as it is a diversion of a short length of an existing pipeline, operating under the same duty. In addition, the diverted route will run through an area with the same population density and consequence effect distances will be relative to surrounding residential houses as the existing route.

Council is in the progress of acquiring a section of the land which currently occupies one residential house for the proposed Orange Aerodrome Expansion. Any future developments of this area will require an assessment to be completed to ensure the risk of the future developments will not impact on the diverted gas pipeline and vice versa.

2.0 INTRODUCTION

2.1 Background

The APA Group is the owner and operator of the Browns Creek to Orange Natural Gas Pipeline. The pipeline starts at an off-take from the Young to Lithgow Natural Gas Pipeline at Browns Creek, 114 km from Young, NSW, and finishes on the outskirts of Orange, running a distance of 23.8 km. An off-take station is located at OS7.3 (7.3 km from the Orange spur off-take) to deliver natural gas to Millthorpe, NSW. The Browns Creek to Orange Natural Gas Pipeline was commissioned in 1987.

Due to the potential threat of construction and operations of the proposed Orange Aerodrome extension on the existing gas pipeline, East Australian Pipeline Pty Ltd (EAPL) is investigating the option of diverting the pipeline around the Orange Aerodrome extension.

The pipeline deviation would be approximately 1.8 km long and will comprise of carbon steel pipe, DN 100 API 5L X42. The same grade and diameter pipe will be used for the majority of this pipeline. Thicker walled pipe, DN 100 API 5L X42 would be used under roads and proposed future graded runway. The alignment sheet [ref 6] for this pipeline deviation indicates a minimum depth of cover of 1200 mm. The pipeline would also have an external three layer polyethylene coating (Trilaminate, 3LPE) and an impressed current cathodic protection system applied to mitigate corrosion and mechanical damage. Cathodic protection test points would be installed to maintain pipeline integrity as per AS2885 [ref 3].

As one element of the planning approval process, a preliminary screening process has been applied in accordance with the State Environmental Planning Policy No.33 – *Hazardous and Offensive Development (SEPP 33)*. The screening process concentrates on the transport and storage of specific dangerous goods classes that have the potential for significant off-site effects. The assessment also involved the identification of classes and quantities of all dangerous goods to be used, stored or produced on site. The natural gas pipeline does not fall within the *SEPP 33* definition for hazardous industry materials, that is, a substance falling within the classification of the Australian Code for Transportation of Dangerous Goods by Road and Rail.

However, due to the potentially hazardous nature of natural gas, the pipeline is classified as potentially hazardous as per the definition by the NSW Department of Planning and Infrastructure. As part of the approval process, the NSW Department of Planning and Infrastructure requires a Preliminary Hazard Analysis (PHA) to be prepared in accordance with the requirements of Hazardous Industry Planning Advisory Paper (HIPAP) No.6 *Guidelines for Hazard Analysis* [ref 1] and for the risk to be evaluated and compared with their risk criteria, as specified in their HIPAP No.4 - *Risk Criteria for Land use Planning* [ref 2].

PHA's of new installations of longer pipes typically require risk work to be performed (consequence x likelihood contours). However, due to the short distance of this pipe, and the fact it is replacing an existing pipe of the same duty and is diverted along a route that has the same population density and distance to the pipeline, it is likely the full quantitative risk assessment (QRA) may not be needed. Therefore, as part of this assessment, GHD has prepared a Fire and Explosion Analysis (FEA) in order to satisfy the likely requirement of the DGRs.

This document presents the PHA of the Brown's Creek to Orange Gas Pipeline Relocation and forms an Appendix to the Environmental Impact Statement for this pipeline.

2.2 Aim of Study

The aim of this PHA is to ensure that there are no constraints from a safety point of view to the location of the proposed pipeline deviation. This PHA considers risk associated with the pipeline deviation in terms of accidental loss scenarios and their potential for hazardous incidents. Through

the evaluation of likelihood and consequence of the major hazards, the risks to the community associated with the proposed gas pipeline may be estimated and assessed against the Department of Planning and Infrastructure's risk criteria.

2.3 Scope of Report

The scope of this report includes the following:

- Systematic identification and documentation of the major hazards based on the information supplied and relevant experience with similar pipelines;
- Analysis of the safeguards to ensure they are adequate and therefore demonstrate that the operation can operate within acceptable risk levels to its surroundings;
- Establishment of the consequence of each identified hazard and determination as to their effects on surrounding people and environment; and
- Identification of risk reduction measures as deemed necessary.

2.4 Exclusions

- The PHA does not assess risk associated with the existing pipeline upstream or downstream of the new 1.8 km section of pipe deviation, nor does it include any activities associated with the Orange Aerodrome expansion project.
- Detailed process analysis (e.g. HAZOP or Fault Tree analysis) were not included in this scope as this type of analysis would be conducted by a multidisciplinary team including designers, construction and process engineers, safety officers and operations management when the pipeline design has been finalised.

2.5 Definitions

In this document, the following definitions apply:

Term	Meaning
Contractor	The person, firm, or company undertaking to supply services, plant, or equipment to which this document applies.
Environmental Event	An event with the potential to cause severe, widespread, long term or even permanent damage to ecosystems; or to impact on the business in terms of legal or regulatory compliance or reputation.
Hazard	The potential to cause harm, including ill health and injury, damage to property, products or the environment; production losses or increased liabilities.
Major Accident Hazard	A hazard with the potential to result in a Major Accident.
Major Accident	A fire, explosion or release of a substance, or any other event connected with operation of the facility, with the potential to result in multiple fatalities or serious injuries to workers or the public. For company facilities this also includes: • any event involving major damage to the structure of the facility or plant affixed thereto or any loss in the stability of the facility; • the collision of an aircraft or marine vessel with the facility.

2.6 Acronyms and Abbreviations

In this document, the following acronyms and abbreviations apply:

Acronym/Abbreviation	Meaning
APA Group	Australian Pipeline Trust and APT Investment Trust
DG	Dangerous Goods
EAPL	East Australian Pipeline Pty Ltd
ERP	Emergency Response Plan
FBR	Full Bore Rupture
HAZID	Hazard Identification
HAZOP	Hazard and Operability Study
HIPAP	Hazardous Industry Planning Advisory Paper
kPa	kilopascals
LFL	Lower Flammable Limit
MAOP	Maximum Allowable Operating Pressure
ME	Multi Energy model
MSDS	Material Safety Data Sheet
PHA	Preliminary Hazard Analysis
Phast	Process Hazard Analysis Software Tool
QRA	Quantitative Risk Assessment
SCMH	Standard cubic meters per hour
SEPP	State Environmental Planning Policy
SSI	State Significant Infrastructure
UK HSE	United Kingdom Health and Safety Executive
VCE	Vapour Cloud Explosion

2.7 Referenced / Associated Documents

Ref.	Document Number	Title/Description
1.	HIPAP 6	Department of Urban Affairs and Planning (DUAP) (1992). *Guidelines for Hazardous Analysis* Hazardous Industry Planning Advisory Paper No. 6.
2.	HIPAP 4	Department of Urban Affairs and Planning NSW, *Risk Criteria for Land Use Safety Planning* Hazardous Industry Planning Advisory Paper No.4.
3.	AS2885.1 - 2007	Australian Standard, *Pipelines – Gas and liquid petroleum. Part 1: Design and Construction.*

Ref.	Document Number	Title/Description
4.	AS/NZS ISO 31000:2009	Risk Management – Principles and Guidelines.
5.	SEPP 33	Department of Urban Affairs and Planning, State Environmental Planning Policy No.33, *Applying SEPP 33, 2012.*
6.	YL80-0235_C	Proposed Pipeline Deviation Alignment sheet preliminary Rev C, October 2012.
7.	Pipeline Licence No 22	APA Group, Browns Creek to Orange NG Pipeline – May 2009 – Risk Assessment in accordance with AS2885.1-2007, May 2009.
8.	PD 8010-3:2009	BSI British Standards, Code of practice for pipelines – Part 3: Steel pipelines on land – Guide to the application of pipeline risk assessment to proposed developments in the vicinity of major accident hazard pipelines containing flammables – Supplement to PD 8010-1:2004.
9.	APAGRO\08-B196	Planager, Preliminary Hazard Analysis of the natural gas delivery pipeline between Young and Bowen in NSW, 13 October 2009, Rev B.
10.	PCAG chp_6K Version 12	UKHSE, Failure rate and event data for use within risk assessments (28/06/2012).

3.0 HAZARD ASSESSMENT METHODOLOGY

The objective of the PHA was to evaluate risk levels and demonstrate that the design and operation can be carried out with an adequate level of safety. The assessment focused on broader locational safety aspects. The assessment has been carried out as per the Department of Planning's HIPAP No 6 [ref 1] and HIPAP No 4 [ref 2] as relevant for the small size of this project.

The initial part of this assessment is to determine that the consequence of all credible hazard events will not impact on nearby residential houses. If the fire and explosion analysis shows this requirement to be met, a full quantitative risk assessment will not be required due to the following reasons:

- It is a diversion of a short length of an existing pipeline;
- This section of the pipeline will operate under the same conditions to the existing pipeline;
- The new route will run through an area with the same population density and distance to residential houses as the existing route.

The assessment was carried out following the steps described hereafter.

3.1 Hazard Identification

The Hazard Identification includes a comprehensive identification of possible causes of potential incidents and their consequences to public safety and the environment, as well as an outline of the proposed operational and organisational safety controls required to mitigate the likelihood of the hazardous events from occurring.

A risk assessment workshop, in accordance with AS 2885 [ref 3], was undertaken by the APA Group for the Browns Creek to Orange Natural Gas Pipeline in May 2009. A cross-functional team of design, operations and maintenance personnel attended and identified threats to the pipeline, protection measures to be taken and evaluated the risk. Findings from this document [ref 7] have been used as part of the Hazard Identification for the PHA. This was completed as a desktop exercise.

The controls that would be in place to prevent the hazards from occurring or to mitigate the outcome are qualitatively assessed as part of the Hazard Identification. This is to ensure that adequate safeguards would be in place and therefore demonstrate that the operation can operate within acceptable risk levels to its surroundings.

3.2 Fire and Explosion Analysis

The fire and explosion consequence analysis results provide an extension of the hazard identification process to provide a better understanding of the potential pipeline hazards and secondly to provide recommendations for the elimination of hazards or the reduction of the consequences which may cover issues such as the location of pipeline route, and safe distances between houses, airport runway and potential impacts on the surrounding area.

The processes used to complete the analysis included:

- Material / phase released;
- Release condition;

- Process conditions;
- Release location;
- Isolation;
- Dispersion modelling of flammable releases;
- Fire and explosion impact modelling.

The release, dispersion and subsequent fire and explosion effect calculations have been performed using the software Phast v 6.7 (Process Hazard Analysis Software Tool). The software is used to assess situations which present potential hazards to life, property and the environment and to quantify their severity.

3.2.1 Weather Conditions

For each consequence modelling scenario, the relevant wind conditions and atmospheric stability factors will be used. Stability typing is employed to facilitate estimates of lateral and vertical hydrocarbon dispersion parameters. The “Pasquill stability” class represents the degree of turbulence in the atmosphere. The spread and selection of weather classes are representative of a large range of weather conditions such as high and low wind speeds, stable and unstable atmospheric conditions and day or night operation.

Different conditions of atmospheric stability and wind speed and direction will be modelled to determine the effects of the heat radiation and on the dispersion of vapour released. Typical conditions found in the Orange area across the day was used and shown in Table 1. These were determined and based on the typical meteorological conditions experienced at Orange as further detailed in Appendix A.

Table 1: Wind Conditions and Atmospheric Stability Factor

Wind Speed (m/s)	Pasquill (Atmospheric) Stability	Description
2	D	Neutral
7	D	Neutral
2	F	Moderately stable

3.2.2 Consequence results

The release, dispersion and subsequent fire and explosion effect calculations have been performed using the software Phast v 6.7 (Process Hazard Analysis Software Tool). The software is used to assess situations which present potential hazards to life, property and the environment and to quantify their severity.

The results from the fires and explosions estimated from the consequence modelling have been correlated with HIPAP No 4 damage levels, as shown in Table 2 and Table 3 below, to determine whether the proposed site layout will present unacceptable safety risks to people due to their proximity to sources of fire or explosion.

Table 2: Effects of Heat Radiation

Heat Radiation (kW/m^2)	Effect
4.7	Will cause pain in 15 – 20 seconds and injury after 30 seconds exposure (at least second degree burns will occur).
12.6	Significant chance of fatality for extended exposure. High chance of injury. Causes the temperature of wood to rise to a point where it can be ignited by a naked flame after long exposure.
23	Likely fatality for extended exposure and chance of fatality for instantaneous exposure. Spontaneous ignition of wood after long exposure. Unprotected steel will need thermal stress temperatures which can cause failure.
35	Cellulosic material will pilot ignite within one minute's exposure. Significant chance of fatality for people exposed instantaneously.

Table 3: Effects of Explosion Overpressure

Explosion Overpressure (kPa)	Effect
7	• Damage to internal partitions and joinery but can be repaired. • Probability of injury is 10%. No fatality.
14	• House uninhabitable and badly cracked.
21	• Reinforced structures distort. • Storage tanks fail. • 20% chance of fatality to a person in a building.

3.2.3 Vapour Cloud Explosion (VCE) Modelling

Vapour Cloud Explosion (VCE) events result from the congestion of flammable vapour clouds if the flammable vapour cloud engulfs any confined or congested region / area and the presence of an ignition source.

If VCE modelling is required, the method for modelling the impacts of a VCE will be the Multi Energy (ME) explosion model within PHAST Risk. The ME model is widely accepted throughout the process industry, and generally produces conservative results. The ME model is an empirical method based on experimental, observational and analytical data on fuel-air explosions. It takes into account the explosion energy (mass), severity or blast strength (based on degree of congestion and confinement) and the attenuation of the blast effects with distance from the epicentre of the explosion.

This model recognises the effect of congestion on explosion process and the increased blast generated by the resulting turbulent flame. The model assesses the effect of different degrees of

congestion in the space. A vapour cloud in a confined and/or obstructed space will produce a major blast, while a vapour cloud in an unconfined and unobstructed space will burn without producing a blast. An explosion strength index, varying from 1 to 10, is assigned to the type of space, with 1, representing a weak explosion in an unobstructed and unconfined space, and 10 representing a detonation.

3.3 Risk Reduction Measures

Where required and possible, risk reduction measures are identified throughout the course of the study in the form of recommendations.

4.0 FACILITY DESCRIPTION

4.1 Background and Scope

The Orange Spur Natural Gas Pipeline was constructed as part of the Young to Lithgow natural Gas Pipeline and was commissioned in 1987. This pipeline runs a distance of 23.8 km from its off-take on the Young to Lithgow pipeline at Browns Creek to the Orange Meter Station on the outskirts of the City of Orange. The pipeline passes by the village of Millthorpe and the Orange Aerodrome which services the local region.

The original Brown's Creek to Orange Pipeline was laid under Commonwealth Government planning processes and therefore does not have a NSW planning permit. State Significant Infrastructure (SSI) is identified in Schedule 3 of State Environmental Planning Policy (State and Regional Development) 2011. This pipeline is considered SSI. Under the Pipeline Act the diversion will require an alternation to Licence 22 and be subject to Part 5.1 of the *Environmental Planning & Assessment Act 1979*.

The pipeline diversion will be constructed in land acquired by Orange City Council as part of the aerodrome development and the pipeline will be located outside the aerodrome perimeter fence as shown in Figure 2.

4.2 Location and Surrounding Area

4.2.1 Location of Facilities

Figure 1 shows the current and proposed alignments with respect to the land ownership. Lot 7 DP 559537 has been acquired by Orange City Council and Lot 384 DP 1045095 is currently awaiting settlement. Orange City Council will provide APA with necessary easements. An impact width of 15 - 20 metres will be required for construction.

The pipeline in the vicinity of the Orange Airport since it was originally constructed has been classified under AS2885 as Rural R1 [ref 7]. This classification was on the basis that the pipeline was well away from the existing airport and situated in grazing paddocks. Very few houses are near the pipeline at this location.

The extension of the airport will change this area classification to T1 due to it being an area where the density of people at any time would justify the higher classification. The future presence of aircraft hangars or related businesses has the potential to further increase the population in the area immediately adjacent to the current location of the pipe and further justifies the reclassification to T1.

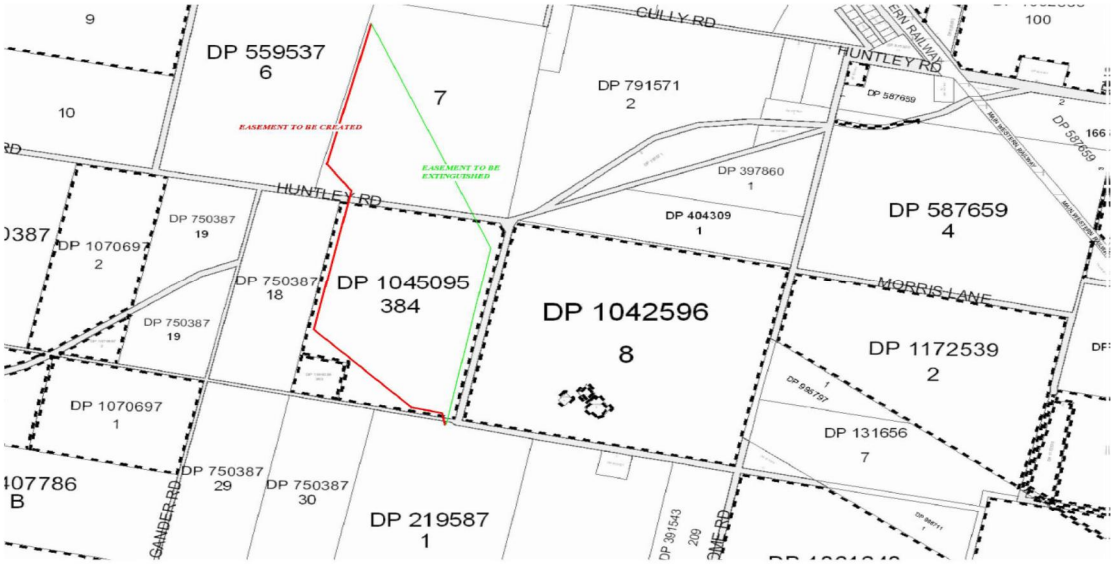

Figure 1: Pipeline alignments with respect to land ownership

4.2.2 Surrounding Land Use

The surrounding land is generally flat and open with low bushes and grasses. The land is largely cleared however some mature trees exist. The pipeline alignment would be adjusted wherever possible to avoid damage to mature trees. There are no sensitive populations (e.g. hospitals, schools) in proximity to the proposed pipeline deviation. There are some private dwellings close to the pipeline which would be assessed for the hazardous impact and effect.

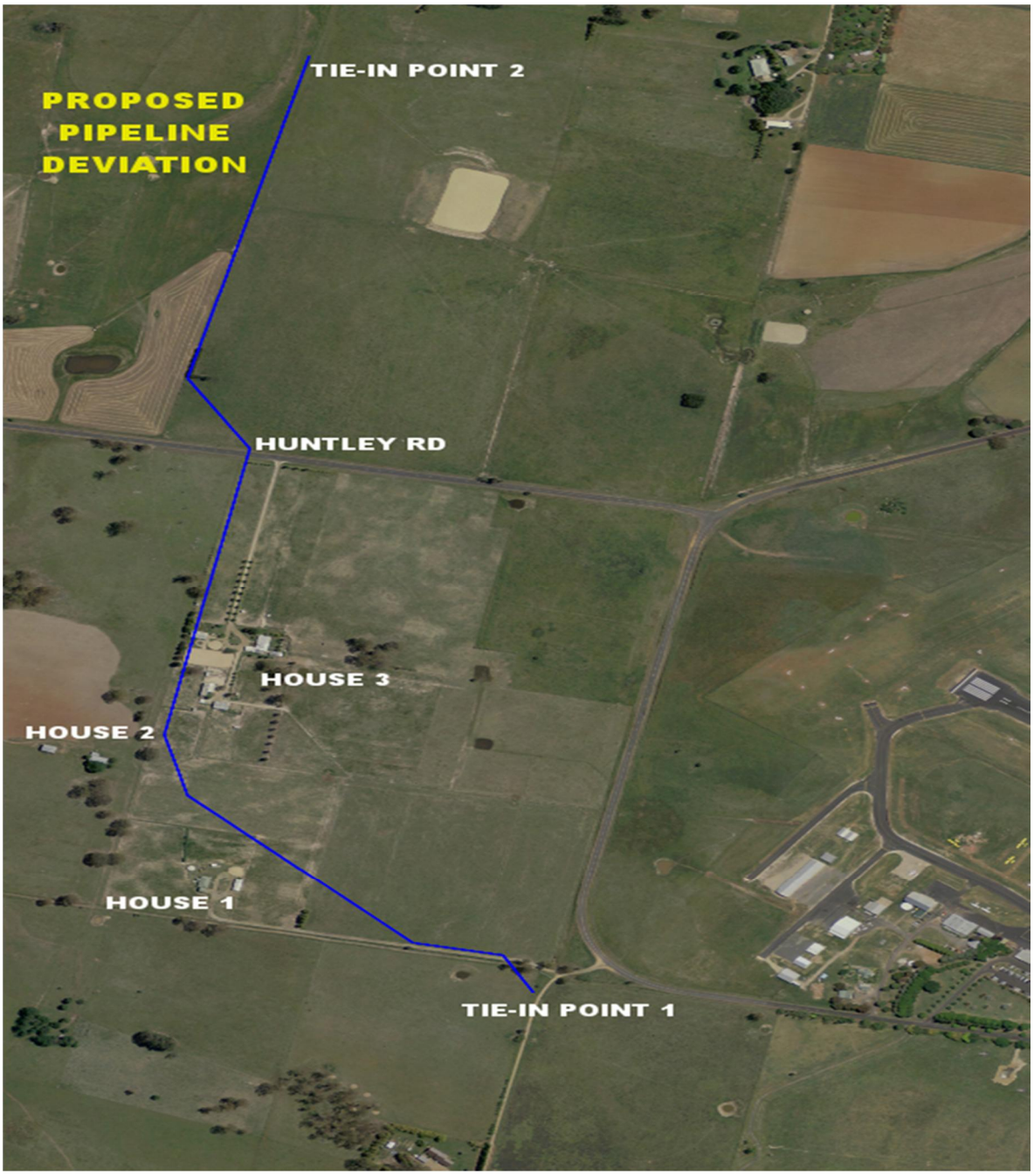

Figure 2: Locations of interest for proposed pipeline deviation

Figure 2 shows the location of houses (House 1, 2 & 3), Orange Aerodrome and the main roads that are within close proximity to the proposed pipeline deviation. Huntley Road crosses the pipeline route and. These identified points of interest will be assessed in the consequence analysis in Section 5.3.

4.2.3 Pipeline Design and Operation

The pipeline would be a buried steel pipe and designed and built to AS 2885 [ref 3], *Pipelines Gas and Liquid Petroleum*. The preliminary design and operating assumptions are listed in Table 4 below.

Table 4: Summary of Preliminary Assumptions for the Pipeline Deviation

Item	Pipeline Design
Pipe Specification	API 5L X42
Pipe Diameter	100 mm NB
Outside diameter	114.3 mm
Pipe Length	1.8 km (approximately)
Maximum Allowable Operating Pressure (MAOP)	9.93 MPa
Actual Operating Pressure	3.0 - 8.5 MPa
Temperature	Ground temperature range 10° to 25° C
Class Location to AS 2885	T1 as per AS 2885 definition
Coating	3 LPE Trilaminate
Pipe thickness [ref 6]	DN100 6.02WT API 5L X42 (General) DN100 8.56 mm API 5L X42 (Key crossings and locations)
Depth of cover	At least 1200 mm
Design Standard	As per AS 2885 requirements
Flow rate	4,600 SCMH (avg)

The pipeline would have an external coating and an impressed current cathodic protection system applied to mitigate corrosion and mechanical damage. The pipeline would be externally coated with a multilayer thermoplastic coating consisting of three layers of polyethylene coating (3LPE Trilaminate) designed to provide maximum long term corrosion resistance and mechanical protection to the steel pipe. Joint coating and coating repairs at construction will use either Denso S40 tape coating or Polyken 942/955 tape coating. The pipeline would not be internally lined.

4.3 Other Hazardous Materials On Site

Hazardous materials are defined within Department of Planning and Infrastructure as substances falling within the classification of the Australian Code for Transportation of Dangerous Goods by Road and Rail. Based on this definition, the hazardous materials to be stored on site during the construction phase of the pipeline deviation, including quantities and storage location, are summarised in Table 5 below.

Dangerous Goods (DGs) are substances that are potentially dangerous to people, property and the environment. A DG Manifest would be maintained as required under the DG Safety Management Regulation 2001. A copy of the DG Manifests would be included in the Emergency Response Plan (ERP), if applicable.

DGs may also be classified as Hazardous Substances according to the Workplace Health and Safety Regulation 2008. A Material Safety Data Sheet (MSDS) for every Hazardous Substance would be maintained on site. This information is stored in an MSDS database and printed copies are also maintained for reference.

Table 5: Hazardous Substances on site during construction

Hazardous Substance	Classification	Description	Storage Quantity	Storage Location
Paint Primer	Class 3, UN No.1263	Flammable, flashpoint 24 C, Boiling point > 137 C	15 Litres	TBC
Diesel Fuel	Class 3, C1	Combustible liquids; flashpoint above 61 C but not exceeding 150 C	1,000 Litres	TBC

It is most probable that small quantities of hydrocarbons as those shown in Table 5 would be used during the construction phase. However, these will be temporary in nature and replenished as required.

Based on the risk screening method of the Department of Planning, neither the storage nor transportation of the hazardous materials to be stored on site would result in the project being considered potentially hazardous. As such, there is no requirement to include these hazardous substances in the preliminary hazard analysis.

5.0 HAZARD IDENTIFICATION

5.1 Natural Gas Composition & Properties

The APA Group provided information on the natural gas composition as summarised in Table 6. Natural gas is composed predominately of methane gas. The methane content of the Browns Creek to Orange gas pipeline varies between 89.5% and 95.2%. The consequence modelling of hazardous events identified in this PHA assumes the gas release is 95% methane.

Table 6: Composition of Natural Gas

Component	Mole %
Methane (C1)	89.5 - 95.2
Ethane (C2)	1.8 - 5.5
Propane (C3)	0.06 – 1.2
Butane (C4)	0.01 – 0.5
Carbon Dioxide	1.0 – 1.36
Nitrogen	1.56 – 2.5

Methane is a flammable gas, which means that it can ignite in air on contact with a source of ignition. The lower flammability limit (LFL or LEL) is 5% and the upper flammability limit (UFL) is 15%. Methane is also an asphyxiant, which means that high concentrations of methane in the atmosphere lead to a reduction of oxygen concentration by displacement or dilution. Atmospheres deficient in oxygen do not provide adequate sensory warning of danger.

Most simple asphyxiants (such as methane) are odourless. The Brown's Creek to Orange spur pipeline is odorised and typically has a hydrogen sulphide concentration of 5.7 milligrams per cubic metre and 4.6 milligrams per cubic metre Mercaptans.

5.1.1 Hazard Identification Process

A risk assessment workshop, in accordance with AS 2885 [ref 3], was undertaken by the APA Group for the Browns Creek to Orange Natural Gas Pipeline in May 2009. A cross-functional team of design, operations and maintenance personnel attended and identified threats to the pipeline, protection measures to be taken and evaluated the risk. Findings from this document and an associated pipeline study [ref 7 & ref 9] have been used as part of the Hazard Identification for the PHA.

For the purpose of this PHA, the most significant hazardous scenario was considered to be the loss of containment of natural gas resulting from leaks or an unplanned release. A total of 10 potentially hazardous scenarios were identified for the gas pipeline, as listed in Table 7. Further details of these hazards, including their potential initiating events and proposed controls are summarised in Table 8.

A leak of flammable natural gas would generally only have the potential to cause injury or damage if there was ignition which resulted in a fire or an explosion incident. The factors involved are:

- The pipeline must fail in a particular mode causing a release. There are several possible causes of failure, with the main one being damage by external agencies, and then corrosion.

- The released material must come into contact with a source of ignition. In some cases this may be heat or sparks generated by mechanical damage while in others, the possible ignition source could include non-flame proof equipment, vehicles, or flames some distance from the release.
- Depending on the release conditions, including the mass of flammable material involved and how rapidly it ignited, the results may be a localised fire (jet fire), a flash fire or an explosion of the vapour cloud formed through the release.
- For there to be a risk, people must be present within the harmful range (consequence distance) of the fire or explosion.

Table 7: Identified Hazards

Number	Potential Hazardous Event
1	Failure of pressure piping through corrosion
2	Failure of pressure piping through erosion
3	Failure of pressure piping due to mechanical impact
4	Pressure increases or surges
5	Land subsidence
6	Spontaneous loss of integrity of pipe (rupture)
7	Aircraft or heavy vehicle crash
8	Damage to pipeline through vandalism / terrorism
9	Neighbouring bush fire
10	Nearby explosion at tie-ins / offs

Natural gas is a buoyant, flammable gas which is lighter than air (relative density of 0.6). On release into the open the non-ignited gas tends to disperse rapidly at altitude. Ignition at the point of release is possible and the gas would burn as a jet flame. On release in an enclosed area an explosion or a flash fire is possible. The pressure of the compressed natural gas may be hazardous in the case of an uncontrolled release however this hazard does not have implications beyond the immediate location of the release unless the release gas is ignited. Therefore, the risk associated with non-ignited gas does not form part of this scope.

Table 8: Hazard Identification

Event	Causes / Possible initiating events	Consequences	Prevention and Protection Measures
BROWNS CREEK TO ORANGE NG SPUR LINE – PIPELINE DEVIATION			
1. Failure of pressure piping through corrosion.	Damage to pipeline coating due to excavation inspection damage leads to corrosion. Construction damage or coating faulty material.	Release of gas. If ignition, a jet fire is possible with potential injury and property damage.	• Cathodic protection for external corrosion, and internal epoxy painting. • 3 LPE Trilaminate coating of pipeline. • Routine inspection of pipeline, including regular patrols. • Test points will be installed to maintain the integrity of the pipeline as per AS 2558. • NG disperses readily upwards, minimising chances of ignition. • Gas is stenched, allowing for detection and subsequent response in case of a small leak before it can develop into a larger leak.
2. Failure of pressure piping through erosion.	Flooding.	Potential for flood waters to wash away soil cover. May cause pipeline to be exposed. Possibility of damage to coating and subsequent corrosion which may lead to pipeline failure.	• Control of erosion through regular and periodic patrols and inspections, including aerial patrols, ground patrols after heavy rain or flooding, and landowner liaison. • No significant creeks or rivers, very flat. • Pipe to be buried 1.2 m below ground. • Repair to soil cover if erosion occurs.
3. Failure of pressure piping due to mechanical impact.	Third party involvement such as digging or trenching or other earthwork.	Massive release of natural gas. If ignition then possible flash or jet fire. Physical	• Bury pipeline to AS 2885 design requirements. • Signage along pipeline route,

Event	Causes / Possible initiating events	Consequences	Prevention and Protection Measures
	First party involvement.	explosion from the pressure of the pipeline creates projectiles. Injury and property damage. Possible fatality.	including Dial-Before-you-Dig. Drawings available, pipeline route within easement. • Resistance of pipelines to penetration through use of pipe thickness and adequate design factor as per AS 2885. • Thicker walled pipe under main roads (Huntley Rd & Aerodrome Rd) and future runway. • Automatic shutdown through automatic line break detection and valve closure if large hole in pipe i.e. pressure drop will instigate a manual shutdown by Network Controller in Control Centre in Young. • NG disperses readily upwards, minimising chances of ignition. Explosion not credible in unconfined situation.
4. Pressure increases or surges.	Operational error upstream or downstream facility.	Over pressuring the gas pipeline causing failures, leaks and release of natural gas. If ignition, then possibility of fire. Injury and property damage.	• Pipeline constructed and hydro-tested to AS 2885 requirements. • The gas pipeline can operate against closed head. • Continuous observation of pressure of pipeline from Control Centre at Young. Lack of control for several hours required before pressure could exceed critical levels. • High pressure trip and automatic line

Event	Causes / Possible initiating events	Consequences	Prevention and Protection Measures
			break protection isolating flow of NG. • Mechanical overpressure protection & controls at compressor stations. The newest compressor station is at Young.
5. Land subsidence.	Mining activities in area or earthquake.	Failure of pipeline resulting in potential for rupture or massive leak. Release of natural gas. If ignition, then possibility of flash or jet fire. Injury and property damage.	• Site is not affected by mine subsidence. • Pipe to be designed to AS2885 requirements in terms of strength of material and design.
6. Spontaneous loss of integrity of pipe (rupture).	Construction defect or operational error.	Massive release of natural gas. If ignition, then possibility of flash or jet fire. Injury and property damage.	• X ray of welds as required. • Cathodic protection. • Design for pipelines to limit crack propagation to about two pipe lengths. • Pipeline complying with AS2885. • Pipeline subject to cathodic protection monitoring at regular intervals. • Pipe wall thickness.
7. Aircraft or heavy vehicle crash.	Aircraft crash Heavy vehicle crash.	Potential damage to pipeline resulting in hazardous releases, fire and explosion. Injury and property damage.	• Buried pipeline unlikely to be susceptible to aircraft or heavy vehicle crash (less than 39 x 10^{-6} crashes/km^2/year, according to UK HSE data [Ref 10]) • Automatic line break isolation valves distance away from this deviation however these valves will minimise amount of gas released if gas pipe is damaged.

Event	Causes / Possible initiating events	Consequences	Prevention and Protection Measures
			• Aviation safety standards apply.
8. Damage to pipeline through vandalism / terrorism.	Malicious damage.	Massive release of NG. If ignition, then possibility of flash or jet fire.	• Buried pipeline (1200 mm U/G).
9. Neighbouring bush fire.	Bush fire.	Possible heat radiation.	• Control of vegetation in easement. • Buried pipeline is unlikely to be affected by heat radiation.
10. Nearby explosion at tie-ins/offs.	Incident, mechanical impact, lightning strike while tie-in completed.	Possible damage to gas pipeline with release of natural gas (NG). If ignition then possibility of flash or jet fire. Injury and property damage.	• Internal risk management procedures system by APA Group. • Pipeline integrity plan. • 24 hour monitoring of NG pipeline. • Dial-Before-You-Dig and signposting. • NG disperses readily upwards minimising chances of ignition. Explosion not credible in unconfined situation. • Buried pipelines. • Thickness and grade of pipe.

5.2 Potential Hazardous Incidents and their controls

Core to the management of hazardous incidents is a comprehensive understanding of how they can occur and the range of controls (safeguards) in place to prevent and / or mitigate the outcome. A description of the controls proposed for this project is included in the following sections. It is important that these controls are designed, installed, operated and maintained in such a way to ensure on-going reliability and effectiveness in preventing the hazard or mitigating the outcome.

5.2.1 Compliance with Relevant Standards

Australian Standard AS2885 [ref 3] sets the minimum standard for high pressure pipelines in Australia. This code gives detailed requirements for the design, construction and operation of gas pipelines. It also sets the classification of locations which guide the designer in the assessment of potential risks to the integrity of the pipeline, the public, operating and maintenance personnel as well as property and the environment.

AS2885 accommodates changes in population density by its location classification scheme concept. The classification scheme allows broad division of the pipeline design requirements according to whether the pipeline is to be installed in rural, semi-rural, suburban or urban areas. For each of these classifications the minimum design requirements in terms of wall thickness and depth of cover are specified.

The primary classification for the commencement of the Brown's Creek to Orange Gas Pipeline through to approximately OS22.2 is given as R1, *Broadly Rural,* for most part of the length of the run (as per the AS2885.1 so called primary location classes). This classification was on the basis that the pipeline was well away from the existing airport and situated in grazing paddocks. Very few houses are near the pipeline at this location.

The extension of the airport will change this area classification to T1 due to it being an area where the density of people at any time would justify the higher classification. The future presence of aircraft hangars or related businesses has the potential to further increase the population in the area immediately adjacent to the current location of the pipe and further justifies the reclassification to T1.

In accordance with the requirements of location classification T1, the pipeline requires two physical measure and two procedural measures of protection against external interference. For these areas of pipeline the following physical measures would be in place:

- AS2885.1-2007 Cl 5.5.5(a)(i) Separation – The pipeline would be buried to at least 1200 mm as required in Table 5.5.2 of AS2885.1-2007. In areas where additional activity is likely to take place, under any future runway extension, the pipeline will be buried to a greater depth of 1500 mm [ref 6].
- AS2885.1-2007 Cl 5.5.5(b)(i) Wall thickness – The pipe wall thickness would be a minimum of 6.02mm as this is the minimum required thickness for impact resistance [ref 6].

This area of the pipeline will be protected by the following three procedural measures:

- AS2885.1-2007 Cl 5.5.6(a)(i) Pipeline awareness – Marking. The pipeline route would be marked using pipeline marker signs to ensure it is identified by any party undertaking an operation which may damage pipeline facilities. For this pipeline the marker signage is above the levels specified in Table 4.4.1 of AS2885.1-2007.
- AS2885.1-2007 Cl 5.5.6(a)(iii) Pipeline awareness – Landowner, occupier and public liaison. Protection of the pipeline route by landowner, occupier and public liaison in accordance with the requirements of AS2885.3.
- AS2885.1 Cl 5.5.6(b)(i) External intrusion detection – Patrolling protection of the pipeline route is obtained by patrolling in accordance with the requirements of AS2885.1.

Under road crossings an additional measures of protection will be included as follows:

- Greater pipeline wall thickness – The pipe wall thickness would be 8.56 mm under road crossings [ref 6] to provide additional protection.

- Buried marker tape. Protection of the pipeline route is provided using pipeline marker tape, which is located at least 300 mm directly above the pipeline to enable external parties to identify that they are digging near a high pressure gas pipeline.

5.2.2 External Interference

External interference is historically the main cause of loss of gas and accounts for about 40% of all incidents leading to a release of gas [Ref 9]. For the pipeline deviation, this potential is minimised in the present development as the pipe would be buried to at least 1200 mm depth. In the unlikely event of damage to the pipeline, a sudden pressure drop would result in alarm initiation in the Control Room in Young, allowing automatic or remotely activated closure of the mainline valves. Also, natural gas disperses readily upwards, reducing chances of ignition. Explosion is not credible in an unconfined situation.

5.2.3 Construction defect and material failure

Construction defect and material failure is a known cause of failure of pipelines and accounts for approximately 15% of all incidents [Ref 9]. For the pipeline deviation, AS2885 would be adopted as a minimum requirement for the design and construction. The pipe seam weld would be 100% examined ultrasonically and the circumferential butt welds would be 100% radiographed.

5.2.4 Corrosion

Corrosion accounts for approximately 15% of all historical incidents, and mainly results in pinholes and cracks [Ref 9]. The pipeline under study would be coated with 3 LPE Trilaminate and would be cathodically protected. Regular pipeline patrols would be undertaken and potential corrosion leaks would be detected by in line inspection. An unlikely corrosion leak can be detected through the fact that the vegetation is browning off around the ground leak and that a small hole would be sonic, a possible detection through high pitched sound.

5.2.5 Earthquake

Earthquakes account for about 5% of all historical incidents that could potentially cause a failure of a pipeline due to the forces involved [Ref 9]. Earthquakes are not common in this area, as per Meteorological Earthquake hazard map of Australia, and steel pipelines are resistant to failure in these circumstances.

5.2.6 Aircraft or Large Vehicle Impact

The pipeline is unlikely to be damaged due to an aircraft or a large vehicle crash, as the gas pipeline will be buried at a depth of 1200 mm [Ref 9]. This scenario is not credible for the proposed pipeline deviation. The UK HSE Database indicates that the probability is less than 39×10^{-6} crashes/km^2/year in a similar relative location to the extended airport runway [Ref 10].

5.2.7 Other / Unknown Causes

Other unknown causes form the remaining 10% of all historical incidents and mainly fall within the pinhole crack category [Ref 9].

5.3 Fire and Explosion Consequence Analysis

The fire and explosion consequence analysis results provide an extension of the hazard identification process to assess the consequence impact on surrounding area.

The AS2885 risk studies completed by the APA Group indicate that most damage to pipelines results from external interference, particularly excavator machinery. Therefore, the following natural gas release cases, as listed in Table 9 were carried forward for analysis.

Table 9: Potential Major Hazards

Item	Hazard	Description
1	Pipeline – External parties Excavation – Natural Gas fire or explosion	Fires or explosions arising from excavation, drilling and other penetration work undertaken by third parties in the vicinity of the pipeline. Third parties include other NG companies, landholders and other utility companies.
2	Pipeline – Contractors Excavation – Natural Gas fire or explosion	Fires or explosions arising from pipeline excavation, drilling and other penetration work by APA and its contractors in the vicinity of the pipeline.

Based on the potential hazards identified in Table 9, the release scenarios for consideration include leaks and ruptures. However, according to APA, the pipeline diversion has been designed to meet the requirements of the 'No rupture' clause 4.7.2 in AS2885.1 [Ref 3] to satisfy the criteria applicable to the largest equivalent defect length produced by threats in the area. Based on this a full bore rupture of the pipeline was considered to be non-credible and hence excluded from this study. The only scenario credible to be considered in the consequence model is listed in Table 10.

Table 10: Modelled Release Scenario

Scenario	Justification
25 mm hole – gas released in the vertical direction.	This scenario represents a puncture to the pipeline by digging equipment penetrating the top of the pipeline. Due to the area being classified as rural, the most likely machinery able to damage the pipeline is an excavator with maximum weight of 25-30 tonnes and equivalent single point penetration of twin point tiger tooth. Hence, a 25 mm hole leak is taken to be representative of these cases.

The release, dispersion and subsequent fire and explosion effect calculations have been performed using the software Phast v 6.7 (Process Hazard Analysis Software Tool). The model inputs were based on the data provided in 4.2.3.

The consequences in terms of dispersion, thermal radiation and explosion overpressure are plotted according to: the release, fire or explosion scenario; the location of the release; the magnitude of consequence; radiation exposure and explosion overpressure exposure. These are further detailed in the following sections.

5.3.1 Gas Composition Modelled

In order to simplify the modelling, the gas composition was assumed as shown in Table 11.

Table 11: Gas Composition used during modelling

Component	Mole %
Methane	95
Ethane	2
Carbon Dioxide	1

Component	Mole %
Nitrogen	2

5.3.2 Gas Release Duration and Isolation

Due to the distance of the pipeline from the scraper station where the closest isolation valves are located, all releases are assumed to reach their maximum extent prior to any isolation of gas.

5.3.3 Points of Interest

As detailed in Section 4.2 only those points that are impacted by a fire or explosion due to a release of gas from the diverted pipeline are assessed in the consequence analysis. These points of interest include:

- House number 1;
- House number 2;
- House number 3; and
- Point at which the diverted pipeline crosses Huntley Road.

5.3.4 Gas Dispersion and Flash fire Studies

This section presents the flammable gas cloud formation and dispersion following an accidental release of natural gas at the various pipeline sections. The formation and dispersion of the flammable gas clouds have been modelled using the selected atmospheric conditions. It was found that F2 atmospheric conditions typically represent the worst case scenario for a gas cloud to develop.

Delayed ignition of a vapour cloud in an uncongested area leads to a flash fire. A summary of the results are shown in Table 12 measured at the cloud centreline. These are also represented graphically in the figures below. It is assumed immediate fatalities occur in the flash fire envelope.

Table 12: Distance to Lower Flammability Limit (LFL) and 0.5 LFL

Hole size (mm)	Release direction	Weather (refer to Table 1)	Distance to LFL (m)	Distance to 0.5 LFL (m)
25	vertical	D2	12.4	13.1
25	vertical	D7	3.1	3.3
25	vertical	F2	21.6	22.8

The flash fire envelope from a 25 mm leak near House 1, 2 and 3 releasing the gas in the vertical direction, with an atmospheric stability of class F, and a windspeed of 2 m/s is shown in Figure 3, Figure 4 and Figure 5 below. This illustrates that the flash fire envelope from a 25 mm leak would not reach House 1, 2, or 3. Please note that the structures around House 3 are uninhabited.

The consequence effect zone could be anywhere along the pipeline, which is illustrated by the dashed orange lines in the pictures.

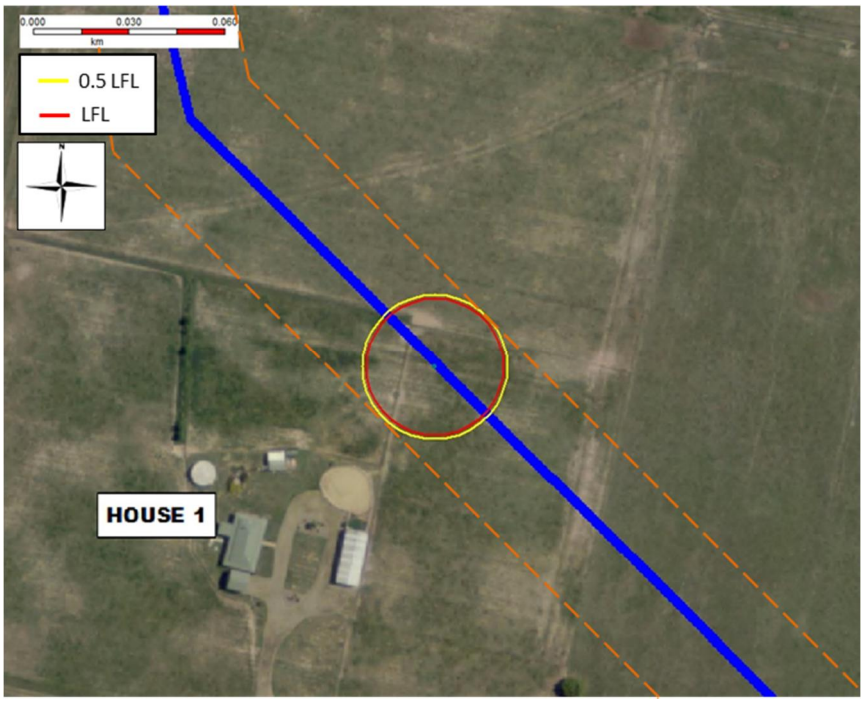

Figure 3: Flash Fire – 25 mm leak near House 1 with winds at F 2 m/s

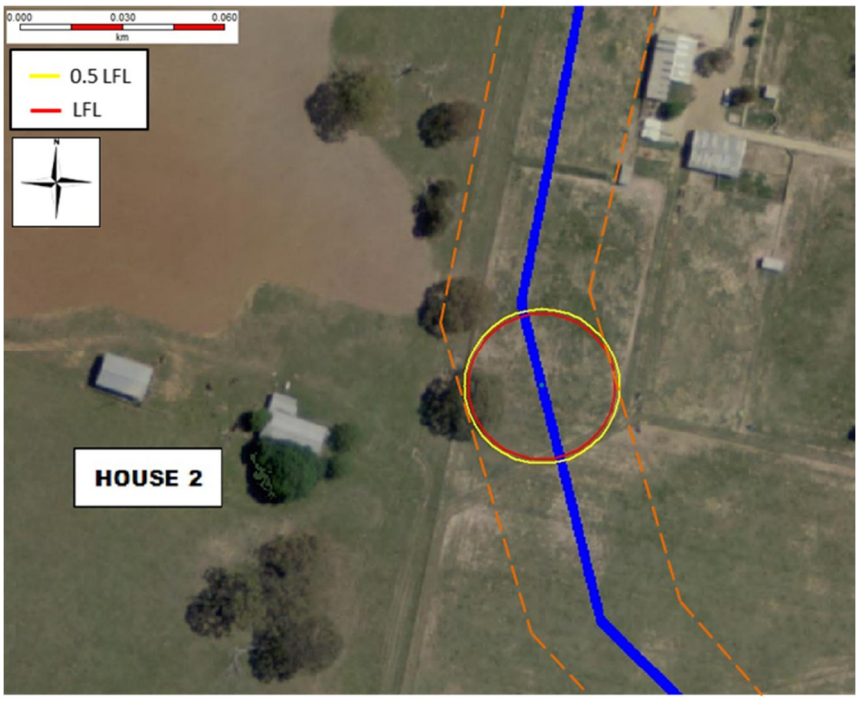

Figure 4: Flash Fire – 25 mm leak near House 2 with winds at F 2 m/s

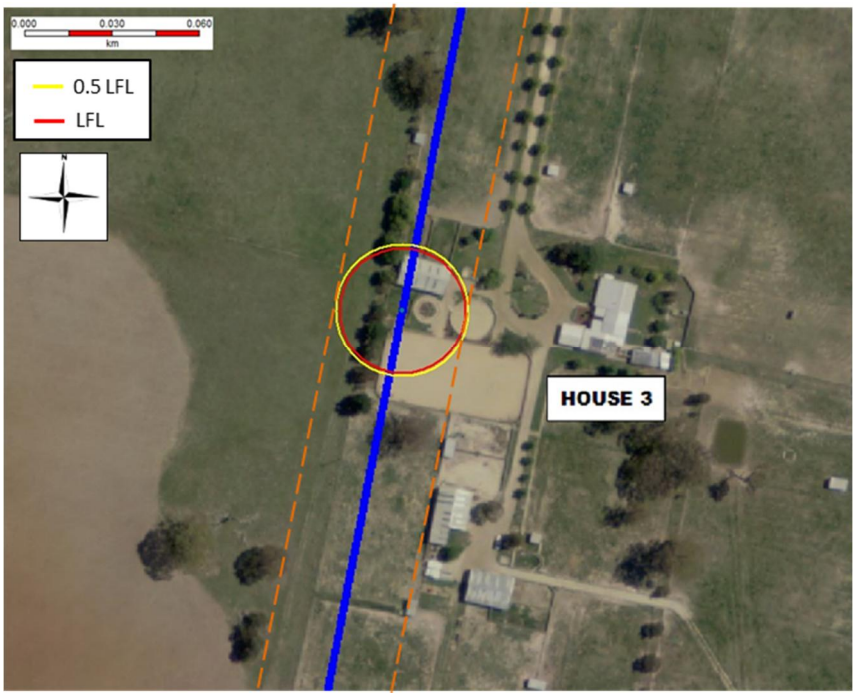

Figure 5: Flash Fire – 25 mm leak near House 3 with winds at F 2 m/s

The consequence effect distance will be the same at Huntley Rd as shown in Figure 6 however the risk is lower at this point due to the requirement in AS2885.1 that specifies that at key societal infrastructure locations additional risk reduction measures must be installed. This requirement would be achieved with a greater wall thickness, and additional protection of the pipeline using pipeline marker tape, which is located at least 300 mm directly above the pipeline to enable external parties to identify that they are digging near a high pressure gas pipeline.

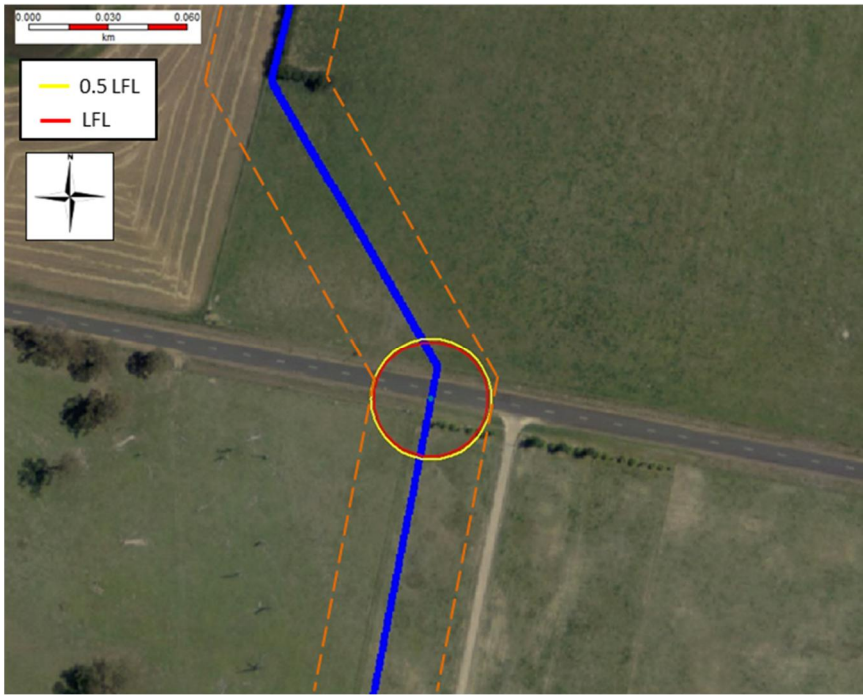

Figure 6: Flash Fire – 25 mm leak at Huntley Rd with winds at F 2 m/s

5.3.5 Jet Fire Studies

Phast was used to calculate the thermal radiation effects of the resulting jet fire scenarios. A summary of results for 25 mm release scenarios at various locations along the pipeline are listed in Table 13 below. A pictorial of these results is also provided in the figures following which represent the effect distance of the various radiation levels measured at 1.5 m from the ground.

Table 13: Distance to Thermal Radiation at various levels from a jet fire

Hole size (mm)	Release direction	Weather	Distance to 4.7kW/m^2 (m)	Distance to 12.6kW/m^2 (m)	Distance to 23kW/m^2 (m)	Distance to 35kW/m^2 (m)
25	vertical	D2	23.3	N/A	N/A	N/A
25	vertical	D7	31.0	18.0	9.8	3.1
25	vertical	F2	23.3	N/A	N/A	N/A

Figure 7, Figure 8 and Figure 9 show the effect of a Jet fire from a medium leak of 25 mm near Houses 1, 2 and 3. The gas is released in the vertical direction at atmospheric stability class of D and a wind speed of 7 m/s from the north. A series of thin ellipses show the zone where the thermal radiation will be above 4.7 kW/m^2, 12.6 kW/m^2, 23 kW/m^2 and 35 kw/m^2. As shown, none of these radiation levels will reach House 1, 2, or 3.

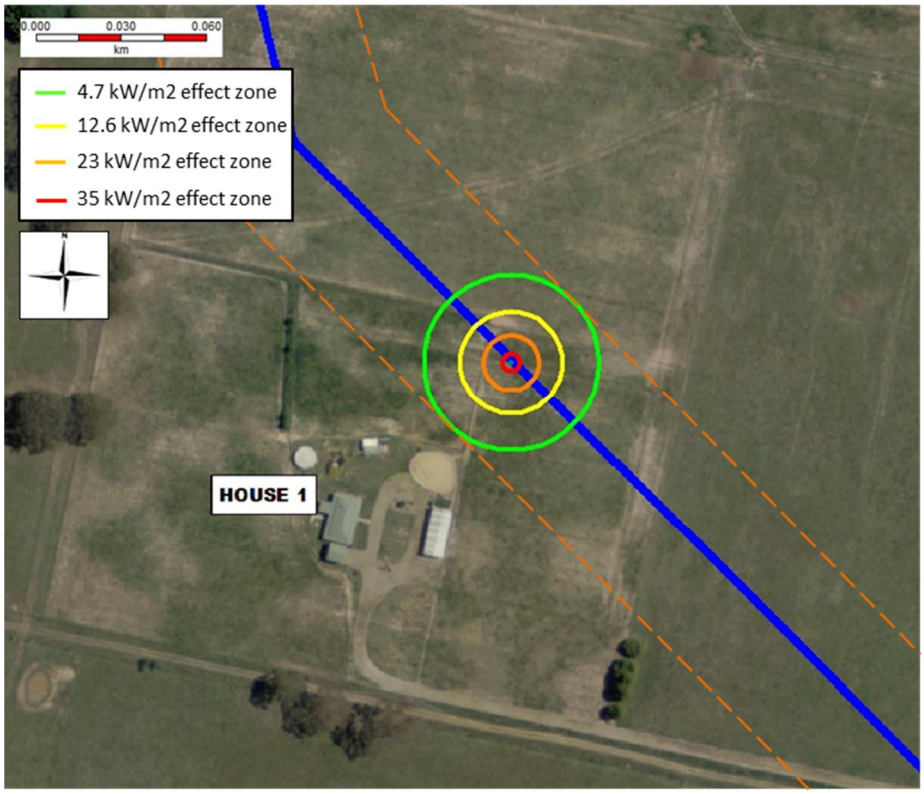

Figure 7: Jet Fire – 25 mm hole leak near House 1 with winds at D 7 m/s

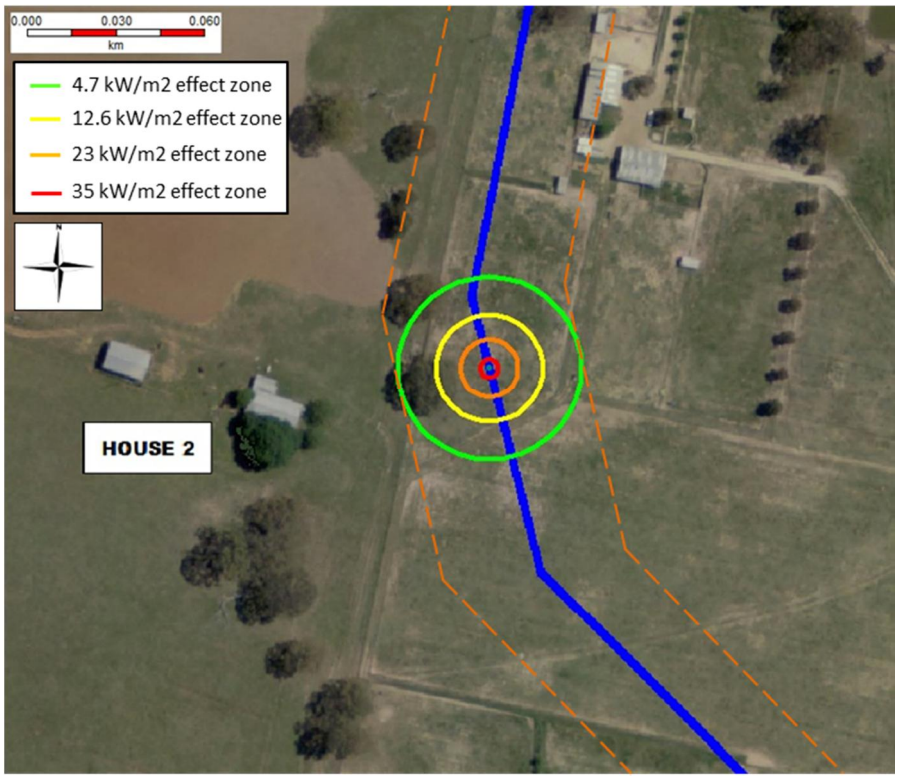

Figure 8: Jet Fire – 25 mm hole leak near House 2 with winds at D 7 m/s

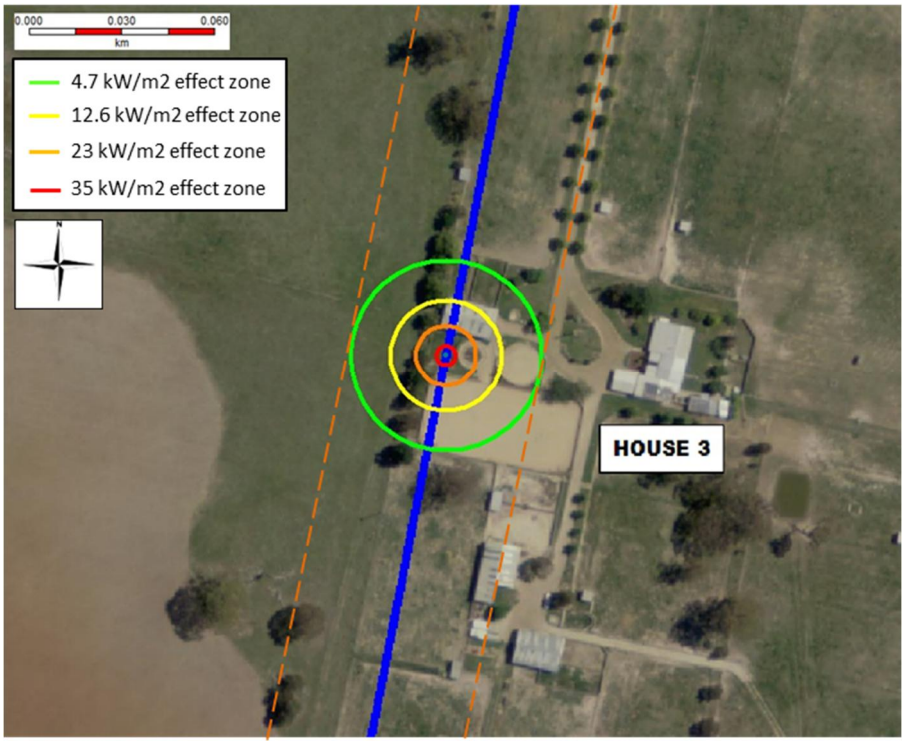

Figure 9: Jet Fire – 25 mm hole leak near House 3 with winds at D 7 m/s

The radiation effect zones of a medium leak of 25 mm at Huntley road resulting in a jet fire is the same as that near House 1, 2, and 3 and shown in Figure 10. As mentioned previously, the risk is lower at this point due to the requirement that additional protection measures be adopted. This requirement would be achieved with a greater wall thickness and pipeline marker tape, located at least 300 mm directly above the pipeline to enable external parties to identify that they are digging near a high pressure gas pipeline.

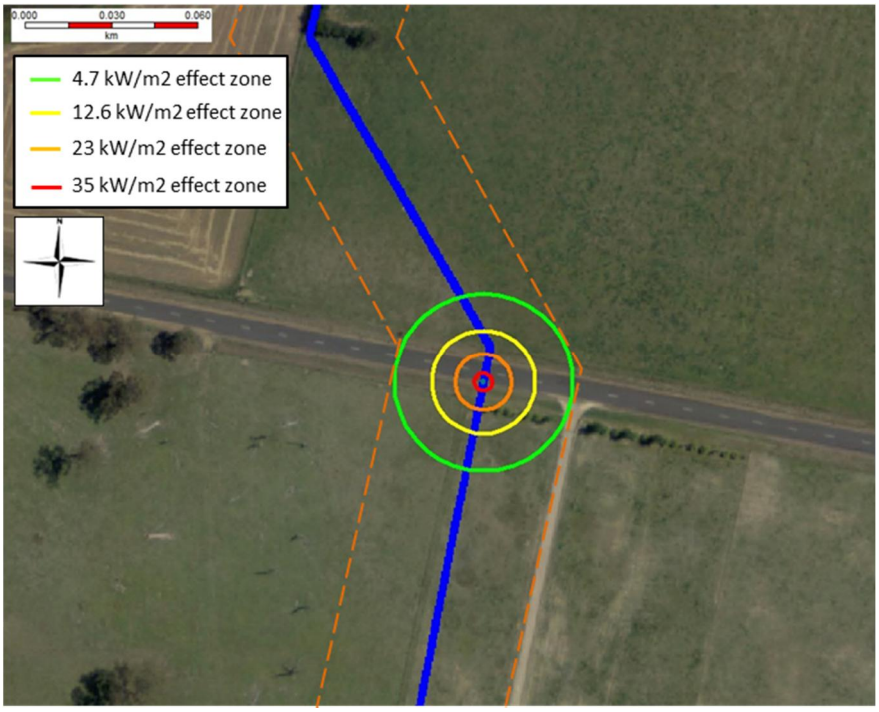

Figure 10: Jet Fire – 25 mm hole leak near Huntley Rd with winds at D 7 m/s

Although not a point of interest as discussed in Section 5.3.3, the effect zones of a jet fire resulting from a 25 mm hole leak at the tie in point is shown in Figure 11. This indicates that there is no impact on the nearby road or any residential houses from a consequence point of view as a result from a 25 mm hole leak at the tie in point.

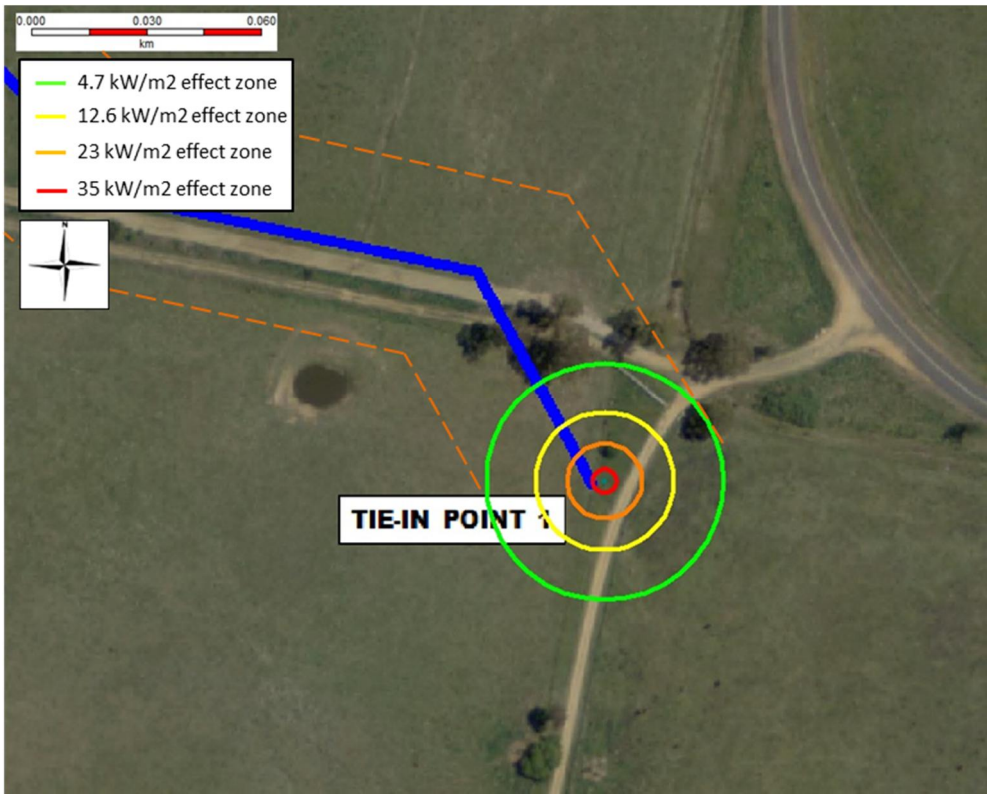

Figure 11: Jet Fire – 25 mm hole leak at Tie-in Point with winds at D 7 m/s

5.3.6 Vapour Cloud Explosions

Vapour Cloud Explosion (VCE) events result from the congestion of flammable vapour clouds if the flammable vapour cloud engulfs any confined or congested region / area and the presence of an ignition source.

The area through which the pipeline will travel is very open, with only a few houses and trees. Therefore, it has been assumed that only 10% of any gas cloud would be congested and have an explosive strength of 2. The Effects of Explosion overpressure criteria is listed in Table 3. From Table 14 below, an overpressure of 14 kPa will make a house uninhabitable and badly cracked. As shown in Figure 12, Figure 13 and Figure 14, this blast effect does not reach House 1, 2 or 3.

Table 14: Distance to Overpressure Levels from an explosion

Distance to 7kPa (m)	Distance to 14kPa (m)	Distance to 21kPa (m)
44.3	21.9	N/A