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18 May 2017

Department of Planning and
Environment
GPO Box 39
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To whom it may concern,

Re: Major Project – Santos Narrabri Gas Project SSD 6456 – Narrabri Shire Council Submission

Introduction

Santos NSW (the proponent) seeks to install up to 850 new gas wells on 425 new well pads over a 20-year period. The construction of associated infrastructure such as water treatment facilities and gas processing plants are also proposed. The project area is approximately 95,000 hectares although direct impacts are only likely for approximately one percent of that area.

According to the EIS, Economic benefits to the Narrabri LGA are expected to be approximately \$526 million (approximately \$250 million net present value), the establishment of approximately 127 full-time equivalent jobs and the establishment of a Gas Community Benefit Fund which would potentially receive approximately \$120 million over the 25-year life of the project.

In 2013 Council adopted an Extractive Industries Policy to provide some guidance to Council staff and the community when dealing with the shires growing extractive industries. The policy attempts to draw a balance between the beneficial impacts on the local and state economies and potential impacts on air and water quality and states in part:

“Narrabri Shire Council recognises that the mining and extractive industry exploration and development has the potential to deliver substantial benefits to the Narrabri Shire, the region, the state and the nation during and after the life of the mining and extractive activity...”

“Narrabri Shire Council recognizes that the mining and extractive industries are not sustainable in the long term and that they compete for a wide range of resources including (but not limited to) the natural resources of land, air and water...”

“Narrabri Shire Council demands a ‘Nil’ effect position in regard to the quality of surface water, domestic, stock and irrigation aquifers used by our community”

Aim

The aim of this submission is not to examine the complex scientific information in great detail or specific modelling methods involved in the project but rather to identify any potential issues that may directly or indirectly impact Council or the surrounding community and where considered necessary call upon the Planning Assessment Commission (PAC) to have more critical sections of the EIS peer reviewed by independent experts in relevant fields and for those peer reviews to be available to the community for review before the conduct of a public hearing.

Council also asks that the Department adopt the precautionary principle in the assessment and potential development consent conditions for the proposal.

This document has been prepared to raise with the Department any concerns that Council and community representatives have with regards to the project and its potential impacts on the amenity, economic development and environment. It is incumbent on Council as an important stakeholder to advocate for a thorough planning process and consideration of all economic and environmental factors before State Significant Developments are determined and if determined by granting of consent that the community has faith in the monitoring programs put in place to protect the local environment.

Methodology

Council has extensively reviewed the Environmental Impact Statement (EIS) prepared by Santos. Chapters of the EIS were then divided up between members of Council and personnel of Mitchel Hanlon Consulting.

Any potential issues or deficiencies in information have been identified for further clarity as part of this submission. A consultation meeting was held with People of the Plains on 27 April 2017 where concerns and issues raised during the meeting were noted and considered as part of this submission, however, Council understands they will be making their own submission as well.

Issues

The following sections identify the economic, environmental and social components that are of main relevance to the Council. Council has identified areas of uncertainty or issues that require further clarification and where appropriate, suggestions or questions have been included for consideration to the determination body (PAC).

It should be noted that Council does not have the technical capability to deal with complex issues such as ground water system interconnectivity and human health impacts of the CSG industry. Council has simply identified issues it thinks warrant further investigation due to their importance in the local area. Council are reliant on the relevant consent authorities to provide technical guidance and appropriate rigorous review of the more complex science upon which the industry relies in their determination of the application.

Produced Water and Surface Water

Chapter 7 of the EIS provides an outline of the composition of produced water and the options for reuse and disposal of produced water.

Produced water is defined as water that, through the depressurisation of coal seams, is extracted from the geological profile. Through the exploration and appraisal process it was found the average salinity of the produced water is approximately 14,000 micro Siemens per centimetre. This level of salinity is approximately 30% of the salinity of seawater.

Treated water is defined as water that has undergone water treatment steps 1 – 5 as shown in Figure 1. Treated water will be used for irrigation, stock watering, dust suppression and drilling. It would also be available for managed release into Bohena Creek.

Amended water is defined as water that has undergone water treatment steps 1 – 5 as shown in Figure 1. Amended water would be beneficially reused for irrigation, rehabilitation and dust suppression.

Produced water will be extracted from gas wells and would be transferred to Bibblewindi and Leewood via a network of water gathering lines and in-field balance tanks. The produced water would be stored in double-lined ponds at Bibblewindi and Leewood before undergoing treatment at the Leewood central water treatment facility.

Produced water will be processed at the Leewood central water plant approximately 13km from Narrabri. It is anticipated that peak produced water will be approximately 10ML per day (for reference an Olympic sized swimming pool is approximately 2.5ML) with a long-term average of approximately 4ML/day over the life of the project. Produced water will be treated in a 6 step process.

Chapter 12 examines the surface water impacts during construction and operation of the project. It was determined that Bohena Creek and its tributaries are highly ephemeral and only flow during periods of heavy rain. Impacts as a result of erosion and sedimentation were considered low provided that erosion controls are implemented.

Appendix G1 Managed Release Study examines the effects of releasing produced water into Bohena Creek. Santos has proposed to release water into Bohena Creek at times where it is deemed necessary provided the flow measured at the Newell Highway gauging station registers more than 100ML flow.

Table 1: Summary of Project Water Volumes

Parameter	Volume (ML/day)
Installed infrastructure capacity	14
Estimated produced water	Peak (years 2-4):10 25-year average:4.1
Estimated treated/amended water	Peak (years 2-4):9.5 25-year average:3.9

Reverse Osmosis (RO) will be the primary treatment option for produced water. RO works through the application of pressure to feed water in order to push it through a semipermeable membrane that will reject salts and other species.

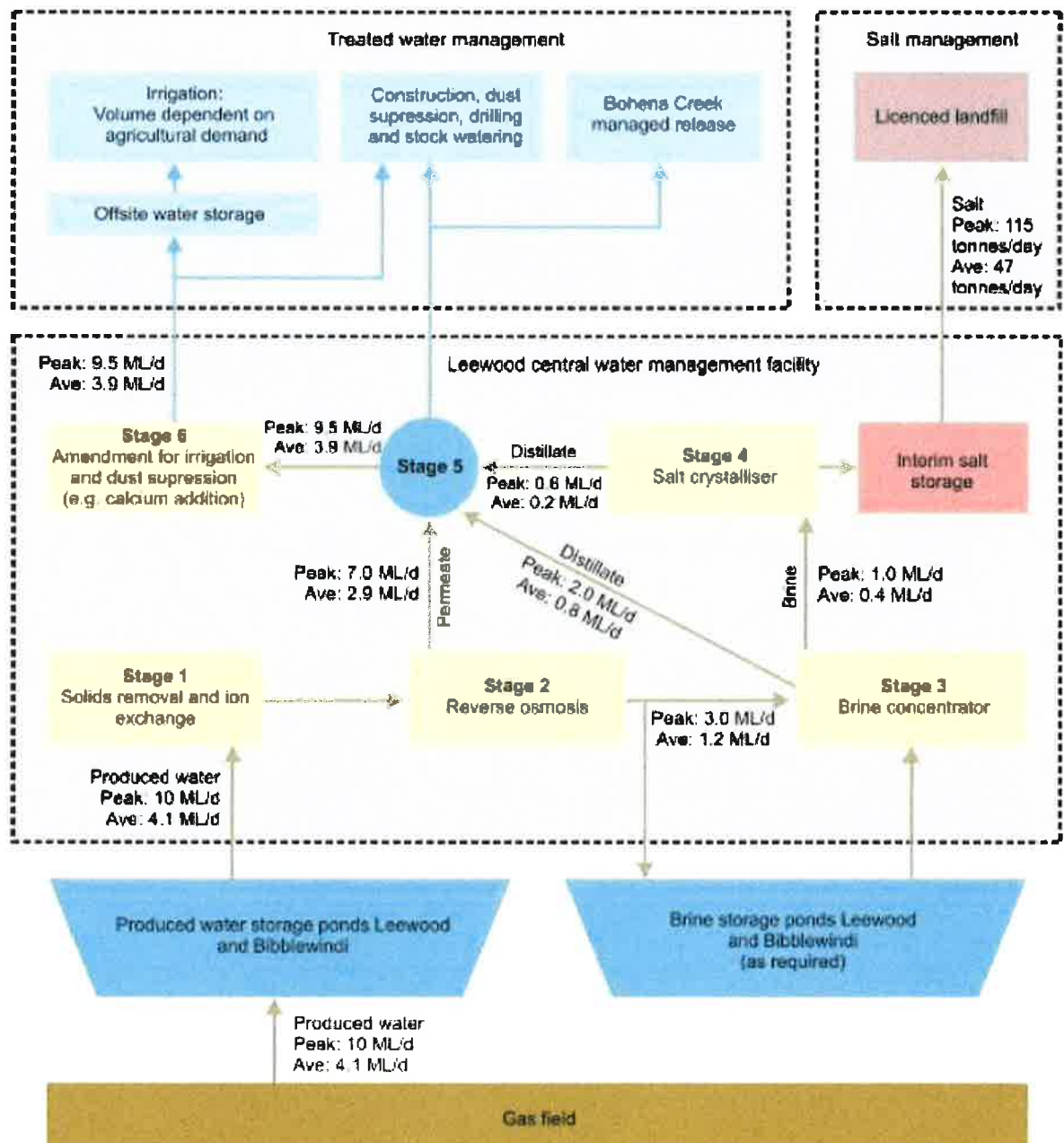


Figure 1: Summary of Water Treatment Process

Step 1: Involves mechanical separation through filtration to remove solids. Certain cations that may interfere with later steps are removed through ion exchange. The proliferation of organisms will be controlled through the use of biocide.

Step 2: Reverse osmosis will be implemented to remove salts. Approximately 66% of produced water will exit as permeate (treated water) with the remaining 33% being brine.

Step 3: Thermal evaporation will be used on the brine to remove any water. This water will then be recombined with the treated water from step 2.

Step 4: Salt crystallisation will occur to remove the solid salt from concentrated brine. This salt will be stored on site and later disposed of at a suitably licensed landfill. Remaining water from the salt crystallisation will be recovered through thermal evaporation and recombined with water from step 3.

Step 5: The produced water will be chlorinated to remove ammonia. Following the ammonia removal, dechlorination and pH adjustment will occur.

Step 6: Treated water will be treated as required to adjust the sodium absorption ratio (SAR).

Once the water has been treated, options have been presented for the beneficial reuse. These options include irrigation, dust suppression, construction and drilling. It has also been proposed to discharge the produced water into Bohena Creek. Produced water will only be discharged into Bohena Creek during periods where flows are above 100 megalitres (ML) per day measured at the Newell Highway gauging station. This threshold limit has been adopted in an attempt to dilute any contaminants present in the produced water that will be released into Bohena Creek.

Summary of Potential Significant Impacts

1. During periods where flows are less than this threshold limit of 100 megalitres (ML), but beneficial reuse (such as dust suppression or irrigation) is not an option due to inclement weather, how will the storage ponds water volume be managed to prevent overtopping? How have the ponds been sized? Have they been sized appropriately?
2. There is not a thorough discussion of hydrocarbons or metals in produced or amended water.
3. In Chapter 12, *Section 12.3.3 Dust Suppression, Construction and Drilling* Table 12-3 indicates that treated water to be used for dust suppression is likely to exceed the 84th percentile of the Bohena Creek baseline water quality for:
 - Electrical conductivity;
 - Sodium; and
 - Boron.

Amended water to be used for dust suppression is likely to exceed the 84th percentile of the Bohena Creek baseline water quality for:

- Electrical conductivity;
- Total Dissolved Solids (TDS);
- Boron;
- Sodium;
- Calcium; and
- Sodium Absorption Ratio (SAR).

For large sample populations that follow a normal distribution, the 16th and 84th percentiles are equivalent to -1 and +1 standard deviations from the mean (50th percentile). Approximately 68% of data population lies within the 16th and 84th percentile, and approximately 32% of data lies outside of this range.

4. The gauging station at the Newell Highway is approximately 5 kilometres downstream (via the creek bed) of the proposed discharge area. Concern has been expressed that two tributaries (Killen Creek, Sawpit Creek) feed Bohena Creek but enter the creek downstream of the discharge area. The gauging station, further downstream than the tributaries input, may register sufficient flow, however, Bohena Creek, at the discharge area, may not have sufficient flow due to the downstream confluence of the aforementioned creeks to provide sufficient dilution.

5. In *Section 8.6 Result in Persistent Organic Chemicals, Heavy Metals, or Other Potentially Harmful Chemicals* within the Managed Release Study: Bohena Creek, the ANZECC/ARMCANZ (2000) default trigger values for cadmium are -

0.2 µg/L. The ANZECC/ARMCANZ (2000) defines trigger values as:

“Trigger values are concentrations that, if exceeded, would indicate a potential environmental problem, and so ‘trigger’ a management response, e.g. further investigation and subsequent refinement of the guidelines according to local conditions.”

(<https://www.environment.gov.au/system/files/resources/53cda9ea-7ec2-49d4-af29-d1dde09e96ef/files/nwqms-guidelines-4-vol1.pdf>)

It is predicted that the treated water may contain cadmium levels of 1 µg/L thus exceeding the trigger values.

Evaluation of Impact Mitigation Proposed

1. No apparent measures in place for this scenario within the EIS.
2. Whilst it is possible to minimise flows into Bohena Creek, questions are raised whether the chemicals above the 84th percentile can accumulate in the soils surrounding Bohena Creek and whether it is likely to leach into Bohena Creek during wet periods.
3. There is no discussion about possible hydrocarbons in produced or amended water.
4. The EIS does not address this potential impact.
5. Cadmium will be exceeded by approximately 5x the threshold limit as stated in ANZECC/ARMCANZ (2000). It is considered that as cadmium is well beyond the threshold limit that dilution may not be an adequate mitigation measure.

Recommendation to PAC

1. Council seeks clarification on what measures will be taken if produced water is unable to be released into Bohena Creek or to be utilised for beneficial reuse but storage ponds are nearing or at capacity to prevent spilling?
2. Council seeks clarification that the proposed mitigation measures are sufficient to ensure the levels above the 84th percentile do not cause impacts either through directly flowing into Bohena Creek or accumulating and leaching in the surrounding soils. Confirmation is sought that these levels of contaminants will not affect the aquatic ecosystems. It is further proposed that an ongoing robust and independent (appointed by the regulator at proponents cost) water monitoring program be implemented to ensure the water quality is not impacted. This would involve sampling of amended water, water downstream of the disposal site and upstream of the disposal site in order to make a suitable comparison. These results should be provided to Council and the community annually.
3. Council seeks clarification that the treated water will not contain hydrocarbons through NATA laboratory testing of existing source water from existing wells.
4. Council seek confirmation that the gauging station located at the Newell Highway is representative of the upstream flow. Depending on inputs from Killen Creek and Sawpit Creek, 100ML may be registered at the gauging station but may not be representative of the discharge site. If it is not deemed to be

representative, it is proposed that a gauging station be installed closer to the discharge area or other actions are proposed that build a higher target flow into the process.

5. Council seeks clarification on whether the cadmium levels can be reduced to comply with the trigger values as stated in ANZECC/ARMCANZ (2000). If treated water levels of cadmium are not able to be reduced to below trigger levels, are Santos able to offer alternative mitigation measures?
6. When Bohena Creek is not flowing, it may be pertinent to conduct soil sampling of the river bed to ensure that there is no build-up of chemicals.

Groundwater

The groundwater assessment considers the potential impacts of the project in relation to the proposed extraction of 37.5 gigalitres of water over the 25-year assessment period from target coal seams.

A scientific peer review of the model was conducted by the CSIRO Land and Water in accordance with the groundwater review principles outlined in the Australian Groundwater Modelling Guidelines. The review concluded that the regional groundwater model for the Gunnedah Basin could be considered 'state of the art' and was suited to assess potential impacts of water extraction for coal seam gas depressurisation on the surface water and groundwater resources in the Gunnedah Basin district.

Groundwater in the assessment area is extracted for private use and town water supply predominantly from the shallow groundwater sources of the Upper and Lower Namoi Alluvium and to a lesser extent from the Pilliga Sandstone aquifer.

Proposed water extraction from the target coal seams in the Bohena Trough would result in drawdown of hydraulic head and reduction of groundwater storage in the target coal seams and in the immediately overlying and underlying formations hosting the coal seams.

The groundwater modelling predicts that there is unlikely to be a discernible impact to shallow groundwater sources in the assessment area compared to natural variation. It is predicted that a maximum drawdown of 0.5 metres of the water table in the Namoi Alluvium would occur with less elsewhere. The predicted times to reach the maximum drawdown at the water table vary between 200 and 700 hundred years.

As the direction of groundwater flow induced by the project would be downward towards the depressurised coal seams, the potential for contamination to shallow groundwater sources is considered small.

Research conducted by the CSIRO has indicated that contamination to groundwater supplies is unlikely provided that the operation is conducted appropriately. This includes the continued robust and peer reviewed monitoring of bore integrity to ensure loss is prevented and appropriate drilling to ensure multiple aquifers are not connected. (http://www.resourcesandenergy.nsw.gov.au/landholders-and_community/coal-seam-gas/the-facts/environment-health-safety). The installation of gas wells would be drilled in accordance with the 'Code of Practice for Coal Seam Gas: Well Integrity (DTIRIS 2012)' which sets a number of engineering requirements to establish zonal isolation, preventing flow between groundwater units.

Recommendation to PAC

As Council is not equipped to critically evaluate the findings of the groundwater assessment, it seeks confirmation that the relevant expert government agencies provide suitable critique and that given the critical nature of this issue an independent peer review is conducted by experts in this field to better inform the PAC.

In terms of the integrity of gas wells guidance has been taken from research by Davies, Gore, & Khan (2015) and in this regard it is requested that:

1. The PAC require well-construction to be designed based on a detailed analysis of site-specific conditions including but not limited to depth of well, the permeability of various strata, the presence of faults and areas of known vertical and horizontal movement.
2. The PAC require ongoing assessment of well integrity by an independent assessor including but not limited to conducting pressure tests and concrete-bond logs to assess the integrity of the well over the full life of the well including post-production.
3. A future fund is established by the NSW Government for rehabilitation of any contamination for a period of 100 years post production.
4. The PAC establish a protocol for continued monitoring of well integrity long after the proponent has ceased operation on the site.

Soils and Land Contamination

Chapter 14 Soils and Land Contamination examines past events that may have caused land contamination or degradation as well as potential impacts as a result of the construction of infrastructure associated with the development and any operational issues that may arise.

It was determined that the soils within the development area have limited overall productive capacity and that the chances of the development interacting with any existing land contamination is minimal.

Potential erosion or sedimentation for the project will be managed through the use of '*Managing Urban Stormwater-Soils and Construction Vol. 1 (Blue Book-Landcom 2004)*'.

To prevent or minimise impacts from leaks and spills, chemicals will be stored and handled in accordance with relevant Australian Standards, including '*AS 1940-2004 The storage and handling of flammable and combustible liquids*'. During drilling of gas wells, steel casings and cement would be installed to prevent drilling fluids entering the geological profile.

Summary of Potential Significant Impacts

1. Any unforeseen residual impacts have not been discussed in regards to who is responsible and how the situation should be remedied.

Recommendation to PAC

Council seeks clarification on who is responsible if there are any unforeseen impacts to the land or groundwater after the life of the project. It is proposed that the government or the proponent establish a future fund by establishing a future fund at the proponents cost so that any unforeseen impacts are able to be dealt with in a timely manner in the event they arise.

Property and Land use

One of the strongest issues with the CSG industry has been a fear that a company has the legal right to enter a person's land and install wells without the landowner's permission. Chapter 17 of the EIS states "*The Proponent will not undertake field development on private land without a Land Access Agreement in place.*" In NSW land access is undertaken in accordance with the *Agreed Principles of Land Access (NSW Government 2014b)*. A Farm Management Plan is developed in consultation with the land owner to minimise the impacts on a landowner's ability to continue operations.

Recommendation to PAC

Council requests the PAC to make adherence to the *Agreed Principles of Land Access (NSW Government 2014b)* a condition of consent that is enforceable upon the proponent thereby giving landowners the option to host wells on their land with fair and reasonable compensation.

Air Quality

Chapter 18 of the EIS examines the air quality impacts of the project and it notes the following.

The air quality assessment was undertaken in accordance with the *Approved Methods for the Modelling and Assessment for Air Pollutants in NSW* (DEC, 2005).

According to the EIS the main project emission that would occur during construction was assessed to be particulate matter from the construction sites. During operation, the main project emissions were assessed to be oxides of nitrogen emissions from well pad sites, the central gas processing facility at Leewood, and safety flares.

An inventory of emissions was developed based on the potential impacts to human health and potential to exceed relevant air quality criteria. The key emissions predominantly included particulate matter, oxides of nitrogen, and carbon monoxide. Dispersion models were developed to predict air emission concentrations at incremental distances from the major emission sources. The predicted concentrations were assessed against air quality criteria defined in the *Approved Methods for the Modelling and Assessment for Air Pollutants in NSW* (DEC, 2005).

During construction (at Leewood and Bibblewindi), it was determined that air quality would comply with the relevant criteria at sensitive receivers with appropriate control measures. These control measures are to be developed in an Air Quality Management Plan but would largely consist of standard construction dust control measures such as watering, speed controls and covering erodible material.

During operation it was determined that the project would meet the relevant air quality criteria at sensitive receptors.

Background air quality for oxides of nitrogen and ozone were characterised from project site monitoring. Particulate matter data was estimated from NSW Office of Environment and Heritage monitoring station at Tamworth NSW.

The University of Adelaide was commissioned to record baseline methane concentrations for the project region over three years. Background methane concentrations were recorded at up to 1.8 parts per million (ppm). Localised increases in methane were attributable to roads near cattle saleyards (over 20 ppm), roads near mining areas (over 30 ppm) and farm bores (over 100 ppm).

There have been 114 sensitive receivers identified within the project area at relatively low density. These receivers are predominantly private dwellings on rural properties. A further 103 sensitive receivers were identified within three kilometres of the boundary of the project area.

Emission during construction will be short-term and managed with standard control measures. The main air emission during construction would be particulate matter (PM₁₀). This emission was assessed to be the most likely parameter to approach the air quality criteria. The sources of particulate matter during construction would be from earthworks and exhaust from vehicles, plant and equipment.

Emissions from Leewood were predicted to mainly comply with air quality criteria. Work activities on the eastern boundary at Leewood will require further mitigation measures in the event of north-westerly meteorological conditions to prevent potential exceedance at a single receiver.

Emissions from construction activities at construction sites for access tracks and gas and water gathering lines, the Leewood to Bibblewindi infrastructure corridor, the Leewood to Wilga Park underground power line, and the

treated water release pipeline from Leewood to Bohena Creek, were predicted to be within air quality criteria about 30 metres from the construction activities.

Sensitive receivers would be sufficiently distant from construction activities to ensure emissions are within air quality criteria. Construction emissions have the potential to affect clarity of the night sky. The Siding Spring Observatory is located 80km south-west of the project area. This operation would be sensitive to atmosphere clarity changes. Air emissions would generally decrease with distance from the construction activity source and impacts to the Siding Spring Observatory are not predicted.

The operational emission sources for the project include:

- Central gas processing facility and power generation facility at Leewood,
- Safety flares at Leewood and Bibblewindi,
- Diesel or gas generators at well pads, and
- Limited number of pilot well flares.

Nitrogen dioxide was assessed to be the pollutant most likely to approach the relevant air quality criteria. The total rate of operational emissions would depend upon the power supply option that is implemented. The operational power supply scenarios include:

1. Power Supply Option 1 – power is generated at Leewood;
2. Power supply Option 2 – power is sourced from the national electricity grid; and
3. Well pad power generation – power is generated locally from gas or diesel-fired engines.

These scenarios include emissions produced by routine operations (release emissions to air on a regular and continuous basis), and non-routine operations (release emissions to air on an irregular basis).

The results of the air quality assessment for operational emissions indicate that emissions would be within air quality criteria at all identified sensitive receivers.

The removal of infrastructure during decommissioning has the potential to generate similar emissions to construction emissions, particulate matter, oxides of nitrogen and ozone. It is expected these emissions would be lower in quantities than construction emissions. Decommissioning emissions would be temporary and readily managed with dust control measures.

Evaluation of Impact Mitigation Proposed

1. Air quality emission modelling has predicted that work activities on the eastern boundary at Leewood will require further mitigation measures. In the event of north-westerly meteorological conditions, a single sensitive receiver may be impacted by a potential exceedance of the air quality criteria. Council would like additional mitigation measures implemented to prevent this potential exceedance at this sensitive receiver. Consultation is recommended with the sensitive receiver regarding what measures will be appropriate to minimise adverse impacts. It is briefly mentioned in the EIS that commercial dust suppressants may be used for dust suppression. Council would like additional information regarding the chemical composition of these suppressants and potential environmental impacts of use.

Recommendation to PAC

1. Council seeks clarification on whether Santos have analysed the gas from the current pilot wells. If this information is known, why was it not utilised for the calculations for fugitive emissions rather than assumptions?
2. Council recommends that consultation be undertaken with the potentially affected sensitive receptor to discuss appropriate mitigation measures specific to this receptor. An appropriate timeframe for this consultation and implementation should be outlined.

3. Council recommends that an appropriate timeframe for the Air Quality Management Plan preparation be outlined and that appropriate consultation occur with the community and Council before implementation.

Traffic and Transport Impacts

Chapter 22, Section 22.3.2 makes the following statements:

“Traffic generated by the project may affect road condition, which can have safety implications as well as accelerate the rate of ongoing maintenance renewals incurred by the relevant road authorities.”

But then goes onto state:

“The proportional increase in traffic generated by the project on major roads like the Newell Highway is not expected to significantly impact on the safety or condition of these roads...”

These two statements are at odds with one another and Council places more weight in the first statement.

Roads will be the major Council infrastructure negatively impacted by this project with particular emphasis on the initial construction phase when activity across the network will be at its most intense. The major sources of traffic associated with the project will be the Civeo Complex for worker accommodation, the Westport Workers Accommodation Camp on the corner of Macfarlanes and Bibblewindi Creek Roads (forestry roads), The Water and Gas plant at Bibblewindi, the Water and Gas processing plant at ‘Leewood’ on the Newell Highway, The existing Wilga Park Gas Power Station and the Santos Depot next to the Narrabri Landfill site on Yarrie Lake Road. The EIS proposes that new intersections will be constructed on the Newell Highway to access ‘Leewood’ via Old Mill Road (Forestry) and X Line Road (Forestry) to deal with the increased traffic expected.

The EIS states that access to the Westport Workers Accommodation Camp will be via X Line Road however the shortest and best route to access the camp from Narrabri will be the Council maintained Westport Road which is unsealed. Similarly, employees and contractors travelling between the field facilities and the Santos Depot on Yarrie Lake Road are likely to increase traffic on Kiandool Lane (unsealed), Cains Crossing Road (unsealed) and Yarrie Lake Road (sealed).

The EIS proposes that a Traffic Management Plan will be adopted in consultation with RMS and Council and Council expects to be fully consulted in the preparation of this plan.

Recommendation to PAC

1. Council seeks PAC confirmation that the proponent will be required by consent conditions to enter into a Road Maintenance Agreement with Council to meet the expected increased cost of rural road maintenance resulting from the project.
2. Council seeks clarification on the timing of the intersection upgrading work to ensure it occurs before any significant construction works commence in relation to the project.

Landscape and Visual

The Secretary’s environmental assessment requirements for the Narrabri Gas Project included a requirement to assess the likely visual impacts of the project on private landowners and key vantage points as well as lighting impacts. An assessment was undertaken in response to this requirement and is contained in Appendix Q, and a summary of the projects potential impacts on landscape and visual receivers is contained in Chapter 23 Landscape and Visual.

Summary of Potential Impacts

1. During night time hours, light emitted from the pilot flares may be visible from sensitive receivers. Similarly, during commissioning and maintenance activities or non-routine situations, the safety flares at Bibblewindi and Leewood may be visible at night.
2. Santos notes that construction of some components of their operation would occur at night and require lighting, including the construction of well pads which part 5.4 of its Landscape and Visual Assessment notes would occur over a 24-hour period.

Evaluation of Impact Mitigation Proposed

1. The carrying out of consultation with landowners through the construction phase of the development is considered to be a good approach to managing issues associated with the location and construction of gas wells.
2. Council considers it is likely that disturbance to sensitive receivers in the vicinity of the gas wells would be most significant during the construction phase of the proposed development as work is to be carried out over 24-hour period 7 days a week. Chapter 23 of the document does not outline whether disturbances that could be caused to sensitive receivers during the construction phase could be reduced by the construction practices employed.
3. The statement included in the EIS relating to the mitigation of sensitive receivers from pilot flares relies on their screening by existing site conditions. The EIS notes that the number of pilot flares would total six. Chapter 23 does not include any details of where these pilot flares would be located. It is recommended that consideration be given to locating pilot flares if/where possible to minimise their visual impact.

Recommendation to PAC

1. The PAC should be satisfied light and other emissions from the operation of the proposed development would not detrimentally affect the operation of the Siding Spring Observatory.
2. It is recommended that the PAC consider whether the required pilot flares could be located so as to minimise their visual impact.
3. Consideration should be given in the Field Development Protocol to possible requirements for screening where existing residences are expected to be impacted by flares or lighting.

Social and Health

Chapter 26 of the EIS examines the social and health impacts of the development.

Social

The community consultation undertaken as part of the Social Impact Assessment (SIA) is not considered to have been sufficiently participatory to provide a comprehensive assessment of the social impacts of the proposed development. The assessment appears to have been predominantly desk-top based and there is a need for further qualitative fieldwork that facilitates a community discussion with a wider range of stakeholders regarding acceptable impacts and both positive and negative social outcomes of the development. Specifically, there has been limited identification of and engagement with vulnerable groups. Some researchers have found negative socio-economic outcomes for specific sub-groups within mining communities despite the positive outcomes at a regional level (Hajkowicz, Heyenga & Moffat, 2010) and potential negative impacts for specific vulnerable sub-groups are not discussed in sufficient detail in the SIA. Council is particularly committed to improved outcomes for the local Indigenous community and whilst their participation in the labour force required for this development is discussed the Diversity and Equal Employment Opportunity Policy does not provide sufficient measurable commitment to Indigenous employment. In this regard an Aboriginal Employment Agreement committing to specific targets for Indigenous employment is required. Similarly, school leavers seeking to access highly skilled

positions in the local energy market need to be considered with a local skills package aimed at preparing them for employment in the local energy sector.

The EIS is dismissive of the impacts 1300 construction workers will have on the provision of medical and health services in particular. Council believes that such a large workforce will have impacts on the provision of vital medical services to existing residents and that this area of the EIS needs further work.

Social Impact Assessment should be an ongoing process over the entire project life cycle in addition to the assessment stage (De Rijke, 2013). This should be required as a condition of consent.

Health

Overall, it was determined that there are no apparent health impacts that are not able to be mitigated against.

It is likely that the development may introduce benefits to employment opportunities both in the local community and within NSW as a whole. A mixture of the proposed camp facilities, current workforce accommodation facilities, hotels and available housing options would afford the workers secure accommodation options.

Land Access Agreements will be developed with landholders to ensure that no gas field infrastructure will be placed within a property without express written permission. This should offer reduced angst on landholders who may believe that Santos will enter their property without permission.

Due to the distances from sensitive receptors coupled with predicted emissions, air quality should not cause health impacts to residents. The CSIRO conducted a study titled '*Methane and Volatile Organic Compound Emissions in New South Wales*'. (<http://www.epa.nsw.gov.au/resources/air/methane-volatile-organic-compound-emissions-nsw-3063.pdf>). This independent investigation was undertaken to quantify fugitive emissions from gas production facilities including the Santos Narrabri facilities. It was determined that:

“There was no sign of unusually elevated CH₄ (methane) concentration over most of the gas field.”

It is noted that community groups have expressed concern regarding the potential impacts of fugitive gas emissions citing perceived health impacts from gas fields in Tara, Queensland.

Mr. Keith Adam, a specialist in occupational medicine, visited Tara in order to identify any potential health impacts caused by coal seam gas. He did not find any clear and direct links between coal seam gas and the complaints made by the residents. (https://www.health.qld.gov.au/data/assets/pdf_file/0022/427171/appx2.pdf)

Residents were also supplied with containers so that they were able to collect air samples when they subjectively felt air quality was at its worst. None of these samples registered contaminants above the threshold limits. This was particularly useful as residents may distrust companies and this allowed them to collect samples for themselves removing the distrust factor.

Community has expressed concerns regarding hydrogen sulphide odours perceived to be from wells. Data obtained by council indicate that the gas does not contain hydrogen sulphide. Further, Dr. Richard Cresswell of Sinclair Knight Merz indicates that:

“Exclusivity generally exists between groundwater wells containing Sulfate Reducing Bacteria (SRB) and CSG wells”

Which generally indicates that hydrogen sulphide odour is unlikely to be occurring from installed wells.

(<https://narrabrigasproject.com.au/uploads/2015/11/April-2013-Narrabri-CCC-Presentation-and-notes.pdf>)

In an article *"CSG and Your Health: Understand the Risks, Protect Your Family"* published by Dr. Wayne Sommerville, it is asserted that as a result of flaring, hydrogen sulphide is produced. Documents produced by the NSW Environmental Protection Agency (EPA), state that:

"Burning of methane converts the gas to carbon dioxide and water vapour. It also produces small amounts of oxides of nitrogen."

This indicates that the flaring of CSG is unlikely to be the source of hydrogen sulphide odour. (<http://www.epa.nsw.gov.au/resources/epa/2564-gas-flaring-fact-sheet.pdf>)

Dr. Wayne Sommerville also goes on to state the health impacts to residents by Volatile Organic Compounds (VOCs). In certain gas field developments VOCs may be present and problematic, however, the CSIRO undertook analysis of fugitive emissions at the Santos Narrabri Facility, including well pads and compression plant, and found that:

"Compounds from the air toxics suite were in the range observed and expected for a natural site".

Indeed, the data indicating the chemical makeup of the retrieved coal seam gas show that the main constituents are methane (>85%), carbon dioxide (approx. 7%), nitrogen (approx. 6%), oxygen plus argon (0.09%) and octanes (0.01%).

Many arguments and assertions made by Dr. Sommerville are events sourced from America and Queensland. Both of these locations have significantly different geology, landscapes and likely gas compositions and methods of retrieval. Whilst some similarities may exist, the situation in Narrabri is its own development with unique constraints and opportunities and must be approached as such.

Recommendation to PAC

1. Council seeks clarification on the allowable proximity of infrastructure to adjoining landholder's residence and whether the 200m buffer is applicable.
2. It is proposed that any gas or water pipelines have meters installed to identify any losses experienced.
3. On-going independent monitoring program carried out by experts in their fields under the direction of the NSW EPA at the proponent's expense for increased presence of health impacting chemicals in the field.
4. Additional qualitative fieldwork on the social impact through a more participatory process needs to be undertaken with more work carried out on the impacts 1300 construction workers may have on the availability of medical services to the existing residents.
5. On-going independent monitoring on performance and impacts of development over its life relative to social impact assessment of the proposal.
6. Development of an Indigenous employment agreement.
7. Development of a local skills package aimed at providing school leavers with a pathway to employment within the gas industry.

Economic Impact

Chapter 27 of the EIS addresses the economic impact of the proposed development. This was assessed by way of a cost benefit analysis and a macroeconomic analysis.

Cost benefit analysis - Project construction has a capital investment value of around \$3 billion and will result in a real economic output of \$11 billion in the Narrabri Shire. The cost benefit analysis concluded that the project will generate a net economic benefit of around \$1.5 billion.

The cost benefit analysis assumes a consistent gas price \$8.70 per Gigajoule supplied by Santos. With the recent volatility of energy market this assumption requires assessment by an independent third party. The cost benefit analysis concludes that if forecast gas prices are reduced by 30 per cent the project will generate a negative net present value (EIS, p. 27).

Macroeconomic analysis - The direct employment provided by the project is expected to be around 1300 jobs during construction and 200 additional jobs during ongoing operations with 127 expected to be based within 100km of the project. The project is expected to result in small reductions in real economic output for agriculture, forestry, mining and manufacturing due to competition for labour and increased costs.

The State will recover \$1.1 billion in tax revenues (net present value estimate). A Gas Community Benefit Fund will be established to receive 10 per cent or around \$120 million through the life of the project.

Summary of Potential Impacts

1. A positive net present value and benefit-cost ratio under the majority of forecast scenarios.
2. The direct employment provided by the project is expected to be around 1300 jobs during construction and 200 additional jobs during ongoing operations.

Recommendation to PAC

1. The Gas Community Benefit Fund should not be able to be accessed for project costs such as payments for compensation for access or road maintenance costs. Should the project be favourably determined the fund and a portion of royalties should be reserved for infrastructure costs to encourage potential decentralisation of industry to take advantage of strategic location of inland rail, gas, electricity, water and road networks to grow the local economy further.
2. To provide maximum benefit to the Narrabri and surrounding community the majority of materials and supplies should be sourced from the immediate area. This is inclusive of labour, construction and supply materials.
3. Council believes the PAC needs to fully investigate the options available to the proponent to utilise existing training facilities within the LGA to provide industry specific training opportunities to allow local people an entry point into the gas industry.

Waste Management

Chapter 28 of the EIS addresses the waste management issues and mitigation measures proposed for the development.

Wastes that will be generated onsite range from construction materials and green waste to salt and drill cuttings. These generated wastes will be managed through the implementation of a waste management plan that will be produced in accordance with the '*Waste Avoidance and Resource Recovery Act 2001*'.

It is proposed to utilise approximately half of the drill cuttings onsite while the remainder would be disposed of at a suitably licensed landfill. Drilling fluid is to be recycled, reducing the volume of the fluid to be disposed of by approximately 90%; the remaining 10% would be disposed of to a suitably licensed facility.

Salt that is removed from treated water is to be classified as general solid waste under the NSW EPA Waste Classification Guidelines and is to be disposed of at a suitably licensed facility.

During construction the quantities of waste are expected before reuse or recycling is shown in Table 2.

Table 2: Waste during Construction (Before Reuse and Recycling)

Material	Average per month (m ³)	Approximate over assessment period (m ³)
Coal-based drill cuttings	3,000	720,000
Rock-based drill cuttings	1,700	400,00
Drilling fluids	740	178,000
Cement slurry	90	21,250
General solid waste (non-putrescible)	54	13,300
General solid waste (putrescible)	8	1,900
Special/hazardous/liquid waste	2	500

During operation and decommissioning the quantities of waste are expected before reuse or recycling is shown in Table 3.

Table 3: Waste During Operation and Decommissioning (Before Reuse and Recycling)

Material	Average per month	Approximate over assessment period (m ³)
Produced water	125 megalitres	37.5 ggalitres
Salt	1,430 tonnes	430,500 tonnes
General solid waste (putrescible)	305m ³	91,500m ³
Special/hazardous/liquid waste	11m ³	2,700m ³
General solid waste (non-putrescible)	7m ³	1,700m ³

The peak in water production will occur in years 2-4 which coincides with the peak in crystallised salt production of 115 tonnes per day. The EIS proposes that this salt will be disposed at suitably licenced local landfill sites. The local Narrabri Landfill site has an existing annual EPA licence to handle 12,000 tonnes of waste and the potential to dispose of such large volumes of salt are not present at this facility. Given the volumes of salt requiring disposal at small local landfill operations it is considered that the proponent should be required to provide other more suitable means of disposal of the salt produced.

Recommendation to PAC

1. Council seeks confirmation that local facilities are equipped to accept such large volumes of produced salt over the life of the project and suggests that alternative disposal practices may require further investigation.
2. The composition of the remaining salt and any chemicals that may or may not be present is not apparent. Council seeks clarification on the chemical composition of the salt and whether there is potential for chemicals used or encountered during the process to contaminate or otherwise alter the salt into a different waste stream.
3. At every stage of the development, the proponent should take all feasible measures to reduce the waste and maximise the amount of waste able to be reused or recycled.

Impacts of Construction Camp

The EIS indicates that during the peak construction of the construction phase of the project a construction workforce of 1300 individuals would be required. This workforce is anticipated to decrease to 200 individuals for ordinary operations beyond this period. The proponent has indicated that a number of these workers would be itinerate workers requiring short term accommodation for the duration of their engagement. In addition to existing and approved accommodation opportunities the proponent has proposed the expansion of the 64 person Westport Road workers' accommodation to accommodate 200 persons.

Summary of Potential Impacts

1. Servicing of the site including the provision of power, water and sewer infrastructure.
2. Management of solid and liquid waste from the operation of the site.
3. Impact of transport associated with the construction, servicing and operation of the site on the existing road network. Issues associated with traffic generation and transport volumes have been considered and commented on in detail under Traffic and Transport Impacts of this submission.
4. Due to the semi-remote location of the workers' accommodation there may be a risk to the safety of occupants in the event of a bush fire.

Recommendation to PAC

1. That the PAC considers requiring the proponent to prepare a detailed waste management plan for the construction and operation of the Westport Workers' Accommodation to be adhered to for the duration of the operation.
2. Council would prefer to see accommodation of workers cease or be restricted to drilling workers only at the Westport Workers Accommodation at the conclusion of the construction phase and existing accommodation options within Narrabri utilised to maximise potential economic benefits.

Environmental Management and Monitoring Process

Chapter 30 of the EIS examines the environmental management and monitoring framework that is proposed to be applied to the project if approved.

The proposed environmental management and monitoring for the project is based upon the findings of the impact assessment process. The findings of this process have been proposed as the environmental and social management and monitoring framework.

The proponent states that the framework would be developed and implemented with reference to Santos' existing Environmental, Health and Safety Management System and in accordance with AS/NZS ISO 14001:2015 *Environmental Management Systems – Regulation with Guidance for Use*.

Environmental Management Overview

The proponent states that the environmental framework for the project includes a number of discipline specific sub-plans that would be implemented during each phase of the project. Environmental management would occur during:

- Planning and design via the preparation of a Field Development Protocol;
- Construction and operation via the preparation of specific environmental management sub-plans (outlined below). As well as ongoing environmental monitoring, compliance, reporting and auditing procedures; and
- Decommissioning and rehabilitation via rehabilitation planning in accordance with an overarching rehabilitation strategy and decommissioning plan.

Field Development Protocol

A field development protocol will be used when siting gas field infrastructure. This involves a desktop review of proposed plans overlaid with site constraints such as ecological constraints. From here, the plan is modified to reduce impacts on constraints and field scouting is carried out to confirm the constraints and design are appropriate. If they are compatible, detailed designs will be carried out.

Sub Plans

A number of sub-plans are proposed to be developed. These include:

- **Erosion and Sediment Control Plan;**

The plan will be developed to minimise sedimentation to surface watercourses as a result of site activities. It would be constructed with the relevant guidelines.

- **Soil Management Plan;**

The plan would include guidance on soil stripping, handling, stockpiling, spreading and rehabilitation of key soil types.

- **Air Quality Management Plan;**

The plan would include an air quality monitoring program and measures to minimise to minimise emissions where appropriate. The management plan would include standard dust control measures such as watering and speed limits.

- **Noise Management Plan;**

The Noise Management Plan would include details of construction, license and consent conditions and options to reduce impacts. A noise monitoring program would also be implemented per the '*NSW Industrial Noise Policy (NSW EPA 2000)*'. It is noted that if vibration generating activities are to be undertaken that a Vibration Management Plan would also be developed.

- **Cultural Heritage Management Plan;**

The cultural heritage management plan has been developed to, where practicable, there will be no impact on cultural heritage. A cultural heritage working group will be established to implement the plan.

- **Biodiversity Management Plan;**

The plan would contain mitigation and management measures to minimise the impacts on flora and fauna in the area. A monitoring program is also proposed to ensure the development remains consistent with consent conditions.

- **Feral Animal Control Strategy;**

The strategy will be designed to target feral fauna deemed to be risk to the survival of native flora and fauna in the Pilliga. Weeds are included in this plan and measures would be undertaken to control them.

- **Historic Heritage Management Plan;**

The plan would include measures to guide the management and protection of identified heritage items within the project area.

- **Traffic Management Plan;**

The plan would be prepared in consultation with Narrabri Shire Council, Roads and Maritime, NSW Police Services and schools that may have routes near the site. A compliance monitoring and consultation procedure to deal with complaints arising from the project would also be developed.

- **Waste Management Plan;**

The plan would outline procedures for recording where different types of waste would be generated, specify waste and recycling collection systems and infrastructure, specify how waste would be transported and sorted onsite and how waste would be transported offsite.

- **Bushfire Management Plan;**

The plan would be developed in conjunction with the NSW Rural Fire Service and would include identification of risks, preparedness plans, identification of specific asset protection zones, identification of appropriate construction standards and annual works required.

- **Produced Water Management Plan;**

The plan would address the options for beneficial reuse options with the following sub-plans:

- **Irrigation Management Plan;**

Detail management methods on maintaining soil structure, productive capacity, and implement effective surface monitoring where required. A monitoring plan is also proposed.

- **Managed Release Protocol;**

The plan would outline the rules around releasing water into Bohena Creek. It would also link to the projects EPL, including toxicity based release criteria to ensure compliant management.

- **Decommissioning Management Plan;**

The plan would outline the decommissioning strategy per the '*NSW Code of Practice for Coal Seam Gas Well Integrity (DTIRIS 2012)*'. It would also detail the strategy for all other major infrastructure.

- **Rehabilitation Strategy;**

The plan would contain detailed rehabilitation schedules and monitoring and would be consistent with approval conditions.

Monitoring

The EIS states that the environmental management strategy for the project will be implemented using ongoing environmental monitoring for specific areas of environmental concern. This ongoing monitoring would be used to guide the management of environmental impacts through early identification.

Individual monitoring plans will include:

- Surface and groundwater;
- Biodiversity;
- Rehabilitation;
- Air quality; and
- Noise and vibration.

The proponent states that environmental monitoring requirements would be included in each sub-plan by technical discipline, with a few exceptions that require a stand-alone monitoring document e.g. the Water Monitoring Plan.

The proponent states that the proposed that the monitoring programs would be reviewed regularly and modified as appropriate to ensure they are adequate for the stated purpose.

Auditing and Compliance

Santos will be required to prepare and submit annual reports on compliance against its EPL and resource tenure. An independent audit has been proposed to be undertaken every three years with the findings being provided to the NSW Department of Planning and Environment and Commonwealth Government Department of Environment and Energy.

Summary of Potential Impacts

1. Largely, the chapter discusses the plans that should be developed with no specific on details, procedures or timing. The community raised concerns over the wording of the chapter with no explicit assurance given to the development of these plans and what role Council would execute on behalf of the community?

2. Environmental monitoring is proposed to be conducted by Santos and not an independent third party engaged by the regulator.

Recommendation to PAC

1. Council seeks more specificity regarding proposed management plans and when they will be developed and what opportunities will be afforded to the public to be involved in the development and sign off of the plans.
2. Council requests that the list of proposed plans be reviewed by the consent authority to ensure all necessary environmental management and monitoring measures are adequately addressed.
3. To provide transparency it is proposed that monitoring be carried out independently by a third party expert at the proponent's expense under the regulators guidance. The environmental monitoring results should be available to the community in an easily approachable format.
4. Council request the following monitoring requirements be taken into consideration:

All monitoring activities are to undertaken by a suitably qualified and independent body at the expense of the proponent and under the guidance of the lead regulator. In the interest of transparency all results and/or outcomes of the monitoring are to be provided to the NSW EPA and made freely available to the general public.

- Air quality

Construction

Particular matter (in particular PM10), VOCs and H2S at various locations around each construction site and in the vicinity of any known sensitive location

Operational

Quarterly Reporting of Air Emissions for (but not limited to):

- | | |
|------------------------------------|----------------------|
| ▪ Nitrogen Dioxide; | ▪ Particular matter; |
| ▪ Sulphur Dioxide; | ▪ Odour; |
| ▪ Sulphuric acid mist | ▪ VOCs; and |
| ▪ Molecular weight of stack gases; | ▪ H2S. |

- Surface Water / Waste Water / Groundwater

Base line analysis prior to operation and subsequent annual surface/effluent/groundwater sampling for (including but not limited to):

- | | |
|-----------------|---|
| ▪ TSS; | ▪ pH |
| ▪ BOD; | ▪ SAR |
| ▪ Oil & Grease; | ▪ Boron; |
| ▪ Total PAHs; | ▪ Sodium; |
| ▪ Phenols; | ▪ Calcium; |
| ▪ Total OC; | ▪ Potassium; |
| ▪ TPH/TRH; | ▪ Heavy metals (in particular Cadmium); and |
| ▪ Ec; | ▪ BTEX |

Installation of gauging station or other means to measure flow at the point of discharge to ensure dilution.

Recording of all extracted and discharged volumes.

- **Noise**

Annual (at the time of the annual return to the EPA) noise monitoring of the normal operation of the premises and flaring events in accordance with the NSW Industrial Noise Policy and AS 1055:

"Acoustics – Description and Measurement of Environmental Noise". The results of which are to be made freely available to the public.

The preparation and implementation of an Operational Noise Management Plan

- **Soil / Sediments**

Base line analysis prior to operation and subsequent yearly soil sampling for (including but not limited to):

- | | |
|-----------------|----------------|
| ▪ CEC; | ▪ SAR; |
| ▪ Ec; | ▪ Boron; |
| ▪ pH; | ▪ Sodium; |
| ▪ TPH; | ▪ Calcium; and |
| ▪ PAHs; | ▪ Potassium. |
| ▪ Heavy metals; | ▪ BTEX |

Annual river sediment sampling (if water level in Bohena Creek permits) downstream of the disposal site for (including but not limited to):

- | | |
|-----------------|----------------|
| ▪ CEC; | ▪ SAR; |
| ▪ Ec; | ▪ Boron; |
| ▪ pH; | ▪ Sodium; |
| ▪ TPH; | ▪ Calcium; and |
| ▪ PAHs; | ▪ Potassium. |
| ▪ Heavy metals; | ▪ BTEX |

Yours faithfully



Tony Meppem

DIRECTOR DEVELOPMENT AND ECONOMIC GROWTH

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