Narrabri Gas Project

Pre-Hearing meeting - Independent Planning Commission

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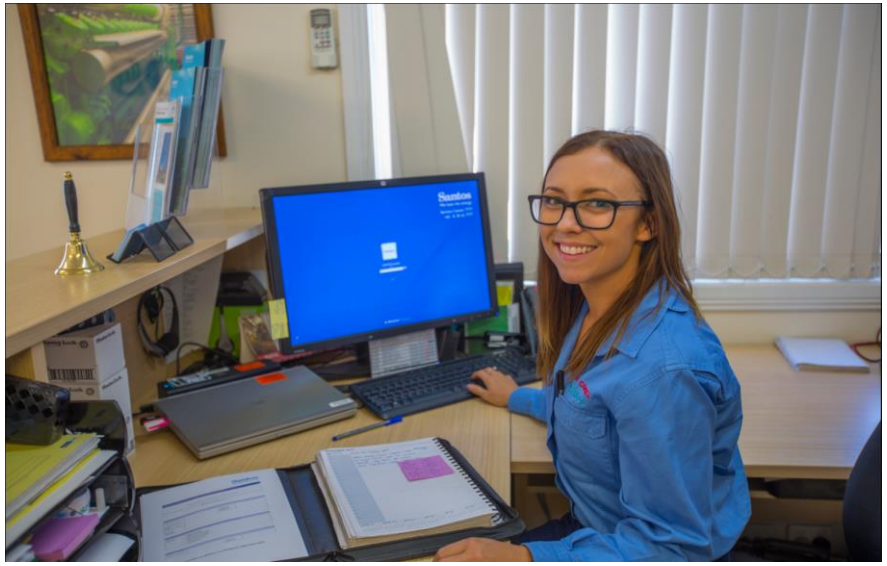
Overview

- Introduction to Santos
- Strategic Overview
- Project Overview
- Key Technical Areas
  - Economics
  - Water
  - Drilling & Well Integrity
  - Hazard & Risk Assessment
  - Ecology



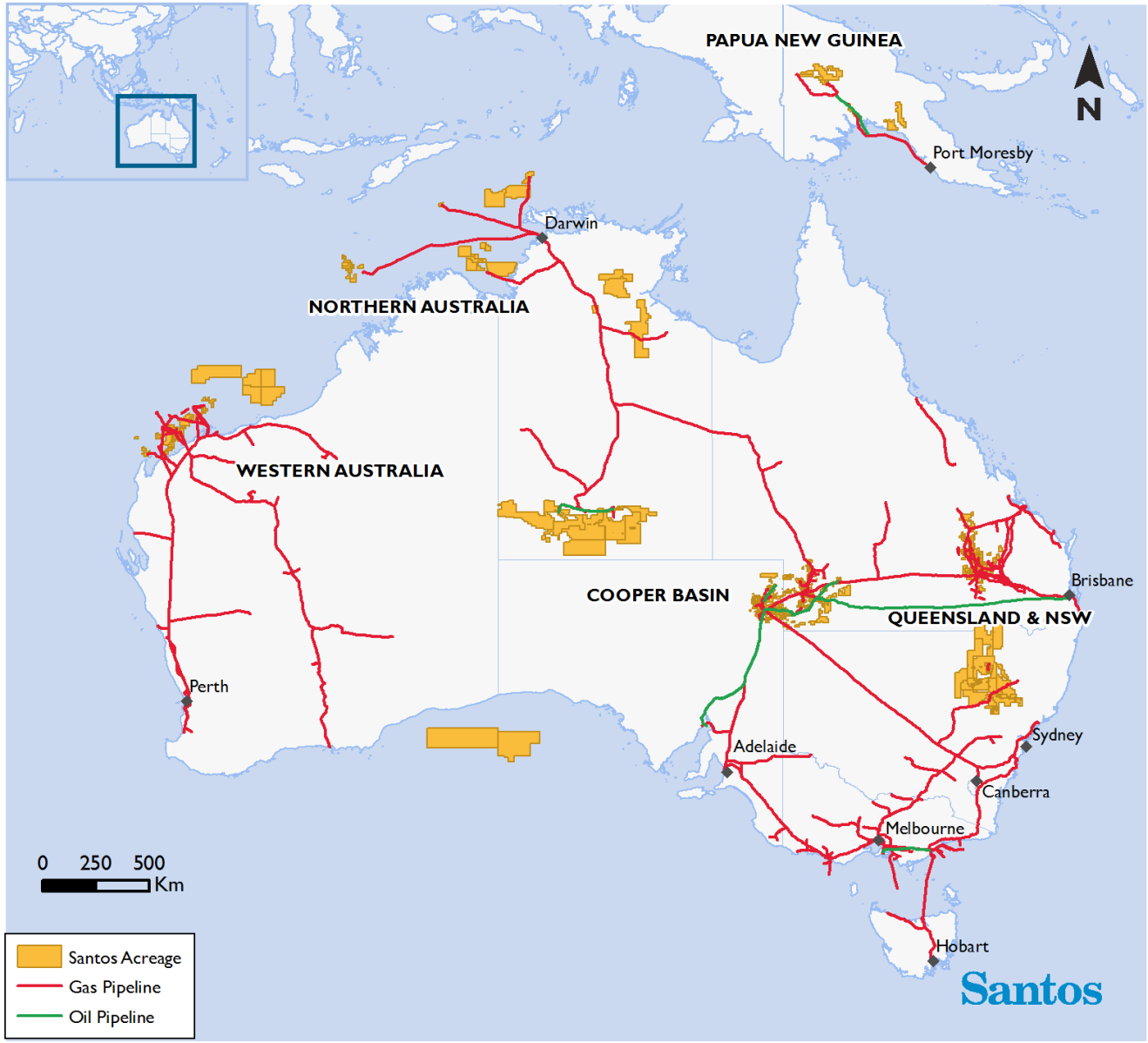
About Santos

A proudly Australian company, Santos is a leading supplier of natural gas, a fuel for the future providing cleaner energy to improve the lives of people in Australia and Asia.

Santos aims to be Australia's leading domestic gas supplier and a leading Asia-Pacific LNG supplier.

For 65 years, Santos has been working in partnership with local communities, providing jobs and safely and sustainably developing Australia's natural gas resources.

Santos' strategy is centred on five core long-life natural gas and LNG assets: the Cooper Basin, Queensland and New South Wales, Western Australia, Northern Australia and Papua New Guinea.



*P'nyang (PRL 3) farm-in subject to the execution of a sale and purchase agreement

Assessment Report

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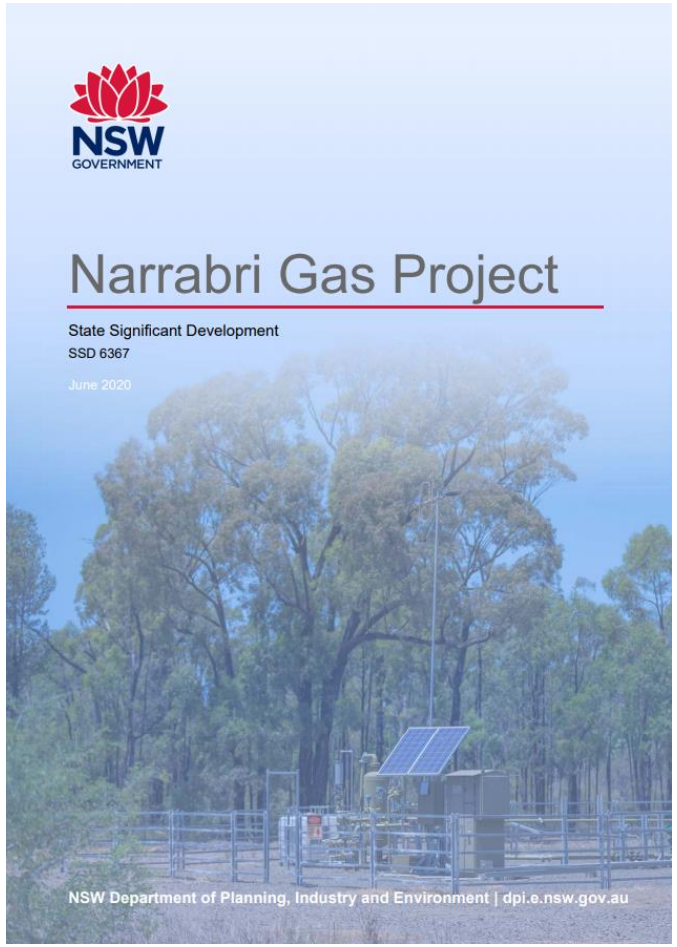
The Department of Planning, Industry and Environment (DPIE) has concluded that the project is in the public interest and is approvable subject to strict conditions



"...the Department has concluded that the project **would not adversely affect the region's valuable groundwater resources**; that the project can be designed to avoid and/or minimise impacts, including reducing the predicted footprint by as much as 30%; and that any residual impacts can be reduced to an acceptable level through effective community engagement, compliance with strict conditions and prompt action to address any problems. Consequently, the project is **unlikely to result in any significant impacts on the local community or the environment**."

(Executive Summary, pXIX)

Assessment Report – Key Findings

The DPIE Assessment Report was informed by extensive community consultation and advice from the Narrabri Shire Council, government agencies and independent experts, including a Water Expert Panel established specifically for this investigation.

- The project **is critical for energy security and reliability in NSW**
  - Supplying up to half of NSW's future gas needs
  - Enabling critical extensions gas pipeline network to the northern parts NSW, connecting major gas users
  - Increasing competition in the domestic gas market and put downward pressure on gas prices
- The project delivers **significant economic benefits to NSW and the Narrabri region** and would stimulate economic recovery from the effects of COVID-19
- The project is **designed to minimise any impacts** on the region's significant water resources, including the Great Artesian Basin (GAB), the biodiversity and heritage values of the Pilliga State Forest, and the health and safety of the local community

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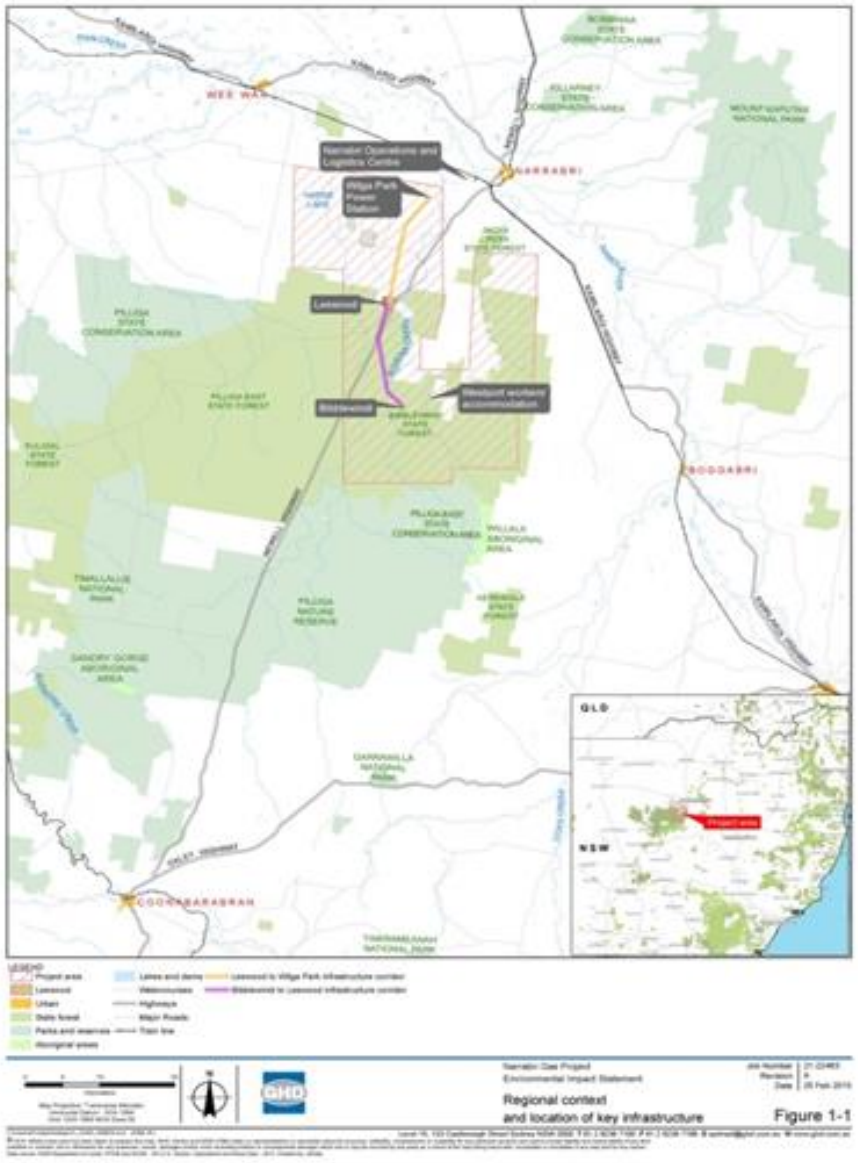
Project Overview

Narrabri Gas Project – Overview



+ **Project area**: ~ 95,000 ha
+ **Total Footprint**: ~ 1% (Up to 1,000 ha)
+ **Project Life**: 25-year approval
+ **Wells**: Up to 850 wells (new & existing) drilling on a maximum of 425 new well pads
+ **Water use**: on average 1.5 GL/year produced water extracted from deep coal seams
+ **Salt removed from the environment**: ~47.5 tonnes/day, beneficial reuse or disposal to a licensed facility
+ Leewood (existing + new ponds, water treatment, gas treatment and compression)

Community engagement

Since September 2014, we have engaged extensively with the community:

- More than **5,000 individual consultations** with landholders, stakeholders and community members
- More than **6,000 visitors** to our Shopfronts
- Over **310 site tours** with more than 2,600 participants
- **136 contractor and supplier forums** and information sessions
- 43 Narrabri Gas Project Community Consultative Committee meetings
- 15,700 Monthly Activity Update reports distributed to individual stakeholders
- Over $1 million on **350 sponsorships** for the local community

Landholders

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+ There are 114 landholders in the project area.
+ Agricultural land in the area is mainly used for dryland cropping and grazing.

Environmental commitment

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More than 13,000 hours of on the ground environmental surveys to produce detailed vegetation and habitat mapping.

The Pilliga

At full production, project activities will cover less than half a percent of the Pilliga's 500,000ha.

- The Project is located in largely dry scrub land that is currently used for industry like timber harvesting.
- The Project area does not include pristine forest, National Parks or Nature Reserves.
- Our operations will be located on about 1,000ha of land within this project area.

Field Development Protocol

Santos will implement a Field Development Protocol to determine where to place gas field infrastructure.

- The Field Development Protocol for the project incorporates:
  - An ecological scouting framework consisting of
    - desktop assessment,
    - in-field micro-siting and
    - post-field micro-siting;
  - Pre-clearing and clearing procedures to minimise risk to fauna.
- The Field Development Protocol sets 'rules' for avoiding impacts on threatened species and key habitat.

Cultural Heritage for the Project

Santos has a deep respect for the Aboriginal communities across Australia and we acknowledge their rich and diverse histories and their connection to the land.

+ The EIS includes a Cultural Heritage Management Plan that has been developed after extensive consultation that will allow the Project to be developed without impact on any significant cultural heritage sites.

+ There are 90 known Aboriginal cultural heritage sites. The Project would completely **avoid** all of these.

+ The Assessment Report shows Santos' commitments to avoidance would appropriately mitigate the project's potential Aboriginal cultural heritage impacts. Conditions are proposed to ensure this occurs, including requiring Santos to establish an Aboriginal Cultural Heritage Advisory Group for the Project.

Greenhouse Gas Emissions

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- Natural gas has a key role to play in a lower-carbon future as it produces **less greenhouse gas emissions** than coal when used to generate electricity, can significantly improve air quality and is the perfect partner for renewable energy sources.

- The Assessment Report concludes that there is **a demonstrable need for the gas generated by the project**, and that the Project is consistent with NSW's and Australia's commitments to a low carbon future.

Noise monitoring & air quality

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+ The Project footprint is located in an area where sensitive receptors are sparsely located and well-spaced.

+ The Assessment Report found the air and noise emissions of the project would **comfortably comply with the relevant criteria** (incremental and cumulative) set by the EPA at all residences, and construction dust and noise impacts could be reduced to acceptable levels with the implementation of standard controls.

+ The Air Quality Impact Assessment for the Project **found that the Project is unlikely to cause an adverse impact to air quality in the region**.

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Key Technical Areas

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Economics

Economics

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Alan Smart
Senior Associate
ACIL Allen

+ Alan Smart is a Senior Associate in the Sydney office of ACIL Allen Consulting. He advises on economics policy and strategy in the resources, energy, and infrastructure sectors. He has 20 years' experience in economics and policy consulting with ACIL Allen Consulting and a further 27 years' experience in the Senior Executive Service of Departments concerned with resources and energy He was the CEO of the then Pipeline Authority in the early 1990s.

+ Alan is an expert in energy market analysis and advises the petroleum, gas and electricity industries on market outlooks, infrastructure and regulation. He has been an energy market advisor for numerous strategy and due diligence assignments in Australia and New Zealand.

Methodology

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Approach included a Benefit Cost Analysis and a Macroeconomic analysis

Benefit cost analysis

+ The benefit cost analysis focussed on the project specific benefits and costs to NSW without accounting for flow-on macroeconomic benefits
+ Net present value and Benefit Cost Ratio over 25 years at 7% real discount rate for the base case
+ Sensitivity tests of key assumptions was also undertaken

Macroeconomic analysis

+ The macroeconomic analysis was carried out using a Computable General Equilibrium (CGE) model of the Australian economy
+ *Tasman Global* - a large-scale CGE model designed to account for all sectors within the economy.
+ Assessment of impacts on output, incomes and employment for NSW as well as the Narrabri region
+ Assumption of no overall growth in national employment – reflecting the tight labour market at the time

Independent Assessment

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Dr Brian Fisher, CEO of BAEconomics

- "I believe that the new assessment together with the supplemental report now meets the reporting guidelines."
- "In my opinion, it is highly likely, if the project were to be approved, that the net benefits to the NSW community flowing from the development would be positive. I believe that the ACIL ALLEN report on the local effects of the project containing a general equilibrium analysis has been carefully done and gives plausible estimates of the likely impacts of the project (given the assumptions made)."

Department's Assessment Report

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General findings

The assessment report and independent expert advice released by the Department concludes:

- The project would deliver significant economic benefits for NSW and the local community
- Attracting $3.5 billion of capital investment to the region
- Creating up to 1,300 jobs during construction and 200 jobs during operations

The Department also concluded that the Narrabri Gas Project would be critical for energy security and reliability in NSW:

- The Australian Energy Market Operator and the ACCC have both foreshadowed a gas shortfall in the south eastern Australia market emerging in the 2024 to 2026 period
- Gas is used by around 500 heavy industrial facilities, 33,000 business, gas-fired power stations, and 1.4 million households and it supports around 300,000 jobs. Energy security is critical to the NSW economy
- The project will also increase competition in the domestic gas market and put downward pressure on gas prices

Benefit Cost Analysis Results

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- Net economic benefit of $1.5 - $1.6 billion in net present value terms at a 7 per cent discount rate
- Benefit/cost ratio of between 1.39 and 1.43 (depending on which electricity option as used)
- The evaluation used a real gas price of $8.7/GJ delivered
  - Spot prices fell in the last few months, but gas futures see them rising again over the next 12 months
- Current contract pricing for industry are higher than these spot prices

Regional and State impacts

Key findings – CGE modelling of regional and state impacts

- Real economic output of $11.9 billion for NSW (around $5.1 billion net present value or around 1 per cent of Gross State Product) including
  - $11 billion (around $4.5 billion net present value) in the Moree Narrabri SA3 region
- Real income of $6 billion (around $2.8 billion net present value), including
  - $605 million (around $307 million net present value) in the Moree Narrabri SA3 region
- Narrabri and surrounds and the rest of NSW also benefit

	Real economic output		
	Total (2017 to 2042)	Net present value*	
		4%	7%
	2016 A$m	2016 A$m	2016 A$m
Moree-Narrabri SA3 region	11,058	6,450	4,516
Rest of NSW	864	674	583
Total NSW	11,926	7,125	5,100

	Real income		
	Total (2017 to 2042)	Net present value*	
		4%	7%
	2016 A$m	2016 A$m	2016 A$m
Moree-Narrabri SA3 region	605	397	307
Rest of NSW	5,388	3,324	2,450
Total NSW	5,993	3,722	2,757

Department's Assessment Report

Key findings – CGE modelling of regional and state impacts (continued)

- Royalty and other contributions of $3.1 billion (around $1.165 billion in present value terms) to Government over the 25-year project assessment period
  - Royalties and payroll tax to NSW Government amount to $950 million ($353 million in present value terms)
- Average direct and indirect additional employment
  - Average of 512 full time equivalent jobs in NSW
  - Average 190 FTE in the Moree Narrabri region
  - Assumption of no net increase in employment nationally meant that some sectors declined relatively to others
    - e.g. employment in Manufacturing in the Moree-Narrabri region is projected to grow by 8.36 per cent over the life of the project instead of a projected 8.55 per cent.
  - Relaxing that constraint would produce a higher result

	Total (2017 to 2042)	Net present value		
		4%	7%	
	2016 A$m	2016 A$m	2016 A$m	
Project company taxes	1,386	745	456	
Project royalties	821	462	293	
NSW payroll taxes	129	83	60	
Other taxes on income	294	178	120	
Other taxes	503	330	237	
TOTAL	3,133	1,799	1,165	

Department's Assessment Report

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Other measures and summary

Other measures

+ Gas Community Benefit Fund which would receive an estimated $120 million through the life of the project
+ Support to local businesses and contractors throughout the construction and operation of the project in accordance with Santos' Procurement and Logistics Policy
+ Compensation agreements with landholders, in accordance with the Santos Landholder and Community Compensation Scheme

In summary

+ The net present value of the project is strongly positive and will deliver net benefits to the Narrabri region as well as the state of NSW
+ The project will also help to moderate the rise in gas prices in NSW, introduce more competition into the south eastern gas market and will provide additional opportunities for industrial loads in NSW to contract gas supply agreements

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Water

Water Assessment Findings

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Dr Richard Cresswell
Principal Hydrogeologist

+ 8 years providing water advice to Narrabri Gas Project
+ 11 years working on coal seam gas
+ 2011-2013 on the Commonwealth Expert Panel for Large Coal Seam Gas Projects
+ 20 years as a practicing hydrogeologist at the Bureau of Rural Sciences, CSIRO and as a consultant
+ 25 years working on the Great Artesian Basin
+ 36 years working on radio-isotopes
+ 41 years working on being a geologist

Dr Detlef Bringemeier
Principal Hydrogeologist

+ 23 years' experience consulting
+ Groundwater modelling, coal hydrogeology and groundwater management
+ Third party review of groundwater studies and due diligence, acquisition and divestment reviews
+ Groundwater impact and risk assessments for various levels of planning studies to major mining and resource companies
+ 7 years as Adjunct Professor at the University of Queensland School of Civil Engineering

DPIE Final Assessment Report (Section 6.2)

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The Water Expert Panel (WEP)
did not identify any land and water issues
that were likely to result in
significant impacts

Baseline groundwater resources

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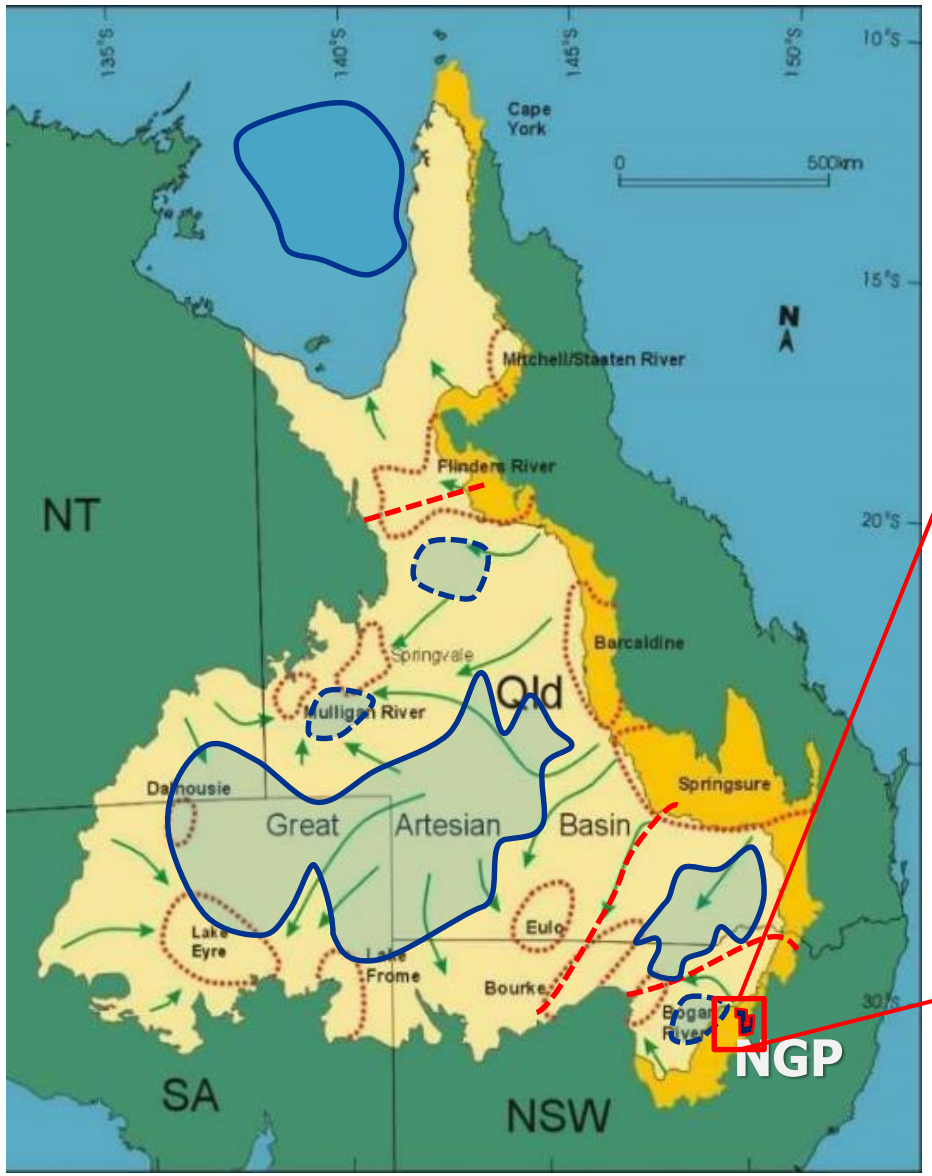

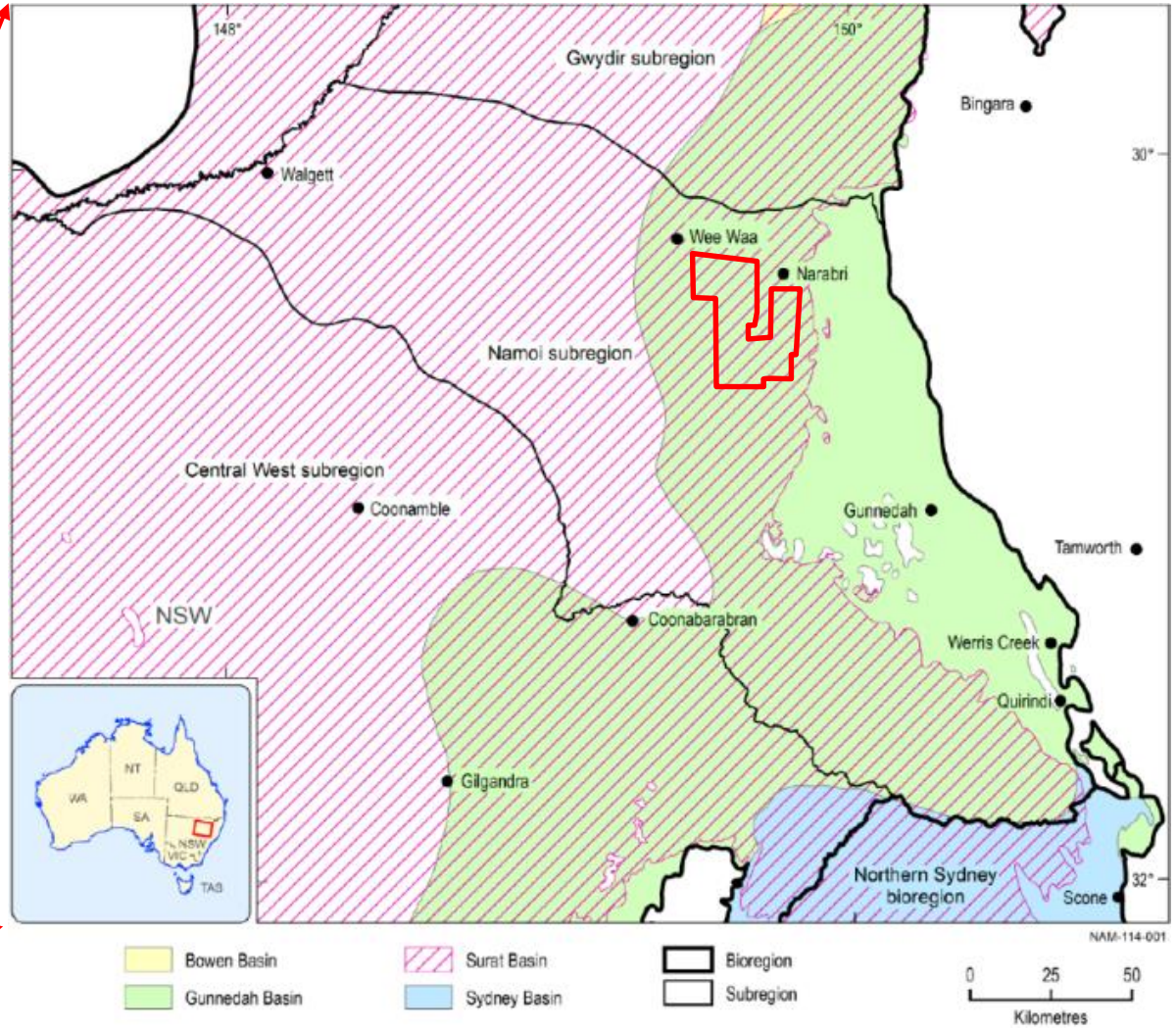

Baseline groundwater resources

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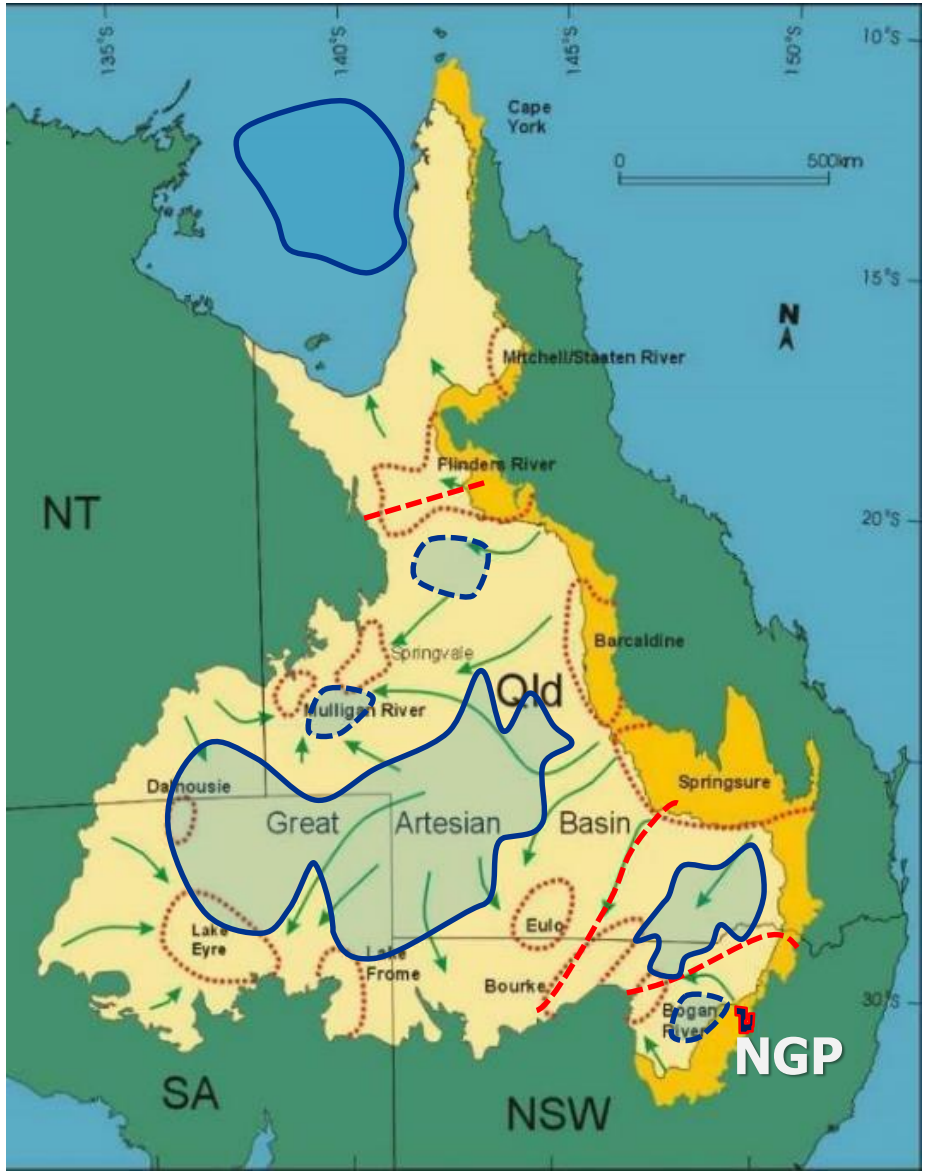
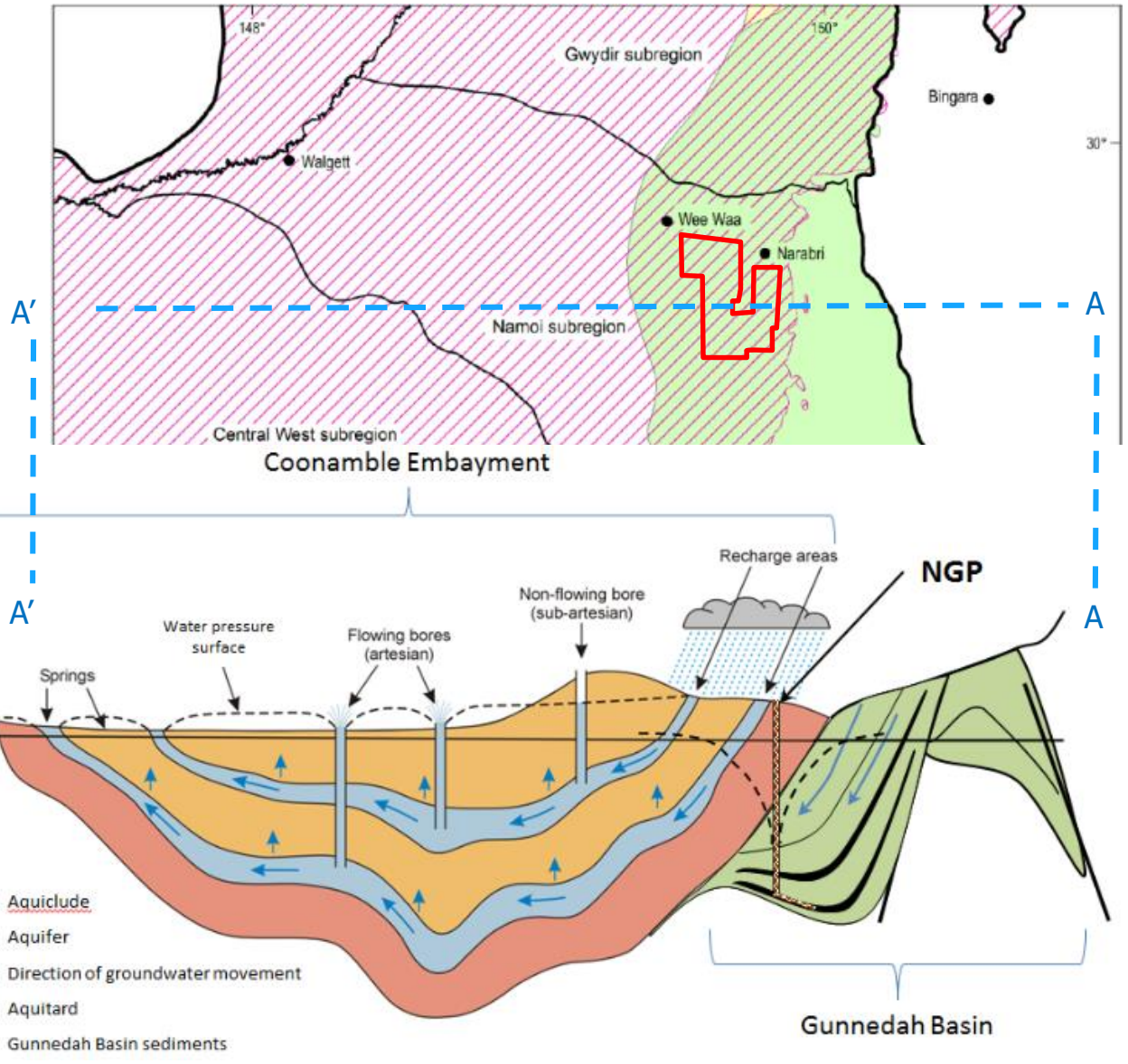
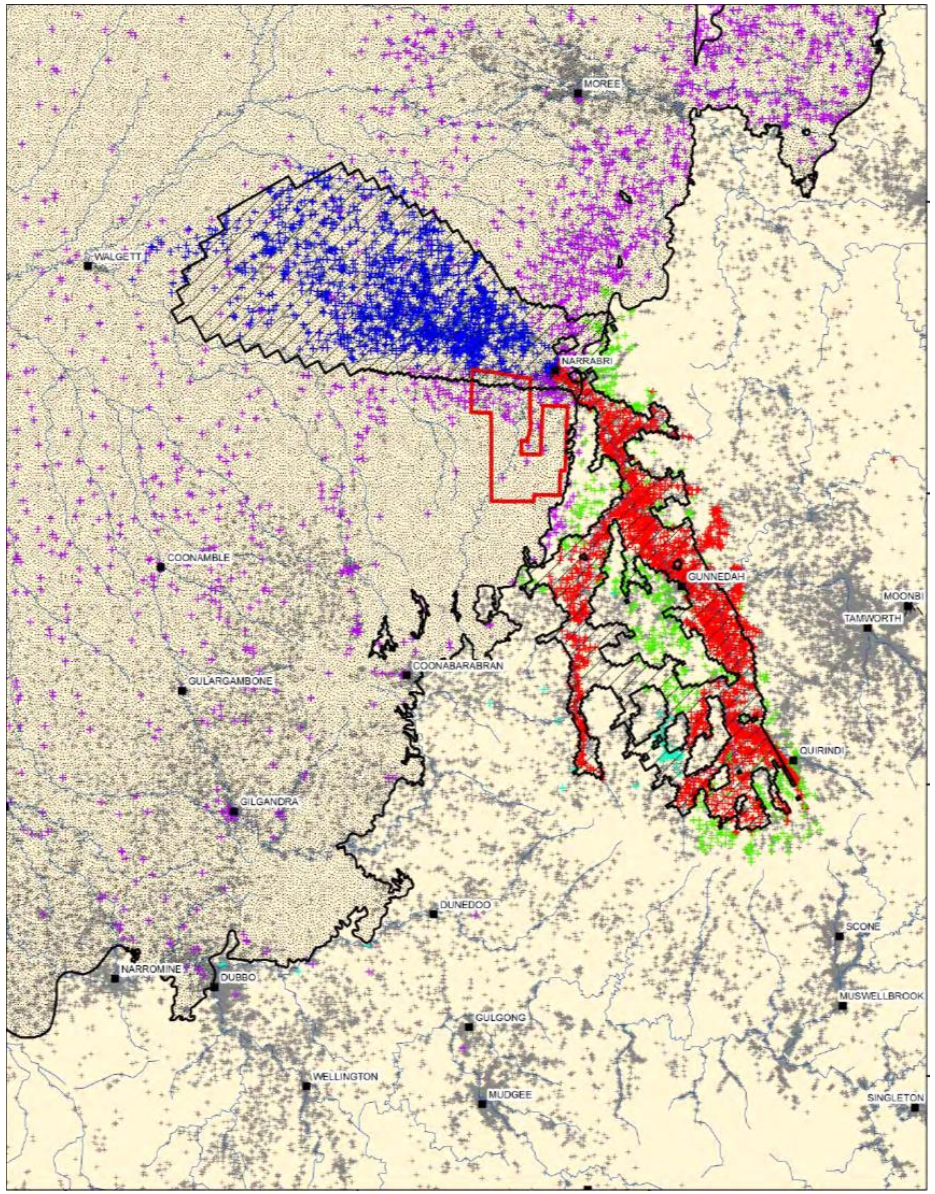
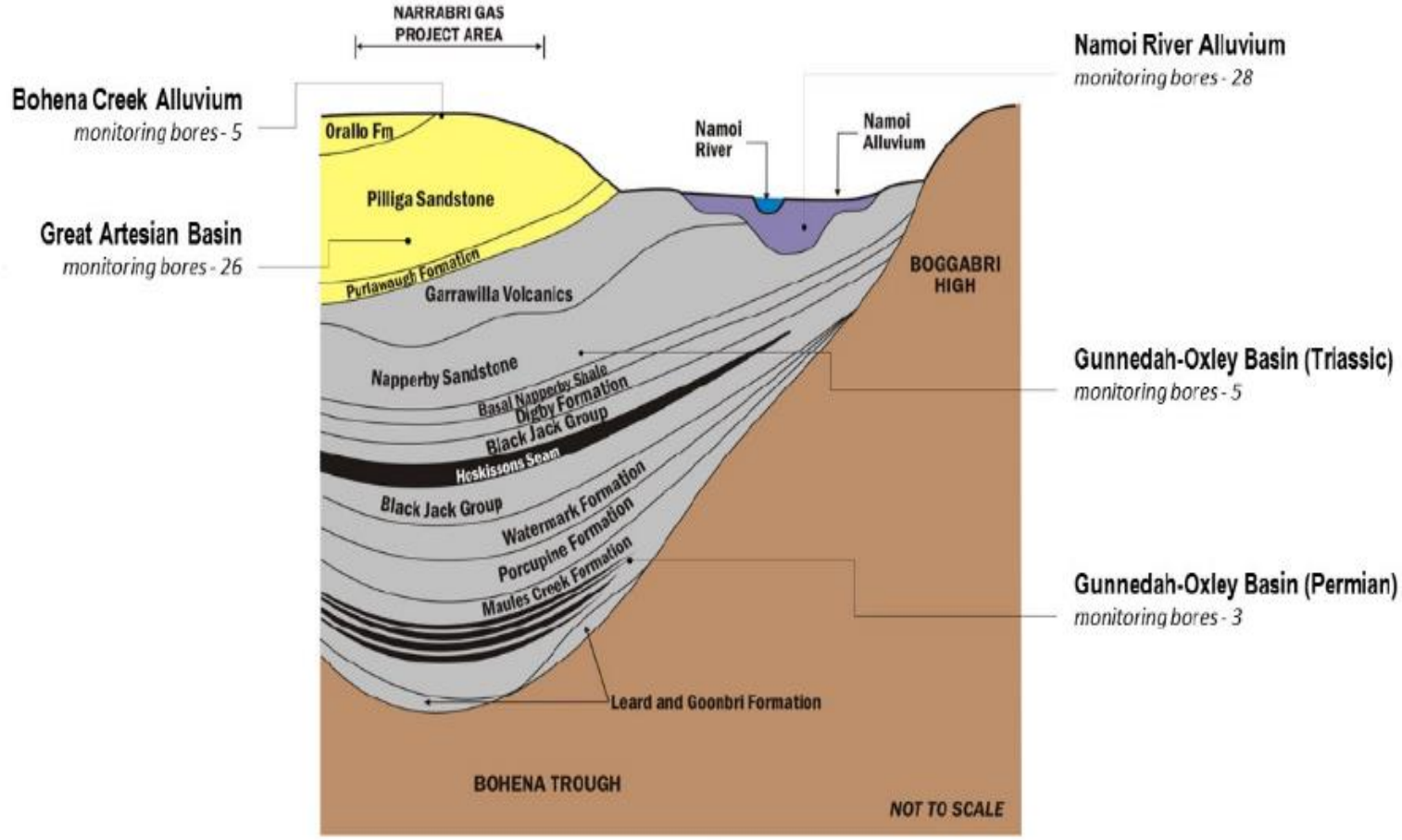




Baseline groundwater resources

Santos





No evidence of groundwater connectivity

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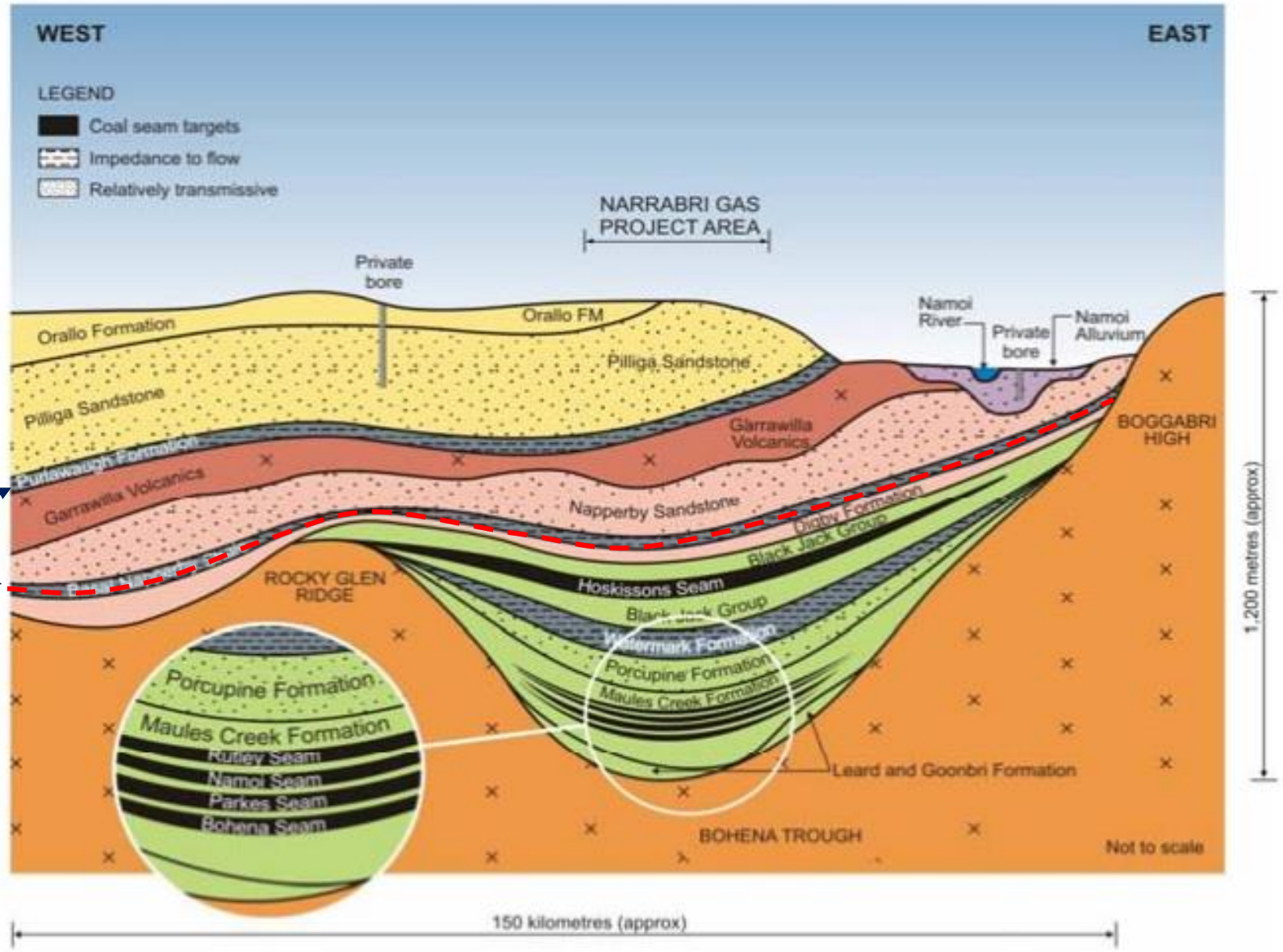
Risk of unintended groundwater movement, contamination or gas leakage remains small

Tight aquitard inhibits vertical connectivity



Groundwater model process

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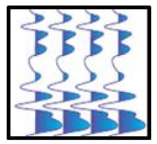
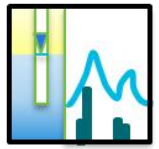
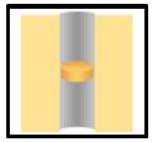
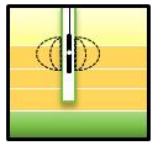
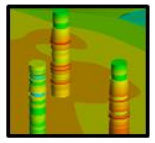
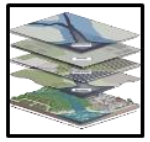

>1000 km seismic lines

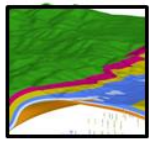

Baseline Monitoring


Core samples


Borehole Geophysics

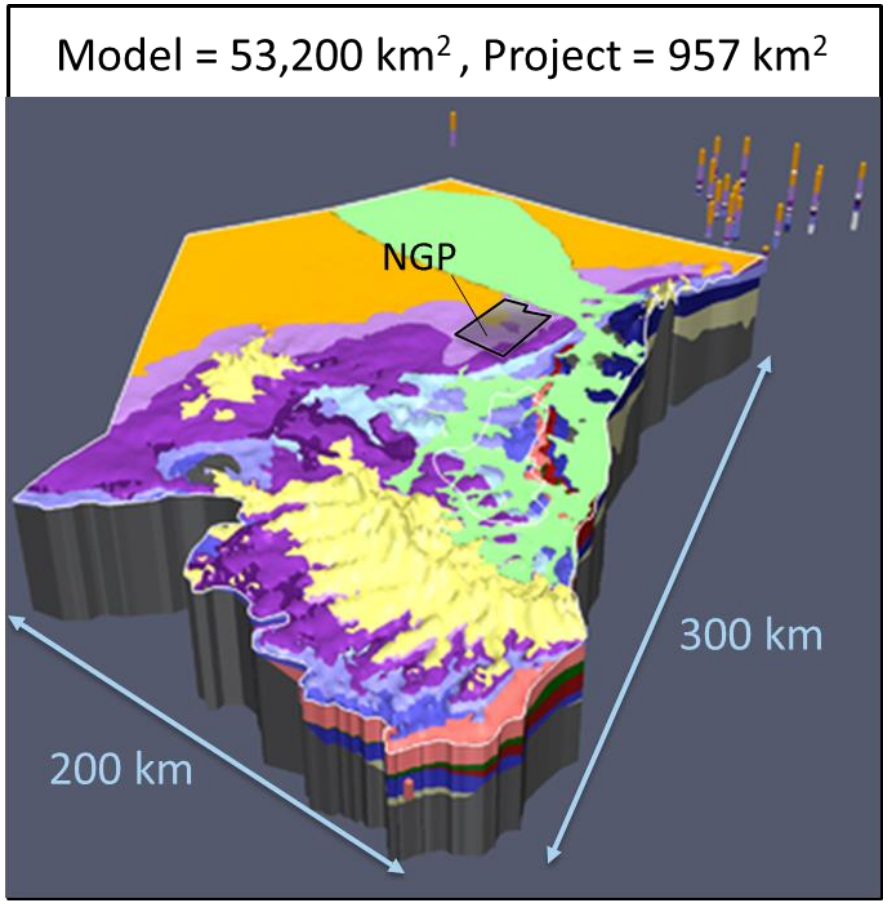

Geological Logs


GIS Layers


3D Leapfrog Models


Historical Studies


Expert Knowledge



Groundwater model is fit for the purpose for identifying formations where drawdown and leakage effects may occur

- CSIRO 2015
- NSW DPI 2017
- Water Expert Panel 2020

Coal seam water production rates are low

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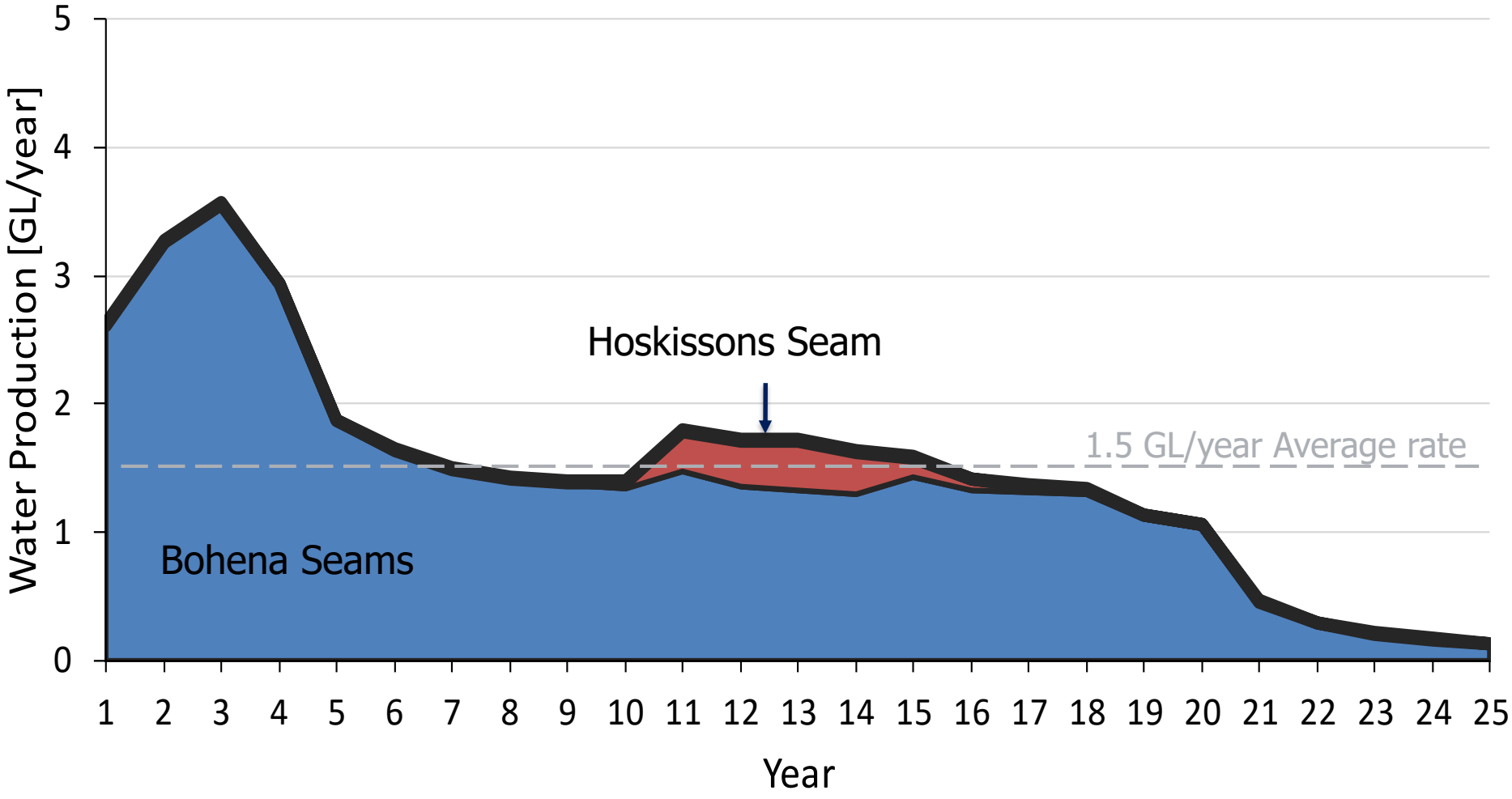
37.5 GL water extraction over 25 years



Model predicts small effects on aquifers

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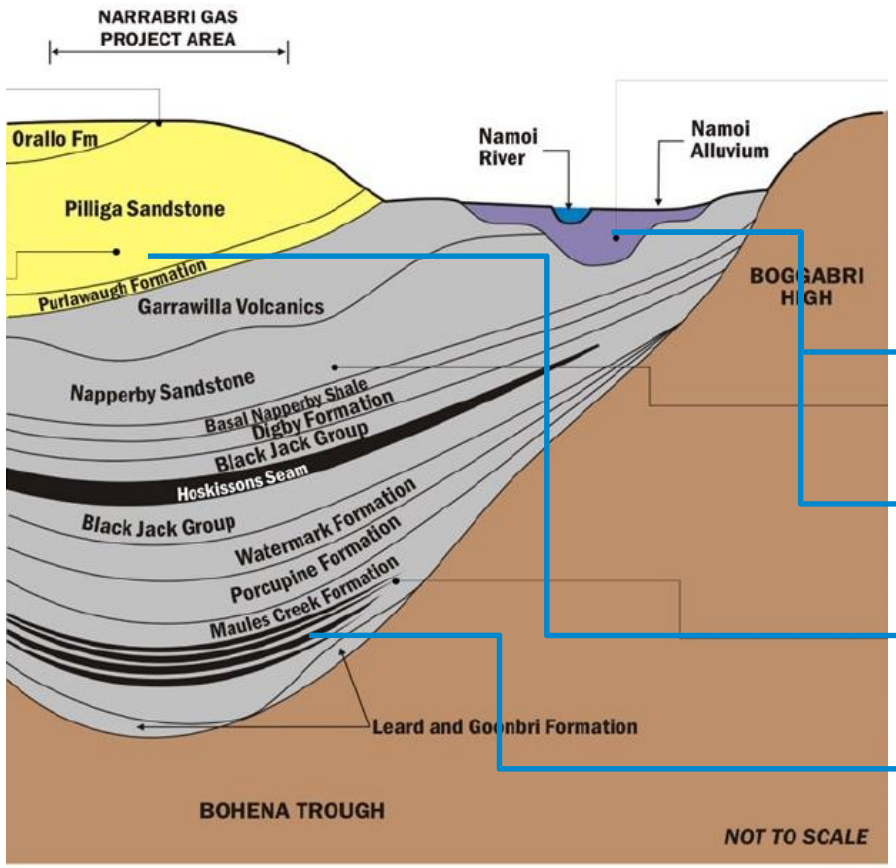

	Water Sharing Plan	NGP effect	
	Extraction Limit (GL/yr)	Induced Water Take (GL/yr)	Time to peak (yr)
Upper Namoi Alluvium	**122**	0.001	>200
Lower Namoi Alluvium	**86**	0.0042	>200
NSW Great Artesian Basin	**30**	0.058	>150
Gunnedah-Oxley-Basin	**127**	1.5	<25

WATER SHARING PLAN

- WSP for Upper Namoi and Lower Namoi Regulated River Water Sources
- WSP for Upper and Lower Namoi Groundwater Sources
- WSP for NSW Great Artesian Basin Groundwater Sources
- WSP for NSW MDB Porous Rock Groundwater Sources
- WSP for NSW MDB Fractured Rock Groundwater Resources

Effects on aquifers will be very small and would not occur until many years after the project commences

Model prediction very small aquifer drawdown

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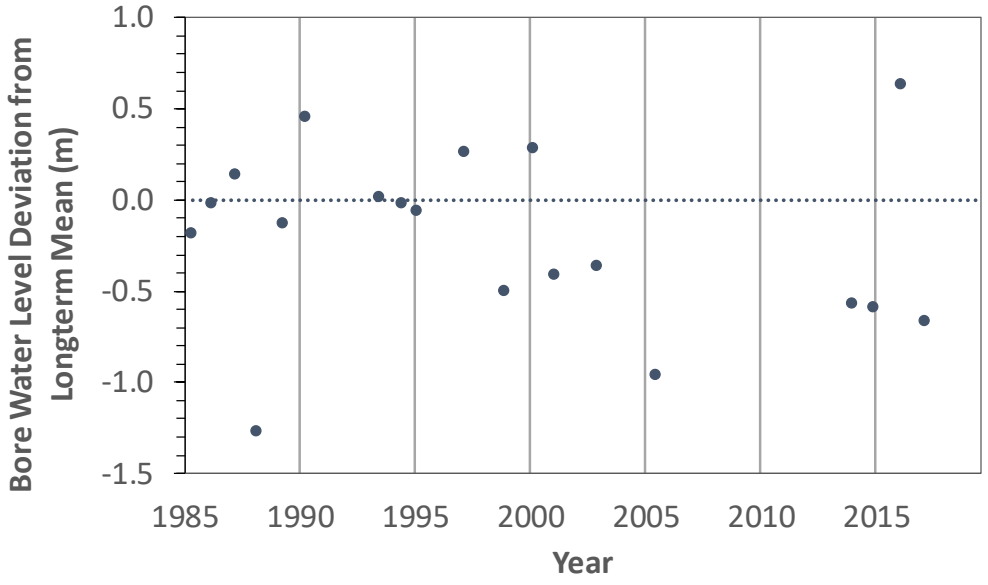
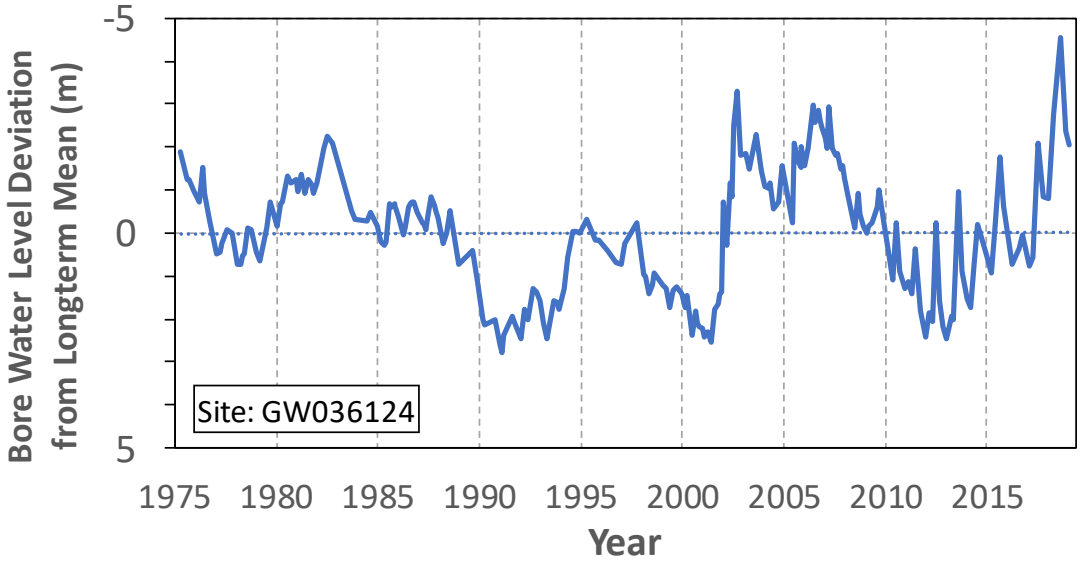
+ Less than 0.5m drawdown
+ Less than natural variation and hard to detect

Existing Pilliga Sandstone water level fluctuations



Existing Namoi Alluvium water level fluctuations



Adaptive Groundwater Management

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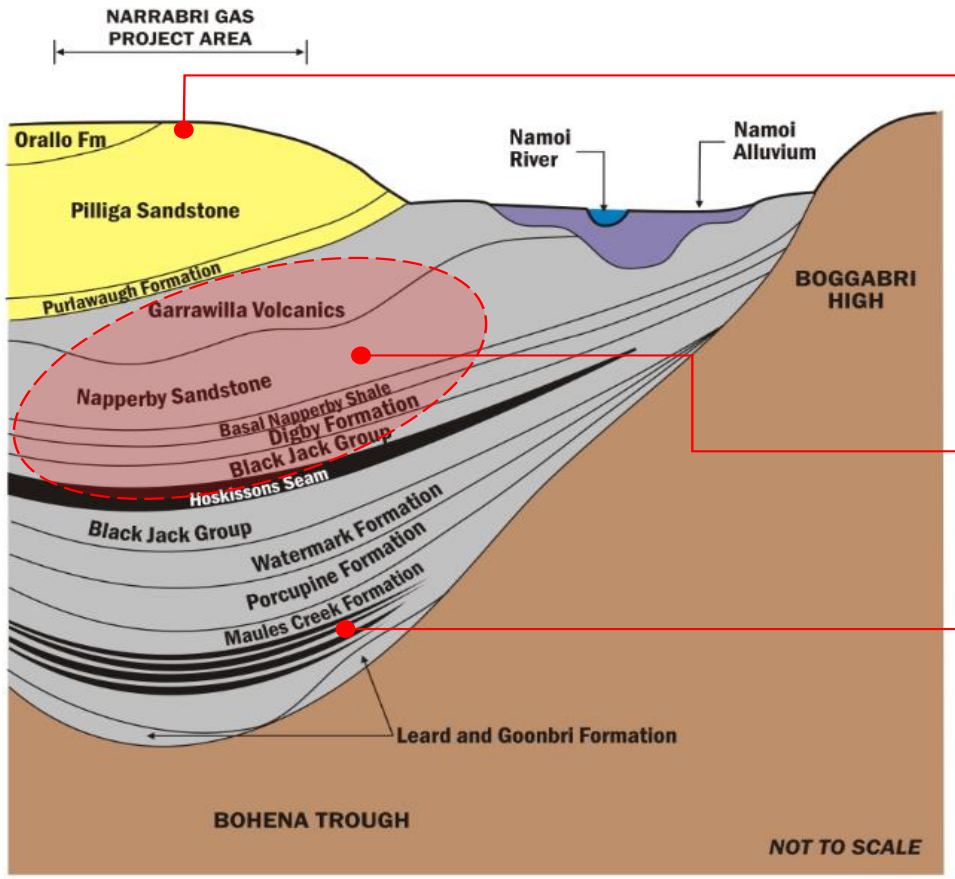


WATER SHARING PLAN

- WSP for Upper and Lower Namoi Groundwater Sources
- WSP for NSW Great Artesian Basin Groundwater Sources
- WSP for NSW MDB Fractured Rock Groundwater Resources
- WSP for NSW MDB Porous Rock Groundwater Sources
- WSP for Upper Namoi and Lower Namoi Regulated River Water Sources

GAB and alluvial aquifers

\+ No measurable effect

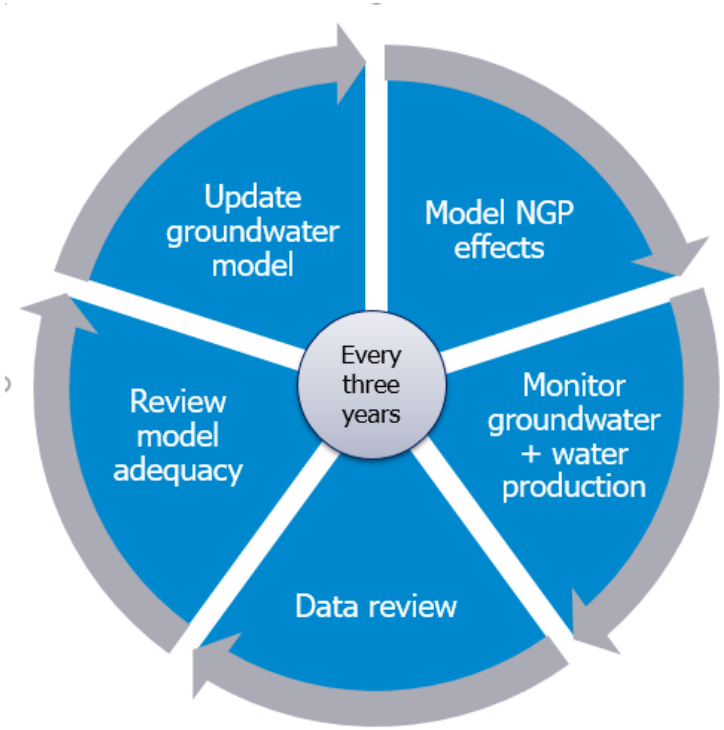
Gunnedah-Oxley Basin

\+ Small but measurable change

Gunnedah-Oxley Basin

\+ Early valuable data

Small number of uncertainties can be managed through on-going monitoring and adaptive management



Produced water management

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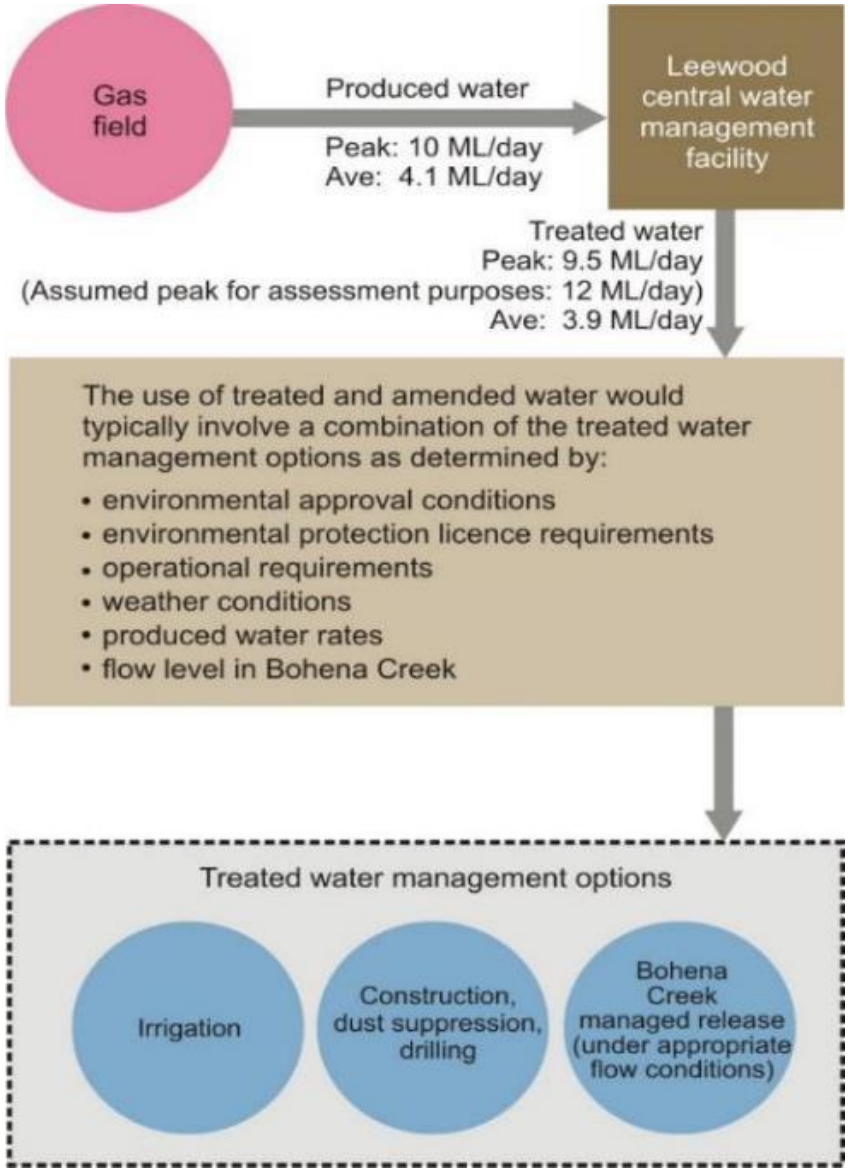
The Narrabri Gas Project will be a relatively low water producer

	NSW NGP
Average Produced Water (GL/year)	**1.5**
Total Produced water (GL)	**37.5**
Water to energy ratio (ML/PJ)	**50**
Santos WTP capacity (ML/day)	**14**

Irrigation is the favoured re-use option



Likelihood of potential harm to humans and the environment from potential spills is low

Effective treatment and responsible re-use of produced water is well known

There is a pathway for the removal of salt

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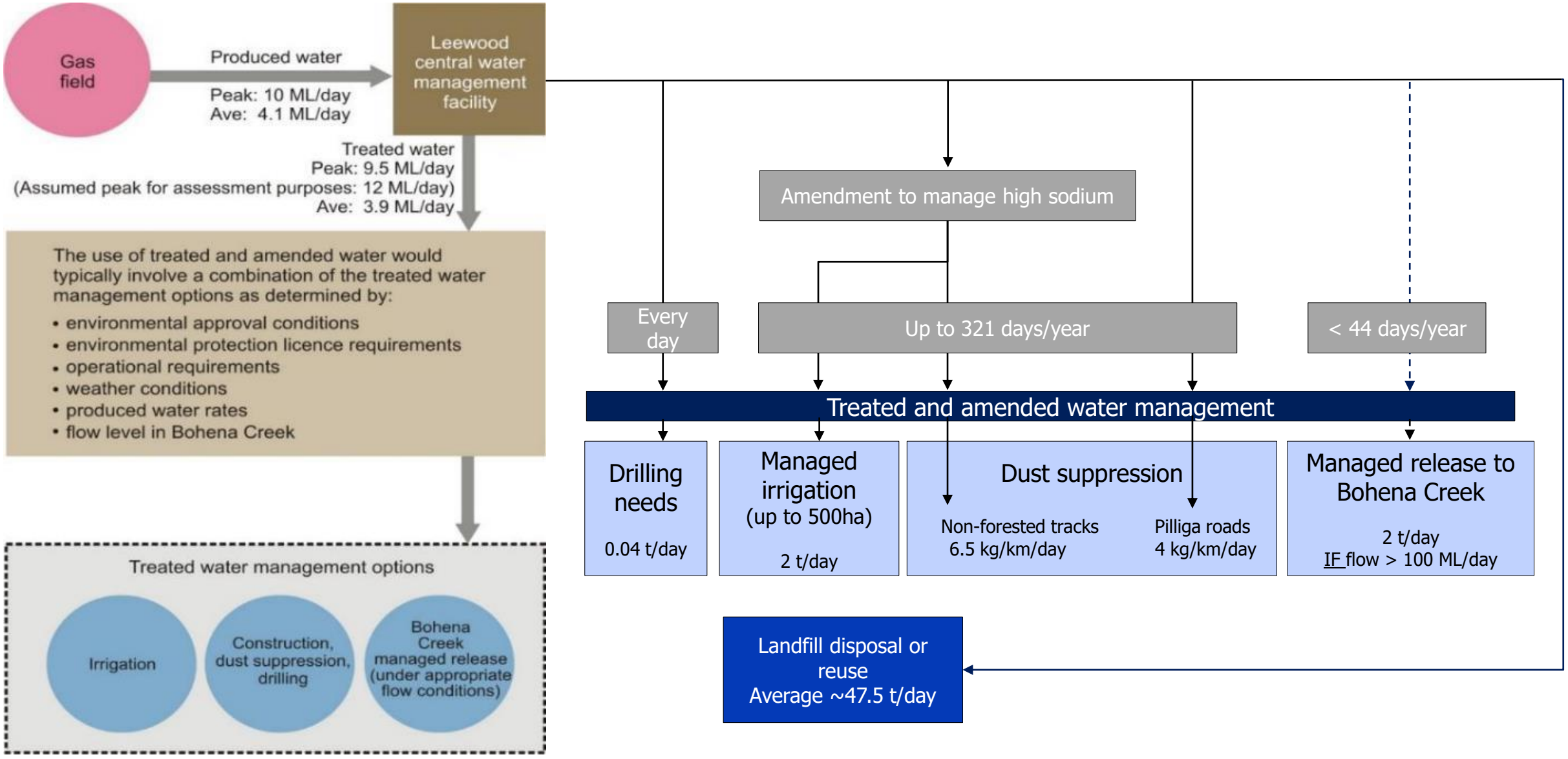

Produced water management & treatment

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Produced water storage pond at Leewood

Modular water treatment system by Reverse Osmosis

Irrigation of lucerne with treated water

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Drilling & Well Integrity

Drilling and Well Integrity

Santos

Michael Zed
Santos CSG D&C Project Lead
BEng (Hons), MIEAust, CPEng, NER

+ With more than 15 years' experience in the oil and gas industry
+ Held a number of well engineering roles across both conventional and coal seam gas operations
+ Currently responsible for the management of drilling and completions operations in New South Wales and supporting Santos' coal seam gas operations in Queensland

Regulatory Assurance

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Santos standards meet or exceed the Australian regulatory requirements

+ Coal Seam Gas industry in NSW is regulated by State / Commonwealth agencies with multiple approvals required prior to the commencement of drilling and completion operations
  - Environment Protection Authority (EPA)
  - Department of Primary Industries (DPI) - Crown Lands and Water
  - Department of Planning and Environment (DPE) – Resources Regulator
+ NSW Petroleum (Onshore) Act (1991), NSW Petroleum (Onshore) Regulation (2016)
+ NSW Work Health and Safety (Mines and Petroleum Sites) Act 2014
+ NSW Code of Practice for Coal Seam Gas, Well Integrity (2012)
+ Industry standards - American Petroleum Institute (API) standards

NSW Code Of Practice for CSG Well Integrity

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- The Well Integrity Code outlines a range of **mandatory** best practice standards for the design, construction, operation, maintenance and, ultimately, decommissioning of coal seam gas wells
- The Water Expert Panel concluded that "the current regulatory framework for coal seam gas well integrity provides reassurance that the likelihood for potential harm to humans and the environment is low, subject to the implementation and enforcement of these regulations" DPIE Assessment Report

How We Extract Coal Seam Gas

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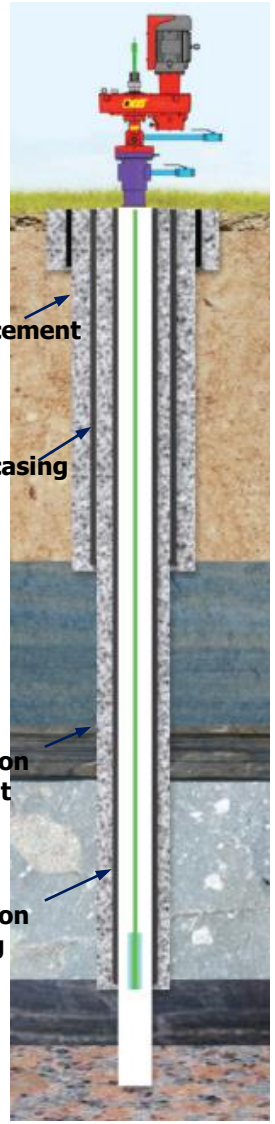

Well Design Considerations

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Wells are designed for anticipated pressure regimes present across the life of the well

- Consideration of drilling risks in design
  - Aquifer isolation / swelling formations
- Local considerations in location for activity
  - Sensitive receptors (waterways / vegetation / public)
- Well type (vertical / horizontal / surface to in-seam)
- Material selection
- Casing depths, sizes and numbers of drilling strings decided accordingly
- Total depth based on target coal horizon depths and requirements for well completion / production
- Engineered cement to meet isolation compliance

Operating Excellence and Well Integrity

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The outcome of operating excellence across our fields is managing and preserving the well's integrity throughout well lifecycle

- Well design element verification methodology during well construction process
- Engineering team dedicated to asset integrity independent of, but working closely with Drilling and Completion team
- Mechanisms that impact asset integrity are well understood
- Structured monitoring and maintenance program
- Well Integrity Principal Control Plan outlines
  - Emergency management
  - Well lifecycle and standards
  - Regular integrity and maintenance inspections

Decommissioning/Abandonment of a Well

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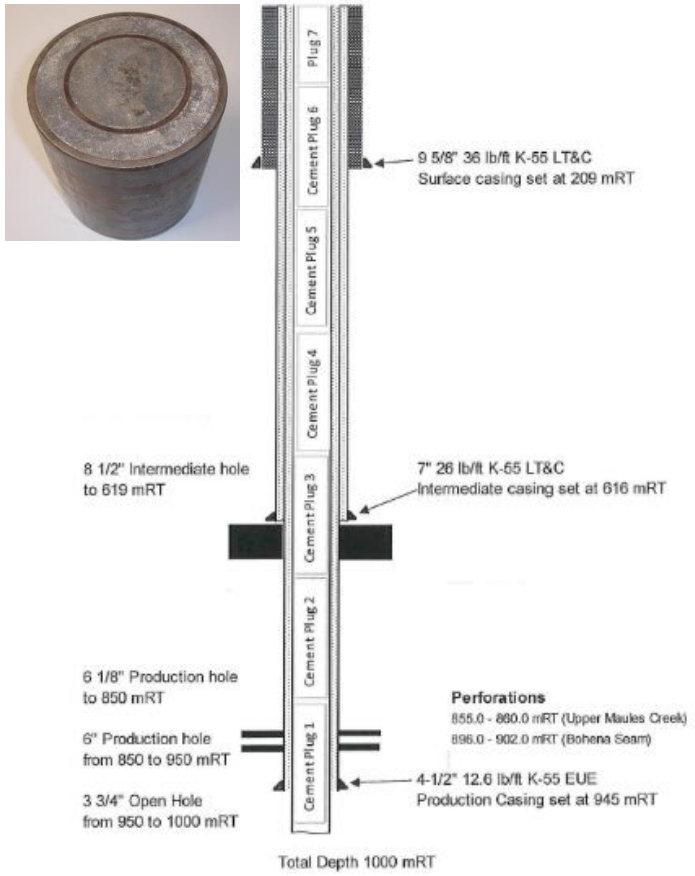
Plug and abandonment designs are submitted to the NSW Resources Regulator and approved before commencing any activity

- Plug and abandonment relies on a robust lifecycle approach
- Reviewing well history, well integrity and operating data
- Plug and abandonment designs are reviewed and approved by NSW Resources Regulator
- The abandonment process involves filling the wellbore from total depth to surface with pumping pressured cement 'plugs'
- Cement slurries are engineered and tested to specific parameters to ensure consistent performance and isolation **without cement degradation**
- Post abandonment monitoring for pressure build-up or gas flow



"The water expert panel believes that long term risks to groundwater resources after decommissioning are low… and that the primary strategy for decommissioning should be to ensure that wells are plugged and abandoned using the best available technology, and to the satisfaction of the regulator" *DPIE assessment*

Rehabilitating the Site

Santos will work pro-actively and collaboratively with our stakeholders and the communities in which we operate

- Manage the impact of our operations on the environment
- Working with landholder to determine the rehabilitation strategy
- The site is rehabilitated back to its original use;
  - Wellhead and casing(s) are cut off below ground level
  - Abandonment marker is welded to the casing
  - All the infrastructure is removed from site
  - Revegetation of the site
- NSW Resources Regulator finally signs off on the rehabilitate site

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Hazards and Risk Assessment

Hazards and Risk – Technical Assessment

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Russell Mills
BSc (Hons) Chem, PhD (Eng Sci)

+ 34 years' experience in relevant industries including coal seam gas (CSG), oil and gas production, refining, chemicals & petrochemicals and hazardous materials storage and transport
+ Extensive consulting experience involving qualitative and quantitative risk analysis, process and operational risk management, Major Hazard Facility Safety Cases
+ Experienced Preliminary Hazard Assessment (PHA) leader, including facilitator for numerous HAZID, HAZOP, CHAZOP, FMECA studies
+ Currently an Approved PHA Study Facilitator, NSW DPIE
+ GHD Representative on the Queensland CSG Industry Safer Together Forum, member of the Process Safety Working Group

Hazards and Risk Assessment

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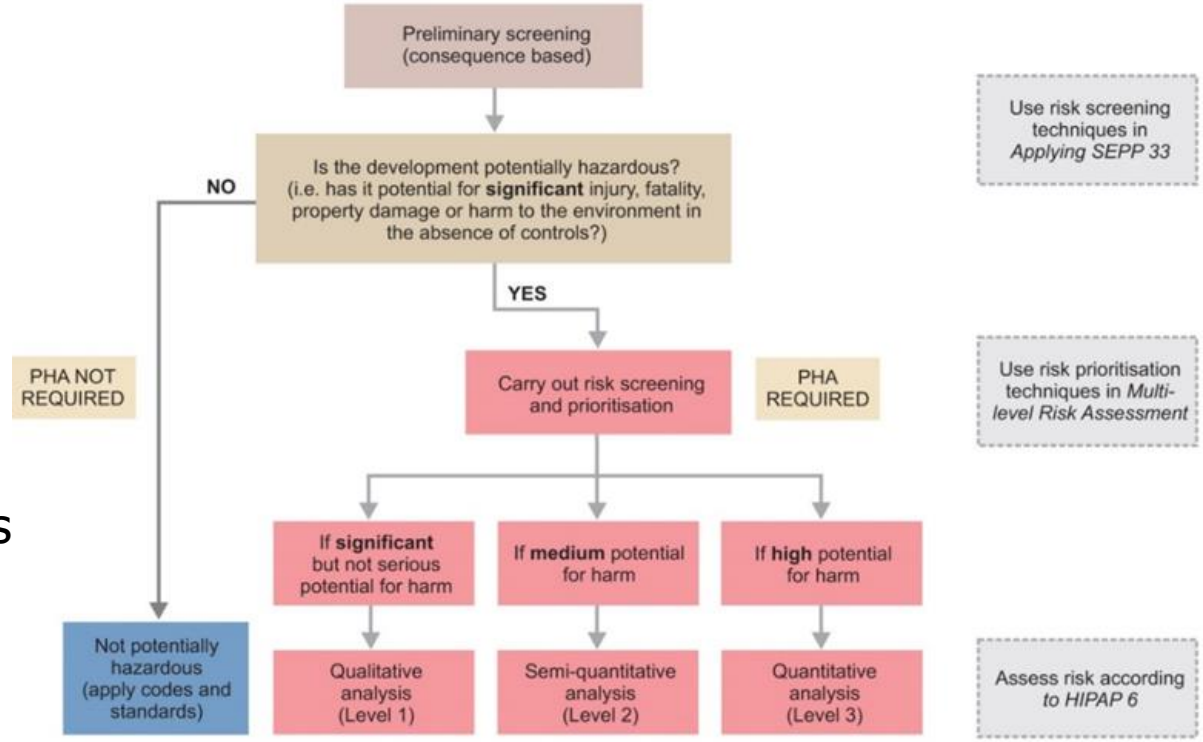
Assessment approach – complied with SEARs

- Preliminary risk screening for transport, handling and use of dangerous goods using NSW State Environmental Planning Policy (SEPP 33) guidelines
- Hazard identification leading to selection of loss of containment (LOC) events for flammable gases, liquid chemicals and large quantities of water
- Preliminary Hazards Analysis of hazardous events using NSW Hazardous Industry Planning Advisory Papers (HIPAP) 6 and HIPAP 4 guidelines
- Bushfire risk assessment, project impact on people, property and biophysical environment



Source: *Multi-level Risk Assessment Guidelines* (New South Wales Department of Planning 2011)

Hazards and Risk Assessment

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Key Findings

- Preliminary risk screening showed dangerous goods activities comply with SEPP 33, and the presence of methane gas triggers a PHA covering all dangerous goods
- The PHA provided a rigorous assessment for all dangerous goods classes present in the project
- Methane gas releases included likelihood and worst case consequence analysis
- The project is compliant with HIPAP 4 criteria for individual fatality, injury (thermal radiation and explosion overpressure), and societal risk
- There is no cumulative risk to a given sensitive receiver from multiple production wells; they are spaced well outside of the impact distance of each well (approximately 50 m), as specified by the Field Development Protocol, which requires at least 750 m separation
- Bushfire risk was medium during the construction and operational phases of the project, based on a remote likelihood of the project to start a fire, but with the potential for a major consequence

  Note: Five natural bushfire events in Pilliga identified by Santos, notification to RFS and Forestry: November 2014, November 2015, February 2017, January 2018 and January 2020

Assessment Report and Independent Expert Review

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Assessment Report

Mr Skinner and the Department's Hazard Unit are satisfied that hazards can be appropriately managed, and have recommended a number of conditions to manage these risks

Independent Expert Review

The 'Public Safety' aspects of the proposed NGP appear to have been addressed in the EIS (Principally Chapter 25 and Appendix S) and in the applicant's responses to the questions raised during the review

- A Final Hazard Analysis (FHA) is required. Scope of the FHA to include:
  - Quantitative Risk Assessment, including risk contours for Leewood central gas processing facility (CGPF)
  - HAZOP of the detailed design
  - Confirmation of setbacks for well heads and Leewood CGPF from their boundaries
  - Optimisation of well pad layouts to minimize safety risks
- Independent and periodic hazard audits to be undertaken
- Safety Management Systems to be developed
- A Bushfire Management Plan (BMP) is to be prepared, including an independent audit of the controls prior to commissioning

Hazards and Risk Assessment Findings

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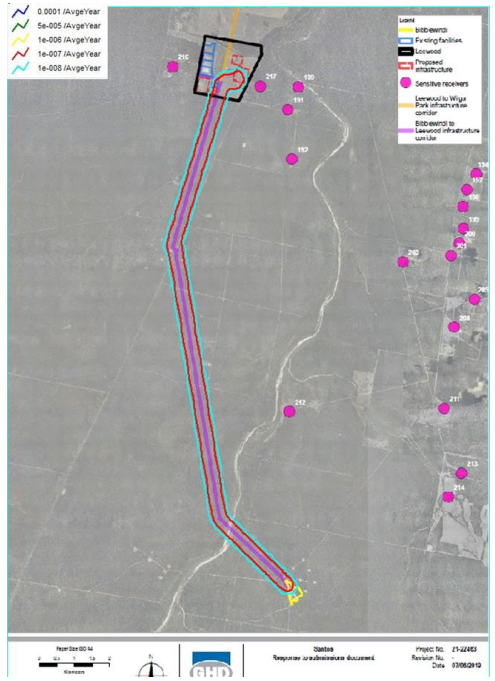
Cumulative risk contours – Leewood CGPF and Medium Pressure Pipeline

PLOT 1
Leewood Facility Individual Fatality Risk Contours

PLOT 2
Medium Pressure Pipeline Individual Fatality Risk Contours



PLOT 3
Leewood Facility Injury Risk Contours (4.7 kW/m^2)

Conclusions:

1. Leewood facility, individual fatality risk at nearest sensitive receiver is <1 x 10^{-6} per year (meets HIPAP 4 criteria)
2. Medium pressure pipeline from Bibblewindi to Leewood, individual fatality risk at nearest sensitive receiver is <1 x 10^{-6} per year (meets HIPAP 4 criteria)
3. Leewood facility, heat radiation injury risk at nearest sensitive receiver is < 5 x 10^{-5} per year (meets HIPAP 4 criteria)

Compliance with HIPAP 4 Risk Criteria

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Leewood CGPF and MP Trunkline (Bibblewindi to Leewood) (1, 3)

Exposure Type	Risk Criteria	Compliance with HIPAP 4?
Individual fatality risk [3]		
Hospitals, schools, child-care facilities and old age housing developments	Half in a million per year (5×10^{-7} per year)	Yes
Residential developments and places of continuous occupancy (hotels/resorts)	One in a million per year (1×10^{-6} per year)	Yes
Commercial developments, incl. offices, retail centres, warehouses with showrooms, restaurants, entertainment centres	Five in a million per year (5×10^{-6} per year)	Yes
Sporting complexes and active open space areas	Ten in a million per year (1×10^{-5} per year)	Yes
Industrial sites [2]	Fifty in a million per year (5×10^{-5} per year)	Yes [4]
Heat radiation and explosion overpressure injury risk		
Incident heat flux at residential and sensitive use areas should not exceed 4.7 kW/m^2	Fifty in a million per year (5×10^{-5} per year)	Yes
Incident explosion over pressure at residential and sensitive use areas should not exceed 7 kPa	Fifty in a million per year (5×10^{-5} per year)	Yes

Notes:
1. There are no sensitive receivers near well pads and the gathering network, and the Bibblewindi Medium Pressure Station
2. There are no nearby industrial facilities for which HIPAP 4 property damage risk criteria apply
3. Individual fatality risk based on fires and explosions
4. The industrial risk contour exceeds the site boundary on the eastern side, however does not reach any sensitive receptors

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Ecology

Ecology and Biodiversity – Technical Assessment

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eco logical AUSTRALIA
A TETRA TECH COMPANY

Martin Sullivan

B.Sc Biodiversity Conservation, Principal Ecologist, National Discipline Lead Ecology & Impact Assessment

+ 15+ years' experience in biodiversity impact assessment, vegetation mapping and conservation assessment.
+ Led all aspects of the biodiversity assessment of the Narrabri Gas Project (since 2010).
+ Technical lead for a national team of more than 80 ecologists at Eco Logical Australia.
+ Regularly engaged by the Department of Planning, Industry and Environment to produce landscape scale vegetation maps for the National Parks estate.

Summary

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+ More than half of the project area is located within the Pilliga
+ The part of the Pilliga in which the project is located has a long history of forestry activities and was specifically zoned for extractive industries including petroleum activities
+ At full production, project activities will cover less than half a percent of the Pilliga's half a million hectares
+ Biodiversity impacts can be avoided and minimised at the site scale by micro-siting surface infrastructure
+ The species and ecosystems of the Pilliga will continue to function as they currently do, without habitat fragmentation and without significant impacts to species or ecosystems
+ When infrastructure is decommissioned, the land will be returned to its natural state

Landscape Context

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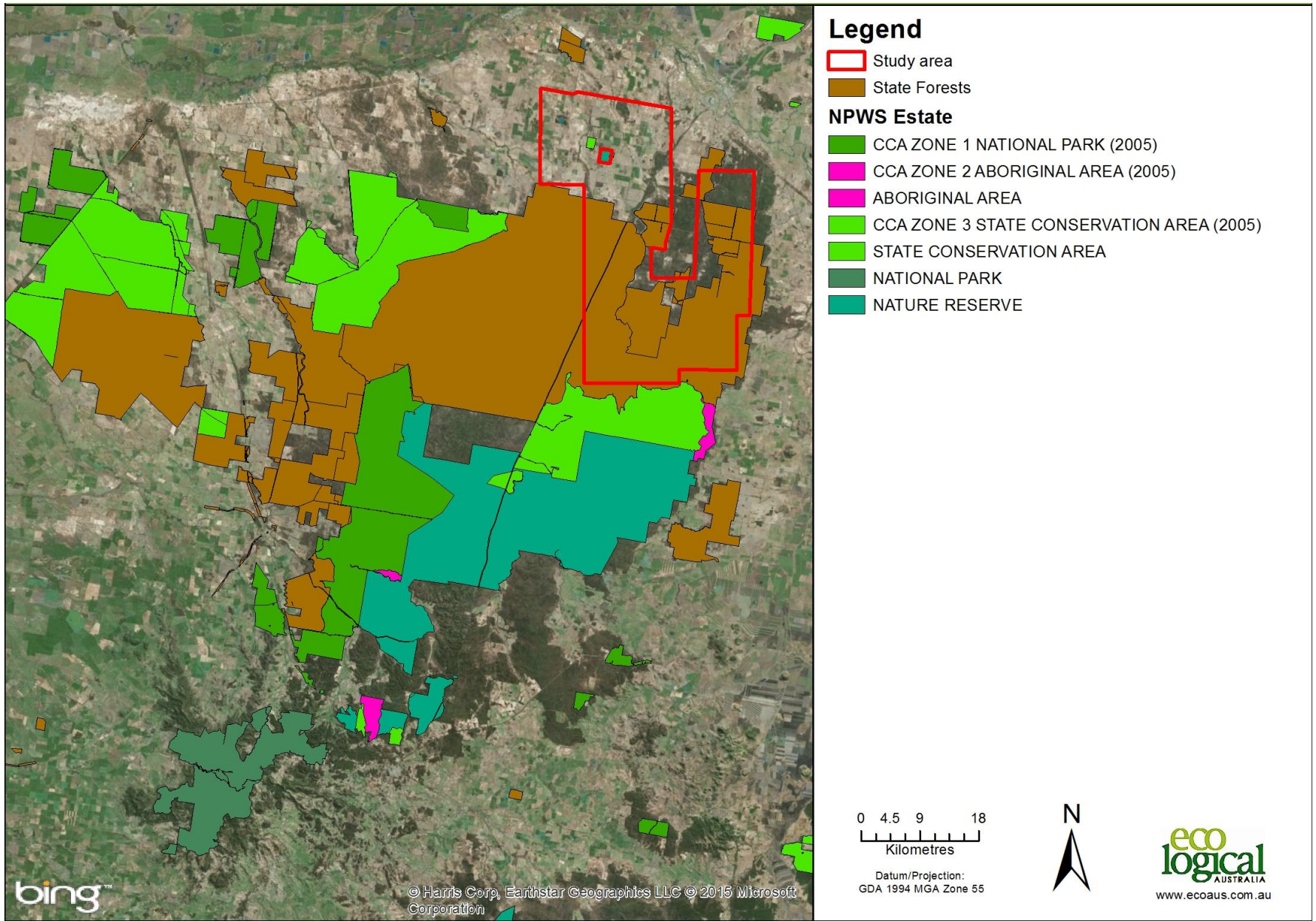

Key findings

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- No significant impacts on threatened species, populations or ecological communities
- Removal of approximately 1.5% of native vegetation in the project area, half of which will be rehabilitated immediately following construction
- Impacts on threatened flora populations <1.6%
- Impacts to threatened communities <1%
- Impacts on threatened fauna habitat <2%
- Residual impacts will be offset

Baseline data and results

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- The EIS draws upon more than 13,000 hours of on the ground survey effort
- Threatened flora survey and population modelling
  - 10 threatened flora species
- Threatened fauna survey, including specific targeted survey for a range of key species
  - 18 threatened birds, 11 threatened mammals and one threatened reptile
- Threatened ecological community survey and assessment
  - Four threatened ecological communities
- Key mapping and modelling datasets

Approach to impact assessment

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- Robust approach to biodiversity impact assessment was undertaken - Framework for Biodiversity Assessment
- Precise location of most surface infrastructure is still to be determined using Field Development Protocol - conservative 'upper disturbance limits' have been set
- Avoidance of significant ecological values prioritised
- The assessment approach is conservative and robust and ensures that Santos will not need to increase disturbance limits

Biodiversity Offset Package

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- Biodiversity offset package compensates for residual impacts = no net loss to biodiversity
- Offsets provided for indirect and cumulative impacts (not required by policy)
- Offset credits required:
  - 66,633 ecosystem credits ~6,400 hectares of land
  - 1,418,928 flora species credits
  - 138,806 fauna species credits
  - 1:1 offset for hollows greater than 300 mm diameter
- Progressive rehabilitation can reduce offset liability
- Package includes land, supplementary measures, fund contributions

Conclusion

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- The project is consistent with strategic land use planning objectives in the region
- Biodiversity Assessment is comprehensive and has been prepared in accordance with relevant guidelines, methodologies and policies
- The Field Development Protocol avoids and minimises impacts to biodiversity values at the specific site level
- Upper Disturbance Limits are conservative and robust
- The project will not have a significant impact on any threatened entities
- All residual biodiversity impacts will be offset in accordance with policy

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End

The project is in the public interest and is approvable subject to strict conditions.