Appendix F

Addendum to the GGP Preliminary Hazard Analysis

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MINOR PIPELINE CORRIDOR REALIGNMENTS - ADDENDUM TO THE PRELIMINARY HAZARD ANALYSIS FOR THE GLOUCESTER GAS PROJECT

Prepared for: **EMGA Mitchell McLennan Pty Limited on behalf of AGL Upstream Infrastructure Investments Pty Limited**

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Minor Pipeline Corridor Realignments - Addendum to the Preliminary Hazard Analysis for the Gloucester Gas Project

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CONTENTS

EXECUTIVE SUMMARY I

ACRONYMS V

1 INTRODUCTION 1

1.1 Background 1

1.2 Scope and Aim of the Addendum PHA 2

1.3 Methodology 2

2 DESCRIPTION OF THE FACILITIES 4

2.1 Description of the Proposed Modification 4

2.2 Facilities as Assumed in the PHA 11

2.2.1 GTP 11

2.2.2 TRS 13

3 VALIDATION AND ASSESSMENT OF IMPACTS AND RISKS 15

3.1 Evaluation Against PHA Assumptions 15

4 MANAGEMENT MEASURES 22

5 CONCLUSIONS AND DISCUSSION 24

6 REFERENCES 26

LIST OF FIGURES

Figure 1 – Gloucester Gas Project - Pipeline modification - Seaham section 6

Figure 2 - Gloucester Gas Project - Pipeline modification - Brandy Hill section 7

Figure 3 - Gloucester Gas Project - Pipeline modification – Millers Forest section 8

Figure 4 - Gloucester Gas Project - Pipeline modification – Tomago section..... 9

Figure 5 - Gloucester Gas Project - Pipeline modification – Tomago Receiving Station 10

LIST OF TABLES

Table 1 – GTP – PHA Engineering Assumptions 11

Table 2 – Design Cases - GTP Evaluated in the PHA 13

Table 3 – TRS - Engineering Assumptions as per the PHA 14

Table 4 - TRS Risk Profile 14

Table 5 - Design Assumptions, Status at Updated Design 16

EXECUTIVE SUMMARY

E1 Background and Introduction

AGL Upstream Infrastructure Investments Pty Limited (AGL) has Commonwealth and State government approval to construct and operate the Gloucester Gas Project (GGP) in the Hunter region of NSW. One component of the GGP is an approximately 95 to 100 km long high pressure gas transmission pipeline (GTP) from a central processing facility at Stratford to a gas delivery station at Hexham. The approved GGP is described and assessed in detail in the AECOM (2009) *Gloucester Gas Project Environmental Assessment* (EA), inclusive of a comprehensive Preliminary Hazard Analysis (PHA) by Sherpa Consulting Pty Limited (Sherpa).

The Sherpa (2009) PHA (referred to as *the 2009 PHA*) was undertaken in accordance with NSW Department of Planning (now NSW Department of Planning and Infrastructure) guidance in their Hazardous Industry Planning Advisory Paper (HIPAP) No. 6 *Guidelines for Hazard Analysis*, HIPAP No. 4 *Risk Criteria for Land Use Safety Planning* and *Multi-level Risk Assessment*. The PHA formed part of the EA for the GGP and evaluated hazards and risks of the facilities which form part of the GGP.

AGL proposes to realign four sections of its proposed pipeline corridor and connect it into AGL's approved Newcastle Gas Storage Facility (NGSF) at Tomago, rather than the Hexham Delivery Station (HDS). End of pipeline facilities are proposed within a compound at the NGSF connection point, referred to as the Tomago Receiving Station (TRS). The proposed TRS facilities are similar to those previously assessed and approved for the HDS. The minor realignments are to further minimise vegetation clearing and other environmental impacts, avoid existing utilities where required, achieve economic and efficiency benefits, and allow the connection with the NGSF.

EMGA Mitchell McLennan Pty Limited (EMM) has been engaged by AGL to prepare an Environmental Assessment (EA) of the proposed modification. Planager Pty Ltd has been engaged by EMM to prepare the PHA component of the EA on behalf of AGL, in the form of an addendum PHA. This assessment has been made in accordance with the above-mentioned governmental guidelines and with consideration to the relevant Director-General's requirements previously issued for the GGP. This report documents the assessment methodology and results, including comparison with results of the original AECOM (2009) assessment of the approved pipeline corridor alignment and HDS. It also identifies mitigation and management measures, including referencing commitments from the original AECOM (2009) EA and approval conditions, which will also be applied to the modified elements where relevant.

The proposed modification is for four minor pipeline corridor realignments and connection to the NGSF via the TRS. The realigned sections are referred to as the Seaham, Brandy Hill, Millers Forest and Tomago sections as follows:

- **Gas Transmission Pipeline**

    - Seaham section - an approximately 0.65 kilometre (km) long section of pipeline corridor at East Seaham, proposed to be straightened and realigned up to 100 m north, to be mostly within cleared areas within and adjacent to a TransGrid transmission line easement. The Seaham section will include a main line valve (MLV) which will be the same as that approved and described in the AECOM (2009) EA. The AECOM (2009) EA identified that an MLV would be required, anticipated to be approximately half way along the pipeline. The current preferred location has since been identified to be within the Seaham section and accordingly this addendum PHA considers the MLV.

    - Brandy Hill section - an approximately 5 km long section of pipeline corridor near Brandy Hill, proposed to be straightened and realigned generally up to 335 m west. The proposed realignment is further from sensitive receptors at Brandy Hill.

    - Millers Forest section – an approximately 2 km long section of pipeline corridor at Millers Forest, proposed to be realigned around 50 m east, to avoid the recently constructed TransGrid transmission line.

    - Tomago section - an approximately 6.5 km long section of the pipeline corridor's southern end, proposed to be realigned to connect with the NGSF at Tomago via the TRS (rather than to the HDS Hexham). The proposed realignment avoids a wetland area, reduces disturbance to acid sulfate soils and only involves one crossing of the Hunter River (rather than the two crossings approved). Consistent with the approved pipeline, the river crossing is proposed to be by horizontal directional drilling (HDD).

- **TRS:** Construction of the TRS adjacent to the NGSF in Tomago, including an odourant facility either at the TRS (option 1) or, immediately adjacent to the TRS, on site at the NGSF (option 2). The proposed TRS facilities are similar to those previously assessed and approved for the HDS. Inclusion of an odourant facility either at the TRS (option 1) or, immediately adjacent, at the NGSF (option 2). The odourant facility was referred to but not addressed in detailed in the 2009 PHA for the approved project.

The addendum PHA is prepared as an addendum to the 2009 PHA to determines whether the proposed modification will result in an increase (worsening) or a decrease (amelioration) of hazards and risks identified in the PHA for the approved project and whether any changes or additions to the design, safety controls and management measures, as detailed in the PHA and the GGP project approval, are required to manage the potential hazards and risks, and any changes to (or additional) recommendations of the PHA.

E2 Results

The review has established that the changes are relatively minor with respect to health and safety risks associated with the GGP, with the following points being noteworthy:

- The changes to the GTP layout do not introduce any new hazards or risks and the assessment of the GTP in the PHA remains valid.

- The assessment of the HDS in the PHA remains valid also for the TRS near the NGSF.

- The risk associated with the main line valve (MLV) to be constructed at the Seaham section of the pipeline is expected to be minimal and very similar to that of the GTP due to the simple and robust design of such a valve site and the stringent requirements for this type of facility, as specified in the relevant codes and standards, including the AS2885 (Ref 1). The buffer distance to the residential landuse is expected to comply with the stringent risk criteria in NSW. However, this risk will need to be evaluated quantitatively in the Final Hazard Analysis (FHA) required as part of the GGP project approval to ensure a consistent approach for all facilities forming part of the GGP.

- The co-location of part of the GTP with AGL's existing Tomago to Hexham high pressure (HP) gas transmission, introduces a theoretical (though extremely unlikely) potential for a domino incident within the pipeline corridor (ie a failure in one pipeline causing a failure of the other pipeline). While construction of several high pressure pipelines within the same easement is common and the likelihood of a domino incident is highly improbable, this potential will need to be minimised through design and construction of the pipeline, and the residual risk needs to be reported in the FHA for the GGP.

- The risk associated with the odourant facility is negligible, whether it is to be located within the TRS or at the NGSF. Provided the requirements of AS1940 are adhered to, the probability of a fire involving the odourant is negligible for both options. The design includes placing the odourant vessels inside a ventilated building which minimises the risk of a release of unpleasant odours to the atmosphere.

The findings in the addendum PHA confirm the conclusions in the PHA, that the modified GGP does not introduce undue risk to surrounding landuse.

The design and safety controls and management measures identified in the PHA remain largely unchanged, and overall, the assessment and recommendations made, and the conclusions drawn in the PHA completed for the GGP remain valid.

The existing project approval conditions for the GGP require that a FHA be prepared for the project. The FHA will be developed once the detailed design has been developed and will re-assess the hazards and risks associated with the all the facilities that form part of the project. The assumptions made in the PHA (Ref 2)

were conservative and these assumptions will be reviewed in the FHA phase, using the detailed (*final*) design details.

ACRONYMS

AGL	AGL Upstream Infrastructure Investments Pty Limited
CPF	Central Processing Facility
DOC	Depth of cover (minimum)
EA	Environmental Assessment
ESP	Export Sales Pipeline
EMM	EMGA Mitchell McLennan Pty Limited
FHA	Final Hazard Analysis
GGP	Gloucester Gas Project
GTP	Gas Transmission Pipeline
HDD	Horizontal Directional Drilling
HDS	Hexham Delivery Station
HIPAP	Hazardous Industry Planning Advisory Paper
MAOP	Maximum Allowable Operating Pressure
MLV	Main Line Valve
NGSF	Newcastle Gas Storage Facility
PHA	Preliminary Hazard Analysis
ROW	Right Of Way
TRS	Tomago Receiving Station
WT	Wall thickness

REPORT

1 INTRODUCTION

1.1 BACKGROUND

AGL Upstream Infrastructure Investments Pty Limited (AGL) has Commonwealth and State government approval to construct and operate the Gloucester Gas Project (GGP) in the Hunter region of NSW. One component of the GGP is an approximately 95 to 100 km long high pressure gas transmission pipeline from a central processing facility (CPF) at Stratford to a gas delivery station at Hexham. The approved GGP is described and assessed in detail in the AECOM (2009) *Gloucester Gas Project Environmental Assessment* (EA), inclusive of a comprehensive Preliminary Hazard Analysis (PHA) by Sherpa Consulting Pty Limited (Sherpa) (Ref 2).

The Sherpa (2009) PHA (referred to as *the 2009 PHA*) was undertaken in accordance with NSW Department of Planning (now NSW Department of Planning and Infrastructure) guidance in their *Hazardous Industry Planning Advisory Paper* (HIPAP) No. 6 *Guidelines for Hazard Analysis*, HIPAP No. 4, *Risk Criteria for Land Use Safety Planning* and *Multi-level Risk Assessment*[1]. The PHA formed part of the EA for the GGP. The PHA evaluated hazards and risks of the facilities which form part of the GGP.

AGL proposes to realign four sections of its proposed pipeline corridor (at Seaham, Brandy Hill, Millers Forest and Tomago) and connect it into AGL's approved Newcastle Gas Storage Facility (NGSF) at Tomago, rather than the Hexham Delivery Station (HDS). End of pipeline facilities are proposed within a compound at the NGSF connection point, referred to as the Tomago Receiving Station (TRS). The proposed TRS facilities are similar to those previously assessed and approved for the HDS. The minor realignments are to further minimise vegetation clearing and other environmental impacts, avoid existing utilities where required, achieve economic and efficiency benefits, and allow the connection with the NGSF.

EMGA Mitchell McLennan Pty Limited (EMM) has been engaged by AGL to prepare an Environmental Assessment (EA) of the proposed modification. Planager Pty Ltd has been engaged by EMM to prepare the PHA component of the EA on behalf of AGL. This assessment has been made in accordance with the above-mentioned governmental guidelines and with consideration to the relevant Director-General's requirements previously issued for the GGP. This report documents the assessment methodology and results, including comparison with results of the original AECOM

[1] The Department's guidelines were updated in 2011 – however, the changes made to the guidelines did not affect the methodology and criteria for risk assessment. Hence the results and conclusions made in the 2009 PHA remain valid for all facilities that have not been modified.

(2009) assessment of the approved pipeline corridor alignment and HDS. It also identifies mitigation and management measures, including referencing commitments from the original AECOM (2009) EA and approval conditions, which will also be applied to the modified elements where relevant. This includes a requirement for a Final Hazard Analysis (FHA) of the GGP (Condition 3.47c of the project approval).

1.2 SCOPE AND AIM OF THE ADDENDUM PHA

This addendum to the PHA determines whether the proposed modification will result in an increase (worsening) or a decrease (amelioration) of hazards and risks identified in the 2009 PHA for the approved project.

This addendum further identifies any changes or additions to the design, safety controls and management measures, as detailed in the 2009 PHA and in the GGP project approval, which are required to manage the potential hazards and risks, and any changes to (or additional) recommendations of the PHA.

The types of risks considered in the PHA, and hence also in this addendum PHA are:

- Risk of acute human injury or fatality, expressed as Individual risk of fatality and injury and as risk of propagation (or escalation), as per the Department's *Guidelines for Hazard Analysis*;

Risk of acute damage to the natural environment was evaluated in the 2009 PHA, which concluded that the effects of an incident involving the facilities forming part of this proposal are unlikely to threaten the long-term viability of the ecosystem or any species within any sensitive natural environmental areas which may exist near the proposed development. Risk to the biophysical environment will not be assessed further in this addendum,

This addendum does not stand on its own. It should be used in conjunction with the 2009 PHA and readers of this addendum are assumed to have a working knowledge and familiarity with the contents of the 2009 PHA. Information provided in the 2009 PHA will not be repeated in this addendum, unless altered due to the proposed modification, to ensure no inconsistencies between the two documents arise. In certain instances, text from 2009 PHA will be quoted in this addendum for ease of reference.

1.3 METHODOLOGY

The methodology for hazard and risk analysis is well established in Australia and is described in the HIPAP number 6 (Ref 3) and the PHA (Ref 2), including the quantitative estimations of consequences and likelihoods of incident scenarios.

By conducting a thorough review of the proposed modification it is possible to determine whether the design has altered sufficiently to warrant a comprehensive re-evaluation of the risks assessed, or whether the design basis has remained basically intact and the conclusions made in the PHA remain valid.

The approach taken has been to systematically assess the proposed modification against the design and operation assumed at the time of the PHA, to evaluate whether there is an influence on the results of the hazard and risk assessment associated with the GGP.

The review in this addendum PHA took the following steps:

1. Identified changes made to the design and layout of the GTP and the TRS, safeguards or systems that may influence the assumptions or conclusions made in the PHA.
2. Undertook a systematic assessment of the proposed modification to determine whether it will result in an increase (worsening) or a decrease (amelioration) of hazards and risks identified in the PHA.
3. Considered any requirement to update the risk contour figures from the PHA.
4. Identified any changes or additions to the design, safety controls and management measures, as detailed in the PHA, required to manage the potential hazards and risks.
5. Identified any changes to (or additional) recommendations of the PHA.
6. Summarised and documented the findings in this addendum PHA, in a format suitable to append to the EA of the proposed modification.

2 DESCRIPTION OF THE FACILITIES

2.1 DESCRIPTION OF THE PROPOSED MODIFICATION

The proposed modification is for four minor pipeline corridor realignments and connection to the NGSF via the proposed TRS. Figures 1 to 5 show the approved and proposed modified pipeline corridor alignments. The realigned sections are referred to as the Seaham, Brandy Hill, Millers Forest and Tomago sections as follows:

- **GTP**
    - Seaham section (Figure 1) – an approximately 0.65 kilometre (km) long section of pipeline corridor at East Seaham, proposed to be straightened and realigned up to 100 m north, to be mostly within cleared areas within and adjacent to a TransGrid transmission line easement. The Seaham section will include a main line valve (MLV) which will be the same as that approved and described in the AECOM (2009) EA. The AECOM (2009) EA identified that an MLV would be required, anticipated to be approximately half way along the pipeline. The current preferred location has since been identified to be within the Seaham section and accordingly this addendum PHA considers the MLV. The exact location and design will be confirmed during its detailed design and will be subject of a detailed hazard and risk assessment as part of the FHA.
    - Brandy Hill section (Figure 2) – an approximately 5 km long section of pipeline corridor near Brandy Hill, proposed to be straightened and realigned generally up to 335 m west. The proposed realignment is further from sensitive receptors at Brandy Hill.
    - Millers Forest section – an approximately 2.5 km long section of pipeline corridor at Millers Forest, proposed to be realigned around 50 m east, to avoid the recently constructed TransGrid transmission line.
    - Tomago section (Figures 3) – an approximately 6.5 km long section of the pipeline corridor's southern end, proposed to be realigned to connect with the NGSF at Tomago (rather than at Hexham) via the TRS. The proposed realignment avoids a wetland area, reduces disturbance to acid sulphate soils and only involves one crossing of the Hunter River (rather than the two crossings approved). Consistent with the approved pipeline, the river crossing is proposed to be by horizontal directional drilling (HDD). The final 1.6 km (approximate) of the Tomago section is within an existing 30 m wide utility easement that contains AGL's Tomago to Hexham high pressure (HP) gas transmission pipeline.

- **TRS:** Construction of the TRS within a compound adjacent to the NGSF in Tomago, including an odourant facility either at the TRS (option 1) or, immediately adjacent to the TRS, on site at the NGSF (option 2). The proposed TRS facilities are similar to those previously assessed and approved for the HDS. The odourant facility was referred to but not addressed in detailed in the 2009 PHA for the approved project

The realigned sections of pipeline corridor generally traverse rural landscapes and cleared utility and access track corridors, and for the final approximate 1.6 km, within an existing utility easement. Consistent with the approved project, the pipeline includes road, waterway and drainage line crossings. There are rural residences in the surrounding area however generally further from residences than the approved route. The pipeline culminates at the connection point to the NGSF in the TRS, which is within an existing industrial area (Figure 4).

The proposed pipeline construction and operating activities are unchanged from those described in the original AECOM (2009) EA for the original (approved) pipeline route. In summary, the pipeline will mostly be constructed by open trenching, though some sections will be by thrust boring or HDD. As described previously, the Seaham section will include a main line valve (MLV) which will be the same as that approved and described in the AECOM (2009) EA (refer to Figure 1). The exact location and design of the MLV will be confirmed during its detailed design and will be subject of a detailed hazard and risk assessment as part of the FHA..

Disturbed areas will be rehabilitated consistent with the existing landuse after construction, with ongoing maintenance activities limited to an approximately 10 m wide easement above the buried pipeline. To allow flexibility in final siting and design of the pipeline, and consistent with the approach in the AECOM (2009) EA for the approved project, this assessment has generally considered a 100 m wide pipeline corridor. However, the disturbance footprint for construction will be within a right of way (ROW) up to around 30 m wide. Further details on the proposed modification are provided in the EA main report.

The impacts of these changes on the assumptions and conclusions drawn in the PHA are assessed in Section 3.

Figure 1 – Gloucester Gas Project - Pipeline modification - Seaham Section

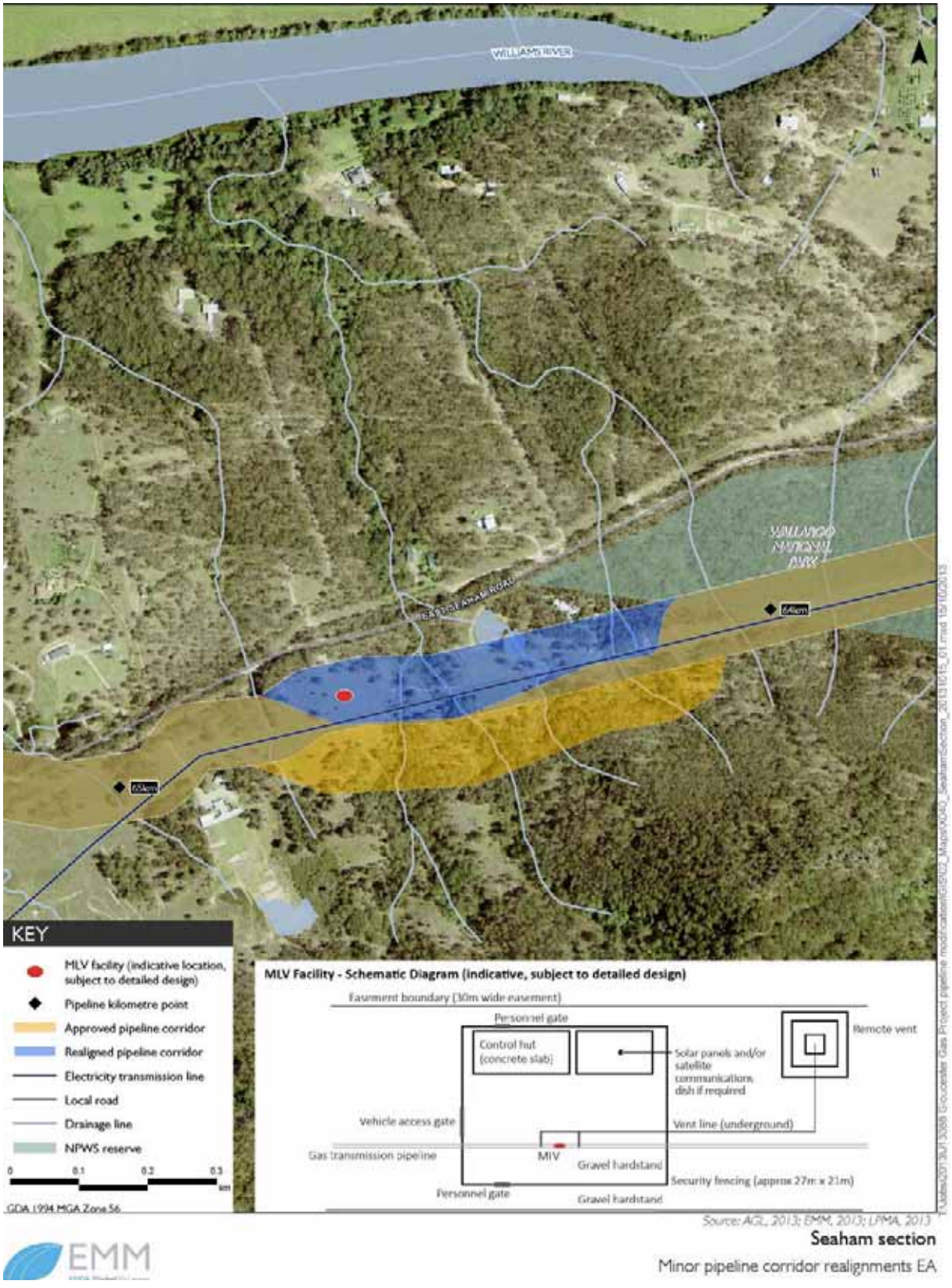
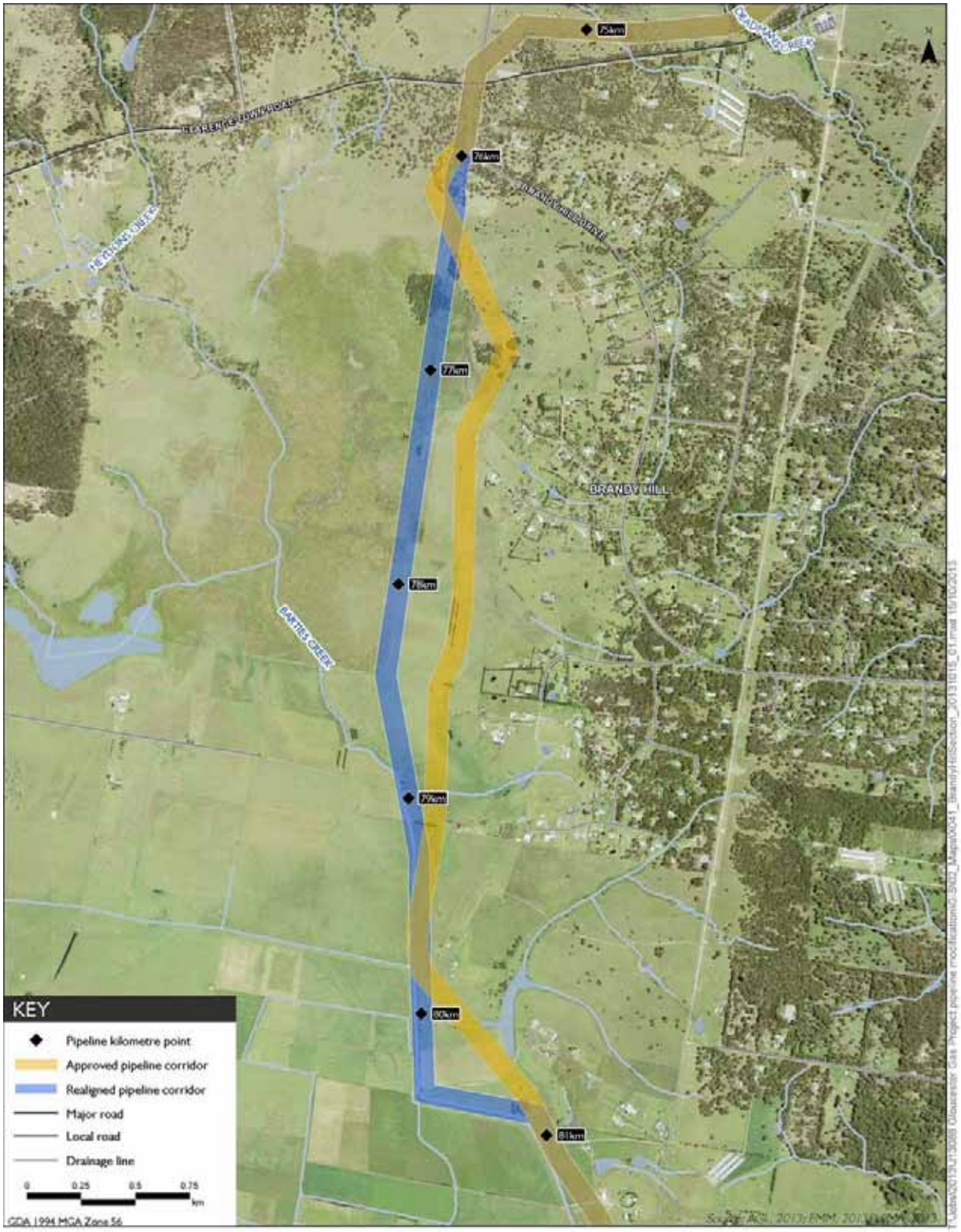


Figure 2 - Gloucester Gas Project - Pipeline modification - Brandy Hill Section



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Brandy Hill section
Minor pipeline corridor realignments EA

Figure 3 - Gloucester Gas Project - Pipeline modification – Millers Forest

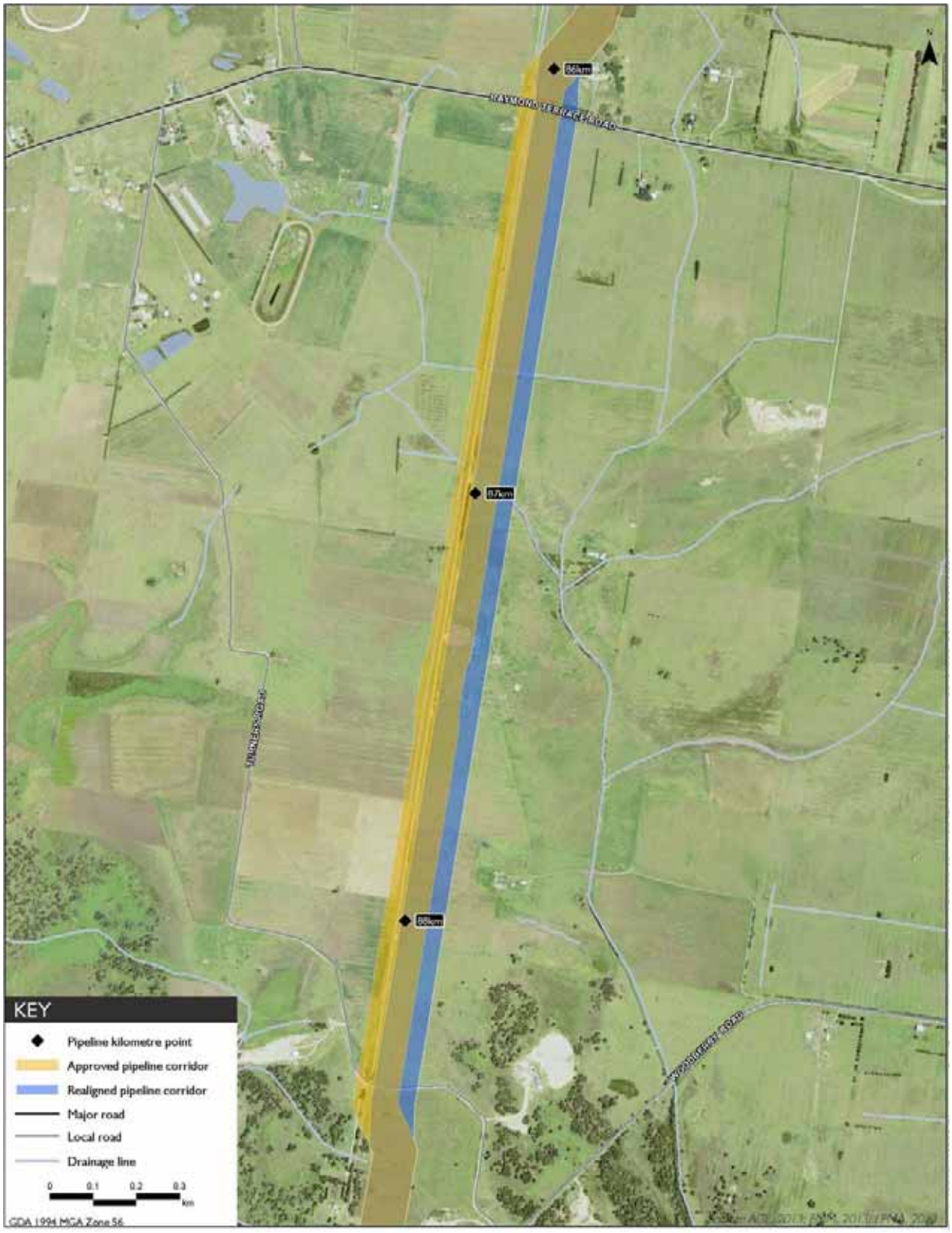
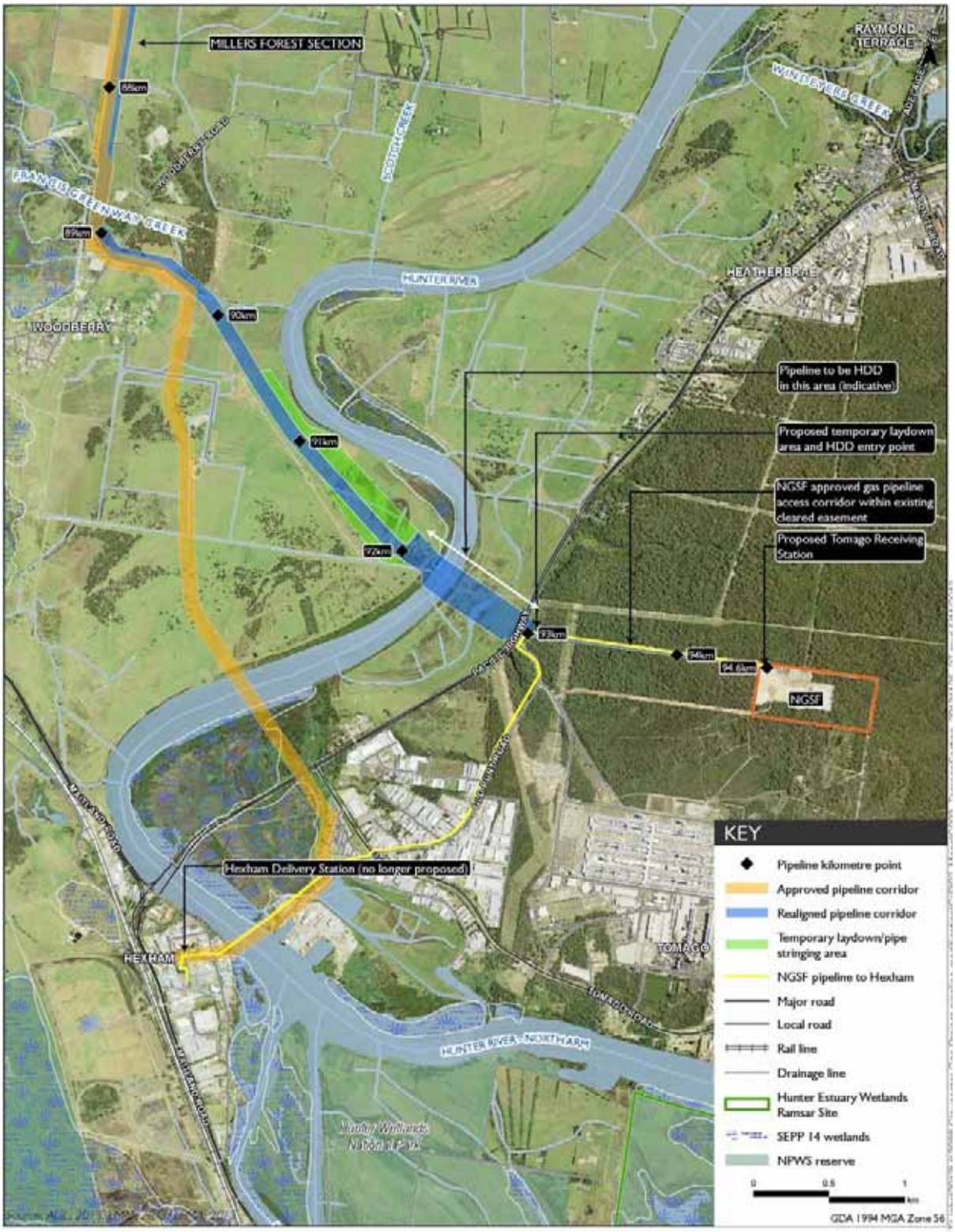


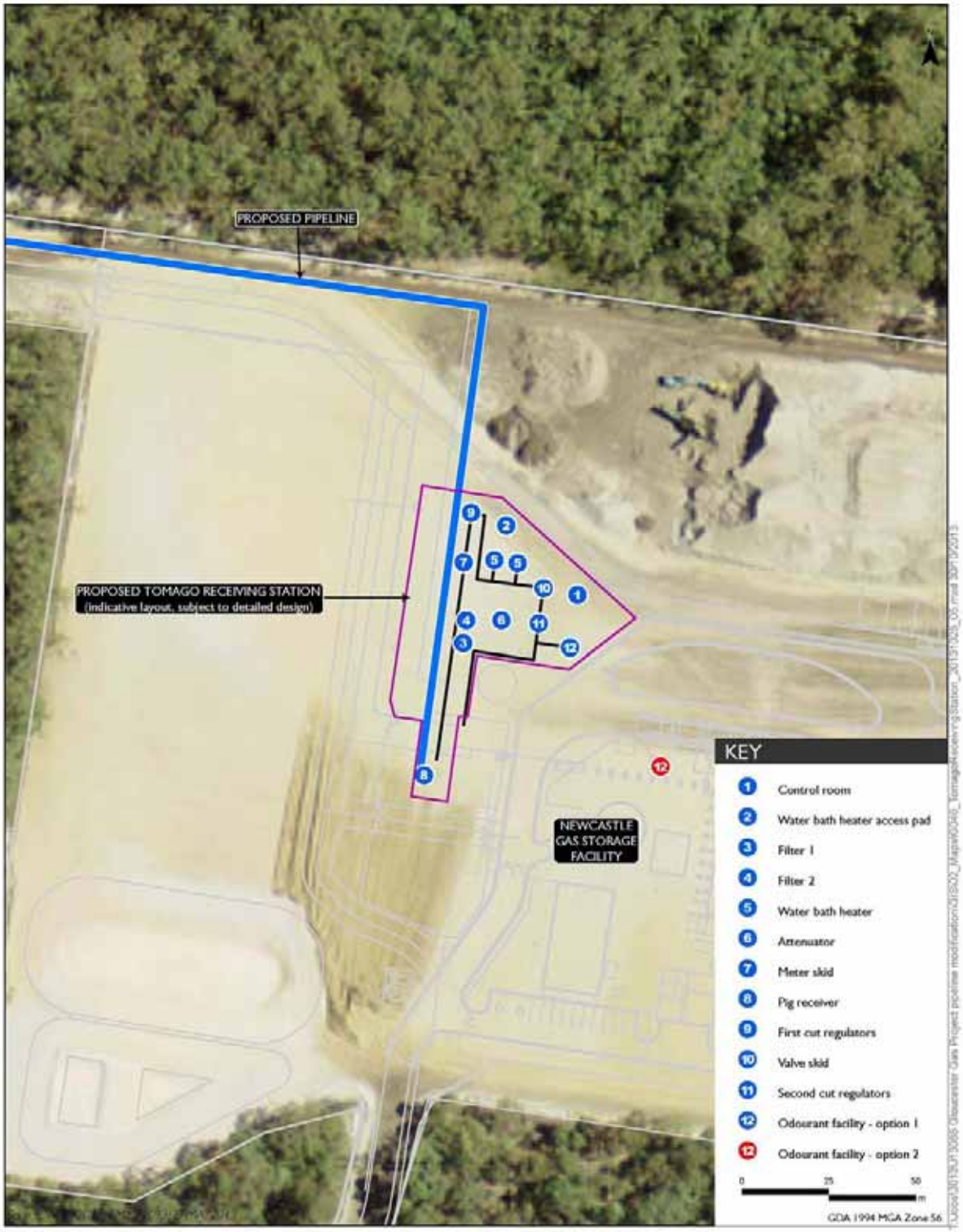
Figure 4 - Gloucester Gas Project - Pipeline modification – Tomago section



EMM

Tomago section
Minor pipeline corridor realignments EA
Figure 1.6

Figure 5 -Tomago Receiving Station – indicative layout



2.2 FACILITIES AS ASSUMED IN THE PHA

2.2.1 GTP

The PHA made a number of assumptions relating to the design and operation of the GTP, as listed in Table 1 below for ease of reference. This included two options for the pipeline diameter, DN250 (250 mm diameter) and DN450 (450 mm diameter). The proposed modification does not involve any changes to these assumptions.

Table 1 – GTP – PHA Engineering Assumptions

Condition / Feature	Engineering Assumption	Any change in the addendum PHA
Diameter	Two options: - 450mm (DN450) - 250mm (DN250)	None
Design Flow Rate DN250 Case	80 TJ/d	None
Design Flow Rate DN450 Case	500 TJ/d	None
Minimum Design Temperature	-10ºC	None
Maximum Design Temperature	65ºC	None
MAOP DN250 Case	10,200 kPa	None
MAOP DN450 Case	15,300 kPa	None
Corrosion Allowance	0mm	None
Wall thickness DN250 Case	- R1 Cross Country: 5mm - T1 Class Locations: 12.7mm - Road rail, intermediate and major creek crossings: 7.5mm	None
Wall thickness DN450 Case	All locations: 11mm	None
Minimum depth of burial	- R1 Cross Country: 750mm - T1 Class Locations: 900mm - Road, rail reserve: 1,200mm - Major watercourse crossing: 2,000mm - Intermediate watercourse crossings: 1,500mm - Minor watercourse crossing: 1,200 mm - Minor road track crossing: 1,200 mm under table drain or road surface - Bitumen Road Crossing: 1,200 mm under the table drain with slabs or 2,000mm under the road surface whichever is greater - Rail Crossing: 1,200 mm under the table drain with slabs or 2,000mm under the rail tracks whichever is greater - Service Crossing: Under the service with a minimum separation of 500 mm with a concrete slab between the two	None

MAOP: Maximum Allowable Operating Pressure

The 2009 PHA provided a location analysis for the entire GTP route (using definitions from AS2885.1 (Ref 1)), and identified land uses and crossing types for this route. The proposed pipeline corridor realignments are relatively minor and accordingly the location analysis results for the Seaham, Brandy Hill, Millers Forest and Tomago sections are generally consistent with those for the entire GTP, as follows:

- The pipeline code AS2885.1 (Ref 1) defines a number of classes depending on the landuse traversed by a petroleum pipeline. Using these definitions, the PHA defines the class location for the GTP as *Rural R1*[2] with isolated sections of *Residential T1*[3] as the pipeline approaches towns, and a secondary class of I for industrial land-use at the end of the pipeline. The latter, formerly used in assessing the HDS, applies to the proposed TRS location.
- Land use and crossing types as follows:
    - Rural landuses (mainly grazing country) and isolated farm houses;
    - Near small towns and suburbs;
    - Parallel to or crossing underneath power lines;
    - Gravel and bitumen road crossings including the Pacific Highway; and
    - Watercourse crossings.
    -

2009 PHA identified the nearest residences to be approximately 15 to 40 m from the approved pipeline corridor alignment. Analysis of aerial photography identified that residences are typically more than 200 m from the modified pipeline corridor alignment, though a small number are in the order of 40 to 50 m from the corridor's centre-line.

Other pipeline design aspects are consistent with the details provided in the 2009 PHA.

The PHA evaluated the risk associated with the GTP for a number of different design scenarios or *cases*, as defined in the table below. All cases are relevant for the addendum PHA and listed in Table 2 below. The 2009 PHA produced risk transects for each of these cases, which identified the minimum separation distances required from the GTP to various landuse types to ensure compliance with the risk criteria defined in the Department's HIPAP 4 guidelines. These calculations remain

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[2] AS2885.1 para 4.3.4(a) *Rural (R1) Land that is unused, undeveloped or is used for rural activities such as grazing, agriculture and horticulture. Rural applies where the population is distributed in isolated dwellings. Rural includes areas of land with public infrastructure serving the rural use; roads, railways, canals, utility easements.*

[3] AS2885.1 para 4.3.4(c) *Residential (T1) Land that is developed for community living. Residential applies where multiple dwellings exist in proximity to each other and dwellings are served by common public utilities. Residential includes areas of land with public infrastructure serving the residential use; roads, railways, recreational areas, camping grounds/caravan parks, suburban parks, small strip shopping centres. Residential land use may include isolated higher density areas provided they are not more than 10% of the land use. Land used for other purposes but with similar population density shall be assigned Residential location class.*

applicable for the modified pipeline corridor alignment and are also listed in Table 2, for ease of reference, and refer to the distance from the centreline of the GTP, not the centreline of the pipeline corridor.

Table 2 – Design Cases - GTP Evaluated in the PHA

Pipeline Diameter	Case	Design Feature	Distance to Individual Risk of Fatality (m)				
			Sensitive (hospital, nursing home etc.) 0.5×10^{-6} per year	Residen-tial 1×10^{-6} per year	Commer-cial 5×10^{-6} per year	Active Open Spaces 10×10^{-6} per year	Indust-rial 50×10^{-6} per year
DN450	Case 1	R1, 750mm DOC, 11mm WT, no marker tape	190	35	Not Reached	Not Reached	Not Reached
	Case 2	T1, 900mm DOC, 11mm WT[4], marker tape	41	Not Reached	Not Reached	Not Reached	Not Reached
DN250	Case 3	R1, 750mm DOC, 5mm WT, no marker tape	230	215	20	Not Reached	Not Reached
	Case 4	T1, 900mm DOC, 12.7mm WT[4], marker tape	35	Not Reached	Not Reached	Not Reached	Not Reached
	Case 5	Road/Rail Crossings, 1200mm DOC, 7.5mm WT, marker tape	43	Not Reached	Not Reached	Not Reached	Not Reached
	Case 6	Intermediate watercourses, 1500mm DOC, 7.5mm WT, no marker tape	45	12	Not Reached	Not Reached	Not Reached
	Case 7	Major watercourses, 2000mm DOC, 7.5mm WT, no marker tape	10	Not Reached	Not Reached	Not Reached	Not Reached

DOC: Depth of cover (minimum)
WT: Wall thickness

Injury risk and escalation risk contours were not assessed in the 2009 PHA.

2.2.2 TRS

The PHA made a number of assumptions relating to the design and operation of the HDS, with the main assumptions listed in Table 3 below, for ease of reference. The TRS is proposed to comprise the same components as the HDS and there have been no changes to these assumptions, as shown in Table 3 below.

[4] The GTP will satisfy AS2885.1 design specifications for pipelines in T1 locations, including minimum wall thickness (WT), such that failure by rupture will not occur and that the maximum energy release rate from the failure will not exceed 10 GJ/s.

Table 3 – TRS - Engineering Assumptions as per the PHA

Condition / Feature	Engineering Assumption	Any Change in the addendum PHA
Main processing equipment	- Inlet shutdown valve for remote pipeline isolation and over pressure shutdown. - Dual redundant inlet dry gas filtration. - Dual redundant water-bath heaters. - Dual redundant flow control valves. - Dual redundant ultrasonic meters. - Dual redundant gas chromatographs and dew point measurement.	None
MAOP	15,300 kPa	None
Design Flow Rate	80 TJ/d	None
Maximum Design Temperature	65ºC	None
Odorant facility	The PHA started that: *Odourant to be injected in the sale gas at the Delivery Station after it has been metered*. No further discussion in the PHA.	Discussed in item 5 in Table 5.

The 2009 PHA produced risk contours for the HDS, which identified the minimum separation distances required from the HDS to various landuse types to ensure compliance with the risk criteria defined in the Departments guidelines. These calculations remain applicable for the TRS and are listed in Table 4, for ease of reference.

Table 4 - TRS Risk Profile

Distance to Individual Risk of Fatality (m)					Risk of propagation (escalation)	Injury risk
Sensitive (hospital, nursing home etc.) **0.5 x 10^{-6} per year**	**Residential** **1 x 10^{-6} per year**	**Commercial** **5 x 10^{-6} per year**	**Active Open Spaces** **10 x 10^{-6} per year**	**Industrial** **50 x 10^{-6} per year**	**Neighbou-ring industry** **50 x 10^{-6} per year**	**Residential and Sensitive** **50 x 10^{-6} per year**
30	20	Contained within the boundary of the HDS site	Not Reached	Not Reached	Not Reached	Not Reached

3 VALIDATION AND ASSESSMENT OF IMPACTS AND RISKS

The 2009 PHA identified potential hazards associated with the GTP and HDS. It evaluated potential for a loss of containment of natural gas, a highly flammable (hydrocarbon) gas and simple asphyxiant which could ignite and resulting in jet fire, if ignited immediately; flash fire, if ignition is delayed. Vapour Cloud Explosion (VCE) were not considered a credible event due to the open layout of the facilities considered in the study. These potential hazards are valid also for the proposed modified sections of pipeline and TRS.

3.1 EVALUATION AGAINST PHA ASSUMPTIONS

Table 5 below discusses the main assumptions having bearing on the results of the PHA, any change following the modified design, and the potential impact (if any) on the PHA.

As shown in the table below, there is minimal change to the main assumptions of the PHA, with regards to design and operation of the GTP or TRS, compared to those for the approved pipeline and HDS.

Table 5 - Design Assumptions, Status at Updated Design

Item	PHA Assumption	Status at Updated Design	Impact on the PHA / Reassessment of Hazards and Risk Required
1. Pipeline modification - Seaham section	The PHA assumed a particular layout of the pipeline in this section	The layout of the pipeline at the Seaham section has been modified resulting in: - A reduction in the total length of pipeline at this section, from about 690m to about 650m. - A reduction in the buffer distance between the GTP and some residential dwellings along the pipeline in this section. - The GTP will be constructed within cleared areas within and adjacent to a TransGrid transmission line easement. - No change to any other landuse along this section of the pipeline.	A reduction in the length of the GTP results in a net reduction in the overall risk associated with the pipeline. The modification in the GTP layout and in the associated buffer distances to residential dwellings does not change the Design Cases that are acceptable for this section of the pipeline. Design Case *DN250 Case 3* remains *not acceptable* at Seaham with the minimum required buffer distance from the centreline of the GTP to the residential dwellings being 215m, i.e. larger than what is the actual distance between the GTP and these dwellings. This is consistent with the situation prior to modification of the pipeline layout in this section. All other relevant Design Cases are acceptable. These restrictions apply for all locations of the GTP within the pipeline construction corridor. The hazard associated with alternating current induction effects on metal pipelines from the TransGrid transmission line was identified and discussed in the 2009 PHA (Section 12.1.2. *Location Specific Hazards*) and is applicable also for other sections of the pipeline. The PHA discussed the associated safeguards and concluded that the impact of power lines near pipelines is a well-known hazard and given the safeguards proposed in the design basis document and corrosion protection reports, the impact of AC induction effects near power lines will be minimised. The location of the GTP within and adjacent to the TransGrid transmission line easement does not introduce any new hazards or require any new safeguards not previously identified and discussed in the PHA. No other landuses would be affected by the change in alignment at this section of the GTP.

Item	PHA Assumption	Status at Updated Design	Impact on the PHA / Reassessment of Hazards and Risk Required
	While assessed as part of the AECOM (2009) EA, and approved, the PHA did not detail an MLV at the GTP.	The updated design of the GTP includes an MLV in the Seaham section of the GTP. The MLV would act as an isolation point for the pipeline in the event of an emergency. The MLV would be designed and constructed in accordance with the standards for this type of facility (including AS2885, Ref 1) and would include an isolation valve (buried or within a pit) with actuators and potentially some smaller bore bypass lines above ground. The facility would be surrounded by a security fence (locked gate) which would describe, at least, the Hazardous Area for the valve. A remote vent would be included to allow emergency depressurisation.	Due to the stringent design and operating criteria and to the very simple and robust construction of the MLV the hazards and risks are expected to be very low and similar to those for the GTP. The required buffer distances to adjacent landuse are therefore expected to be similar compared with those evaluated for the GTP in the PHA. For consistency with the methodology in the PHA it is recommended that the Final Hazard Analysis (FHA) of the GGP provide a quantitative evaluation of the risk of the MLV, following its detailed design.
2. Pipeline modification - Brandy Hill Section	The PHA assumed a particular layout of the pipeline in this section.	The layout of the pipeline at the Brandy Hill section has been modified. The GTP will mostly run in a straight line instead of the originally proposed curved sections. This results in: - A reduction in the buffer distance between the pipeline and one residence at the northern part of the section, which is now located at about 30m from the GTP. - An increase in the buffer distance between the pipeline and most residential dwellings along the pipeline, in average from about 200m to over 400m. - No change to any other landuse along this section of the pipeline.	Design Case DN250 Case 3 remains not acceptable at the northern and southern sections of the Brandy Hill section of the GTP, with the minimum required buffer distance from the centreline of the GTP to the residential dwellings being 215m, i.e. larger than what is the actual distance between the GTP and these dwellings. This is consistent with the situation prior to modification of the pipeline layout in this section. An increase in the buffer distances between the GTP and the most other residential dwellings along the pipeline in this section results in a net reduction in the risk at these dwellings. The buffer distance for most residential dwellings in this section of the GTP is such that all relevant Design Cases are acceptable. All other relevant Design Cases are acceptable.

Item	PHA Assumption	Status at Updated Design	Impact on the PHA / Reassessment of Hazards and Risk Required
3. Pipeline modification – Millers Forest	The PHA assumed a particular layout of the pipeline in this section.	The layout of the pipeline at the Millers Forest section has been modified. This results in: - An increase in the buffer distance between the GTP and residential land uses to west. - A reduction in the buffer distance between the GTP and the residential dwellings to the east. - The GTP will be constructed within cleared areas within and adjacent to a TransGrid transmission line easement.	While all relevant Design Cases are acceptable for most dwellings in this section of the GTP, the reduction in the buffer distance between the GTP and some of the residential dwellings to the east of the pipeline results in Design Case *DN250 Case 3* being *not acceptable* for part of the GTP in this section.

Item	PHA Assumption	Status at Updated Design	Impact on the PHA / Reassessment of Hazards and Risk Required
4. Pipeline modification – Tomago section	The PHA assumed a particular layout of the pipeline in this section.	The layout of the pipeline at Tomago has been modified to allow for connection to the NGSF. This results in: - An increase in the buffer distance between the pipeline and the industrial and commercial landuses at Hexham and some at Tomago. The PHA assumed that the GTP would run through, or immediately adjacent to developments at Hexham. - No significant change in the risk levels experienced at the Eastern most industrial landuse at Tomago or the Open Space at Hunter Region Botanic Gardens. - Increased buffer distance between GTP and residential dwellings at Woodberry. - No change to any other landuse along this section of the pipeline. - No change to the below-ground crossings approved for under Woodberry Road and the Pacific Highway, though involves one crossing of the Hunter River (rather than the two crossings approved). - At the approach to the NGSF, the GTP will be located within the same pipeline corridor as the HP pipeline which connects the NGSF with the Main (Jemena) Trunkline.	An increase in the buffer distances between the GTP and the industrial, residential and commercial landuses results in a net reduction in the risk at these locations. The PHA showed that the risk levels applicable for commercial and industrial zonings were never reached for the GTP for all cases except for the DN250 Case 3 pipeline where a buffer zone of 20m to commercial land uses would be required. This buffer requirement is achieved for the pipeline in this section. There is no change to the risk to and from the GTP associated with the crossings under Woodberry Road and the Pacific Highway. There is a reduction in risk associated with one crossing under the Hunter River rather than two. The fact that part of the GTP will be located within the same pipeline corridor as AGL's HP gas transmission pipeline which transports gas from the NGSF to Hexham introduces the potential for a domino incident from one pipeline to the other. The preventative and protective features for this potential hazard are specified in AS2885.1 and include internal risk management procedures / systems in use by the pipeline operator; the pipeline integrity plans (incl. systems in use to monitor integrity of pipeline and coating inspection); thickness and grade of the pipelines; the fact that both pipelines are buried at a depth of at least 750mm (450mm in rock); and natural gas disperses readily upwards. As determined in the 2009 PHA, the likelihood of ignition and explosion is highly unlikely in an unconfined situation such as for this section of the pipeline. Construction of several HP pipeline within the same easement is common throughout the industrialised world and the likelihood of a domino incident is highly improbable. However, the detailed design and construction of the GTP in the location where it is co-located with the HP pipeline should ensure minimisation of the risk associated with a potential domino incident from one pipeline to the other. This is to be addressed in the FHA.

Item	PHA Assumption	Status at Updated Design	Impact on the PHA / Reassessment of Hazards and Risk Required
5. TRS	The PHA assumed that the Delivery Station was to be located in Hexham, adjacent to the Jemena transmission pipeline.	The proposed modification includes the TRS directly to the west of the NGSF.	The TRS will be located within an industrial area, in which there are no sensitive, residential or commercial land-uses (as defined in Table 2 of HIPAP 4, Ref 3). This is identical to the situation evaluated in the PHA, where it was to be located at the industrially zoned area of Hexham. Open space at the Hunter Region Botanic Gardens is around 245 m north. The risk profile for the HDS, as determined in the PHA, remains valid also for the TRS at the NGSF. The risk contours for sensitive land-use and residential areas extend off-site by a maximum of 30m. The actual buffer between the TRS and such development is much larger (more than 1.5 km). The risk levels for other land use types (active open spaces, industrial) were not reached for the TRS – refer to Table 4. The PHA (Ref 2) showed that the risk contours relevant for escalation (accident propagation) from the HDS were not reached for the TRS (i.e. the risk level remains below such risk levels at all locations and hence the risk of propagation of an incident at the TRS to the adjacent NGSF is negligible. The FHA prepared for the NGSF (Ref 4) shows that the propagation risk contour from the NGSF does not extend into the proposed TRS location - hence the risk of propagation of an incident at the NGSF to the TRS is negligible.

Item	PHA Assumption	Status at Updated Design	Impact on the PHA / Reassessment of Hazards and Risk Required
	The PHA stated that odourant was to be injected into the sales gas. However, no further discussion was provided on the odourant facility in the PHA.	The design of the odourant facility is still in the preliminary stage. Two options are assessed: - Option 1 - located at the TRS; and - Option 2 - located within the NGSF facility, co-located with the odourant facility dedicated to the NGSF. The odourant facility will include the following: - Pressure vessels, containing a mercaptan which is expected to be mix of tetrahydrothiophene and tert-butyl mercaptan. - For option 1, the total volume would be that of 2 vessels @ 850kg each. - For option 2, the total volume of odourant on the NGSF site would need to double (i.e. total of 4 vessels @ 850kg each). - The vessels would be located in a bund inside a closed building which would be mechanically ventilated through a carbon filter or adsorber. - The vessels wold be delivered to site, moved off the truck and transported into place. No liquid unloading operation would take place. - Odourant would be pumped or pushed out of the storage vessel using a slight overpressure of natural gas and injected into the natural gas stream via a fixed stainless steel line. - Excess dosing of odourant into the natural gas stream is expected to be a gas quality issue only and is likely to be identified through periodic gas checks. Under-dosing is to be prevented through monitoring of levels in the vessels as well as at manual checks. Once the line has been in use for some time, the odourant *contamination* of the piping is such that the gas would continue to be odourised for some time after cessation of dosing.	<u>Fire risk:</u> The odourant (mercaptan) is a flammable liquid with properties similar to petroleum. The requirements for fire risk management of the relatively small quantities of odourant will be managed by compliance with AS1940 (Ref 5), including: - Bunding requirements, i.e. 100% of the largest tank, with bunding design and construction as per Section 5.9.3 in AS1940. - Fire protection, including fire extinguishers, hose reel requirements, separation distances. - Design of ventilation of enclosure with regards to flammable vapours. - Valving and piping associated with the storage as per AS1940 Section 7. - Control of ignition sources is as per AS1940 Section 9.7.6. Provided the requirements of AS1940 are adhered to, the probability of a fire involving the odourant is negligible for both options for the odourant facility's location. Should a fire occur within either option (options 1 or 2) for the odourant facility the impact on the neighbouring facility (TRS or NGSF) would be negligible. <u>Risk of release of odourous material:</u> The odourant is a colourless malodorous gas with. In the event of spillage, unless contained, the odour could extend considerable distances at detectable odour levels, thus adversely affecting amenity for people in the vicinity. To manage this risk, AGL proposes - in both options - to remove a depleted vessel and exchange for a full vessel and locate the vessels inside a building which is ventilated to a scrubber or an adsorber in order to remove any unpleasant odours in the event of a loss of containment inside the building. By eliminating the need for liquid unloading operation and placing the odourant vessels inside a ventilated building ensures that the risk of a release of unpleasant odours to the atmosphere of mercaptan has been minimised.

4 MANAGEMENT MEASURES

The GGP project approval requires the preparation of hazard and risk studies upon finalisation of detailed design and prior to construction, with these submitted to the Director-General. The approval conditions relevant to the proposed modification are:

Condition 3.47:

> The proponent shall prepare and submit the following studies to the Director-General no later than one month prior to the commencement of construction of the project, or within such further period as the Director-General may agree. Construction, other than of works that are outside the scope of the hazard studies, shall not commence until study recommendations have been considered and, where appropriate, acted upon. The Proponent shall submit:
>
> (a) A Fire Safety Study covering the relevant aspects of the Department's 'Hazardous Industry Planning Advisory Paper No.2, Fire Safety Study Guidelines'. The study shall meet the requirements of the NSW Fire Brigades.
>
> (c) [5]A Final Hazard Analysis consistent with the Department's Hazardous Industry Planning Advisory Paper No. 6, 'Guidelines for Hazard Analysis'. The final design shall apply appropriate risk mitigation measures for the Export Sales Pipeline (ESP) in locations where the pipeline risk transects exceed the Department's risk criteria. Further, the final design shall consider all recommendations in Table A1.1 to A1.5 of the PHA presented in the EA.
>
> (d) A Construction Safety Study, consistent with the Department's Hazardous Industry Planning Advisory Paper No.7, 'Construction Safety Study Guidelines'. The study should consider the bush fire risk during construction of the project.

Condition 4.10

> Twelve months after the commencement of operations of the project and every three years thereafter, or at such intervals as the Director-General may agree, the Proponent shall carry out a comprehensive Hazard Audit of the project and submit the audit report to the Director-General within one month of the audit report being completed. The audits shall be carried out by a qualified person or team, independent of the project and shall be consistent with the Department's Hazardous Industry Planning Advisory Paper No. 5, 'Hazard Audit Guidelines'.

[5] Note that condition 3.47(b) relates to the Central Gas Processing Facility and is therefore not detailed in this addendum PHA.

Condition 7.4

> The Proponent shall prepare and implement an Operation Environmental Management Plan to detail an environmental management framework, practices and procedures to be followed during operation of the project. The Plan shall be consistent with Guideline for the Preparation of Environmental Management Plans (DIPNR 2004) and shall include, but not necessarily be limited to:
>
> e)(vii) hazard and safety and emergency management measures including measures to control bushfires

The requirements of the GGP project approval listed above will also be applied to the proposed modification and be sufficient to address risks identified in the PHA and this addendum PHA. The proposed modification does not warrant changes or additions to the design and safety controls and management measures and recommendations identified and discussed in the PHA and those included in the project approval. The risk associated with the use and handling of odourous and flammable material at the odourant facility is largely eliminated through design.

It is noted that the FHA required under Condition 3.47 of the project approval, will addressed the MLV and proposed co-location of the two HP gas transmission pipelines within the easement between the Pacific Highway and the NGSF.

5 CONCLUSIONS AND DISCUSSION

A review of the proposed modification, and the implications of the change in the assessment and conclusions drawn in the PHA (Ref 2) was conducted.

From a landuse safety point of view, only minor changes have been made to the facilities since the stage of the PHA in 2009. These changes are related to minor changes to the layout of the GTP in the Seaham, Brandy Hill, Millers Forest and Tomago sections and connection to NGSF via the TRS at Tomago rather than the HDS at Hexham.

The review has established that the changes are relatively minor with respect to health and safety risks associated with the GGP, with the following points being noteworthy:

- The changes to the GTP layout do not introduce any new hazards or risks and the assessment of the GTP in the PHA remains valid.

- The assessment of the HDS in the PHA remains valid also for TRS adjacent to the NGSF.

- The risk of propagation of an incident at the TRS to adjacent facilities (including the NGSF) and the risk of propagation of an incident at the NGSF to adjacent facilities (including the TRS) are very low and adhere to the risk criteria in use in NSW.

- The risk associated with the MLV at the Seaham section of the pipeline is expected to be minimal and very similar to that of the GTP due to the simple and robust design of such a valve site and to the stringent requirements for this type of facility, as specified in the relevant codes and standards, including the AS2885 (Ref 1). Hence, the required buffer distance to the residential landuse is expected to comply with the stringent risk criteria in NSW. However, this risk will need to be evaluated quantitatively in the FHA to ensure a consistent approach for all facilities forming part of the GGP.

- The co-location of the GTP with AGL's HP pipeline, which transports natural gas between the NGSF and the Main (Jemena) Trunkline at Hexham, introduces a potential for a domino incident within the pipeline corridor. While construction of several high pressure pipeline within the same easement is common throughout the industrialised world and the likelihood of a domino incident is highly improbable, this potential will still need assessed to ensure that it is minimised through design and construction of the pipelines. The residual risk needs to be reported in the FHA for the GGP.

- The risk associated with the odourant facility is negligible, whether it is located within the TRS or at the NGSF. Provided the requirements of AS1940 are adhered to, the probability of a fire involving the odourant is negligible for both options. The design includes placing the odourant vessels inside a

ventilated building which minimises the risk of a release of unpleasant odours to the atmosphere.

The findings in the addendum PHA confirmed the conclusions in the PHA, that the GGP does not introduce undue risk to surrounding landuse.

The design and safety controls and management measures identified in the PHA remain largely unchanged, and overall, the assessment made, and the conclusions drawn in the PHA completed for the GGP remain valid.

The project approval conditions for the GGP require that a FHA be prepared for the project. The FHA will be developed once the detailed design has been developed and will re-assess the hazards and risks associated with the all the facilities that form part of the project. The assumptions made in the PHA (Ref 2) were conservative and these assumptions will be reviewed in the FHA phase, using the detailed (*final*) design details.

6 REFERENCES

1 Australian Standard AS2885 - 2007, *Pipelines – Gas and liquid petroleum*, Parts 1, 2 and 3

2 Bertram J, *Preliminary Hazard Analysis, Gloucester Coal Seam Project*, Sherpa, 29 October 2009

3 Planning NSW, *Hazardous Industry Planning Advisory Paper No. 6: Guidelines for Hazard Analysis*, 2011 Edition

4 Nilsson K, *Final Hazard Analysis Newcastle Gas Storage Facility Project in Tomago, NSW - Phase 2*, Planager Pty Ltd, 25 September 2013

5 AS1940:2004 *Storage and handling of flammable and combustible liquids*

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