The Secretary

Department of Planning and Environment NSW

RE: NARRABRI GAS PROJECT - WATER IMPACT ASSESSMENT

Dear Sir/Madam

The Santos EIS for Narrabri Gas Project Appendices F and G have failed to correctly risk assess the groundwater impacts of Narrabri Gas Project on irrigation, domestic and stock water users and groundwater dependent ecosystems. This is serious because there are over 4,000 bores within 30 km of Leewood, including Narrabri town water supply.

Santos EIS claims their modelling indicates there will be less than 0.5m drop in the Pilliga Sandstone aquifer because of the assumptions that there are 'relatively impervious rock layers' between the target coal seam and the aquifer. The vertical hydraulic conductivity values are too conservative. The Namoi Water Catchment Study Phase 2 conducted by Schlumberger indicates there is no such impervious layer:

Table 7.11 Summary of parameters for each geological unit					
Geological units	Hydrogeological significance	Horizontal hydraulic conductivity, K _s {m/d}	Vertical hydraulic conductivity, K, (m/d)	Specific yield, S, (-)	Specific storage, S (1/m)
Narrabri Formation	Significant Aquifer	0.1-30"(6.3")	0.000001.7 - 0.037 *{0.0003*}	0.005-0.1"	0.000005°
Gunnedah Formation	Significant Aquifer	0.05-30'(7.1')	3.5 to 7.21	0.15'	0.000001 - 0.0005'
Lower Namoi / Weathered Horizon	Significant Aquifer	0.0009 - 8.6'	0.009 - 0.9	0.15*	0.000001 - 0.0005'
Fractured rock horizon	Aquifer	0.01 - 10	0.001 - 0.1	0.01	0.00001
Great Artesian Basin	Aquifer	0.004 - 0.265	0.000015 - 0.0002 ^t	0.1"	0.0001 - 0.00001"
Pilliga Sandstone	Aquifer	0.004 - 0.265°	0.000015 - 0.0002	0.1°	0.000005°
Purlawaugh Formation	Aquifer	0.004 - 0.02	0.000015-0.001	0.001*	0.000005°
Garrawilla Volcanics	Minor Aquifer	0.001 - 0.04 ^b	0.000006- 0.001°	0.002*	0.000005°
Napperby and Deriah Formation	Minor Aquifer	0.001 to 0.04°	0.000006° to 0.71°	0.1 °	0.00014
Digby Formation	Minor Aquifer	0.9 to 1.5	0.62 to 0.71	0.14	0.0001
Upper Black Jack	Aquitard	0.0003 - 1.1°	0.19-0.59	0.1°	0.000014
Hoskissons seam	Aquifer	0.13 to 3.3	0.00022 to 0.002	0.2	0.0001
Middle Black Jack	Aquitard	0.0015 to 0.0474	0.005 to 0.4 ⁴	0.1°	0.0001 ^d
Melvilles seam	Aquifer	0.02	0.005 to 0.4°	0.1 ^e	0.00011
Lower Black Jack	Aquitard	0.0015 to 0.047°	0.005 to 0.4 ^d	0.1 ^e	0.0001 ^d
Watermark and Porcupine Formations	Aquitard	0.0009 - 0.00014	0.00009 - 0.0014	0.01	0.000011
Maules Creek Formation	Aquifer	0.13 to 3.3	0.00022 to 0.002	0.1°	0.0001
Leard Formation	Aquitard	0.009 - 0.25	0.0009 - 0.025	0.01	0.00001

Refs: a = NSW Office of Water (2010), b = Aquaterra (2009), c = Golder Associates (2008), d = Golder Associates (2010), e = GABCC (2010), f = Freeze and Cherry (1979), g = GeoTerra (2009)

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Furthermore the EIS is deficient in the following regards:

I. Santos has made a subjective risk assessment of the induced connectivity between the Pilliga sandstone aquifer and toxic coal seam target water accessed by gas wells - with no data presented. There is no well integrity data presented to back up their assessment either

from elsewhere of from the current exploration wells in the Pilliga. The damage consequences to groundwater system are too high to make subjective assessments.

2. The hydrology model and its assumptions need to be critically and independently reviewed since the consultant has used their own values for the key hydraulic parameters. They have assumed very low permeability of rock strata above the coal seams which are to be dewatered. Both the model and the hydraulic conductivity values could be totally wrong (or faulting in the rock strata could render the entire model meaningless).

3. The calculated subsidence (done by ECOLOGICAL) from de-watering is assumed to be no more than 20cm – this cannot be verified.

4. The risk of gas leakage into shallow irrigation, domestic and stock bores has been subjectively assessed as low by Santos – there is no data or measurements, and no reference to QLD coal seam gas industry or international experience. Frankly, it is not believable, especially given the empirical evidence from Queensland of methane flux through soils of the Condamine/ Tara/ Chinchilla area. Connectivity of the aquifer with the Walloon coal measure in the Condamine River has been proven: <u>https://www.nature.com/articles/srep15996</u>.

5. Faulting - Santos did their own faulting study and concluded low risk. The faulting study carried out by Santos is not sufficiently detailed to rule out connectivity faulting in the rock strata under the project area.

7. Santos has failed to adequately assess the risk to groundwater dependent ecosystems in the Project area through failure to identify species and the key assumption of low vertical hydraulic conductivity and their conclusion of no faulting or well-induced cross contamination of water.

8. If Santos is wrong about water damage the bores most likely to be impacted will be those in the east Gunnedah Basin GMA first.



9. Santos admit to induced groundwater flow from the pure Southern GAB recharge into the deeper lower quality Gunnedah-Oxley Basin groundwater, but conclude from their water model assumptions that this induction is minimal and over 100s of years. Frankly, this is wishful thinking based on a water model with faulty assumptions of low conductivity and no interconnectivity being caused by drilling and fracturing.

10. Santos admit to water being induced from the Namoi Alluvium into the Pilliga sandstone aquifer and thence into the de-watered Gunnedah basin - they say this is a 'good thing' since it will improve the Gunnedah basin water!!!

11. There is no assessment of the super alkaline Purlewaugh Formation water that could be conducted through layers through drilling, induced connectivity, induced water flows and well casing failure.

Yours sincerely Dave Smith Narrabri 17 May 2017-05-17