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Local Water Bore Testing

Santos Community Committee – Upper Hunter

January 24, 2012

Water – understanding aquifers

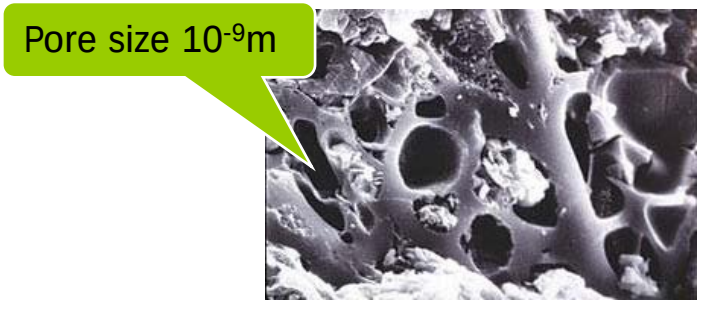
- **Coal seam water** and **community aquifers**.
- An **aquifer** is a layer of the earth that is infused with water, like a sponge. It is *not* a free flowing underground river many people may imagine.
- A coal seam also contains water.
- **Community aquifers** are typically close to the surface, recharged from ground water and have good quality water.

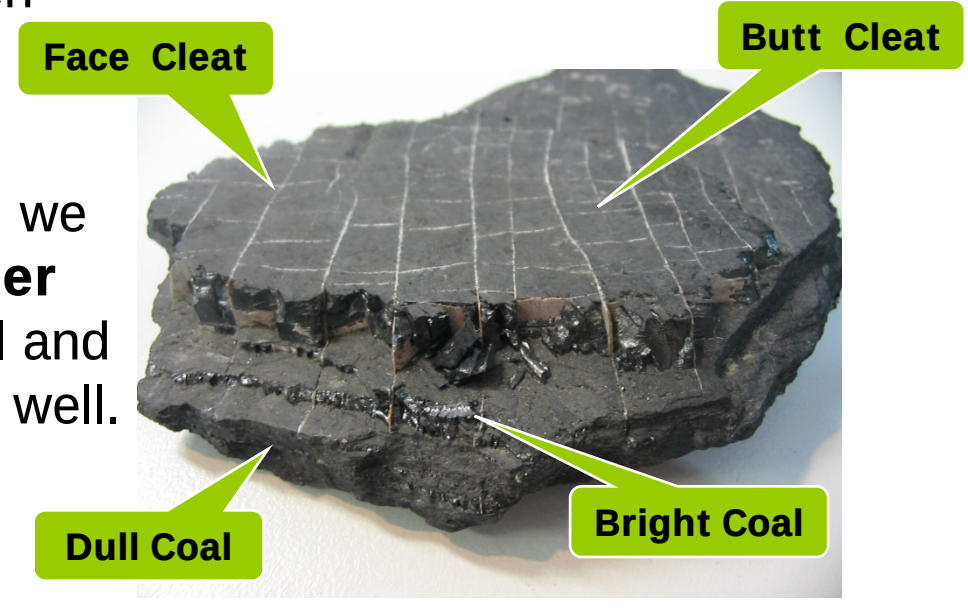
Water – understanding aquifers

- Under shallow strata which contain water used by the community, are typically layers of earth and rock which are impermeable, which means they act like a seal.
- **These layers exist at various depths and provide natural seals that stop water seeping down to deeper strata.**

Water – coal seam water

- Both **water and gas** particles are trapped within the cleats or micropores of the coal.
- Water and gas is a **by-product** of coal formation. It has been trapped within the coal for typically **millions of years**.
- To release gas from a seam, we remove the **coal seam water** which depressurises the coal and allows the gas to flow into a well.





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Water - coal seam water

- For viable gas production, water must not be able to enter the coal seam or the well.
- It is critical to commercial gas production and the protection of aquifers used by the community that the coal seams targeted are **sealed** from other water sources.

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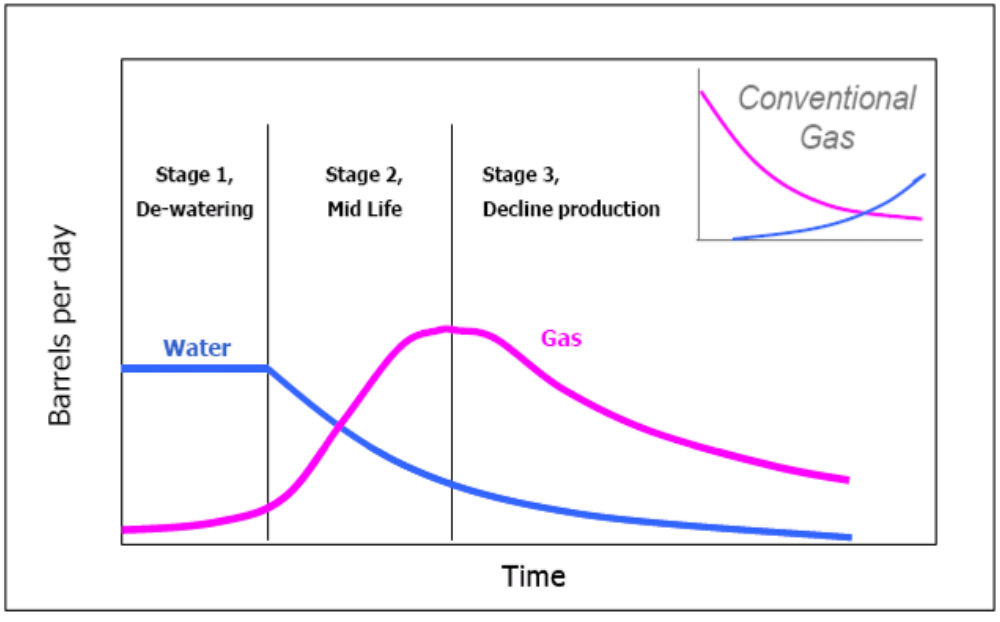
Water - coal seam water

- The volume of water is highest at the beginning of well operation then typically declines, as gas production increases.



- Every coal seam is **unique** and has different quantities and qualities of water and gas. We don't know how much water may be in local coal seams yet.

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Water - coal seam water

- The water we produce is from the coal seam, *not* from the aquifers used by the community.
- Coal seam water is typically **brackish**, but can be treated and used for a range of uses.
- Treated coal seam water is **additional** water to farmers, it is *not* from their aquifer.

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Scientific proof

Science can prove if community aquifers are protected by:

1. **local water bore testing** data from the community aquifers;
   We are at this point in the Upper Hunter area.
2. **studying the local geology** to find natural seals;
   This occurs during seismic and core hole exploration.
3. **groundwater impact assessments** and modelling, and
   All data available is used to build a model, which is then tested.
4. **pilot well testing,** including pumping some water from the coal seam. *This occurs during test well operation.*

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Step 1 – local water bore testing

We are at this point in the Upper Hunter.

- **When** we test local water bores:
  - Before any drilling exploration activities

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Step 1 – local water bore testing

- **Why** we test:
  - To measure the **natural state** of the community aquifers, before any drilling exploration or production.
  - Gather **baseline data**.
  - To **characterise** each individual water bore and aquifer, which is unique; like a fingerprint.
  - Testing is not a requirement, it is a **voluntary** activity.

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Step 1 – local water bore testing

- **What** we test for includes:
  - isotopes;
  - water levels;
  - salinity;
  - naturally occurring metals;
  - organic compounds;
  - gases, and
  - nutrients.

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Step 1 – local water bore testing

- **How** we test local water bores
  - **Specialist independent** water monitoring consultants
  - **Water industry standard** equipment and protocols
  - Collection **containers** are prepared and provided by a National Association of Testing Authorities Australia (NATA) accredited laboratory to ensure no contaminants.
  - Professional **techniques** ensure quality assurance and control, for example water characteristics change when exposed to the air or the metal bore casing.

Step 1 – local water bore testing

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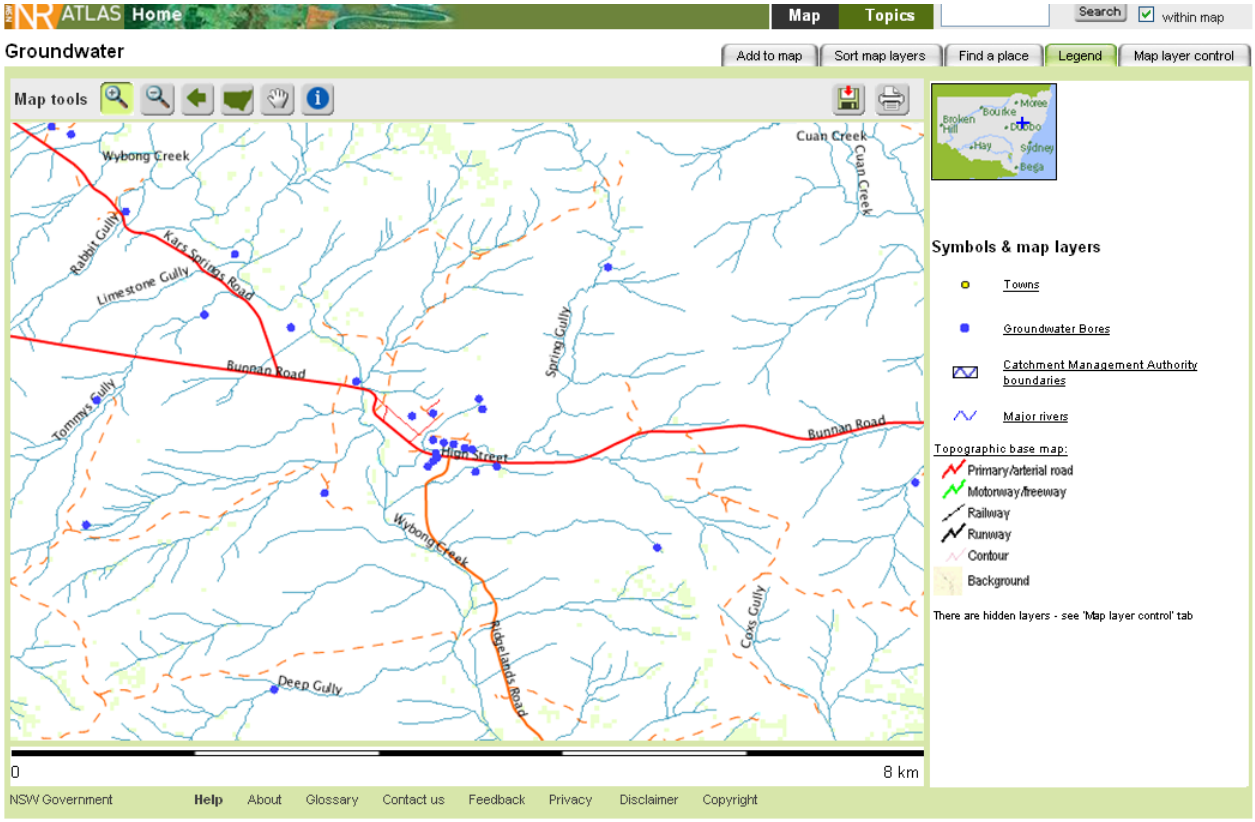
Step 1 – local water bore testing

- **Where** we test:
  - Generally within a 2 kilometre radius of exploration drilling.



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Step 1 – local water bore testing

- Within a 2km radius there are approximately **21** registered bores, 9 on surrounding properties and 12 within the township of Bunnan.
- Testing this number of bores would take approximately one week.

Step 1 – local water bore testing

- **Who** is involved with the testing:
  - **Specialist independent** water consultants
  - **Santos water team** member
  - **Landowners**
  - **Other interested people**

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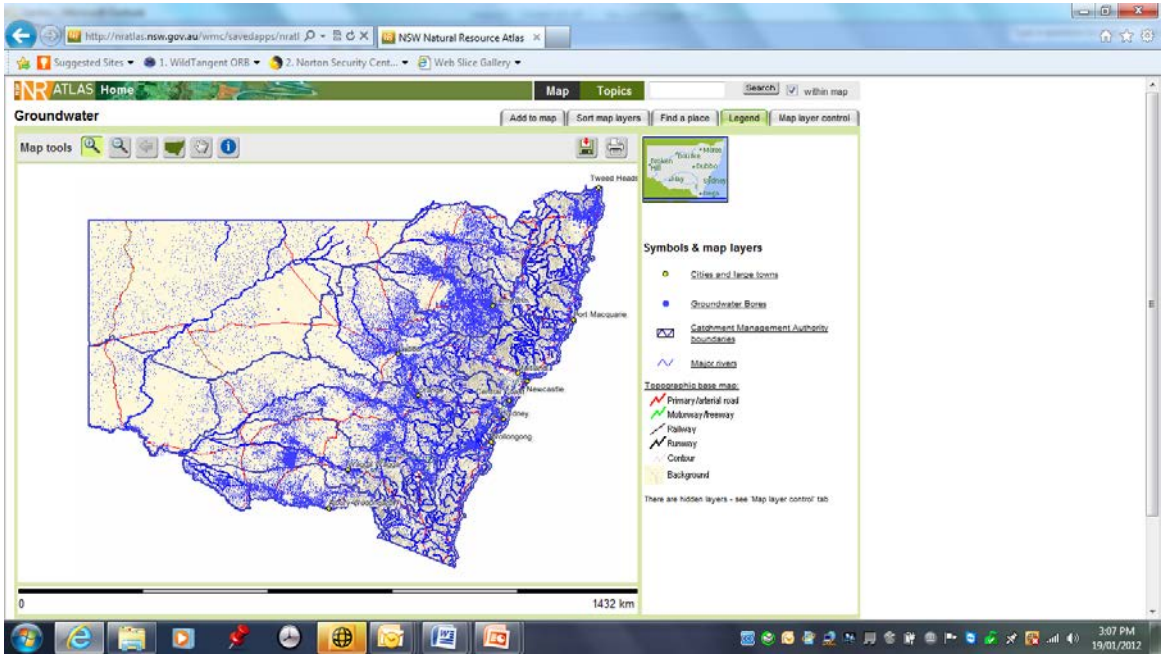
Step 2 – studying the local geology

- The local geology is studied through:
  - reviewing existing data on file with the government;
  - seismic surveys, and
  - core hole analysis.

Step 2 – studying the local geology

- There is a wealth of information held by **government,** much of which is freely available to the public.
- ie we can access **information on registered bores** from a government website: www.nratlas.nsw.gov.au/wmc/



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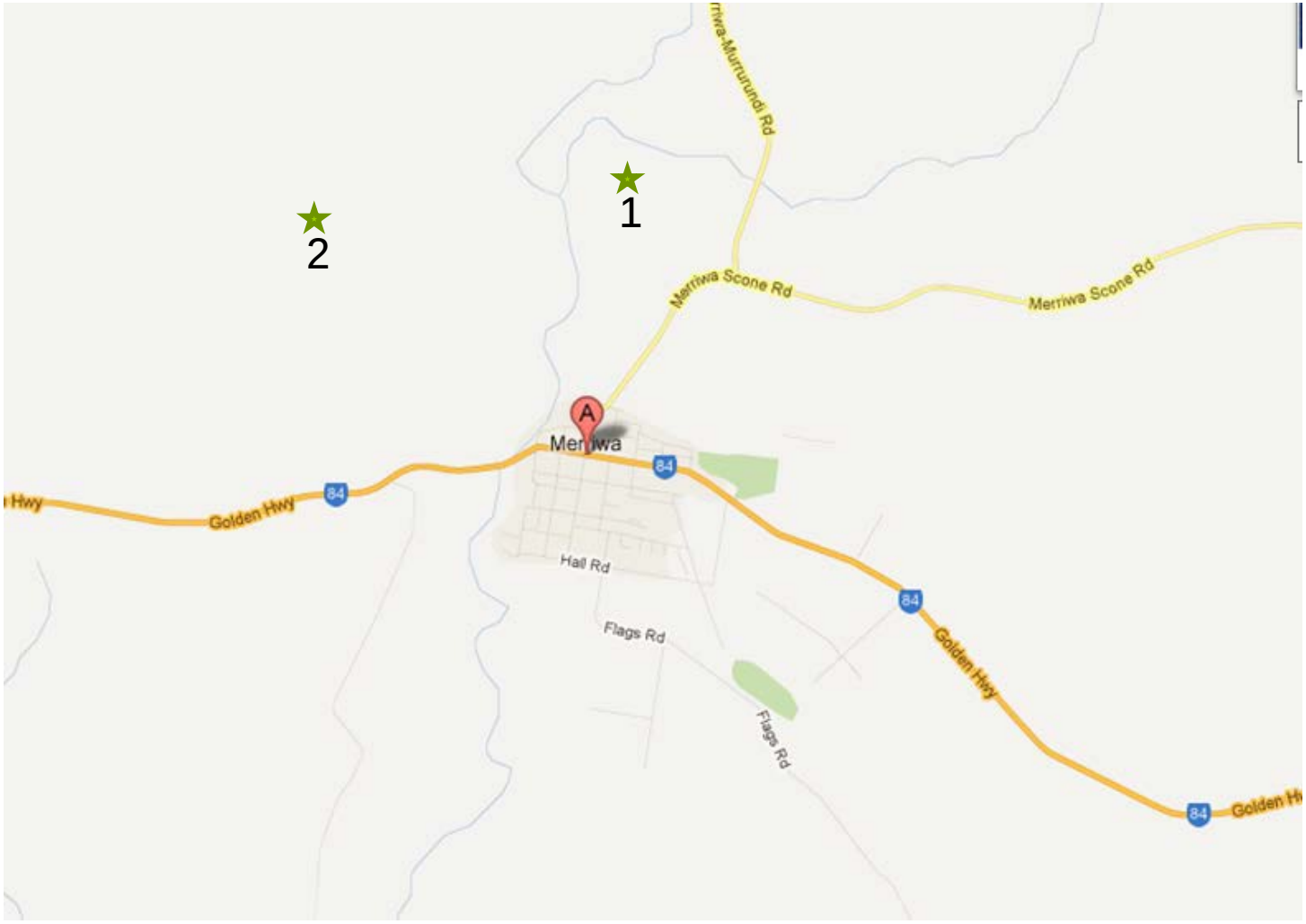
Step 2 – studying the local geology



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Step 2 – studying the local geology

GROUNDWATER NUMBER	GW080102
LIC-NUM	20BL167299
AUTHORISED-PURPOSES	TEST BORE
INTENDED-PURPOSES	TEST BORE
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	Rotary
OWNER-TYPE	
COMMENCE-DATE	
COMPLETION-DATE	2000-06-13
FINAL-DEPTH (metres)	302.00
DRILLED-DEPTH (metres)	302.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	BRINDLEY PARK
GWMA	-
GW-ZONE	-
STANDING-WATER-LEVEL	11.50
SALINITY	
YIELD	61.25

FROM	TO	THICKNESS	DESC	G
0.00	0.60	0.60	Soil	
0.60	5.50	4.90	Clay, brown	
5.50	7.00	1.50	Basalt, decomposed	
7.00	14.90	7.90	Basalt, very weathered	
14.90	16.20	1.30	Shale, very soft	
16.20	22.60	6.40	Shale, firm	
22.60	38.00	15.40	Basalt, hard, blue	
38.00	39.00	1.00	Mudstone	
39.00	39.60	0.60	Sand	
39.60	48.50	8.90	Clay, pebbly, white	
48.50	50.10	1.60	Shale, grey	
50.10	67.00	16.90	Sandstone, soft, clayey	
67.00	87.80	20.80	Conglomerate, grey, hard, broken	
87.80	133.80	46.00	Mudstone, grey, firm	
133.80	148.40	14.60	Sandstone with shale layers	
148.40	151.20	2.80	Mudstone, grey	
151.20	171.30	20.10	Sandstone, white	
171.30	182.00	10.70	Mudstone	
182.00	212.90	30.90	Sandstone with shale layers	
212.90	216.10	3.20	Sandstone, muddy	
216.10	227.70	11.60	Shale, grey, sandy	
227.70	229.80	2.10	Sandstone, soft, coarse, free	
229.80	234.00	4.20	Sandstone shale, tight, cemented	
234.00	244.10	10.10	Sandstone, soft, coarse, free	
244.10	255.70	11.60	Sandstone, cream, sandstone, tight	
255.70	265.80	10.10	Sandstone, fine grained, free	
265.80	269.70	3.90	Sandstone with mudstone layers	
269.70	302.00	32.30	Sandstone, fine grained, tight	

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Step 2 – studying the local geology

- **Bunnan:** According to government data there are local bores in the Bunnan area ranging from depths of 7 metres to approximately 150 metres.
- In the Bunnan area coreholes will have surface casing of steel and cement run past all surface aquifers to seal these aquifers from other formations (i.e. to about **150m**). The coreholes will then extend to depths of up to **1400m** to intersect coal seams that are expected at depths greater than **800m** or so.
- **Local water bore testing** will build more information on local water bores and aquifers used by the community.

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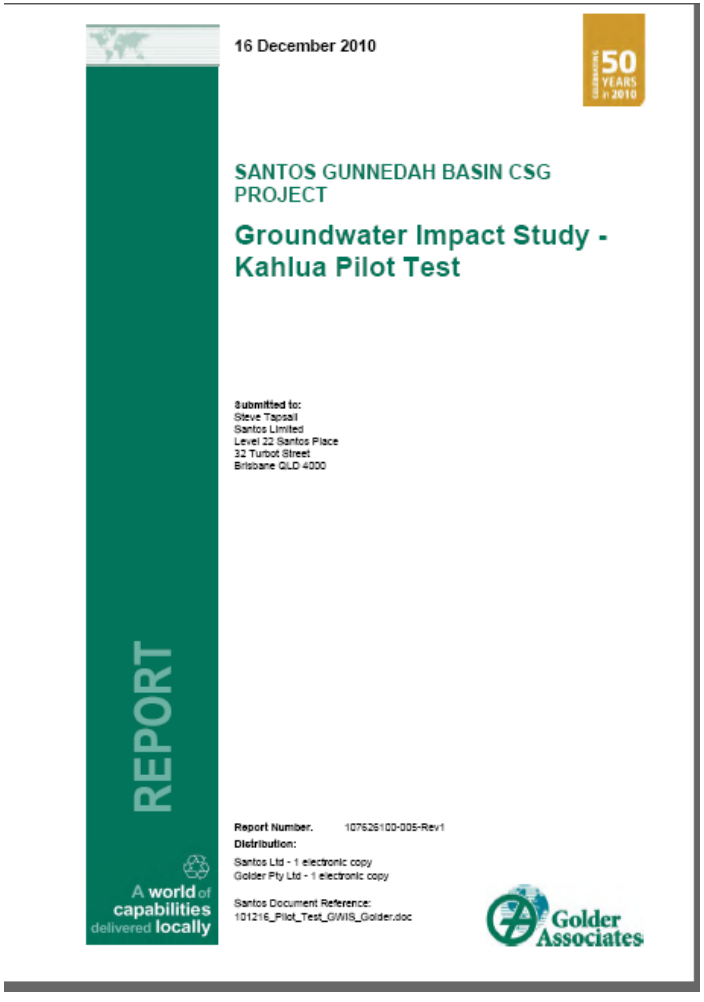
Step 3 – groundwater modelling

- Before pilot well tests begin thorough ground water modelling is undertaken. This modelling is placed on public display and is a requirement of government approvals.
- Kahlua pilot well example: http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0005/384692/20110311-REF-PEL-1-Kahula-Pilot-Test-GWIS-pt-1of2.pdf
- Or Google Kahlua GWIS



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Things to discuss in future meetings

- Local water bore results
- Geologist to talk about seismic and core hole exploration
- Pilot well planning
- Pilot well dewatering tests
- Potential reuse of treated coal seam water