Desalination in Australia

Coal Seam Gas Water

Session 3

Sheraton Hotel - Perth

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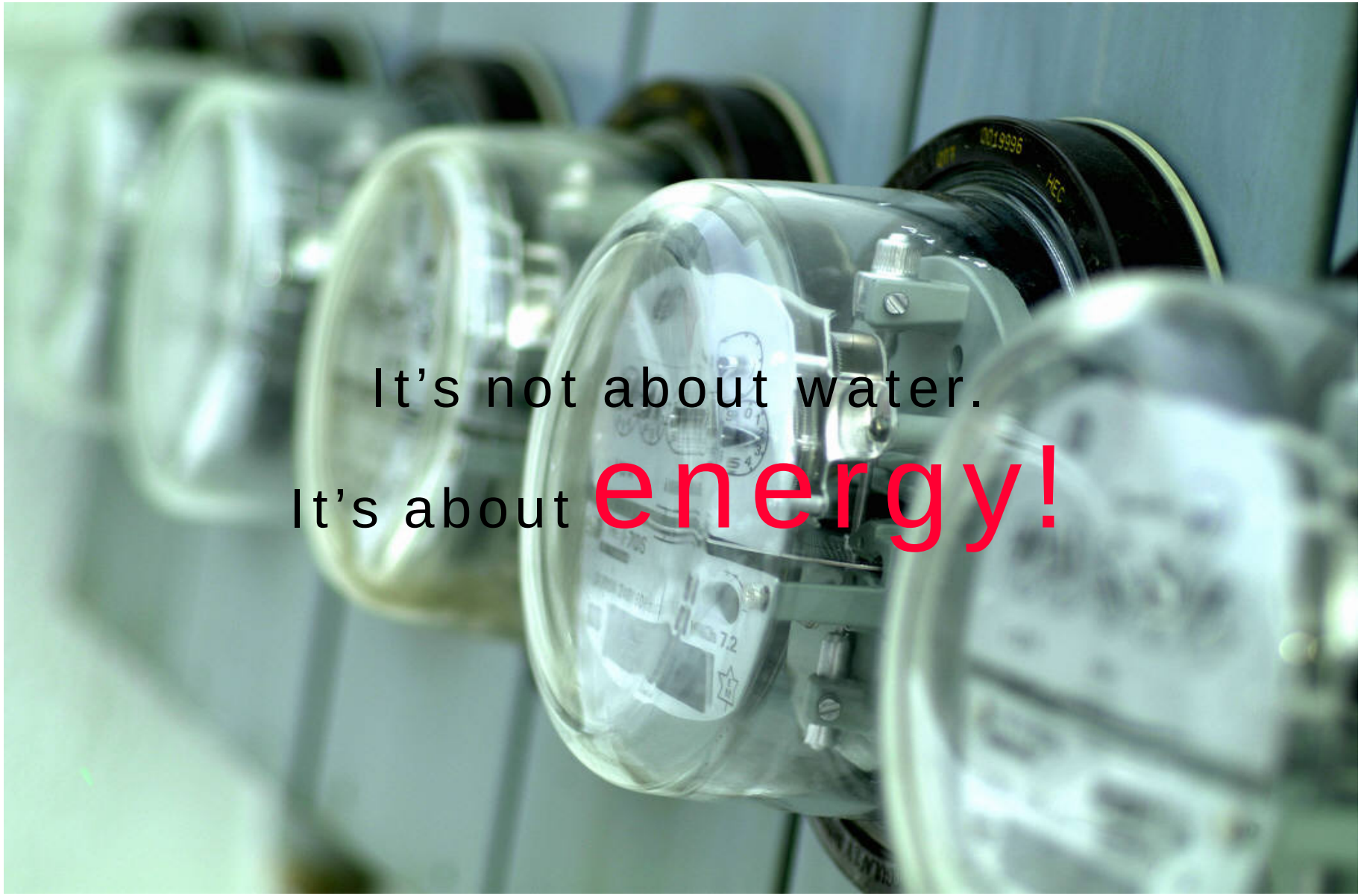
It’s not about water.
It’s about energy!


“Energy is eternal delight!”
Energy is liberation.
William Blake, author, poet, visionary, 1757 – 1827

“The Water - Energy Nexus”

Becoming the big issue in Water and Energy Circles

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AUSTRALIA – INDIA
ENERGY AND MINERALS FORUM

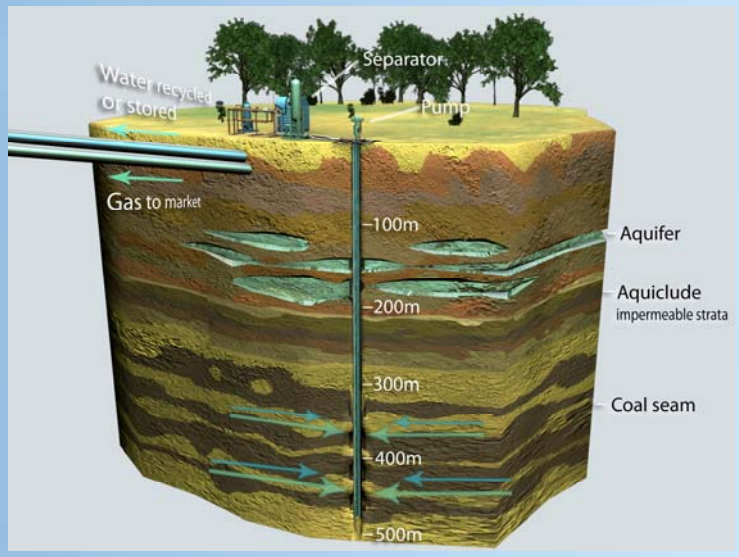
The Sustainability of SWRO

Mammoth Water Condenser, Coolgardie Water Distillery, 132,000 gpd

The ultimate in un-sustainability

In 1896 the worlds largest desalination plant was built in Western Australia at Coolgardie

Coal Seam Gas – Case Study



- Significant water production as part of gas recovery
- Peak flow rate -Surat projects 100 – 300 ML/ day

Coal Seam Gas Industry – Moving Forward

- Brackish Water TDS 2,500 – 10,000 mg/ L
- With desalination – the potential beneficiaries include;
  - Replacement of surface water in mining/industry;
  - agriculture
  - municipal non-potable and potable uses

Two key deliverability issues

1. Footprint/ landholders
   - 10 million tons/ yr LNG = 6,150 km^2

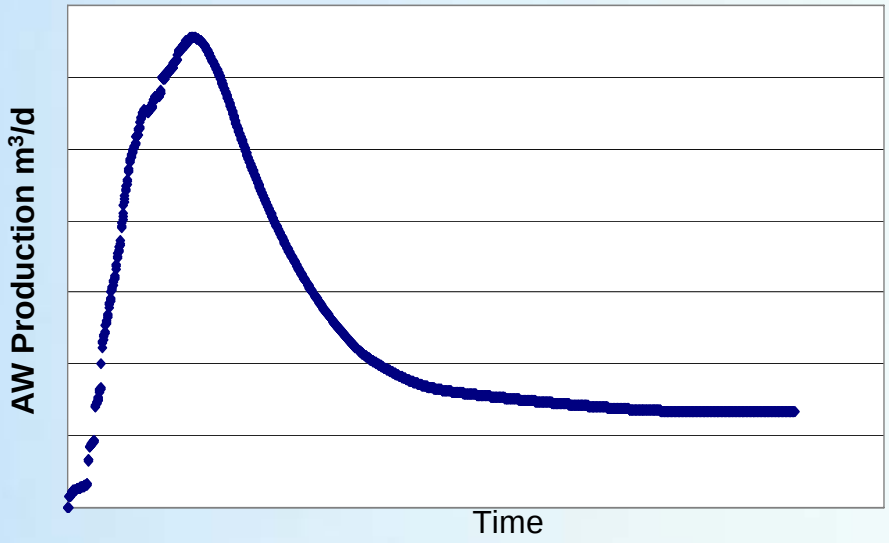
Two key deliverability issues

2. Water
   - Est. peak > 200 ML/ day
   - I mill Equ. Person
   - Highly distributed
   - Concentrate
   - Remote

Nature of CSG Associated Water

Varying production rates - location and age of well
Queensland CSG Statistics (2006)

	Water/gas bbl/TJ
Dawson valley	66
Daandine	9148
Kogan North	5910
Moranbah	169
Tipton West	21203
Peat	34
Spring Gullly	559
Berwyndale South	1922
Fairview	612
Scotia	0
Total (Operating 2006)	**667**



Statistics for Calender 2006. Source: Statutory Tenure Reports, DME

Nature of CSG Associated Water

Quality impacted by two elements (Van Voast, 2003)

1. Formation water specifically associated with CSM regardless of formation lithology or age similar characteristics;
   - low sulfate, calcium, magnesium
   - high in sodium, bicarbonate, and where influenced by marine association chloride
2. Whatever is in any connected aquifers

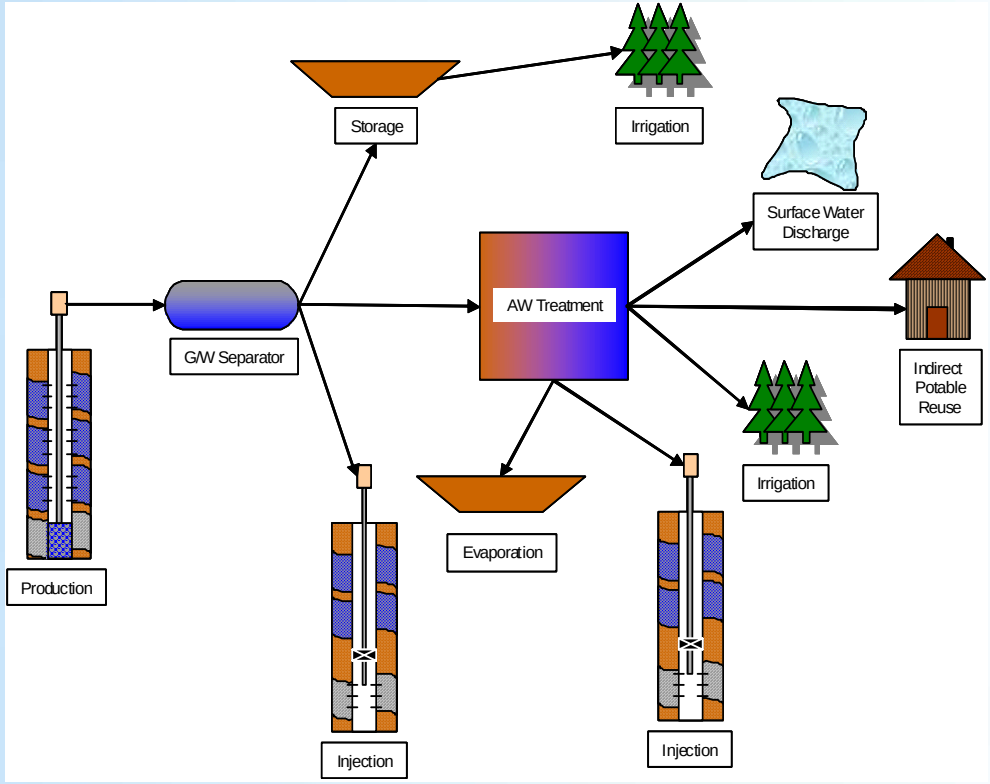
Treatment Approaches

Non desalination

- e.g.. Re-injection or direct use
- Treatment stages: degassing, oxidation, filtration and chemical treatment

Desalination

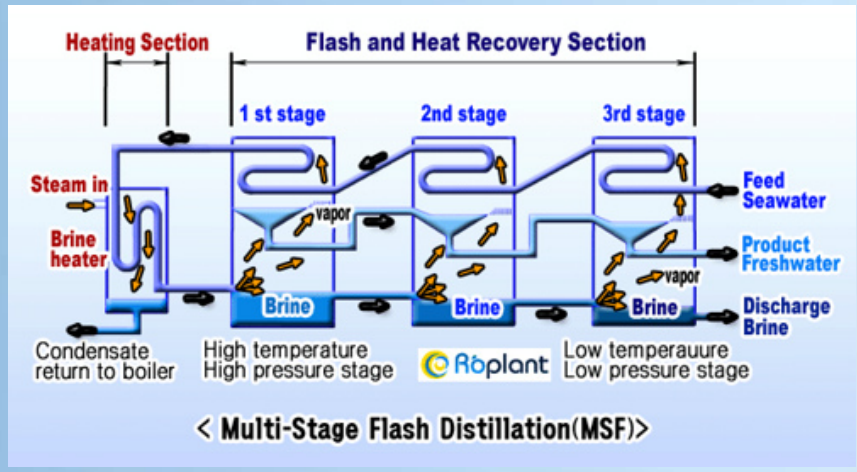
- Where dissolved salts need to be reduced
- Various methods (reverse osmosis, ion exchange).



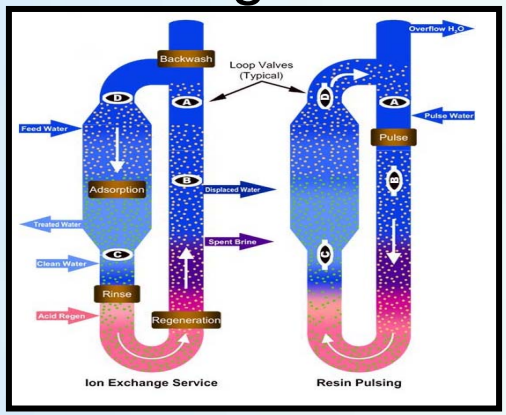
Desalination Technologies

Membrane

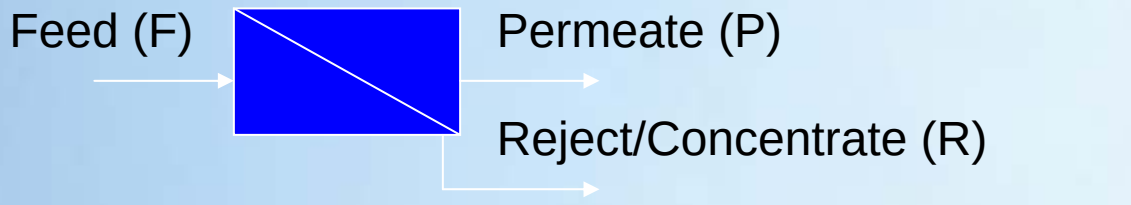
Thermal

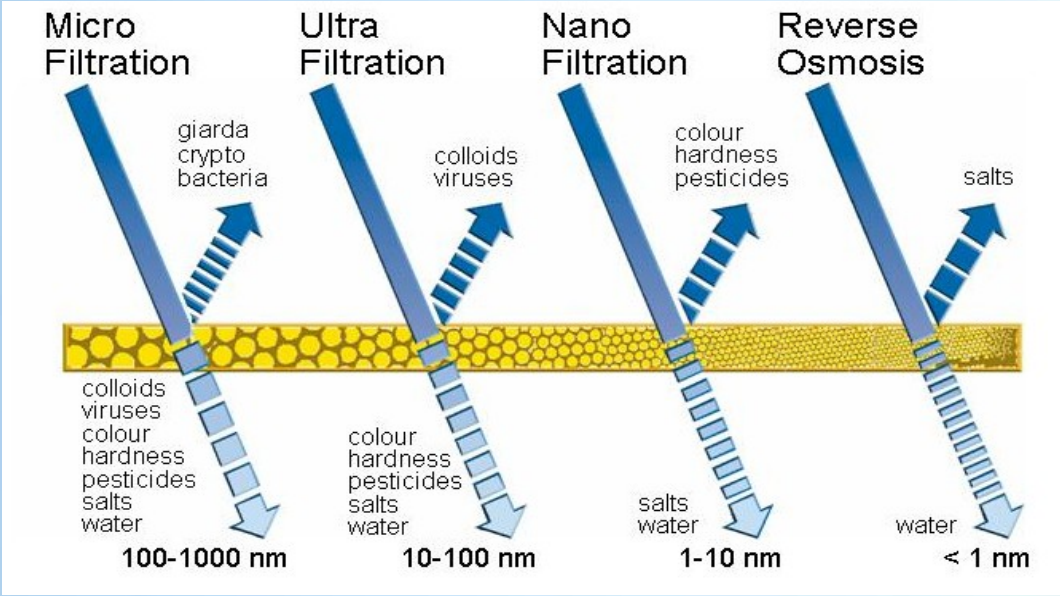


Ion Exchange



Membrane Desalination

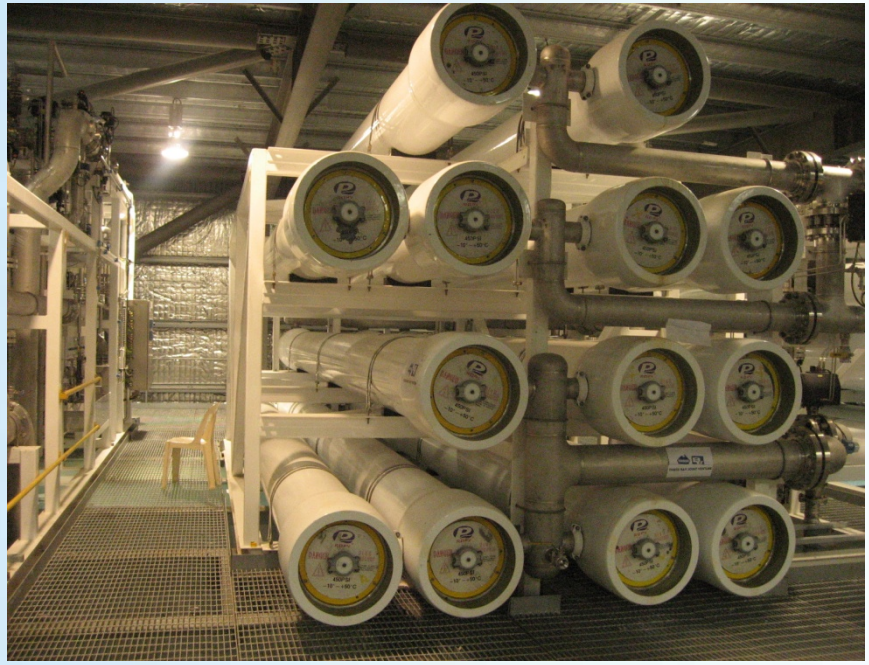




Desalination - Parameters

Permeate Flux and salt rejection are the key performance parameters of a reverse osmosis process.

- TDS
- Temperature conductivity
- Limits by behavior of concentrated stream
  - pH scaling characteristics
  - Specific elemental composition
  - ***Scaling*** design limiting parameter



Water Classifications (TDS)

- Fresh water < 500 mg/L
- Brackish (up to 10,000 – 15,000mg/L)
- River water 500 – 3,000 mg/L
- Brackish water 3,000 – 15,000 mg/L
- Wastewater 250 – 3,000 mg/L
- Seawater 30,000 – 45,000 mg/L

Plant Recovery

Water Source	Feed Water Salinity (mg/l)	Recovery Rate	Concentrate Salinity (mg/l)
Brackish Water	1700	80%	8,500
Brackish Water	3,500	80%	17,000
Saline Water	6,500	65%	18,500
Saline Water	10,000	50%	20,000
Seawater	35,000	40%	58,000
Seawater	35,000	45%	63,500
Seawater	35,000	50%	70,000

We would like 100 % for Inland Plants

CSM Water Management Historically

- Deep injection
- Evaporation
- Surface Discharge
- Limited opportunistic use for livestock/ irrigation

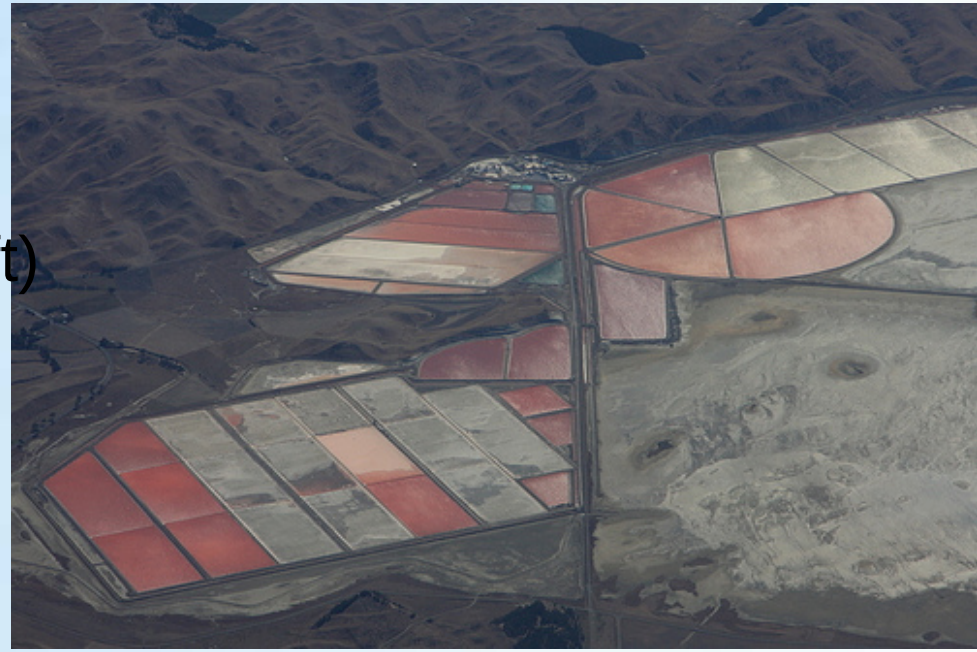
- We want to put good water back into the system and minimize concentrate/ waste (ZLD)

BWRO Brine Management
Single Biggest Issue

1. Evaporation (Solar/ Thermal)
2. Marine discharge
3. Re-injection (Well/ Mine Shaft)
4. Salt Pans
5. Old Quarries

Subject to env. Regulations

5. ZLD



Why Change?

1. Good Ethical Corporate Practice
2. Changes in regulatory requirements
3. Stakeholder expectations – inc landholders
    - Water as a resource
    - Maintain environment

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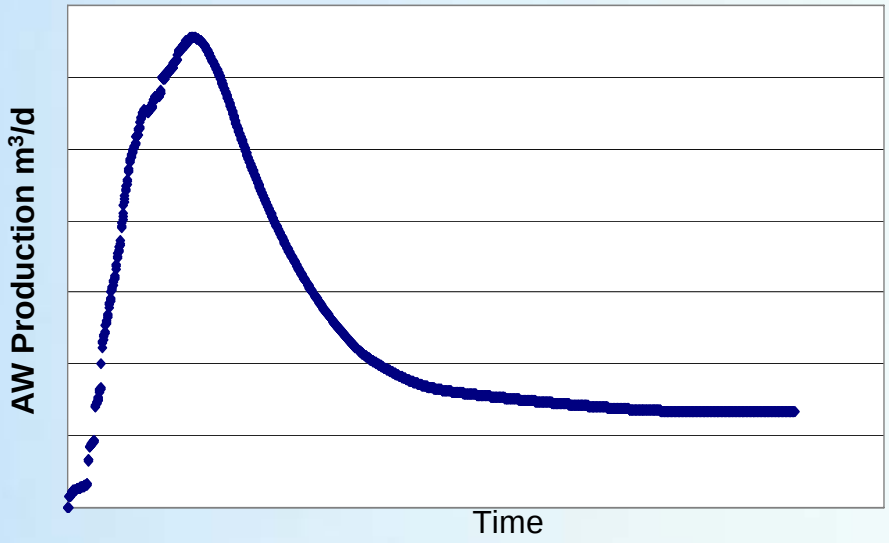

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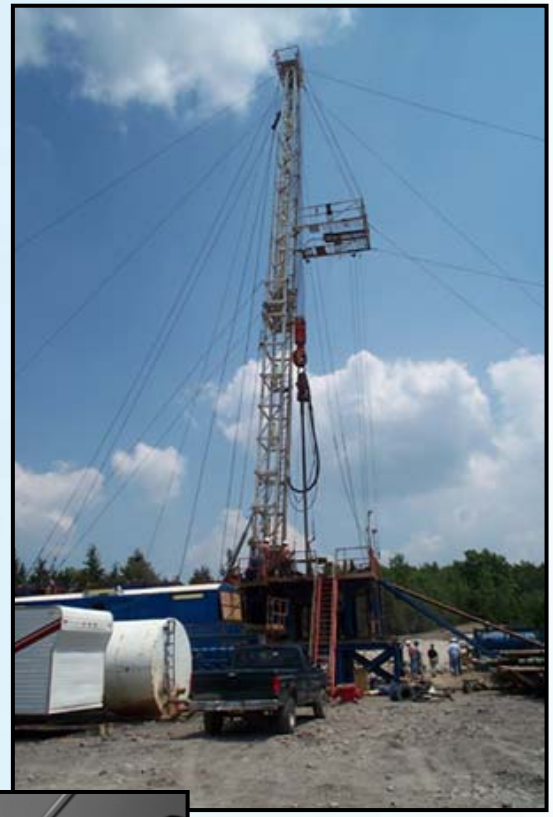
Beneficial Use & Water Quality

Application	Critical Parameters
Re-injection	Particle size Receiving groundwater quality Precipitation
Surface Discharge - environmental flows for surface or recharge shallow aquifers ephemeral streams	Receiving surface water quality Temperature
Agriculture - intensive horticulture	TDS $\Rightarrow$ SAR (Na, Ca & Mg)
Municipal use potable or potable offset	Specific toxic elements – health
Industrial use - power stations/ mines	TDS $\Rightarrow$ guideline values

Within the context of the regulatory guidelines

Drilling and Associated Water

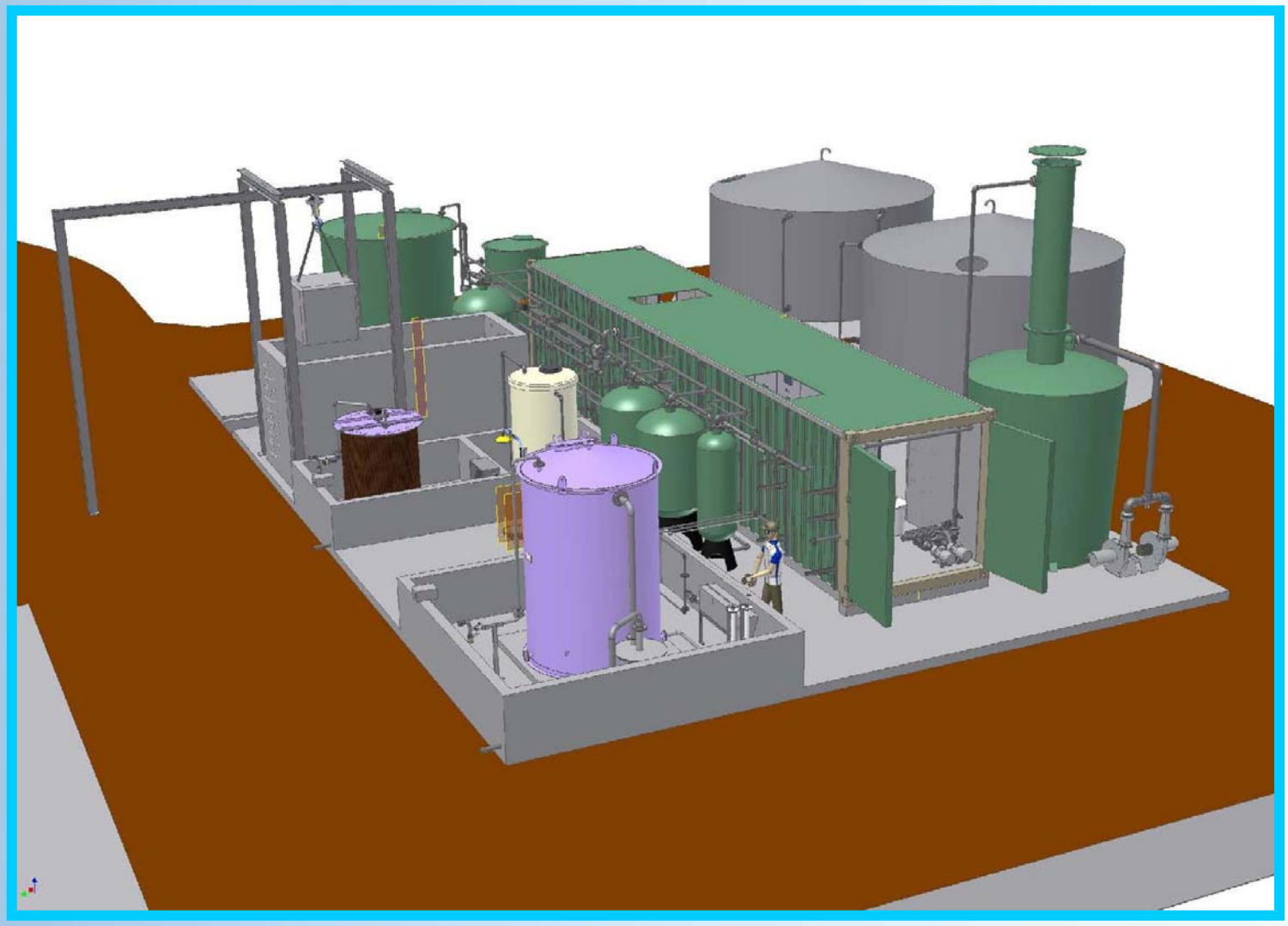
- Early touch
- Early information extremely valuable
- Can sample at multiple depths
- Can sample prior to putting well on production
- Historical issues
  - Contamination from drilling fluids
  - Inaccurate water quality results



Sampling During Drilling

- Current Drilling Fluids
  - Drilling mud's (i.e. KCl)
  - Formation water
- Impacts on WQ from Drilling Fluids
  - Elevated analyte concentrations (i.e. K, Cl, others)
- Advice on Sampling During Drilling
  - Establish protocol
  - Flush samples
  - Filter samples
  - Allow for contaminants and follow indicators

Yalgoo 300 kld HERO™ Plant Layout



Yalgoo 300 kL/d HERO™

Evaporation Basins

The Future…

- CSG has a massive future in Australia (Queensland and NSW)
- Disposal of CSG water crucial to success
- Highest recovery of fresh water will ensure:
  - CSG image
  - Cost Minimisation
  - Waste Minimisation
  - Minimal environmental degradation

“I have said that I thought if we could ever competitively get fresh water from saltwater…that it would be in the long range interests of humanity which would really dwarf any other scientific accomplishment.”

John F. Kennedy, September 22, 1961

“If we could produce clean unlimited energy at a viable cost, that would indeed be a great service to humanity and would dwarf any other scientific accomplishment.”

Gary J. Crisp, 2006

Questions?
Thank you.

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