DOC18/435021

Mr Steve O'Donoghue
Manager Resource Assessments
NSW Department of Planning and Environment
GPO Box 39
Sydney NSW 2001

Dear Mr O'Donoghue

I refer to your email of 23 April 2018 to the NSW Environment Protection Authority (EPA) regarding Santos' Narrabri Gas Project's Environmental Impact Statement (EIS) Response to Submissions (RTS). The EPA has reviewed the RTS, focusing on Santos' responses to the matters raised in our 1 June 2017 advice to the Department of Planning and Environment (DPE) regarding the EIS. Following detailed technical assessement by specialist staff, the EPA is pleased to provide the following advice.

The RTS satisfactorily addresses a range of matters identified in the EPA's advice on the EIS. Accordingly, the EPA does not require any further clarification on these matters.

While the RTS provides additional information on a range of items, the EPA recommends DPE request further clarification from Santos on a number of outstanding matters, summarised under headings below. The provision of this additional information is crucial to ensure a robust assessment process that is commensurate with the scale and nature of the proposed project. Provision of the requested information will also provide greater assurance that Santos has a clear plan for managing the risks associated with the project.

The EPA recommends that, if approval for the project is granted, a number of matters be addressed via conditions of approval. Although the RTS provides supplementary information, there are a number of matters that the EPA considers are most appropriately addressed through conditioning. The EPA notes that these matters comprise issues that are generally managed through conditions of development consent or other applicable instruments. As lead regulator for gas activities in NSW, and in accordance with the *Memorandum of Understanding on the regulation of gas activities in NSW*, the EPA will provide advice on conditioning to ensure we can take the appropriate regulatory action if non-compliances with conditions are identified.

Finally, the EPA recommends that any management plans proposed by Santos or recommended by agencies are developed in consultation with the relevant agencies. The EPA also recommends the inclusion of enforceable conditions requiring Santos to implement, and operate in accordance with, all endorsed management plans, if approval for the project is granted.

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Waste

The RTS provides further information on the classification of salt waste. However, the EPA recommends DPE request further clarification regarding the disposal of this waste prior to project determination. The EPA also recommends DPE request additional information on the management and disposal of drill cuttings prior to project determination.

Groundwater

The RTS provides additional groundwater information. However, the EPA recommends DPE request further clarification on Santos' proposed monitoring program prior to project determination. The EPA also recommends that, should the project be approved, a condition is applied requiring that a formally endorsed groundwater monitoring program is developed and implemented in consultation with the Department of Industry – Land and Water (LW) and the EPA. The EPA further recommends that the groundwater monitoring plan include conditions relating to baseline analysis prior to activity commencement, and regular updating of model projections during the life of operations.

Produced Water

The RTS provides supplementary information on water related matters. However, the EPA recommends DPE request further information on the potential options for the beneficial re-use of treated water prior to project determination. If approval is granted, the EPA recommends DPE apply conditions relating to preferred and contingency water management options, including identification and assessment of specific irrigation areas.

Air

The RTS provides additional air quality information. However, the EPA recommends DPE request additional clarification on the characterisation and assessment of fugitive emissions, including methane, volatile organic compounds and air toxics. Additional detail on the proposed leak detection and repair program should also be requested. The EPA recommends that all other residual air quality matters be addressed via a revised assessment, based on detailed plant and project design, if project approval is granted.

Noise

The RTS largely addresses the EPA's recommendations on noise related matters. However, the EPA recommends DPE request further clarification on several minor issues related to noise impacts prior to project determination. The EPA has also identified a number of approaches to manage noise impacts, if approval is granted.

Further detail is provided on all of the topics outlined above at attachments A to E.

If you would like any further information please do not hesitate to contact Ms Sarah Carr on 02 6883 5383.

Yours sincerely

04/07/2018

ANDREW COWAN
A/Director Gas Regulation
Environment Protection Authority

Enclosure

Attachment	Title
A	Comments on waste management issues in the RTS
B	Comments on groundwater management issues in the RTS
C	Comments on produced water management issues in the RTS
D	Comments on Appendix I Air Quality Addendum
E	Comments on noise related issues in the RTS

Attachment A – comments on waste management issues in the RTS

Information reviewed

2018 – *Santos Narrabri Gas Project Response to Submissions,* Section 5.6

Matters resolved requiring no further clarification

1. Waste storage

EPA EIS recommendation: The EPA recommended that Santos provide additional information regarding the quantity and classification of waste that may be temporarily stored on site prior to disposal.

Comment on RTS: The RTS directs the EPA to a number of tables in the EIS which contain this information. The information in the EIS identifies quantities and classification of waste that may be temporarily stored on site prior to disposal at different stages of the project life cycle.

Recommendation: No further clarification required.

Matters that can be resolved through conditions of approval – should the project proceed

2. Waste classification of salt

EPA EIS recommendation: The EPA recommended that Santos provide further information to demonstrate that waste salt would not contain any contamination which may change its classification.

Comment on RTS: The EPA is satisfied with the additional information that Santos provided in the RTS with regard to the current potential for contamination of the waste salt. However, this assessment relies on the quality of the produced water and brine remaining consistent through the life of the project.

Recommendation: The EPA recommens DPE include a condition of consent requiring Santos develop a waste management plan, in consultation with the EPA. This should include requirements for an ongoing monitoring program to ensure consistency with waste guidelines and to confirm the classification of waste over life of the project.

Matters requiring additional information prior to project determination

3. Waste Salt Disposal

EPA EIS recommendation: The EPA recommended that Santos identify the facilities where the salt waste is to be disposed and demonstrate the capacity and capability of those facilities to handle the salt.

Comment on RTS: The RTS does not provide the details requested. The EPA has concerns regarding the disposal of the salt waste as it has the potential to create a large point source of salt in the environment if not disposed of appropriately. The EPA expects that many, if not all, landfill facilities in the local government area will not have the capacity to receive the quantity of salt (and other waste) generated by the project. Furthermore, sites with capacity may not be capable of managing that salt in an environmentally satisfactory manner because they may be un-lined or not have an operating leachate management system.

Recommendation: The EPA recommends DPE request from Santos further information detailing the criteria that will be used when selecting disposal facilities, prior to project determination. This information should include the measures that will be used to evaluate landfill capacity and capability. DPE should also request an assessment of salt disposal options at different scales, including:

- what is the capacity and capability of local landfills located within 200km of the project to take the quantities and types of waste proposed to be generated by the project?
- what is the capacity and capability of landfills at a regional scale (Northern Inland Regional Waste) to take the quantities and types of waste proposed to be generated by the project?
- the assessment should also outline any contingencies if either option stated above does not achieve the desired waste management outcomes. This should include accessing landfills in other parts of the state.

4. Drill Cutting Disposal

EPA EIS recommendation: The EPA recommended that Santos supply additional information relating to the management of drill cuttings at the well pad sites. Additionally, the EPA requested that Santos provide detail on how they will determine whether the drill cuttings are suitable for reuse under the strategy (the EIS indicates that a suitability assessment is carried out).

Comment on RTS: The RTS provided some additional information, mostly regarding the separation of coal-based and other drill cuttings. However, not all requested information was provided. The EPA has concerns regarding the management of non-coal drill cuttings at the drill pad sites, specifically the suitability of this material for the use on well pads. This is important to consider to ensure long term rehabilitation and revegetation outcomes are met. Santos indicate that they intend to reuse non-coal cuttings by land applying those on the pad site using a “mix, turn, bury” strategy. The RTS did not provide any detail on what the strategy entails or how Santos will determine suitability for reuse under the strategy.

Recommendation: The EPA recommends DPE request from Santos further information fully describing the “mix, turn, bury” strategy, prior to project determination. Additionally, the EPA recommends that DPE request further detail from Santos regarding determining the suitability of using non-coal cuttings at drill pad sites. The EPA also recommends DPE request Santos conduct ongoing monitoring of this material over the life of the project to continually assess the suitability of using this material at drill pad sites as part of a waste management plan.

5. Waste risk assessment and management plan

EPA EIS recommendation: The EPA recommended that Santos provide further details regarding the waste risk assessment and provide a copy of the Waste Management Plan referenced in the EIS.

Comment on RTS: The RTS indicates that the waste management plan, which is likely to contain the relevant detail, has not been completed or implemented. (Note: a Waste Management Plan for exploration phase and conceptual Waste Management Plan had been prepared for the EIS). The risk matrix that was provided indicates that details of risk mitigation measures necessary for the management of waste at the site are to be outlined in the waste management plan. Without being supplied the waste management plan the EPA is not able to assess the risk mitigation measures which are to be in place to manage waste at the site.

Recommendation: The EPA recommends DPE request further information from Santos on mitigation strategies to manage potential impacts associated with waste for the project, prior to project determination, including:

- proposed mitigation and management measures to manage the risks as identified in the risk matrix.
- proposed contingencies if the preferred mitigation and management measures cannot be achieved.

The EPA also recommends DPE request this information is included in the Waste Management Plan to be developed, if the project is approved. The EPA recommends that DPE include the development of the Waste Management Plan as a condition of consent.

6. Waste aspects of produced water management

EPA EIS recommendation: The EPA recommended that Santos provide additional information about the management and beneficial reuse of the treated, amended, and produced water.

Comment on RTS: The RTS provides additional surety that Santos understand their regulatory obligations with regard to the reuse of the produced water. The RTS provides a general commitment under the *Protection of the Environment Operations Act 1997*, including reference to Environment Protection Licences and resource recovery arrangements.

Recommendation: The EPA recommends DPE request Santos provide additional information outlining the available options to lawfully dispose of the produced water from the water treatment plant, prior to project determination. This should include developing in principal agreement with the EPA on these disposal options. Specifically, this would include in principal agreement on the contents of any Resource Recovery Order and Exemption.

Attachment B – comments on groundwater management issues in the RTS

Information reviewed

2018 – *Santos Narrabri Gas Project Response to Submissions,* Section 5.6

2018 – Appendix D - *Santos Narrabri Gas Project Water Baseline Report Response to Submissions,* prepared by EcoLogical Australia and CDM Smith, December 2017

Matters that can be resolved through conditions of approval – should the project proceed

1. Gunnedah Basin Regional Groundwater Model

EPA EIS recommendation: The EPA recommended the proponent increase Gunnedah Basin Regional Groundwater Model (GBRM) confidence by conducting ongoing testing of geological layers encountered during installation of gas and monitoring wells to characterise hydraulic properties within the Gunnedah Oxley Basin (GOB). This data should then be used to regularly update the GBRM and associated predictions of groundwater impacts.

Comment on RTS: The RTS answered the recommendation and stated that the proposed water monitoring plan provisions for regular data review and, if required, model re-calibration, re-prediction, and review and revision of groundwater monitoring and management.

The RTS also states the proponent will collect hydrostratigraphic data during drilling and installation of coal seam gas wells for the project, and that Santos will also support local-scale review of the thickness of the intersected strata and hence provide updated values for the model.

Updates to the GBRM will need to occur when further data becomes available through the monitoring and baseline requirements outlined in the recommendations below.

Recommendation: The EPA recommends DPE include a condition of consent requiring Santos update the GBRM as further data becomes available through the ongoing monitoring and baseline data collection.

2. Water Quality

EPA EIS recommendation: The EPA recommended that detailed management plans and trigger action response plans be developed, in consultation with the relevant agency, prior to commencement of proposed activities, with appropriate trigger actions and thresholds determined from robust statistical analysis of baseline data trends.

Comment on RTS: The Water Monitoring Plan (EIS Appendix G3) includes these concepts, including identification of thresholds, trigger levels and management actions designed to reflect the level 1 and level 2 impacts defined in the NSW Aquifer Interference Policy. The proponent also committed to working with relevant Commonwealth and State Government stakeholders to refine the groundwater monitoring program for the project.

Recommendation: The EPA recommends DPE include a condition of consent requiring Santos develop a Water Monitoring Plan, in consultation with EPA and LW that contains:

- trigger action response plans for any changes in groundwater quality
- thresholds for water quality impacts considering baseline data collected.

3. Water Baseline Report

EPA EIS recommendation: The EPA recommended additional water quality baseline monitoring points to be installed and sufficient baseline dataset be collected to address groundwater quality prior to installation of gas wells in each area across the western area of the GOB and within the Narrabri Gas Project Area (NGPA).

Comment on RTS: All available hydrogeological data is presented in the revised Water Baseline Report (WBR) with assessment of its capability to provide interpreted surfaces. This includes all water level / water pressure data and hydraulic properties reported by the hydro-geological formation and described spatially in relation to the project.

The data on hydrogeological properties summarised in Section C of the Groundwater Impact Assessment (GIA) are referenced to their sources and are publicly available. Relevant data compilations are explicitly described and presented in the updated WBR.

Santos committed to working with relevant Commonwealth and State Government stakeholders to refine the groundwater monitoring program. However, Santos have provided no sureties that an expansion of monitoring infrastructure to further establish baseline confidence will occur.

Recommendation: The EPA recommends DPE include a condition of consent requiring Santos update the Water Monitoring Plan, prior to commencement of works, in consultation with the EPA and LW to:

- commit to installation of monitoring bores as the gas field is progressively developed
- ongoing collection of baseline dataset.

Matters requiring additional information prior to project determination

4. Water Quality

EPA EIS recommendation: The EPA recommended that Santos commit, where current facilities are expanded, to additional monitoring points being installed commensurate with extent and nature of the new development. These monitoring points should be identified and constructed prior to commissioning of new infrastructure.

Comment on RTS: The RTS states the proposed water monitoring network includes sentinel monitoring bores that are strategically located within deeper formations close to target coal seam. The monitoring plan includes trigger values for early warning and management actions for further investigation into potential risks to shallower high value groundwater sources.

The RTS states all monitoring data will be compiled into a reporting framework, such that sufficiency of monitoring will be continuously assessed to allow identification of additional monitoring requirement. The RTS also states the Water Monitoring Plan will be updated to reflect necessary changes.

Santos have committed to considering new seepage detection monitoring around any new produced water storage facilities in line with *Code of Practice for Produced Water Management, Storage and Transfer*.

The RTS does not provide assurances that an expansion of monitoring points in conjunction with an expansion of development will occur. The RTS justifies this by stating the existing monitoring bore network is adequate with sufficient coverage to account for the area. However, the EPA believe further coverage should be provided, in particular in the areas to the west of the project area.

Recommendation: The EPA recommends DPE request Santos further develop a conceptual Water Monitoring Plan in consultation with the EPA and LW, prior to project determination. The plan must:

- enable validation of current and future model simulations and associated predictions
- be capable of detecting water level and quality impacts from coal seam dewatering before they propagate into beneficial aquifers.

The EPA also recommends DPE include a condition of consent requiring Santos develop a Water Monitoring Plan based on this conceptual Water Monitoring Plan agreed to with EPA and LW, if the project is approved.

5. Water Monitoring Plan

EPA EIS recommendation: The EPA recommended that the proponent revise the Water Monitoring Plan to include monitoring the areas of greatest potential impact, as identified by the GBRM and associated uncertainty analysis as presented in the GIA.

The EPA recommended Santos revise the Water Monitoring Plan, in consultation with the EPA, with baseline data monitoring locations as presented in the Water Baseline Report (WBR).

The EPA also recommended that proposed groundwater monitoring infrastructure be installed and monitored to establish a baseline prior to gas well (including pilot well) development.

Comment on the RTS: The areas of greatest potential impacts identified in the Model and the GIA, were not addressed in the Water Monitoring Plan. The only revisions to the Water Monitoring Plan detailed in the RTS were that it would be revised with available and reliable data of future data. Future data is reliant on the establishment of monitoring infrastructure.

Recommendation: The EPA recommends DPE request Santos further develop a conceptual Water Monitoring Plan, in consultation with the EPA and LW, prior to project determination. The plan must:

- better incorporate water level impact findings presented in the EIS
- enable validation of current and future model simulations and associated predictions
- demonstrate that sufficient data will be collected to enable significant improvements in the certainty of regional groundwater flow model simulations and regular intervals over the lifetime of the activity
- be capable of detecting water level and quality impacts from coal seam dewatering before they propagate into beneficial aquifers.

The EPA also recommends DPE include a condition of consent requiring Santos develop a Water Monitoring Plan based on this conceptual Water Monitoring Plan agreed to with EPA and LW, if the project is approved.

Attachment C – comments on produced water management issues in the RTS

Information reviewed

2018 – *Santos Narrabri Gas Project Response to Submissions,* Section 5.6

2018 – Appendix D - *Santos Narrabri Gas Project Water Baseline Report response to Submissions,* prepared by EcoLogical Australia and CDM Smith, December 2017

Matters that can be resolved through conditions of approval – should the project proceed

1. Water balance

EPA EIS recommendation: The EPA's submission recommended that "*the proponent demonstrate that the various water management options identified in the EIS have been sufficiently scoped to ensure that the predicted disposal volumes can be realised, and that contingency plans are in place if any or all the disposal options identified cannot be delivered*."

Comment on RTS: The RTS does not fully scope elements to achieve water balance and developed contingency plans, including:

- of the 9,000ha of irrigation land identified as suitable for irrigation, no specific areas are confirmed as being available
- the EPA's submission recommended that contingency areas (in addition to the 500ha required for modelled irrigation rates) and the location of offsite storages be identified prior to produced water being generated and specified in the relevant Irrigation Management Plan(s). This contingency is important to cover a range of potential uncertainties when producing and storing effluent and managing a 500ha irrigation area with potentially multiple users
- the EIS indicates that the 200ML for storage of treated irrigation water will be provided offsite. The location and operation of these storages has not been identified or discussed
- the EIS states that: "*In the unlikely event that water levels approached the maximum storage capacity of a pond, water production can also be ceased.*"

It should also be noted that the NSW Effluent Irrigation Guidelines advises that "*establishing the commercial responsibilities of suppliers and users of effluent can be achieved through the development of agreements between the effluent supplier and user*".

Produced Water Management Plan
The EIS stated that a Produced Water Management Plan (PWMP) will include "*a water balance that would detail the quantities of water being stored, treated and beneficially reused by option and over time*." A PWMP and water balance cannot be implemented without irrigation areas being confirmed as available for the duration of years required for peak and ongoing water production volumes.

Recommendation: The EPA recommends DPE include a condition of consent that requires Santos develop a PWMP, in consultation with the EPA, prior to produced water being generated, that includes:

- clear identification of access to sufficient irrigation area and offsite storage, and/or clear processes and milestones to do so, to sustainably irrigate effluent in the lead up to peak water production, during peak water production, and for the remaining years of water production
- contingency irrigation areas (i.e. in addition to the nominated 500ha)
- confirmation of agreements with third parties receiving effluent to establish the commercial responsibilities of the supplier and user of effluent and ensure the water balance is achieved

- details on how landowners will coordinate optimal cropping regimes to ensure the water balance is maintained throughout a year and throughout the project
- how amended and unamended water would be distributed to the various reuse options
- a process for annual review and reporting of the water balance based on actual reuse locations, water volumes treated, reuse volumes, and rainfall
- procedures and management triggers for use of produced water storages as upstream storage for excess irrigation or discharge
- procedures and triggers for ceasing produced water production if water is more than all available management options.

2. Agricultural irrigation

Soil survey data and density

EPA EIS recommendation: The EPA requested clarity regarding the soil assessment methodology to consider its application at an operational irrigation scale, including providing Santos with detailed examples.

The EPA submission also recommended that detailed soil surveys and/or appropriate baseline monitoring of specific sites to be irrigated be conducted prior to produced water being generated.

Comment on RTS: While water quality levels presented in Appendix D of the RTS have improved compared to those assessed in the EIS, the need for appropriate baseline assessment/monitoring of soils remains as some risks relate to water volume (e.g. water logging) and treated water quality levels could vary once operational rates of water production and treatment commence.

Additional information on the references used were provided and this information can be assessed when operational scale irrigation areas are identified. At this time, however, specific irrigation areas have not been identified and appropriate operational scale assessments have not been conducted.

Recommendation: This recommendation is captured under a consent condition related to the PWMP below.

Soil risks

EPA EIS recommendation: The EIS and EPA submission highlighted that the different soil types in potential irrigation areas have different sets of risk factors, including sodic subsoils, saline soils and potential waterlogging. The EPA submission recommended that baseline assessments of specific irrigation areas should better define the specific soil risk(s) for each soil type and landscape and provide an appropriate basis for identifying and managing key differences (e.g. between Vertisols and Sodsols).

Comment on RTS:

Customised amendment

The RTS states that: "*distribution of treated and amended water for irrigation use has yet to be determined. The proponent notes, however, that all interested landholders will have data to support the use of the amended waters for irrigation on their soils. This information will be used by the landholders subsequent to approval and will allow customised amendment of treated waters to suit the specific soils and intended use*". It is not clear how customised amendment would occur with potentially multiple end users over a large geographic area.

Landowner assessments proposed in RTS
The EIS irrigation assessment stated a specific need for:

- cropping based on optimal, year-round utilisation of water

- irrigation equipment and methods (e.g. center pivots; variable frequency drive pumps, redundant pumping systems, onsite weather stations)
- monitoring equipment and methods (e.g. soil moisture monitoring is considered essential and deficit irrigation and automation is recommended)
- pre-irrigation assessments (e.g. electromagnetic induction (EMI) surveys, baseline monitoring, soil dispersity and cation exchange capacity, and soil permeability)
- site establishment actions, including tree clearing and soil surface leveling (e.g. strongly gilgai Vertosol unit will need to be levelled if it is to accommodate irrigation)
- storage of 200 ML of effluent "offsite" that may include landowner's properties.

The RTS states that: "*Consistent with standard practice, irrigators would undertake their own assessment of the suitability of their land in line with typical irrigation management practices that would consider leaching fraction, drainage, water quality and a range of other parameters, including soil assessment through soil survey and analysis, to inform the suitability of the land for irrigation*." The RTS is therefore indicating that the above key requirements for sustainable irrigation are to be undertaken by individual irrigators.

Recommendation: The EPA recommends DPE include a condition of consent that requires Santos develop a PWMP in consultation with the EPA and LW that includes:

- a procedure for the collection of site-specific soil surveys and/or baseline monitoring of irrigation sites to develop management requirements that ensure the sustainability of irrigation. This must include, but not be limited to:
  - representative soil baseline data relevant to an operational scale irrigation scheme
  - sampling to cover key soil parameters such as salinity, exchangeable sodium percentage (ESP)/sodium adsorption ratio (SAR) values, and permeability/water logging risk
  - adequately detailed soil profile descriptions
  - an initial EMI survey of all potential irrigation areas so that a common baseline data set is established
  - an inland acid sulfate soil risk assessment, including testing of soil materials from lower slope and drainage line locations for titratable acidity and acid-base accounting
  - use of a standardised soil classification system across all irrigation areas
  - an appropriate basis for identifying and managing key differences between Vertisols and Sodsols, including profile textural ranges and volume expansion to allow the two soils type to be effectively differentially managed
  - appropriate ongoing soil monitoring of each risk factor (to be implemented based on baseline assessments), including, at a minimum: salinity, ESP/SAR, permeability/water logging and pH
- clearly defined Trigger, Action and Response Plans
- protocols for dust suppression and stock water use.

3. Bicarbonate

EPA EIS recommendation: The EPA submission noted a target alkalinity value of 139 mg/L and recommended that bicarbonate levels in effluent be clarified and the implications for soils in the irrigation areas addressed in Irrigation Management Plans.

Comment on RTS: The RTS has provided bicarbonate data from the Leewood Water and Brine Treatment Plant that indicates levels in treated and amended water of around 30 mg/L. This level is below the Queensland Government limit for beneficial reuse of coal seam gas waters of 100 mg/L (DERM 2000). However, monitoring of bicarbonate in effluent is recommended considering sodicity is an identified risk factor for soils in the proposed irrigation areas.

Recommendation: This recommendation is captured under a consent condition related to monitoring below.

4. Un-amended effluent Sodium Absorbtion Ratio risk assessment including stockwater supply

EPA EIS recommendation: The EPA submission identified potential impacts of reuse or discharge of un-amended water with elevated SAR, including proposed use on forested soils and access tracks, site construction and operation areas, and for stock drinking water and stock water dams. EPA requested further information on SAR levels and associated risks.

Comment on RTS: The RTS provides a suitable response to the above issues as follows:

- the maximum SAR for treated and treated and amended water are 29 and 3.7 respectively
- irrigation of vegetated forest areas is not proposed
- only effluent amended for SAR risks will be used for any irrigation reuse activity including dust suppression on forested roads, well pads, and construction and operational areas.

The RTS does not provide sufficient information in relation to stock watering where unamended water is still proposed for use and the potential risks to the integrity of stock water dams receiving unamended effluent has not been addressed.

Recommendation: The EPA recommend that DPE include a condition of consent, if the project is approved, that requires:

- the use amended effluent for all reuse activities (except for fire-fighting)
- any proposal for reuse of unamended effluent, such as stock water use, must be adequately assessed in consultation with the EPA and DPI prior to undertaking the reuse activity
- there must be no irrigation in forested areas other than amended effluent use for dust suppression on roads, access tracks and project construction and operational areas.

5. Discharges to Bohena Creek

a. NSW Water Quality Objectives and downstream users

EPA EIS recommendation: The EPA submission recommended further assessment of downstream users to describe and consider impacts on all potential environmental values and downstream human uses.

Comment on RTS: The RTS compares treated water quality with stock water guidelines for a range of analytes. However, information has not been provided on actual downstream water uses. It is important that all relevant downstream water users are identified and considered in the assessment (e.g. if out of specification water is discharged then the relevant downstream users can be identified and notified by the operator).

Recommendation: The EPA recommends DPE include a condition of consent that requires Santos develop a Produced Water Management Plan in consultation with the EPA and LW that includes:

- identification and consideration of all downstream water uses and values in operational plans regarding potential exceedances of water quality guidelines, including homestead water use, stock water, irrigation, recreation and aquatic ecosystems
- consideration of all relevant downstream environmental values in commissioning monitoring and monitoring to validate the mixing zone model.

b. Managed release trigger

EPA EIS recommendation: The managed release trigger of 100ML/day is proposed to be measured about 6 to 8 km downstream of the discharge point. The EPA submission advised that there is the potential for substantial variation in flow volumes between the two locations given variation in the morphology of the creek and recommended a monitoring point for the flow trigger

upstream of the proposed discharge point. The submission also recommended a release protocol be developed that clearly indicates the trigger(s) to stop discharging.

Comment on RTS: The RTS noted that the variable nature of the bed at the discharge point would limit flow measurement and calibration of the flow at the discharge with the Newell Highway site is possible. EPA considers that when flows are approaching and exceeding 100ML/day the variable nature of the bed would not be a limiting factor in flow measurement.

Recommendation: The EPA recommends that DPE include a condition of consent, if the project is approved, that requires:

- the monitoring location for the managed release trigger of 100ML/day must be at or immediately upstream of the proposed discharge point
- if the discharge point is not located upstream that Santos provide evidence of why this is not a practical site and provide an alternative that will ensure the same outcomes can be met.

In addition, a release protocol must be developed in consultation with the EPA that clearly indicates the trigger(s) to commence and stop discharging to Bohena Creek.

6. Other pollutants

EPA EIS recommendation: No recommendation on the EIS. This is in response to further information provided in the RTS (Appendix D).

Comment on RTS: The RTS (Appendix D) provides additional water quality data to consider the potential impacts of the proposed discharge. Discharge risks including ionic risks, some major ions (such as bicarbonate), hydrocarbons and ammonia were not able to be fully assessed as part of the EIS.

Ammonia and Hydrocarbons

Ammonia levels in treated and treated and amended water are higher than predicted in the EIS. Levels in treated water (250 µg/L) are now above the Australian and New Zealand Environment Conservation Council (ANZECC) guidelines for lowland rivers (20 µg/L). No data is presented on hydrocarbons in the RTS. Hydrocarbons should be included in commissioning monitoring and potentially ongoing monitoring suites (subject to results) for the water treatment plant.

Treatment chemicals

A range of treatment chemicals are used in the reverse osmosis process, e.g. effluent will be chlorinated after treatment/before discharge. Residual chlorine is toxic, although residence time in water is short. The ANZECC guideline trigger value for residual chlorine is 3 µg/L in freshwater and is close to acutely toxic values. Residual levels must be managed to ensure no toxicity at the point of discharge. The RTS proposes to periodically monitor treatment chemicals in treated water.

Bicarbonate and ionic risk

Bicarbonate and iconic risks are recommended for inclusion in ongoing water treatment plant monitoring and should be included in an initial discharge monitoring program to verify predictions.

Salinity

EPA EIS recommendation: The EPA recommended that the electrical conductivity value in the assessment should be a specific value and not a general range. A trigger value of 200 µS/cm should be used as an indicative level for any further mixing zone assessments based on actual water quality data.

Comment on RTS: Once Bohena Creek exits the Pilliga Forest the predominant landscape is of lowland type and below 250m so the trigger value for slightly to moderately disturbed lowland systems applies (12-2200 µS/cm). A salinity value within this range therefore needs to be established. The preferred option in the ANZECC guidelines is to use site-specific data to develop local trigger values.

To narrow the default salinity range in ANZECC the incomplete data set can be used and the 80th percentile trigger value updated as additional data becomes available. Based on the available data, the trigger value for EC should be about 200 µS/cm. This trigger value can be used as an indicative level for further mixing zone assessments based on actual water quality data.

The RTS has not demonstrated that the 80%ile tigger value has been calculated consistent with ANZECC guidance for reference sites and data requirements. This can be addressed in consultation with the EPA.

Salinity levels in the discharge are potentially lower than predicted in the EIS based on data from the Leewood Water Treatment Plan (WTP). With an EC maximum value of 83 µS/cm there is a need to consider if there is potential for ionic impacts due to low salinity as minimum and average values will be lower.

Recommendations to address these issues can be found below in section 7.

7. Mixing zone assessment

EPA EIS recommendation: The EPA requested additional information on the mixing zone assessment to verify predictions as the EIS did not contain sufficient Cormix input data to verify plume dispersion and the occurrence of the predicted 10:1 dilution at the edge of the near-field mixing zone.

Comment on RTS: Appendix D of the RTS does not cover the full range of potential pollutants that must be assessed in commissioning stage monitoring or to validate the mixing zone modelling. The EPA believe that the full range of potential pollutants must be covered and used as a basis for the mixing zone assessment.

Recommendation: The EPA recommens that DPE include a condition of consent, if the project is approved, requiring Santos:

- conduct an updated modelling assessment prior to discharge that:
  - provides the additional Cormix information requested by EPA in its submission
  - considers potential ionic risks, osmotic impacts of low salinity, bicarbonate, ammonia, hydrocarbons, treatment chemicals and the full range of analytes assessed in commissioning monitoring for the Leewood WTP (the commissioning analytes are set out in the document entitled “Santos Energy NSW Leewood Phase 2, Water Treatment Plan”, Document No: 7056-465-PLA-0001, dated 19 November 2015)
- monitoring of the mixing zone occurs in conjunction with commissioning assessments to validate model predictions of dilution
- initial direct toxicity assessment of representative effluent during the commissioning stage to assess any combined impacts of different chemicals in the discharge water, including biocides and treatment chemicals. Toxicity testing methodology should be developed in consultation with the EPA. Direct toxicity assessment testing can then be used as a future monitoring tool if there are any significant departures in chemical quality and should be based on the most sensitive test species identified during the initial test. A trigger value system should be developed in a discharge management plan to identify the need for any future toxicity testing.

8. Monitoring and reporting

EPA EIS recommendation: No recommendation on the EIS. This is in response to further information provided in the RTS (Appendix D).

Comment on RTS: As noted above, Appendix D of the RTS does not cover the full range of analytes that could be a risk in effluent for discharge or reuse. As part of exploration activities there were requirements for the development of a Water Treatment Plan that included commissioning and ongoing monitoring requirements for effluent quality. These same requirements should apply to the operation stage and it is noted that WTP commissioning data generated during exploration and appraisal activities can contribute to WTP commissioning data for the operational stage.

Recommendation: The EPA recommends that DPE include a condition of consent, if the project is approved, requiring Santos to include information in the PWMP on water treatment to ensure the treatment process meets the requirements for the proposed end uses or disposal options for treated water. This should include but not be limited to:

- a commissioning monitoring program and report for the water treatment plant that must:
  - be developed in consultation with the EPA prior to commencing full scale operations
  - be consistent with commissioning monitoring requirements and analytes set out the document entitled "Santos Energy NSW Leewood Phase 2, Water Treatment Plan" (Document No: 7056-465-PLA-0001, dated 19 November 2015)
  - in addition to the commissioning analytes in Document No: 7056-465-PLA-0001, include hydrocarbons and any chemicals used in the WTP that may have a non-trivial impact on water quality
  - consider all end-uses of effluent
  - propose ongoing water quality monitoring, including monitoring to be required under the EPL
- ongoing operational monitoring requirements for discharge and reuse (subject to results from the treatment plant commissioning monitoring). Note that monitoring requirements for pollutants may be removed, added or amended in an Environment Protection Licence (EPL)
- maintenance, operational triggers and responses to ensure that the treatment process is functioning in a proper and efficient manner
- procedures for water discharges that do not meet specifications, treatment failure, spills, and communication with downstream water users.

9. Discharge monitoring

Comment on RTS: Standard 'Pollution of Water' General terms of approval can be used for ongoing discharge monitoring requirements, including reference to Section 120 of the *Protection of the Environment Operations Act 1997*, and analytes, limits and monitoring in accordance with an EPL.

Recommendation: The EPA recommens that DPE include a condition of consent, if the project is approved, requiring Santos to:

- conduct ambient upstream and downstream monitoring
- conduct sampling during or immediately after discharges (and not "within 5 to 7 days")
- include a downstream monitoring point close to the edge of the modelled near-field mixing zone.

Attachment D – comments on Appendix I Air Quality Addendum

Information reviewed

2018 – *Santos Narrabri Gas Project Response to Submissions,* Section 5.6

AEN, 2018 – Appendix I - *Santos Narrabri Gas Project Air Quality Impact Statement Response to Submissions,* prepared by Air Environment Consulting for GHD, no date supplied (the Air Quality Impact Assessment (AQIA) addendum)

Matters resolved requiring no further action

1. Choice of Air Dispersion Model

EPA EIS recommendation: The EPA recommended the proponent should clarify the choice of models used for different activities associated with the project.

Comments on AQIA addendum: The AQIA addendum includes additional discussion on the choice of dispersion models for different activities. The response advises that:

- modelling utilising CALPUFF was conducted for air emission sources with a known fixed geographic location, specifically the facilities at Leewood and Bibblewindi and other emission sources considered (Wilga Park Power Station)
- it was not feasible to utilise CALPUFF to assess the impact to sensitive receptors for sources that have not yet been determined and sited (well pad emission sources)
- a generic AUSPLUME model configuration was used to determine the distance between the source and receptor at which the air quality assessment criterion is met for well pad emission sources.

Recommendation: No further action required.

2. Particulates criteria

EPA EIS recommendation: The EPA recommended the proponent revise the AQIA to asses PM_{10} and $PM_{2.5}$ impacts against the *Approved Methods for Modelling and Assessment of Air Pollutants in NSW* (2016).

Comments on AQIA addendum: The AQIA addendum advises that the changes in the impact assessment criteria of PM_{10} and $PM_{2.5}$ within the revised *Approved Methods for Modelling and Assessment of Air Pollutants in NSW* have not affected the conclusions of the air quality assessment. Specifically:

- predicted maximum 24-hour and annual average ground level concentrations of PM_{10} complied with the revised impact assessment criterion
- predicted maximum 24-hour and annual ground level concentrations of $PM_{2.5}$ complied with the revised impact assessment criterion.

A summary of the predicted incremental ground level concentrations for PM_{10} and $PM_{2.5}$ is tabulated below.

Recommendation: No further action required.

Pollutant	Leewood and gas fired infrastructure at well pads	Leewood and diesel fired infrastructure at well pads
$PM_{2.5}$ (24 hour)	~ 1 ug/m3 (5% of IAC)	~ 6 ug/m3 (23 % of IAC)
$PM_{2.5}$ (annual)	< 1 ug/m3 (4% of IAC)	~2 ug/m3 (21 % of IAC)
PM_{10} (24 hour)	~1 ug/m3 (2 % of IAC)	~1 ug/m3 (2% of IAC)
PM_{10} (annual)	< 1 ug/m3 (< 1 % of IAC)	< 1 ug/m3 (<1 % of IAC)

Matters that can be resolved through conditions of approval – should the project proceed

3. Emission estimation

EPA EIS recommendation: The EPA recommended Santos provide further clarification of all potential emissions from the project in the AQIA. Any identified air emissions should be assessed. The proponent should also provide further clarification on the actual equipment items that will be installed as part of the project. Sources of information for site-specific source parameters and emission factors should include supplier guarantee or monitoring data.
Specifically, the EPA noted:

- should gas turbines be used in the final design, a different Clean Air Regulation limit may apply
- actual operation of the project may be different to the nominal assumptions and parameters in the AQIA
- fuel specification for diesel fuel to be used in the generators are also not specified.

Comments on AQIA addendum: The AQIA addendum advises:

- that at this early stage of the project's development planning, no decisions have been made on the specific type and model of engines for power generation and that actual equipment specifications and supplier details will not be known until the Front End Engineering Design (FEED) is completed
- gas turbines were not proposed and have not been considered.

The AQIA addendum does not include a detailed process description of all equipment items, specifically the response has not described the membrane/amine treatment and triethylene glycol dehydration system(s). Potential emissions/discharges from these sources have not been described or assessed.

The assessment has been based on nominal assumptions, emission factors and/or Clean Air Regulation limits. Newly designed and purchased equipment should be able to achieve emissions lower than the Clean Air Regulation in line with contemporary best practice emission performance.
The addendum states that the mass emission rate of sulfur dioxide for diesel-fired well pad generators were estimated based on National Pollutant Inventory (NPI) emission factors, and based on the sulfur content of diesel reported in the NPI. Sulfur dioxide emissions factors as per NPI emission estimation technique manual is based on a 10 ppm maximum sulfur content in diesel fuel as per the Australian Fuel Standard (Automotive Diesel).

Recommendation: The EPA recommends DPE include a condition requiring additional assessment of all processes and emission sources associated with the project, if the project is approved. This must include the Leewood gas processing plant and the gas field. The revised assessment must:

- be completed prior to the commencement of project construction
- be based on final plant design, engineering parameters and emission performance
- provide detailed description of all processing plant including but not limited to gas processing and treatment systems such as they triethylene glycol dehydration systems

- demonstrate that the plant design and emission performance is consistent with best practice emission performance
- account for cumulative impacts.

4. Emission types

EPA EIS recommendation: The EPA recommended that further information regarding all potential pollutants of concern associated with the project should be provided.
Specifically, the EPA noted that the assessment for ground level impacts focused on buffer limiting pollutants such as PM_{10} and NO_2. For transparency each identified pollutant should have been assessed, noting:

- impacts from PAHs are not presented
- $PM_{2.5}$ emissions from construction were estimated in the AQIA but the results only show PM_{10} as the buffer limiting pollutant
- $PM_{2.5}$ emissions from operational activities were not assessed in the report.

Comments on AQIA addendum:

Assessment of all identified pollutants

The AQIA addendum presents ground level concentrations of all other pollutants due to project activities for all scenarios predicted at any location beyond the site boundaries and at the closest sensitive receptors in Appendix A of the AQIA. Predicted ground level concentrations (~>1% of assessment criteria) for additional pollutants assessed are tabulated below. Predicted ground level concentrations are presented as a percentage (%) of the impact assessment criteria prescribed in the *Approved Methods for Modelling and Assessment of Air Pollutants in NSW.*

	Routine in Isolation		Considering Well Pads	
Pollutant	Leewood Power (Option 1)	Grid Power (Option 2)	Leewood Power (Option 1)	Grid Power (Option 2)
NO_2 (1 hour)	40 %	40 %	48 %	48 %
NO_2 (annual)	6 %	6%	14 %	14 %
Ozone (1 hour)	48 %	48%	49 %	49 %
Ozone (4 hour)	31 %	31%	92 %	36 %
$PM_{2.5}$ (24 hour)	5 %	5 %	23 %	23 %
$PM_{2.5}$ (annual)	3 %	3 %	21 %	21 %
PM_{10} (24 hour)	2 %	2 %	2 %	2 %
PM_{10} (Annual)	1 %	1 %	1 %	1 %
Cadmium	3 %	3 %	3 %	3 %
Formaldehyde	8 %	< 1 %	18 %	10 %
Acrolein	71%	-	83 %	-
PAH (as BaP)	< 1 %	< 1 %	< 1 %	< 1 %

Notes: - Not assessed in RTS or EIS
BaP – Benzo[a]pyrene

These predictions do not represent predictions at sensitive receptors, rather, they are predictions beyond the site boundary for the Leewood power supply option coupled with nominal predictions at a select distance from a well pad emissions.

Predicted impacts for acrolein were not included in the RTS for Option 2. However, this is not expected to change the outcomes of the assessment as Option 2 (Grid Power) is based on fewer emission sources and lower emissions than Option 1 (Leewood power).

Particulate matter – Construction

The response to submissions does not provide a $PM_{2.5}$ assessment for construction activities but advises that construction PM emissions predominantly comprise the coarser fraction. The AQIA addendum additionally advises that emissions during the construction phase will be minimised through a dust management plan.
The EPA advises that construction dust emissions will predominately exist as the coarser fraction. While the exhibited AQIA predicted a single 24-hr PM_{10} exceedance due to construction, the assessment was essentially a screening assessment that did not account for standard dust mitigation measures.

Particulate Matter – Operation

The AQIA addendum includes assessment of $PM_{2.5}$ from operation. Predicted ground level concentrations of $PM_{2.5}$ from operation are tabulated in Appendix A of the AQIA. Additionally, the AQIA addendum includes contour plots.

For Power supply option 1 – Leewood power plant (routine operations):

- the contour plot for $PM_{2.5}$ (24 hour) is provided as Figure A-1
- the contour plot for $PM_{2.5}$ (24 hour) is provided as Figure A-2.

For Power supply option 2 – Grid power (routine operations):

- the contour plot for $PM_{2.5}$ (24 hour) is provided as Figure A-5
- the contour plot for $PM_{2.5}$ (24 hour) is provided as Figure A-6.

Predicted incremental ground level concentrations for the Leewood facility as per the contour plots are low (<1 ug/m^3).

Recommendation: The EPA recommends DPE include a condition requiring additional assessment of all processes and emission sources associated with the project, if the project is approved. This must include the Leewood gas processing plant and the gas field. The revised assessment must:

- be completed prior to the commencement of project construction
- be based on final plant design, engineering parameters and emission performance
- provide detailed description of all processing plant including but not limited to gas processing and treatment systems such as the triethylene glycol dehydration systems
- demonstrate that the plant design and emission performance is consistent with best practice emission performance
- account for cumulative impacts.

Additionally, the EPA recommends that DPE should consider a condition requiring a Management Plan in relation to Air Quality for the construction phase, if the project is approved.

5. Cumulative impact assessment

EPA EIS recommendation: The EPA recommended the proponent include well pads in the cumulative assessment. The cumulative assessment should take into account the maximum number of well pads that are likely to be in operation at one time during the life of the project.

Comment on AQIA Addendum: The AQIA addendum advises that the location of future well pads is not yet fixed and that an indicative assessment of the cumulative effect of well pad emissions at both the Leewood and Bibblewindi sites was conducted by adding the peak modelled pollutant concentration predicted at the boundary of a typical well site (nominally a distance of 25 to 30 m from the well pad) for each pollutant to the modelled scenarios as a constant background. The results are presented in Appendix A of the AQIA addendum.

Additionally, the addendum advises that a proposed well pad spacing of 750 m would provide a significant separation between emissions sources.

The EPA notes that the AQIA provided during public exhibition advises that "*the total quantity of operating well pads will be up to 425 over the project lifetime. The number of operating engines at any given time is not known at this stage and will likely vary throughout the project lifetime*".

The EPA advises that the indicative cumulative assessment does not quantify and assess peak emissions from the entire project, including all well pads proposed or likely to be in operation at any one time.

The EPA notes that Table A-18 of the AQIA addendum presents predicted ground level concentrations of assessed pollutants at approximate distances from well pad sources. At a distance of approximately 500m predicted concentrations are typically an order of magnitude below the impact assessment criteria. It is noted that predicted ground level concentrations of $PM_{2.5}$ are presented as 1-hour averages, whilst the impact assessment criteria is a 24 hour average. Hence predicted $PM_{2.5}$ concentration over a 24-hour period would be substantially less than as advised within Table A-18. The additional information broadly indicates that the proposed well pad separation distance (750m) is suitable to manage non-fugitive emissions from well emission sources. However, it is noted that a comprehensive assessment based on detailed plant design, peak well pad numbers and well pad locations has not been provided.

Recommendation: The EPA recommends DPE include conditions that require the assessment of well head locations and well head emission sources prior to construction through the design phase, if the project is approved. An ongoing assessment of the final well head locations and sources must be incorporated into these conditions.

The EPA recommends DPE include conditions requiring additional assessment of all processes and emission sources associated with the project, if the project is approved. This must include the Leewood gas processing plant and the gas field. Revised assessment must:

- be completed prior to the commencement of project construction
- be based on final plant design, engineering parameters and emission performance
- provide detailed description of all processing plant including but not limited gas processing and treatment systems such as the triethylene glycol dehydration systems
- demonstrate that the plant design and emission performance is consistent with best practice emission performance
- account for cumulative impacts.

6. Background concentration

EPA EIS recommendation: The EPA recommended the proponent provide clarification on the background data used in the cumulative assessment.

The EPA noted that:

- ambient air monitoring of nitrogen dioxide and ozone was completed in the project area from 11 April to 5 August 2014
- use of less than a year of monitoring data and 70^{th} percentile as background is not general practice in NSW, and differs from guidance in the *Approved Methods for Modelling and Assessment of Air Pollutants in NSW*.

Comment on AQIA addendum: The addendum advises that monitoring conducted at Maules Creek and Wil-gai as part of the Namoi Region Air Quality Monitoring Project have been considered in the cumulative impact assessment. The addendum advises that data from the Wil-gai monitoring station has been adopted for PM_{10} and $PM_{2.5}$. Table 1 of the AQIA addendum report advises that 70^{th} percentile background concentration data has been used as per Victorian guidance.

As per previous advice the use of 70th percentile background data is not general practice in NSW and differs from the methodology listed in the *Approved Methods for Modelling and Assessment of Air Pollutants in NSW*. The EPA advises that the use of 70th percentile may understate the potential maximum cumulative concentration.

The predicted ground level concentrations for particulates from the Leewood facility are relatively low. It is also noted that tabulated ground level concentrations (as per Appendix A) show $PM_{2.5}$ ground level concentrations considering diesel powered well pad emissions up to approximately 4.8 ug/m^3 (24-hour average) and 1.4 ug/m^3 (annual average). Although, the EPA understands that these predictions are based on a shorter distance (approximately 30 m) from the well head sources rather than the 750m separation distance proposed.

Further, as discussed in Issue 4 above the predicted 1 hour maximum ground level concentration for $PM_{2.5}$ at a distance of 500m is approximately 3 ug/m^3 (12% of the impact assessment criteria). The EPA would expect the 24 hour average predictions to be lower.

Recommendation: The EPA recommends DPE include a condition of consent requiring further cumulative assessment in accordance with methods listed in the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*, or a method otherwise agreed to in writing by the EPA, if the project is approved.

7. Impact assessment results

EPA EIS recommendation: The EPA recommended the proponent clarify the maximum predicted impacts from the project and impacts at the nearest existing or likely future off-site sensitive receptor. The proponent should also provide clarification on the largest source of emission and source apportion predicted impacts from the project.

Comment on AQIA addendum:

Clarification of maximum results

The EPA previously noted that – based on the exhibited assessment:

- for the option 1 scenarios, the predicted NO_2 impacts were assessed at the boundary with results stated as being 'highly conservative' as impacts are generally assessed at existing and future offsite sensitive receptors. However, the isopleths around Leewood indicated that impacts higher than those shown at the boundary occur approximately 10 km north of Leewood facility
- the area of the isopleths shown in the AQIA does not extend far enough north to show Wilga Park or where the maximum predicted ground level concentration occurs. Hence, it is unclear whether the maximum impacts have been assessed in the AQIA.

The AQIA addendum includes revised tabulated predicted ground level concentrations within Appendix A and revised NO_2 isopleths for power supply option 1 - Leewood Power (Figure A-3, Figure A-4) and power supply option 2 – Grid power (Figure A-7 and Figure A-8).

The revised isopleths cover a larger area to the north to show the contributions from the Wilga Park Power Station and show that concentrations of NO_2 are not predicted to exceed the impact assessment criteria.

The isopleths provided show a much a higher contribution from the Wilga Park Power Station than the proposed Leewood plant. The EPA understands that the Wilga Park Power Station has been approved for 40 MW, however only 16 MW of generating capacity has been installed. Hence there appears to be some discrepancy between the proposed 100 MW Leewood power generation plant and its contribution to potential localised air quality impacts as compared with the 16 MW Wilga Park Power Station.

Comparison between results and emission estimation

The EPA previously noted that based on the exhibited assessmentthe emissions estimation in Section 5 of the AQIA indicated the largest source of emissions is from the proposed Leewood power station. Based on the emissions estimation, Option 1 is expected to have higher impacts due to the operation of the Leewood power station. However, the Option 1 and 2 routine operation isopleth around Leewood is very similar. The results tables for the two scenarios are also the same. This appears to indicate that the hot oil boilers are the dominant source of emission since the only difference between Option 1 and 2 is the operation of Leewood power station.

The AQIA addendum advises that:

- the emissions of oxides of nitrogen associated with the engines are more than 11 times greater than the boilers
- the exhausts from the six closely located 30-metre-tall engine stacks (for the Leewood power station) were determined to have the potential to merge after release and consequently an enhanced buoyancy effect. However, the boiler emissions will be released from four 10-metre-tall stacks with no enhanced buoyancy
- the differences in buoyancy flux causes the highest contribution to ground-level concentrations of nitrogen dioxide being from the boiler's emissions.

The additional discussion on discharge parameters and buoyancy flux between the power plant and hot oil boiler emission sources is plausible as an explanation of why impact results do not significantly differ between the two options assessed. However, the EPA advises that actual impacts will depend on the final selected option and actual engineering design and configuration. As such, predicted impacts may differ from those assessed depending on final design and emission performance. Additional assessment for the as designed plant is recommended to be undertaken (prior to construction) to confirm the assessment outcomes.

Recommendation: The EPA recommends DPE include conditions requiring additional assessment of all processes and emission sources associated with the project, if the project is approved. This must include the Leewood gas processing plant and the gas field. The revised assessment must:

- be completed prior to the commencement of project construction
- be based on final plant design, engineering parameters and emission performance
- provide detailed description of all processing plant including but not limited to gas processing and treatment systems such as they triethylene glycol dehydration systems
- demonstrate that the plant design and emission performance is consistent with best practice emission performance
- account for cumulative impacts.

Issues requiring additional information prior to project determination

8. Fugitive emissions

EPA EIS recommendation: The EPA recommended Santos identify and quantify all potential fugitive air emissions, particularly air toxics and odorous substances, from the proposed operations. All identified fugitive air emissions should be assessed in the AQIA. Additionally, the AQIA should detail the proposed management measures to minimise potential for fugitive emissions.

Comment on AQIA Addendum: The RTS states that a leak detection and repair (LDAR) program is currently in place for the exploration activities. However, the specifics of the LDAR program are not detailed in the response to submission and the robustness of the program to justify omission of fugitive emission quantification has not been provided.

The AQIA addendum discusses results of studies undertaken by the CSIRO (CSIRO, 2016)[1]. The AQIA addendum presents data on methane emissions from well heads, and states "*overall, the emission rates measured on the Narrabri wells are comparable to measurements made previously at CSG wells throughout NSW and Queensland, where the average emission rate was 3.2 g CH4/min, but with a range of zero to about 44 g CH4/min*". However, the AQIA addendum does not quantify the potential fugitive emissions of other components of the gas including any trace odorous compounds or air toxics. Hence it is unclear if there is potential for significant fugitive emissions of other volatile organic compounds (VOCs) or air toxics that warrant further evaluation or if the proposed leak detection and repair program will adequately manage potential fugitive air toxics and odorous substances.

The AQIA addendum does provide a summary of ambient air data for VOCs published by the CSRIO, including ambient air data collected at well pads for CSG operations (Camden, Gloucester, Narrabri). The ambient air data referenced does not indicate significant issues with air toxics from individual well pads. However, further data is required in order to assess the potential for fugitive emissions from the proposed project in totality as it does not provide analysis of specific gas composition.
Appreciating that there are potential difficulties in preparing a robust estimate and assessment of potential fugitive emissions from gas infrastructure that has yet to be designed, the issue of fugitive emissions could be further addressed.

Recommendation: The EPA recommends DPE request Santos provide further information to inform the assementent of fugitive emissions for methane, trace VOCs and air toxics, prior to project determination.

As a minimum, Santos should provide:

- project specific gas composition data to inform a risk evaluation of air toxics/trace VOCs
- additional information that demonstrates that the proposed leak detection and repair program adequately:
  - minimises the potential for significant fugitive emissions of air toxics/trace VOCs from all gas infrastructure
  - manages potential impacts from residual emissions.

[1] CSIRO, 2016 – *Methane and Volatile Organic Compound Emissions in New South Wales,* 2016

Attachment E – comments on noise related issues in the RTS

Information reviewed

2018 – *Santos Narrabri Gas Project Response to Submissions,* Section 5.6

Matters requiring no further action

1. Leewood Power Plant

EPA EIS recommendation: The EPA recommended DPE request clarification from Santos as to whether there will be eight or ten operational engines at any one time.

Comments on RTS: The gas turbine configuration in the Leewood power generation facility has been clarified in the report to be ten operating gas engines plus two standby gas engines. The assessment remains valid.

Recommendation: No further action required.

2. Wilga Park to Leewood transmission line

EPA EIS recommendation: The EPA recommended DPE request Santos commit to additional mitigation measures for noise that may exceed highly affected noise levels. In the absence of any additional mitigation measures for that activity, EPA also recommended that respite should be provided to receivers who may receive construction noise above the 'highly affected' noise level.

Comments on RTS: Mitigation and management measures for the single resident predicted to receive construction noise above the 'highly affected' noise level will be determined in consultation with the resident, including respite periods if appropriate.

Recommendation: No further action required.

3. Expected start dates

EPA EIS recommendation: The EPA recommended DPE request Santos amend the expected start date of Bibblewindi. Appendix M states that construction at Bibblewindi was expected to start in the middle of 2016, and in the gas field in 2016.

Comments on RTS: Expected start date has been amended.

Recommendation: No further action required.

Matters that can be resolved through conditions of approval – should the project proceed

4. Drilling activities and tonal noise

EPA EIS recommendation: The EPA recommended DPE request Santos commit to all construction noise meeting noise management levels outside standard hours, including the combined contribution of this project and other related projects such as the Dewhurst pilot expansion.

Comment on the RTS: The RTS committs to meeting the relevant noise criteria, unless a written agreement is in place with the landholder for:

- operational activities, including cumulative impacts from the operation of existing pilot wells and Wilga Park power station
- construction outside standard construction hours.

Recommendation: The EPA recommends DPE include a condition of consent requiring Santos to meet the relevant noise criteria for the activities mentioned above unless a written agreement is in place with the landholder, if the project is approved.

5. Drilling activities and tonal noise

EPA EIS recommendation: The EPA recommended DPE request clarification from Santos on tonal noise from drill rigs.

Comments on RTS: The RTS commits to implementing additional noise mitigation to address any low frequency, tonal or other problematic noise characteristics from operational equipment, including drill rigs.

Recommendation: The EPA recommends DPE include a condition of consent requiring Santos to implement additional noise mitigation measures to address any low frequency, tonal or other problematic noise characteristics from operational equipment, including drill rigs, if the project is approved.

Matters requiring additional information prior to project determination

6. Seismic surveys

EPA EIS recommendation: The EPA recommended DPE request Santos confirm the required buffer distances to meet construction noise and vibration criteria. The EPA notes that seismic surveys are predicted to generate vibration levels potentially exceeding human comfort criteria at nearby occupied residences or buildings for a short period of time.

Comment on the RTS: The RTS provides additional information on potential exceedances of the relevant criteria at sensitive receivers. However, the RTS does not provide information on the likely duration and frequency of these exceedances to gauge possible impacts on affected residents.

Recommendation: The EPA recommends DPE request further detail from Santos on how long and how often these surveys are expected to occur near any given sensitive receiver location, prior to project determination.

7. Drilling noise

EPA EIS recommendation: The EPA recommended DPE request Santos clarify and explain the mitigation measures to be applied to drilling, and how the mitigated buffer distance for drilling was calculated.

Comment on the RTS: The RTS advises that buffer distances were assessed using SoundPlan noise modelling software under various weather conditions as required by the NSW industrial Noise Policy (NSW EPA 2000).

It also assessed noise with standard mitigation measures applied to pump engines, generators and power units. This was based on operational noise monitoring of drilling rigs utilised by the proponent for the construction of existing exploration and appraisal wells. The RTS does not provide information on the nature of these standard mitigation measures, which will affect the outcomes of the noise modelling process and potential impacts on sensitive receivers.

Recommendation: The EPA recommends DPE request further detail from Santos on the ‘standard mitigation measures’ to be applied to drilling unit pump engines, generators and power units, prior to project determination.

8. Noise levels

EPA EIS recommendation: The EPA recommended DPE request Santos clarify how the Lmax levels have been calculated and if they were assumed, the assessment should also quantify the likely error in that assumption.

Comment on the RTS: The RTS indicates a set maximum noise level (Lmax) adjustment has been assumed. The RTS has not identified whether there is any expected variation to that adjustment value for different items of plant and equipment, which in turn will affect the outcomes of the maximum noise level assessment.

Recommendation: The EPA recommends DPE request further detail from Santos on the expected error in maximum noise level (Lmax) adjustments applied to operating equipment.

9. Blasting

EPA EIS recommendation: The EPA noted that some of the mitigation measures suggested for blasting impacts are more appropriate for larger, in pit, blasts than for the activities expected for this project. For example, limiting bench heights.

The EPA recommended the proponent consider whether the proposed measures are likely to be feasible and reasonable for the type of blasting they may need, and whether there are any other feasible and reasonable measures that could be used.

Comment on the RTS: The RTS commits to selecting and implementing measures to mitigate and manage any blasting impacts in accordance with the ANZECC Guidelines (1990). Aside from frequency and times of blasting, these guidelines do not list any mitigation or management measures.

Recommendation: The EPA recommends DPE request further information from Santos on what additional measures will be considered if blasting is required, prior to project determination.