Attachment A Expenditure on Mine Subsidence Activities – Capital Works and Monitoring

1 Background

1.1 The relevant background regarding the mine subsidence ground for review raised in Jemena Gas Networks (NSW) Ltd's (**JGN**) application for review of a full access arrangement made by the Australian Energy Regulator (**AER**) is set out in the covering submissions.

1.2 In providing its reasons for deciding to remit the matter to the AER, the Australian Competition Tribunal (**Tribunal**) identified three key issues that would need to be addressed ([41]):

(a) the precise nature of "monitoring" and its cost;

(b) the degree of connection between "monitoring" and any capital works that were undertaken; and

(c) if there is no connection, whether the cost of "monitoring" can be sufficiently determined so that it can be separated from capital works.

1.3 On 11 April 2011, JGN wrote to the AER proposing to provide information that is responsive to the three issues identified by the Tribunal. On 15 April 2011, the AER wrote to JGN indicating it agreed with the provision of further information by JGN and identifying the following information that it considers it requires:

(a) For mine subsidence expenses proposed to be included in the opening capital base:

(i) details of the nature of "monitoring" activities and the associated costs;

(ii) the amount of those "monitoring" costs that are not connected with any subsequent capital works. If the actual costs are unknown, estimates will need to be provided. In this regard, the AER requires details of the basis for the estimates and any underlying assumptions used to derive the estimates; and any spreadsheets showing full calculations and any other material that supports the analysis;

(b) for forecast mine subsidence expenses for the 2010-15 regulatory period, for each year of the regulatory period:

(i) details of the nature of "monitoring" activities and the associated forecast costs;

(ii) the amount of those forecast "monitoring" costs that are not connected with any subsequent capital works. The AER requires details of the basis for the forecasts and any underlying assumptions used to derive the forecasts including any spreadsheets showing full calculations and any other material that supports the analysis.

1.4 This document is responsive to both the Tribunal's reasons for decision and determination, and the AER's letter of 15 April 2011. Section 2 describes the nature of "monitoring" activities at a general level. Section 3 sets out the precise nature of the "monitoring" activities in respect of two projects – at Unnamed Creek {c-i-c} – where "monitoring" took place in the 2005-10 regulatory period. The total costs for these

projects for the 2005-10 regulatory period, inclusive of monitoring costs, were included in the mine subsidence expenditure in the opening capital base submitted by JGN to the AER.

1.5 JGN notes that the AER has also requested information regarding mine subsidence monitoring expenses included in the *forecast* for the 2011-15 regulatory period (it is assumed that this was meant to be a reference to the 2010-15 regulatory period). As explained below, the only monitoring expenses included in the forecast related to monitoring at {c-i-c} , where mining activity has not yet been completed. All other ongoing mine subsidence projects forecast to be undertaken in the 2010-2015 regulatory period are at the rehabilitation stage (i.e., the final stage).

2 Nature of "monitoring" in the context of mine subsidence works

Introduction

2.1 The Wilton-Newcastle trunk pipeline owned and operated by JGN is over 200 kms long and passes through the Appin area in NSW, which is south west of Sydney and is where BHP Billiton (**BHPB**) conducts long-wall coal mining (Appin and Westcliff Collieries).[1]

2.2 Long-wall mining can cause ground subsidence and other ground movements that can overstress or damage the sections of the pipeline. In particular, mining beneath rivers, creeks, cliffs, gorges and valleys has the potential to cause:

(a) ground subsidence – if the ground on which the pipeline is positioned subsides, the pipeline will drop;

(b) ground upsidence – the ground buckles or bulges upwards and the pipeline "pops" up as that upsidence occurs; and

(c) closure movements – whereby the two sides of a valley move horizontally towards the valley centreline. Upsidence will typically occur if there is closure.

"Mine subsidence" is a general term to describe all the above three impacts on the ground that is caused by mining and which have the potential to overstress or damage the pipeline.

2.3 To avoid damage to the pipeline as a result of mine subsidence, JGN undertakes certain steps at particular locations along the pipeline before, during and after BHPB commences its long-wall mining. These steps, which are outlined below, would not ordinarily be undertaken in the day-to-day maintenance of the pipeline.

2.4 Day-to-day "monitoring" of the pipeline does not involve excavating or exposing the pipeline, or use of strain gauges to monitor stress on the pipeline. Rather, it involves patrols along the pipeline easement by car or by helicopter on a rolling basis and there is no inspection of the pipeline itself which remains buried. While these patrols will continue in mine subsidence affected areas, the cost of conducting the patrols is not capitalised and instead treated as operating expenditure.

[1] JGN, *Access Arrangement Information – Appendix 7.1: Jemena Asset Management Plan for the Jemena JGN (NSW) Network 2009-10 – 2014-15*, 26 August 2009, p 87.

Notification and Decision Phase (Pre-Mining)

2.5 Before a decision is made by JGN as to whether any work needs to be undertaken as a result of mining activity near the location of JGN's pipeline, the following will occur:

(a) BHPB notifies JGN of its intention to mine and will send JGN ground movement predictions and preliminary stress analysis conducted by BHPB's external consultants, typically expert mining engineers. This stress analysis shows if and how the proposed mining may lead to the pipeline being shifted or moved from its original position. This information is also sent by BHPB to the owners of other pipelines in the Appin area, namely Gorodok Pty Limited (**Gorodok**) and Jemena Eastern Gas Pipeline (**EGP**). The pipeline owners and BHPB will then discuss the future and current mining activities and the potential impact on their respective pipelines at an "Engineering Forum".

(b) The information from BHPB is used to decide whether it is necessary to commence any mitigation and monitoring work to deal with the anticipated and actual stress on sections of the pipeline that are likely to be affected. If mitigation and monitoring works are required, each affected pipeline owner and BHPB will send a technical representative to the "Technical Committee" to develop specific engineering designs and technical solutions to deal with the potential subsidence. A Steering Committee comprising of representatives from each pipeline owner will review and approve the plans developed by the Technical Committee and consider the commercial issues. If JGN's pipeline is the only pipeline affected by BHPB's mining activities, this committee structure will not be used and JGN will develop and approve the relevant plans.

The steps described above are preliminary steps only and taken in the lead up to making a decision on the necessity for any mitigation and monitoring work to deal with the impact of mining activity on the pipeline. The costs of undertaking the assessment described above are treated as operating expenditure.

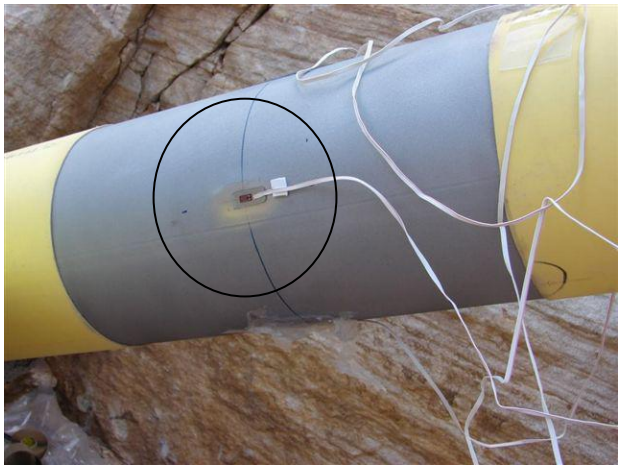
Pre-Mining Activity Phase

2.6 Once a decision has been made to commence a project to deal with potential stress and damage to the pipeline caused by mine subsidence, the following takes place:

- **Stage 1 – Pipeline excavation and installation of strain gauges** (approximately 1-3 months). The pipeline is excavated (i.e., dug out), exposing the pipe at a number of locations in a particular area of potential subsidence. The number of locations is dependent on design requirements at each site. Pipe coating on those sections is removed so that strain gauges[2] can be installed to monitor whether the pipeline is stretching or contracting during mining (see Figure 1). The pipeline is then coated with a temporary epoxy coating, which is applied over the installed strain gauge and is intended to prevent corrosion which might occur as the pipeline is exposed to the elements. The strain gauges are calibrated and a baseline stress reading is established.

[2] A strain gauge is a thin device with electrical circuits that is used by engineers to measures stress and strain on a stationary object when external forces are applied to it.

Figure 1 – Example of a strain gauge[3]



- **Stage 2 – Mitigation** (approximately 3 months or more). The pipeline is further excavated and exposed to allow for the pipeline to be realigned, that is, to be moved from its original position to prevent or mitigate damage from anticipated mine subsidence. The pipeline is under most pressure in places where the pipeline has been bent or curved (which is typically in areas where there are creeks which sit in gullies or valleys). The bend in the pipeline can be relocated or otherwise altered to "move" the stresses in one section of the pipeline to another section. That is, by realigning the pipeline, stress can be "relocated" to another part of the pipeline so the section of the pipeline that will be most affected by the mining activity has minimum stress levels prior to mining or will negate / accommodate any additional stress placed on that section during the mining. Data readings from the installed strain gauges are downloaded remotely and are logged. The readings are then used to determine existing stress levels along the pipeline and to assist with the realignment of the pipeline. Survey prisms are attached to the pipeline and survey pegs are placed on the ground around the pipeline. These are used to measure the movement of the ground and the pipeline during mining.

- **Stage 3 – Confirmation sent to NSW Department of Trade and Investment, Regional Infrastructure and Services (DTIRIS)**.[4] Before approving any mining activity, the DTIRIS will seek confirmation from JGN that it has conducted the necessary pre-mining work and established plans to relieve and monitor stress on the pipeline during mining. JGN provides this confirmation to BHPB who shows the confirmation to DTIRIS. If BHPB has satisfied all other requirements, DTIRIS will allow the long-wall mining to commence.

Mining Activity Phase

2.7 When mining commences, the following stages take place:

- **Stage 4 – Ongoing Monitoring and Further Mitigation (as necessary)** (approximately 1-3 years or more from the commencement of mining). As BHPB undertakes mining activity, JGN monitors the pipeline using the strain gauges (installed in stage 1 above) and field surveys.

[3] This photograph is for illustration purposes only. It is not an actual strain gauge on JGN's pipeline.

[4] Previously Industry & Investment NSW (**IINSW**).

Data from the strain gauges is logged and downloaded remotely to assess whether the stress levels on the pipeline are as anticipated. Specifically, data from strain gauges is used to track the increase and / or decrease in stress along the affected section of the pipeline compared with the baseline stress reading taken in Stage 1 and readings taken in Stage 2. Project engineers will use the data to:

- validate the pipeline stress modelling done prior to the commencement of mining;
- in the event that excessive stress levels are observed, generate a scope of works to manage that stress, that is, determine what part of the pipeline needs to be further realigned and by how much;
- validate stress levels following realignment of the pipeline to ensure an optimised stress profile; and
- screen for any anomalies. If there are any anomalies, a strain gauge consultant will visit the site and repair strain gauges if they are damaged.

This is done on a regular basis (weekly or monthly depending on the proximity of the mining to the pipeline) until such time as the likelihood of (further) effects of long-wall mining on the pipeline is negligible. Once that point has been reached data from strain gauges is reviewed on an ad hoc, as required basis.

Field surveys are undertaken by survey crews who patrol the area around the exposed pipeline with measuring instruments. They use the survey prisms and pegs to analyse ground movements that have taken place since the mining started. If the mining is taking place within 500m of the pipeline, these surveys will be undertaken once a week.

Depending on the results of the monitoring using the strain gauges and field surveys, further works may be required to prevent or mitigate damage from actual subsidence. It may be necessary to reduce the operating pressure of the pipeline and further excavate and realign the pipeline, repack pipeline supports, de-water pipeline trenches, repair damaged strain gauges and fences, and remove excess vegetation that may impact the engineering team's ability to conduct field surveys.

Post-Mining Activity Phase

2.8 Once mining activity has ceased, the following stages take place:

- **Pre-Rehabilitation Stage Decision**. JGN conducts a further analysis of the actual impact of the mining activity on the pipeline. This review determines whether residual pipeline stresses are, and will, remain within acceptable limits (as determined by the stress modelling developed during the Notification and Decision Phase). The level of residual stress will determine the scope of any rehabilitation works. The Steering Committee will meet again to make a decision on whether to progress to the Rehabilitation Stage. All decisions on the scope of rehabilitation works are based on ground movement predictions provided by BHPB's consultant and also detailed stress analysis conducted by JGN's consultant using the strain gauge readings collected during this stage and previous stages. These readings are verified by BHPB.
- **Stage 5 – Rehabilitation** (3 or more months). Depending on the impact of mining, further mitigation work such as the realignment of the pipeline may be required before the pipeline can be reburied. Readings from the strain gauges continue to be collected to detect any residual stresses. Once any realignment is completed, and the strain gauge readings show that any stress on the pipeline is at an

acceptable level, the strain gauges and survey prisms are removed and the pipeline permanently recoated. The section of the pipeline that has been exposed will always require recoating because of exposure to the environment, which would have damaged the coating. The final steps are to backfill or rebury the pipeline and restore the site to its pre-mining state.

2.9 In summary, the "monitoring" that JGN undertakes in the context of mine subsidence projects involves the review and analysis of strain gauge readings that show stress levels on parts of the pipeline affected by mining activity and mine subsidence. It also involves field surveys that determine ground movements caused by mining. This monitoring occurs prior to mining activity commencing so that mitigation works can take place to prevent or mitigate damage to the pipeline once mining has commenced. It also occurs during actual mining to measure increases and / or decreases in pipeline stress levels and determine whether further realignment or other mitigation works are necessary to deal with the stress on the pipeline and any further ground subsidence. Monitoring is also necessary to develop the scope of rehabilitation works. In this sense, monitoring is taking place as soon as the strain gauges are installed in Stage 1 through to Stage 5 as it is necessary to analyse the pipeline's stress levels and the ground movements in order to determine the anticipated and actual impact of mining and any mitigation and rehabilitation works required.

2.10 Whether monitoring will lead to any physical works will depend on the nature and location of the mining activity in the vicinity and the stress on pipeline and ground movements that the monitoring reveals. The scope of the physical works will also be determined by results obtained through monitoring. As a result, monitoring is interconnected with, and difficult to separate from, other aspects of mine subsidence projects. Monitoring in this context is not an activity that arises as a result of the day-to-day operation of the pipeline and only takes place as a consequence of a third party undertaking mining that has the potential to detrimentally affect the pipeline.

3 "Monitoring" at Unnamed Creek {c-i-c}

3.1 The costs associated with "monitoring" are project specific and will differ on a site by site basis. In this section, JGN elaborates on the monitoring and mitigation works that took place within the 2005-10 regulatory period and the associated costs of the monitoring activities.

3.2 During the period 1 July 2005 to 30 June 2010, JGN undertook mine subsidence works at five (5) specific sites along a stretch of approximately 8 kms of the Wilton-Newcastle trunk pipeline near the BHPB Appin mine.[5] At three (3) of those sites – {c-i-c} Simpsons Creek – mining activity in the vicinity had ceased by June 2005 and the work at those sites had moved to the rehabilitation stage (i.e., Stage 5). In respect of these sites, the mine subsidence expenses that JGN proposed to have roll into the regulatory asset base in respect of activities undertaken in the 2005-10 regulatory period related only to rehabilitation works. The nature of mine subsidence works and expenses for the remaining two (2) sites – Unnamed Creek {c-i-c} – are outlined below.

3.3 All BHPB long-wall mining in the vicinity of Unnamed Creek was completed by July 2008 but mining at {c-i-c} is ongoing until 2013. As Unnamed Creek {c-i-c}

[5] JGN, *Initial response to the draft decision – Appendix 3b.4A: 2008-09 Business Case* , 19 March 2010, 9, [**MS.11**]. {c-i-c}

3.4 At Unnamed Creek, the stages set out in Table 1 below took place within the 2005-10 regulatory period.

Table 1: Unnamed Creek – Mine subsidence activity stages and costs 2005-10[6]

Stage	Timing	Description of Works	Costs
Stage 4 – Ongoing Monitoring and Further Mitigation (as necessary)	FY2006-FY2008	This stage involved collecting strain gauge readings and reviewing and analysing those readings. Field surveys were also undertaken. Anomalies were detected in some strain gauge readings which led to damaged strain gauges requiring repair. As long-wall mining was continuing in {c-i-c} monitoring continued in the 2008/9 financial year even after mining in the Unnamed Creek area had ceased and that section of the pipeline was ready to be restored to maximum allowable operating pressure.[7]	{c-i-c} (all monitoring related)
Stage 5 – Rehabilitation	FY2009-FY2010	Removal of epoxy coating, strain gauges and survey prisms. Around 40m of the pipeline was further excavated to allow for recoating of the pipeline.[8] The pipeline was then reburied. See also Figure 2.	{c-i-c} (estimate)

[6] The amounts in this table are the total costs incurred by JGN.

[7] See JGN, *Initial response to the draft decision: Appendix 3b.4A – 2008-09 Business Case* , p 6. {c-i-c}

[8] JGN, *Initial response to the draft decision: Appendix 3b.4A – 2009-10 Business Case Appin Mine Subsidence Unnamed Creek*, p 6.

Figure 2 – Stage 5 Rehabilitation of JGN pipeline at Unnamed Creek

3.5 At {c-i-c} , the stages set out in Table 2 below took place within the 2005-10 regulatory period.

Table 2: {c-i-c} – Mine subsidence activity stages and costs 2005-10[9]

Stage	Timing	Description of Works	Costs
Stage 2 – Mitigation	FY2006-FY2007	**Fully excavating and realigning 200m of the pipeline (see Figure 3 and** Figure 4).	{c-i-c}
Stage 3 – Confirmation sent to DTIRIS	FY2007	Confirmation to DTIRIS (formerly IINSW) that appropriate mitigation had been completed	N/A
Stage 4 – Ongoing Monitoring and Further Mitigation (as necessary)	FY2007-current (still ongoing)	This stage involved collecting strain gauge readings and reviewing and analysing those readings. Field surveys were also undertaken. It also involved repairing damaged strain	{c-i-c} (the estimated amount in respect of "monitoring" activities is {c-i-c} being expenditure on strain gauge data collection, review and analysis of

[9] The amounts in this table are the total costs incurred by JGN.

Stage	Timing	Description of Works	Costs
		gauges and site fencing, repacking pipeline supports and dewatering pipeline trenches. Further realignment of the pipeline was also necessary at {c-i-c} because of the extent of the subsidence.	data, and engineering and design required based on data).

{c-i-c}

Figure 3 – Excavating the JGN Pipeline at {c-i-c}

Figure 4 – Stage 2 Mitigation Works on JGN Pipeline at {c-i-c}

3.6 The costs that JGN proposed to be included in the regulatory asset base for each year of the 2005-10 regulatory period (inclusive of capital contributions) are set out in Table 3 below.

Table 3: Mine subsidence expenditure proposed by JGN to be rolled into the regulatory asset base 2005-2010[10]

Expenditure ($m 2010)	2005-06	2006-07	2007-08	2008-09	2009-10	Total
	Actual	Actual	Actual	Actual	Estimate	
{c-i-c}	{c-i-c}	{c-i-c}	{c-i-c}	{c-i-c}	{c-i-c}	{c-i-c}
{c-i-c}	{c-i-c}	{c-i-c}	{c-i-c}	{c-i-c}	{c-i-c}	{c-i-c}
Simpsons Creek	{c-i-c}	{c-i-c}	{c-i-c}	{c-i-c}	{c-i-c}	{c-i-c}
Unnamed Creek	{c-i-c}	{c-i-c}	{c-i-c}	{c-i-c}	{c-i-c}	{c-i-c}
{c-i-c}	{c-i-c}	{c-i-c}	{c-i-c}	{c-i-c}	{c-i-c}	{c-i-c}
{c-i-c}	{c-i-c}	{c-i-c}	{c-i-c}	{c-i-c}	{c-i-c}	{c-i-c}
Total	{c-i-c}	{c-i-c}	{c-i-c}	{c-i-c}	{c-i-c}	{c-i-c}

3.7 The forecast for the 2010-15 regulatory period includes monitoring expenses only in respect of {c-i-c} . The project at {c-i-c} is still at Stage 4 as long-wall mining in the area has not yet ceased. Once mining has stopped, the site is likely to require significant rehabilitation work (as described above in Stage 5) as mining in the area has resulted in significant ground movements. The costs included in the forecast for the 2010-15 period in relation to {c-i-c} are as set out in Table 4 below.

[10] The amounts in this table are the total costs incurred by JGN.

Table 4: Forecast mine subsidence expenditure involving Stage 4 (Monitoring) 2010 – 2015[11]

Expenditure ($m 2010)	2010-11	2011-12	2012-13	2013-14	2014-15	Total
Monitoring	{c-i-c}					{c-i-c}
Rehabilitation		{c-i-c}	{c-i-c}			{c-i-c}
Total	{c-i-c}	{c-i-c}	{c-i-c}			{c-i-c}

4 Conclusion

4.1 As outlined above, "monitoring" in the context of mine subsidence projects involves the review and analysis of data collected by strain gauges and field surveys. The data is an indicator of actual and anticipated stress levels on the pipeline and ground movements in areas where BHPB is conducting long-wall mining.

4.2 Data from monitoring is used in the following ways:

(a) to determine the mitigation works required to prepare a site prior to mining activity, so that the pipeline is preserved and able to withstand damage from mining activity;

(b) once mining has started, monitoring is again necessary to check for increases and decreases in stress levels, undertake further mitigation works as necessary and determine whether it is possible to move to the rehabilitation stage; and

(c) once mining has ceased, strain gauge readings are again used to determine the scope of rehabilitation works and to detect any residual stresses while the pipeline is being reburied.

There is therefore a strong degree of connection between monitoring and any works undertaken to prevent or mitigate damage to the pipeline as a result of long-wall mining.

4.3 It should be noted that the "monitoring" that JGN undertakes in relation to mining activity differs from day-to-day, ongoing monitoring of the pipeline. "Monitoring" in relation to mining activity is undertaken specifically to deal with actual and potential damage to the pipeline that may be caused by mining and mine subsidence. It involves the installation of strain gauges on parts of the pipeline likely to affected and field surveys focused on the particular locations where mining is occurring. Day-to-day monitoring of the pipeline involves mainly patrols along the pipeline easement by car or helicopter. JGN does not treat patrolling expenses as capital expenditure.

4.4 In relation to the specific projects, JGN notes that the "monitoring" costs included in the mine subsidence expenses related to mining-specific monitoring and not day-to-day

[11] Note: the forecast amounts in this table only relate to sites where it is forecast that Stage 4 (Monitoring) activities will be undertaken in the 2010-2015 regulatory period. JGN's total forecast for mine subsidence expenditure for the 2010-2015 regulatory period was {c-i-c} ($2009-10) (referred to at page 69 of the Final Decision), which would equate to {c-i-c} ($2009-10) if the adjustments the AER made in the final decision for overheads and margin were made. The difference between the forecast amount of {c-i-c} in this table and the amount of {c-i-c} (being {c-i-c}) is for expenditure at the {c-i-c} site, which during this period is at Stage 5 (Rehabilitation). The amounts in the table are inclusive of {c-i-c}.

monitoring. For the two projects where monitoring occurred in the 2005-10 regulatory period:

- in the case of Unnamed Creek, monitoring expenses amounted to {c-i-c}
- in the case of {c-i-c} monitoring expenses amounted to {c-i-c} .

4.5 In relation to the forecast for the 2010-15 regulatory period, an amount of {c-i-c} was included for monitoring at {c-i-c} , where mining activity has not yet ceased.