Department of Primary Industries and Regional Development

GOVERNMENT OF WESTERN AUSTRALIA

GREAT SOUTHERN livestock'20 October 22-23

WATER CORPORATION

WaterSmart Farms – Water Security now and beyond 2030

Dr Richard George [1], Anthony Bodycoat & Nick Wright [1]

Department of Primary Industries & Regional Development[1] & Water Corporation

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Todays focus…**WaterSmart Farms**

- Emphasis – self sufficiency
  1. Drier climate - its here to stay
  2. Sources
     - Dams (*climate sensitive*)
     - Groundwater (*secure – decade scale*)
  3. Groundwater desalination & disposal
  4. Examples

- ***"…Water forever whatever the weather…(and salinity)"***

How much water per year….

- Mixed farm: < 10,000 kL (10 ML)
- Feedlot: ~ 100 ML
- Processor: ~ 300 ML (0.3 GL)
- (Irrigator 2 GL)
- Fit-For-Purpose quality

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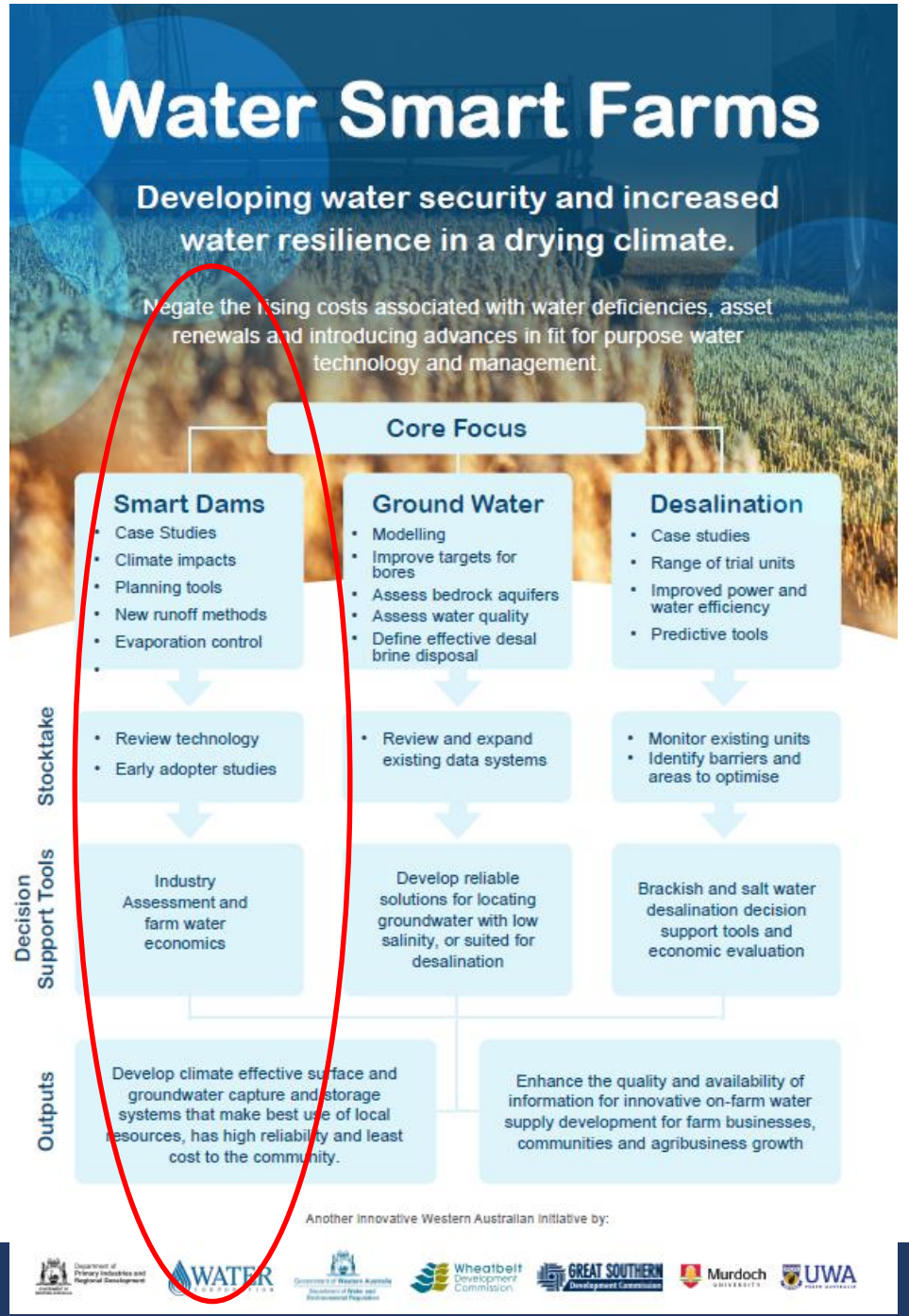
- Part 1 – Smart Dams

Criteria – key dams

- Deliver design water 9 out of 10 years
- Storages - 5,000 to 10,000 kL
- Engineered catchments
- Leakage < 2mm day
- Costs < $1 kL

- *Cant rely on natural catchments*



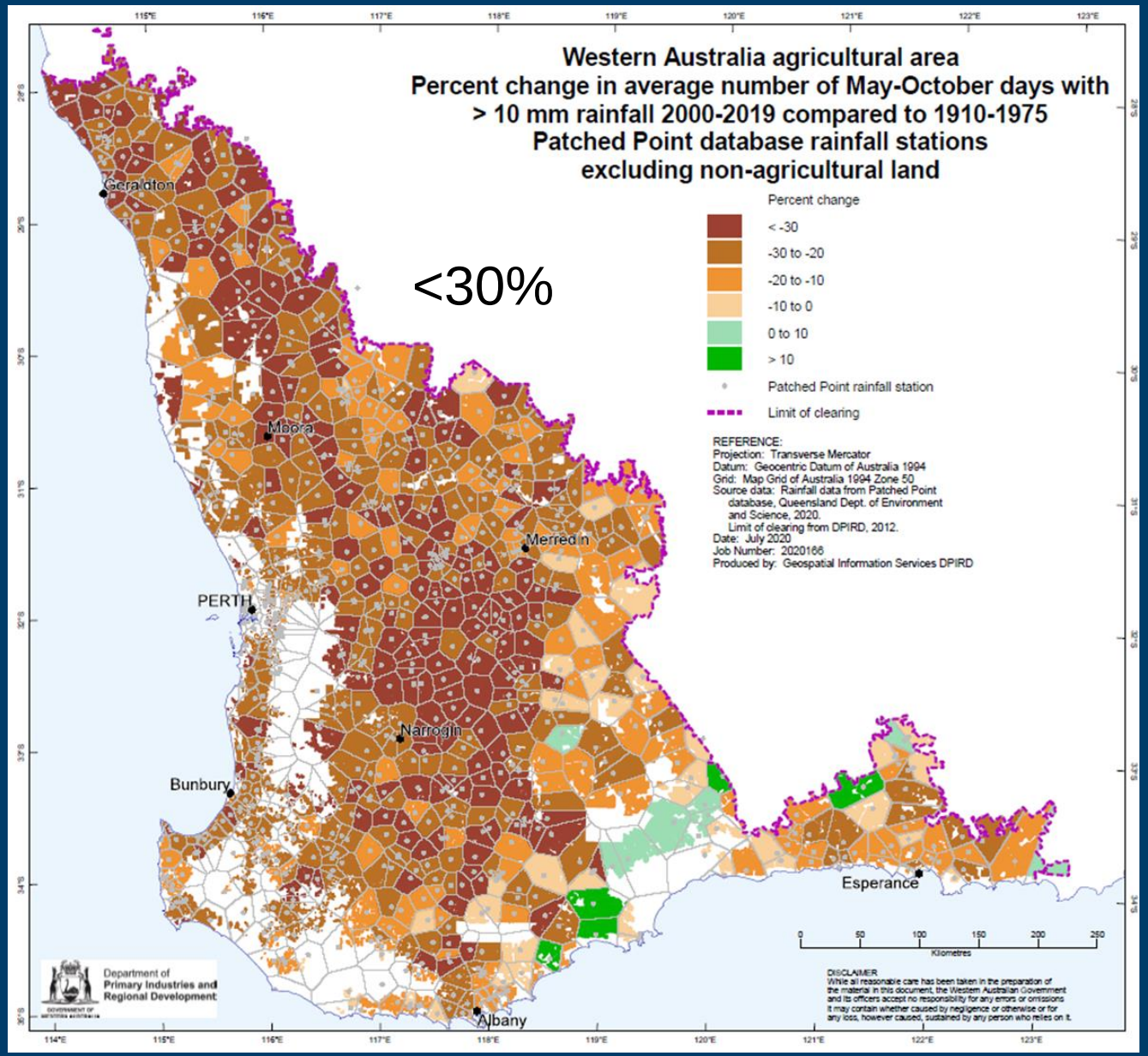
Changes in daily rainfall

Winter daily rainfall has declined since 2000

30% less >10mm rainfall-runoff events

(*12mm design for a roaded catchment*)

Winter rainfall (fill frequency) reduced by much more that 30%



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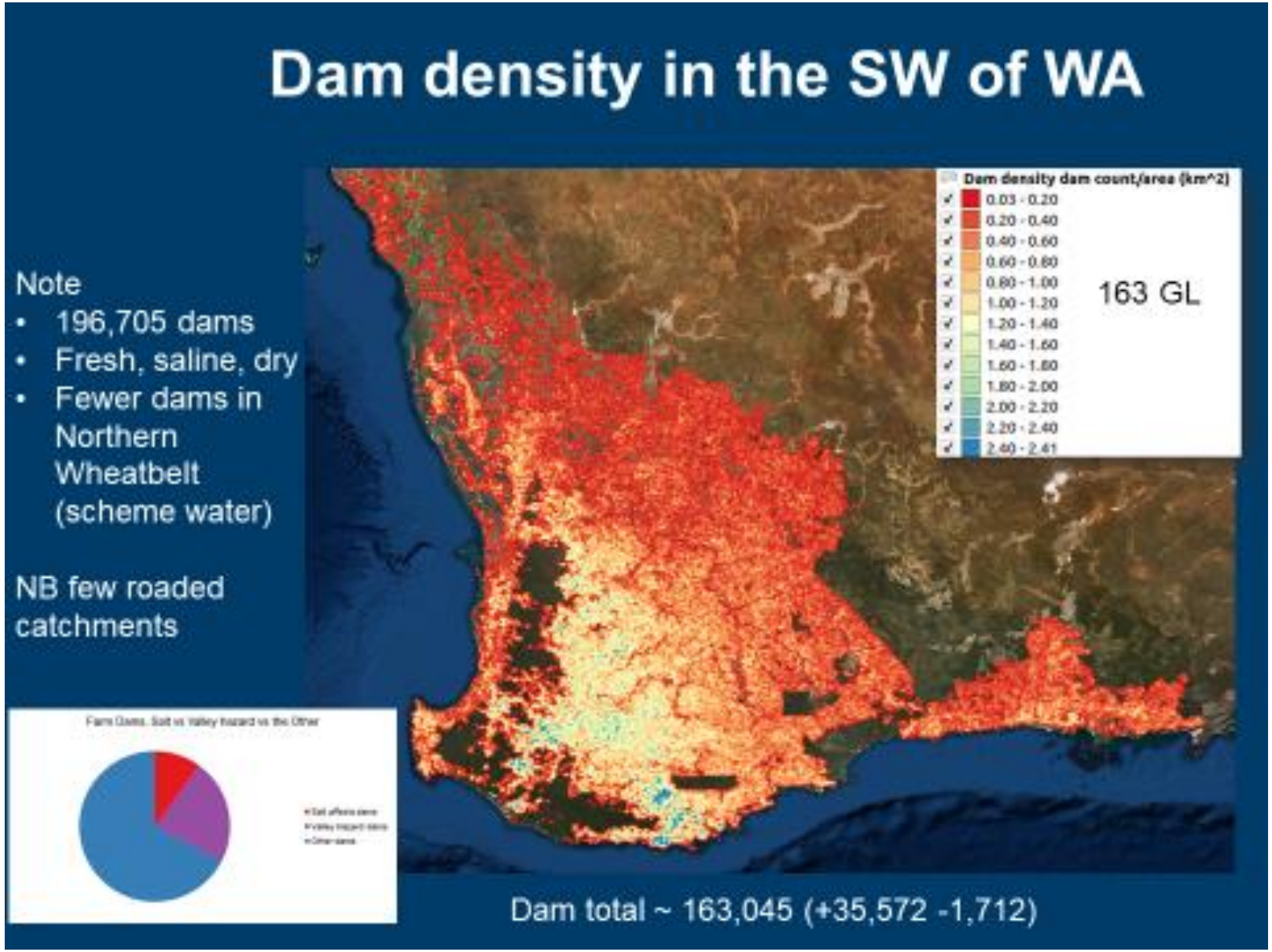
Dams

Usually farmers first choice water…

Nicks 2020 project learning

- 196,705 dams
- 30% saline or shallow watertable

- ~14 M sheep need 30 GL/yr
- add cattle, pigs etc
- ~7 M ha crop need 3 GL for sprays (nutrition, weeds etc)

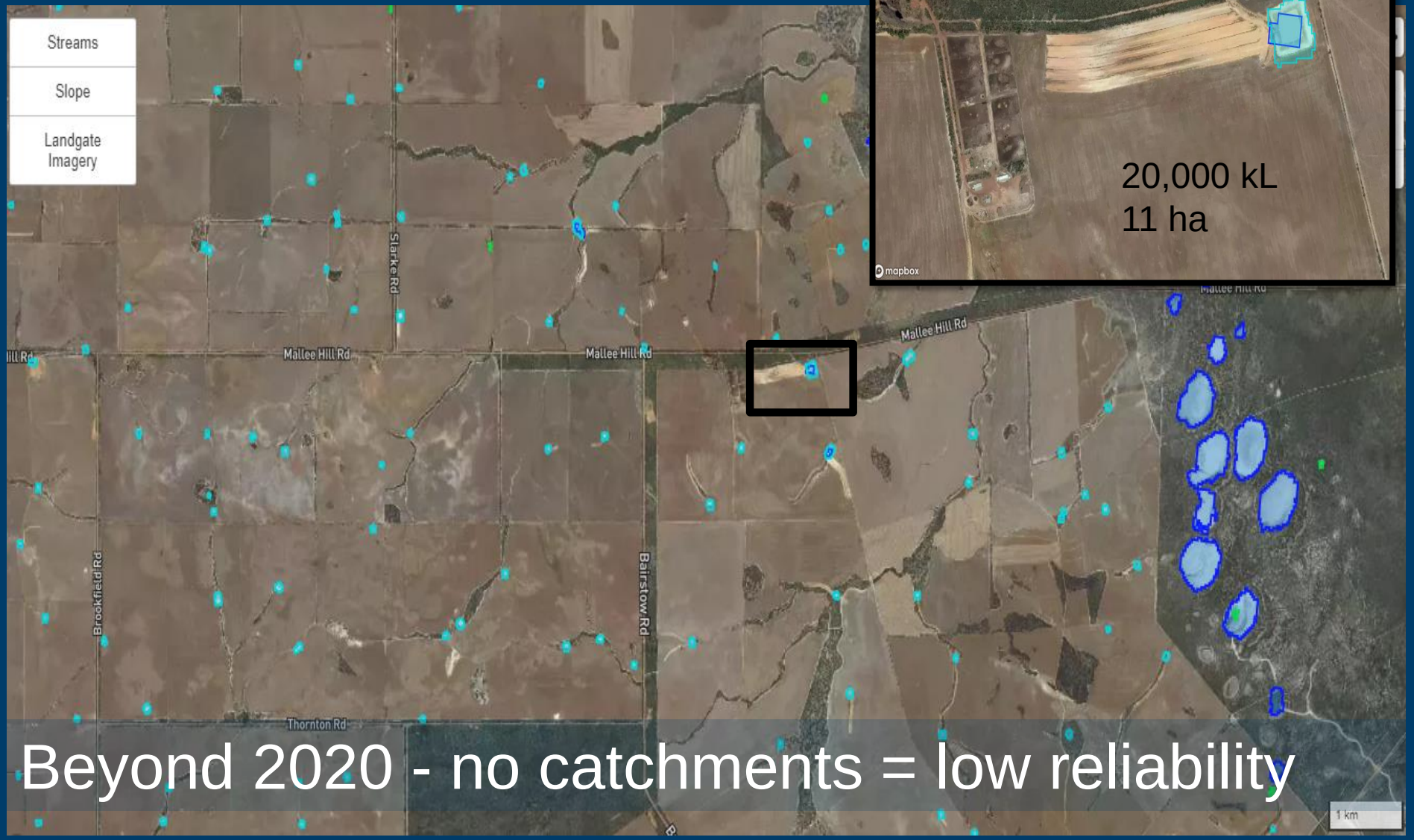


Most dams designed on historic rainfall records

Dams fed by natural runoff – unreliable

Dams; Built >50 years ago on design 1970/80s , now operating on 2020 climate !!

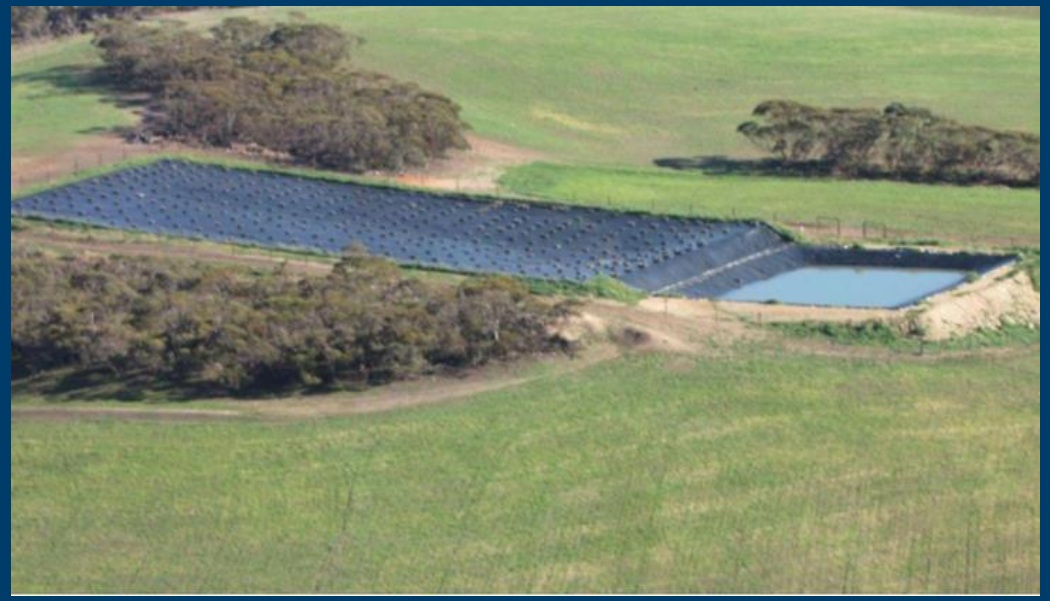
WaterSmart Farms: Large (deep) dams with engineered - improved catchments



Beyond 2020 - no catchments = low reliability

Other options to improve farm water security

- Audit & Plan
- Double dams, deeper dams
- Seepage control – clay
- Evaporation control – covers, shade
- Polymers – improve runoff
- Plastics



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Future runoff…

Global Climate models

Zheng et al CSIRO
Dec 2019

1976-2005
v
2046-2075

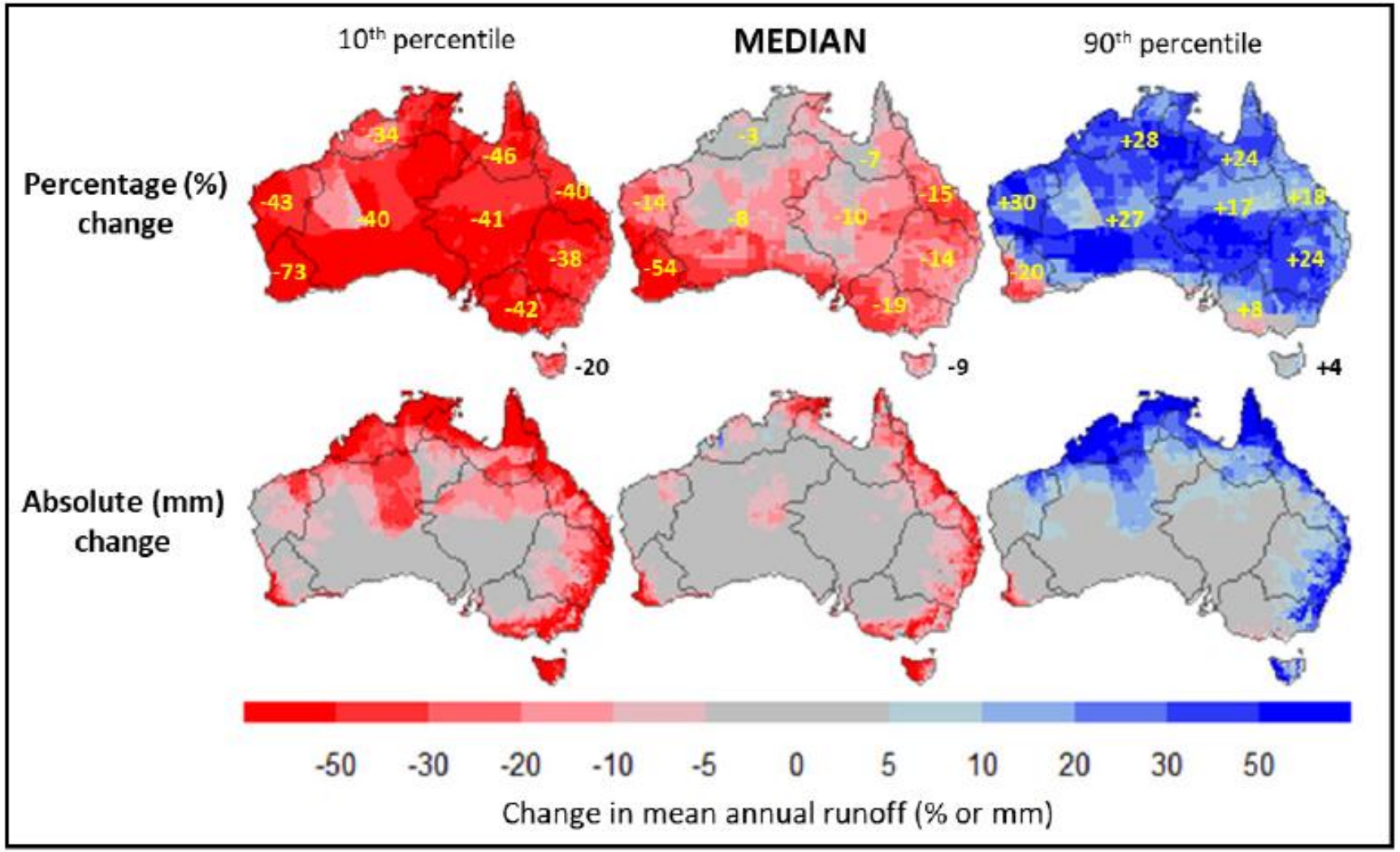

Figure 1. Projected change in mean annual runoff (median and the 10th and 90th percentile values from GR4J hydrological modelling informed by climate change projections from the 42 CMIP5 GCMs) for RCP8.5 for 2046–2075 relative to 1976–2005. The projections also reflect change in runoff for a ~2.2°C global average warming relative to the 1986–2005 IPCC AR5 reference period. The large range in the projections mainly reflects the uncertainty in rainfall projections across the 42 CMIP5 GCMs.

WA has transitioned to groundwater… and desalination

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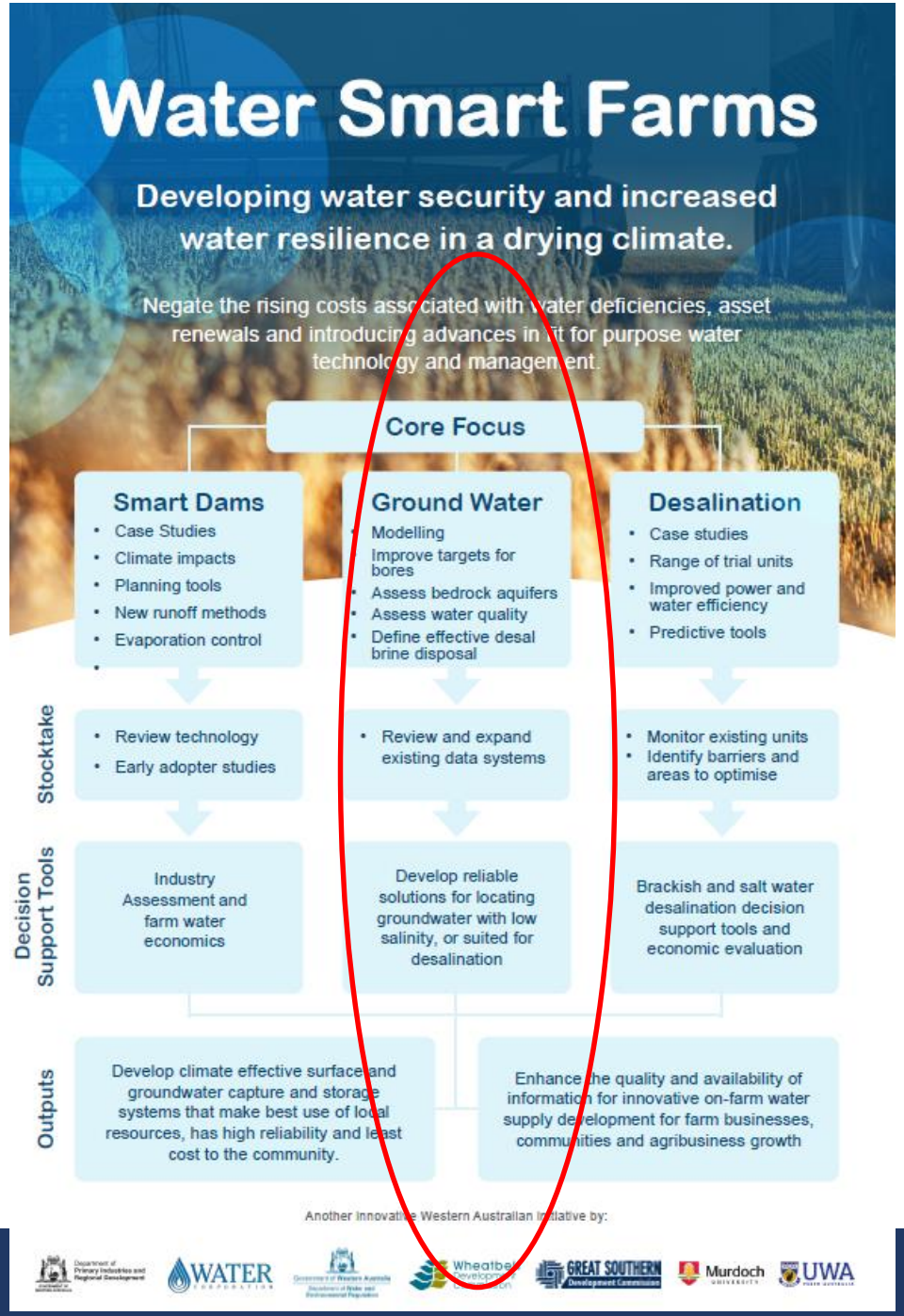
- Part 2 – Groundwater

Criteria - reliable supply

- Supplies 20 - 86 kL/day
- Salinity < 8,000 mg/L
- Used 200 days per year
- Deliver design flows by testing
- Salinity increases slowly
- Target costs <$1 kL

Fit-for-purpose salinity



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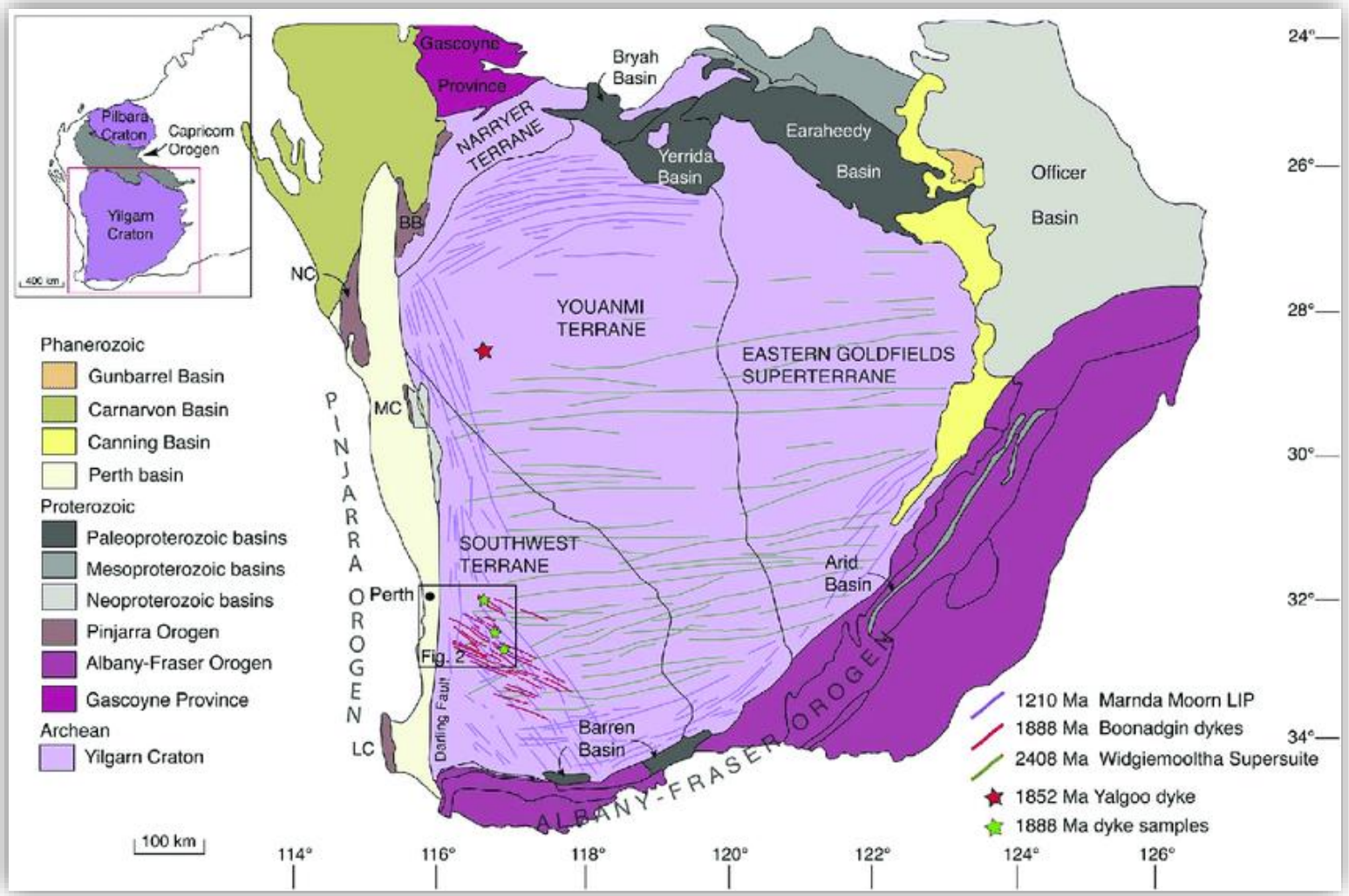
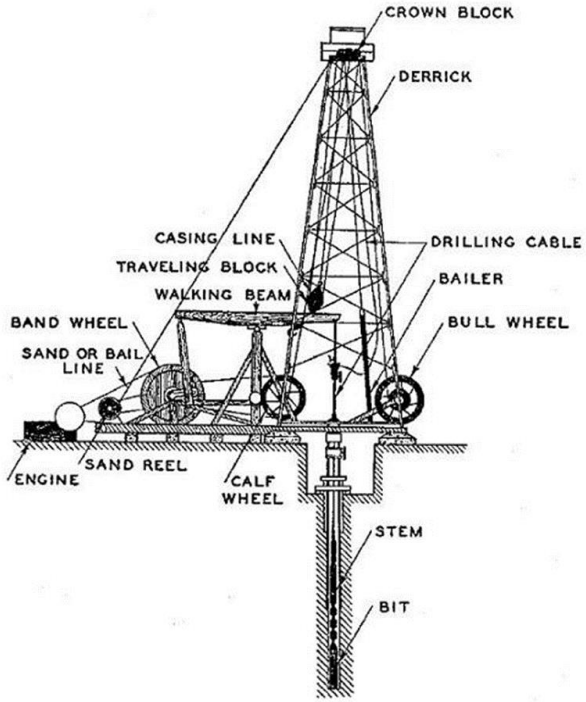
Yilgarn Block – bedrock





Coolgardie - Artesian Basin?

- July 1896 – 2 years drilling
- Finished at 900m
- Small flow salty water 36m

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Great Southern aquifers

Major Aquifers	Security	Where
Granite – saprock	High	Yilgarn block
• Soaks	Low	"
• *Hard rock*	*Med ??*	"
Sediments -	Low	"
• palaeochannels	Medium to high	" Gt Sthn to South Coast; Dardadine and Wellstead

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1968-70 Drought Drilling (wheatbelt)

- GSWA (DMIRS)
- 2639 bores – drilled at 521 Farms; 162 Government Reserves
- Drilled 67,294m (average bore <30m)
- 263 bores successful (*1000 gallons; 11,000 TDS*)
  - 10% wet suitable
  - 13% wet insufficient
  - 17% wet saline
  - 60% dry/abandoned
- Average flow 21 kL/day
- Private 1:3 farms; reserves 1:4
- If every good bore equipped = ~2 GL/yr

CONCLUSIONS

While the methods used may be criticised they proved successful under the emergency circumstances. The results more than justified the expense incurred when considered in the long term.

The programme has clarified the underground water potential in many difficult areas and the results, which are incorporated in the records of the Geological Survey, will be of great assistance in the future.

In some areas, such as Holt Rock, North and South Stirling, and Ongerup, property owners should be encouraged to investigate their properties for stock supplies of underground water. The methods used for drought relief are recommended for such testing.

In other areas, such as South Yilgarn, South Burracoppin, Mount Walker, and Lake Grace, the search for underground water by individual farmers cannot be recommended as the chances of success are very remote.

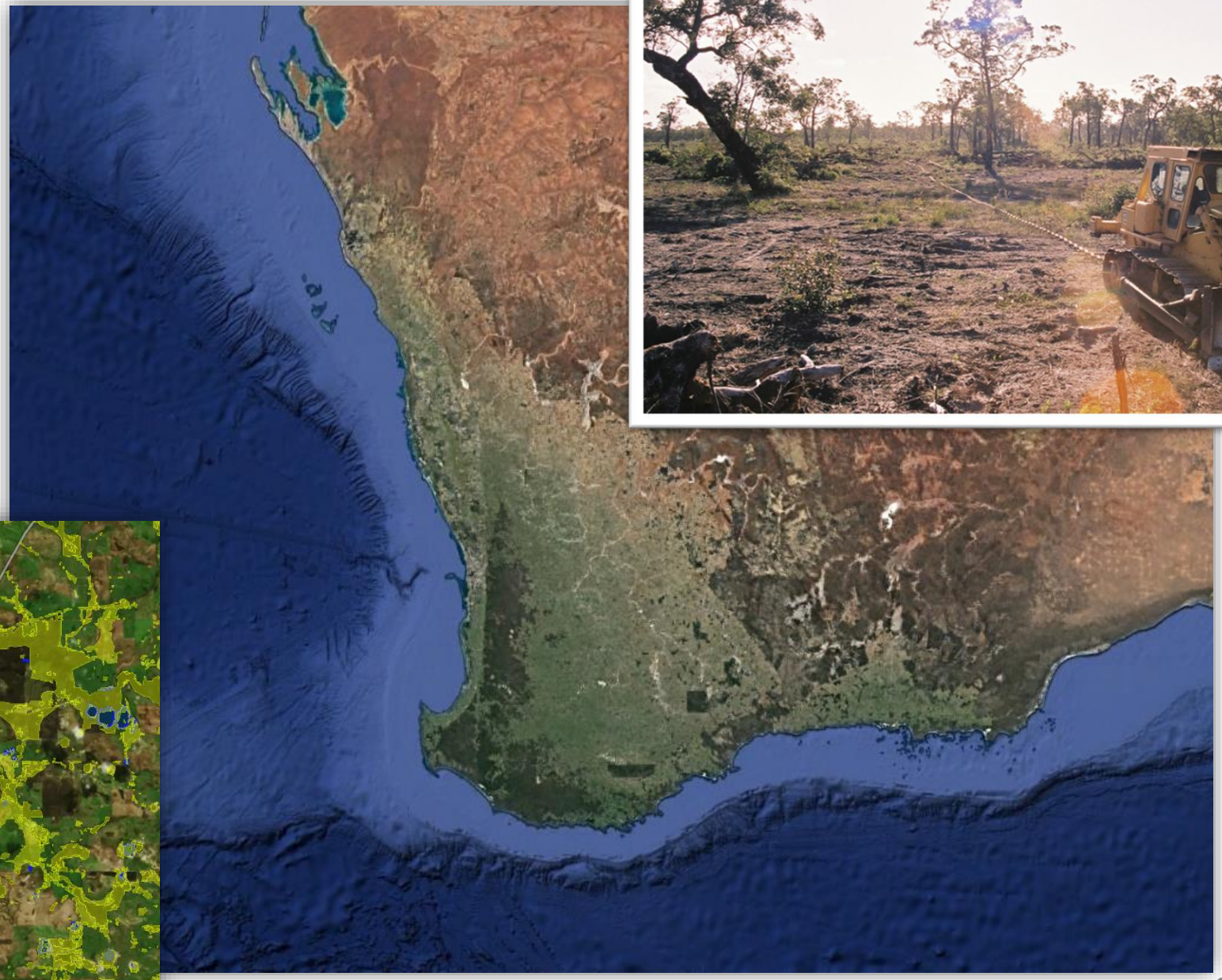
1969-70 Government carted 73,000 kL; Drilling approx. $330,000 (~$10m 2020 - $150/m)

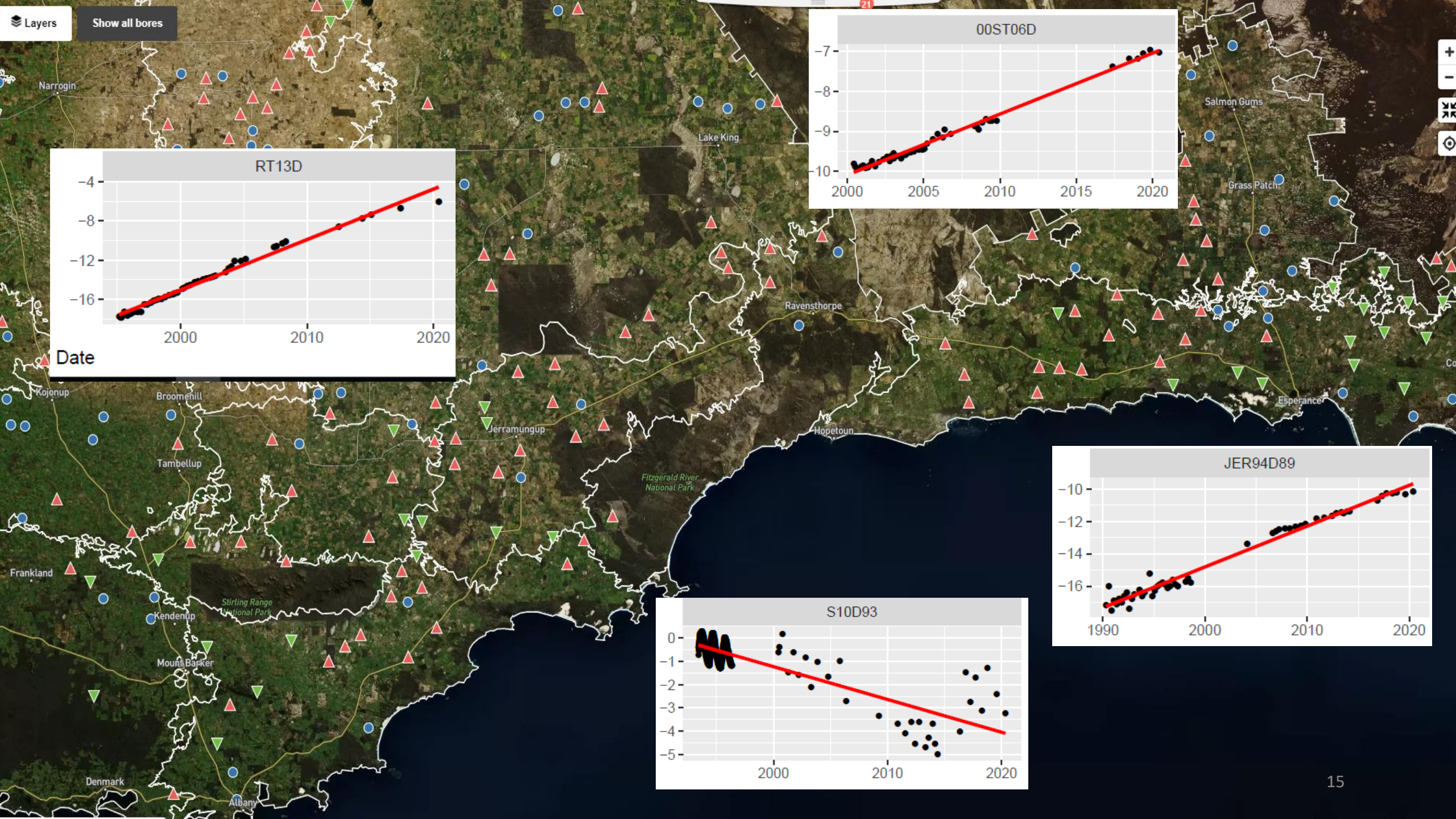
Wheatbelt - 15 M ha

Salinity = Rising watertables

>1000 GL/a recharge

Pulses… 2017




Layers
Show all bores
Narrogin
Lake King
Salmon Gums
Grass Patch
Ravensthorpe
Hopetoun
Esperance
Kojonup
Broomehill
Jerramungup
Tambellup
Fitzgerald River National Park
Frankland
Stirling Range National Park
Kendenup
Mount Barker
Denmark
Albany
RT13D
−4
−8
−12
−16
2000
2010
2020
Date
00ST06D
−7
−8
−9
−10
2000
2005
2010
2015
2020
JER94D89
−10
−12
−14
−16
1990
2000
2010
2020
S10D93
0
−1
−2
−3
−4
−5
2000
2010
2020


Water after 2017 – recharging valleys (and hills – slowly)

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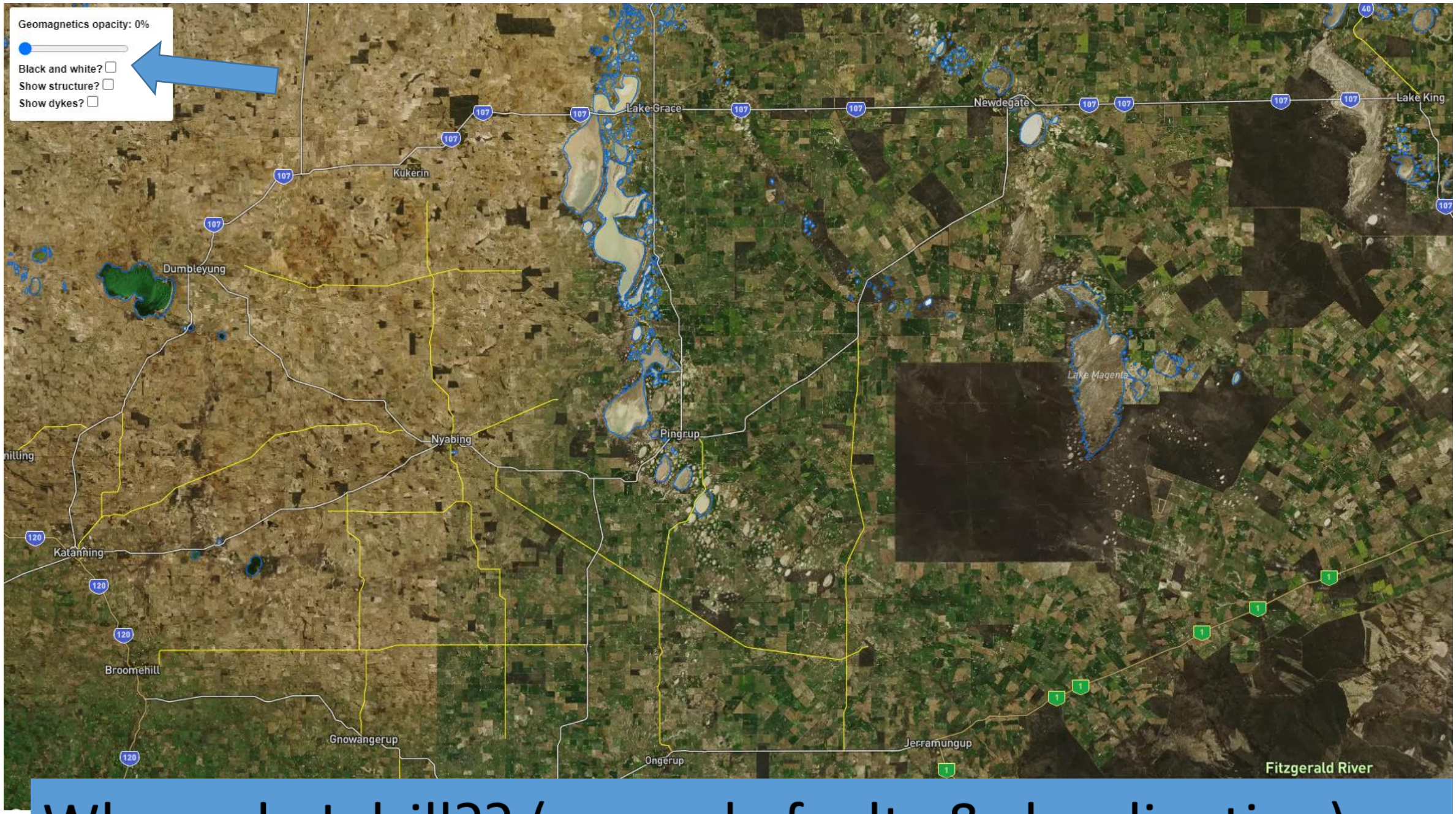
Hardrock aquifers - watch this space as R&D

Fractured rock drilling 74m – June 2020 at York

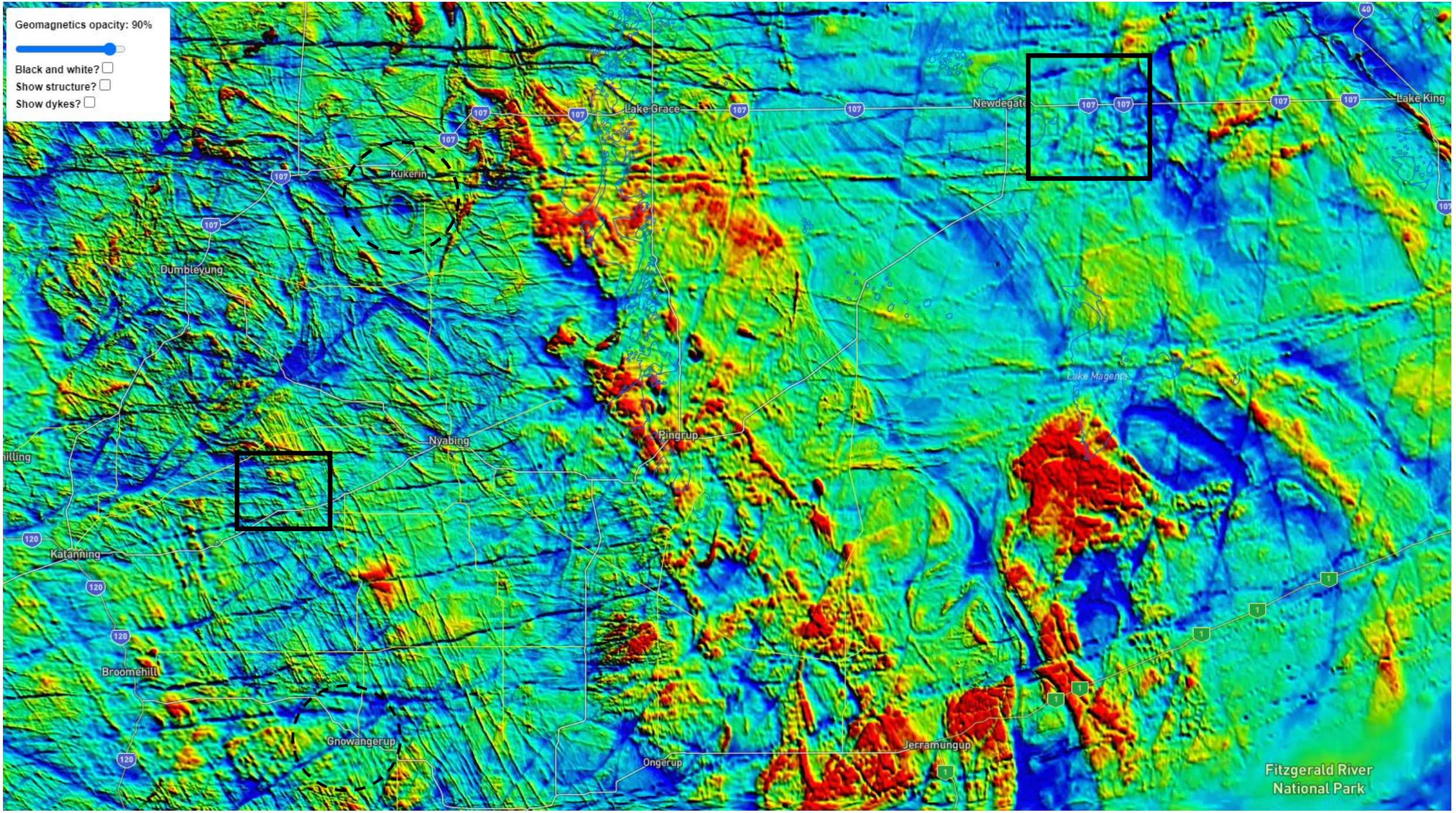
Untapped water source in Merredin

4 Nov 2010, 1:19 p.m. Agribusiness

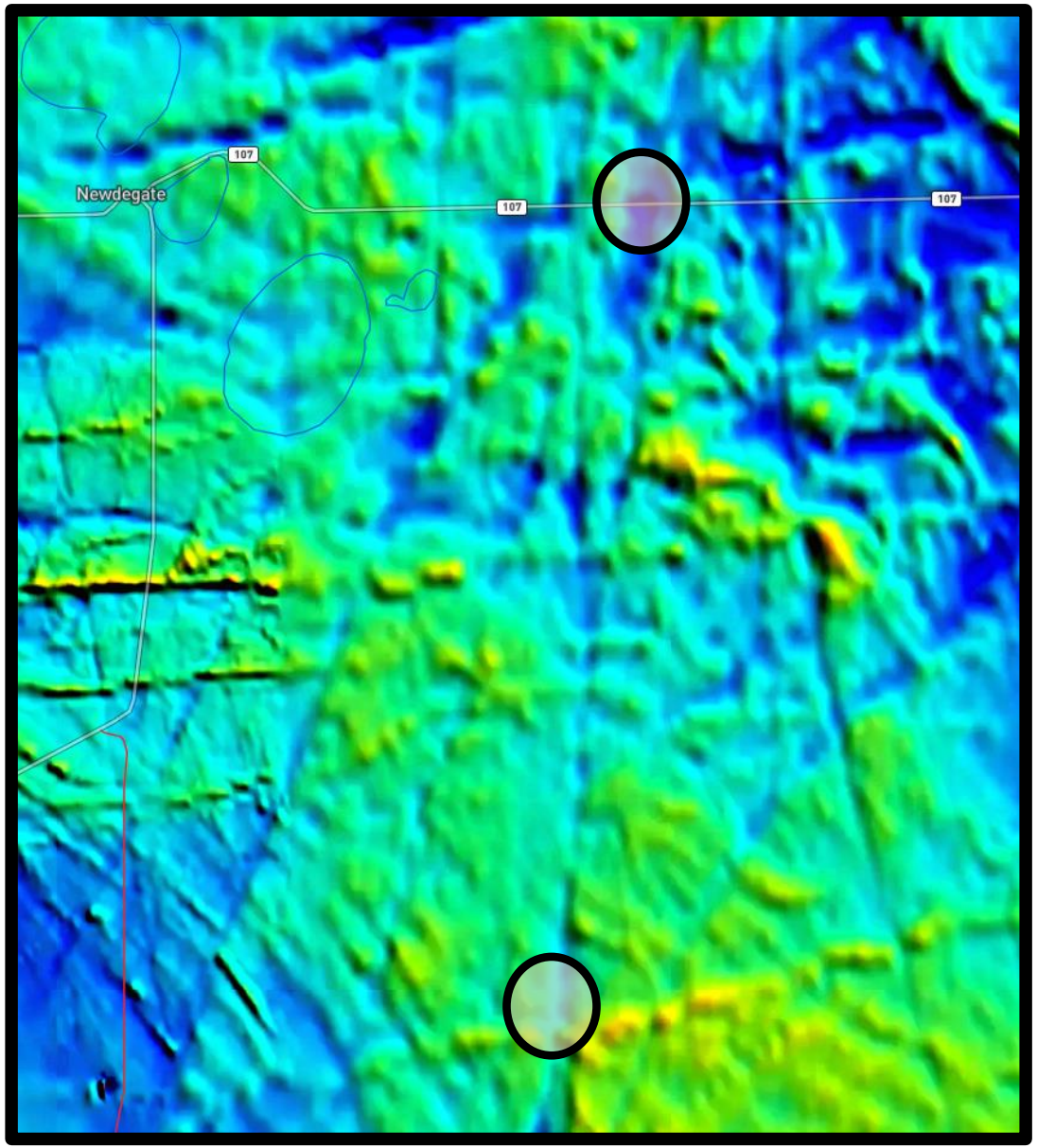
Fault line: This photograph was taken by a remote-controlled camera inside the Merredin drill hole. As they drilled through solid granite at a depth of 327 metres, Globe Drill came across this fault line (seen here as a dark crack), from which water was flowing in vast quantities.



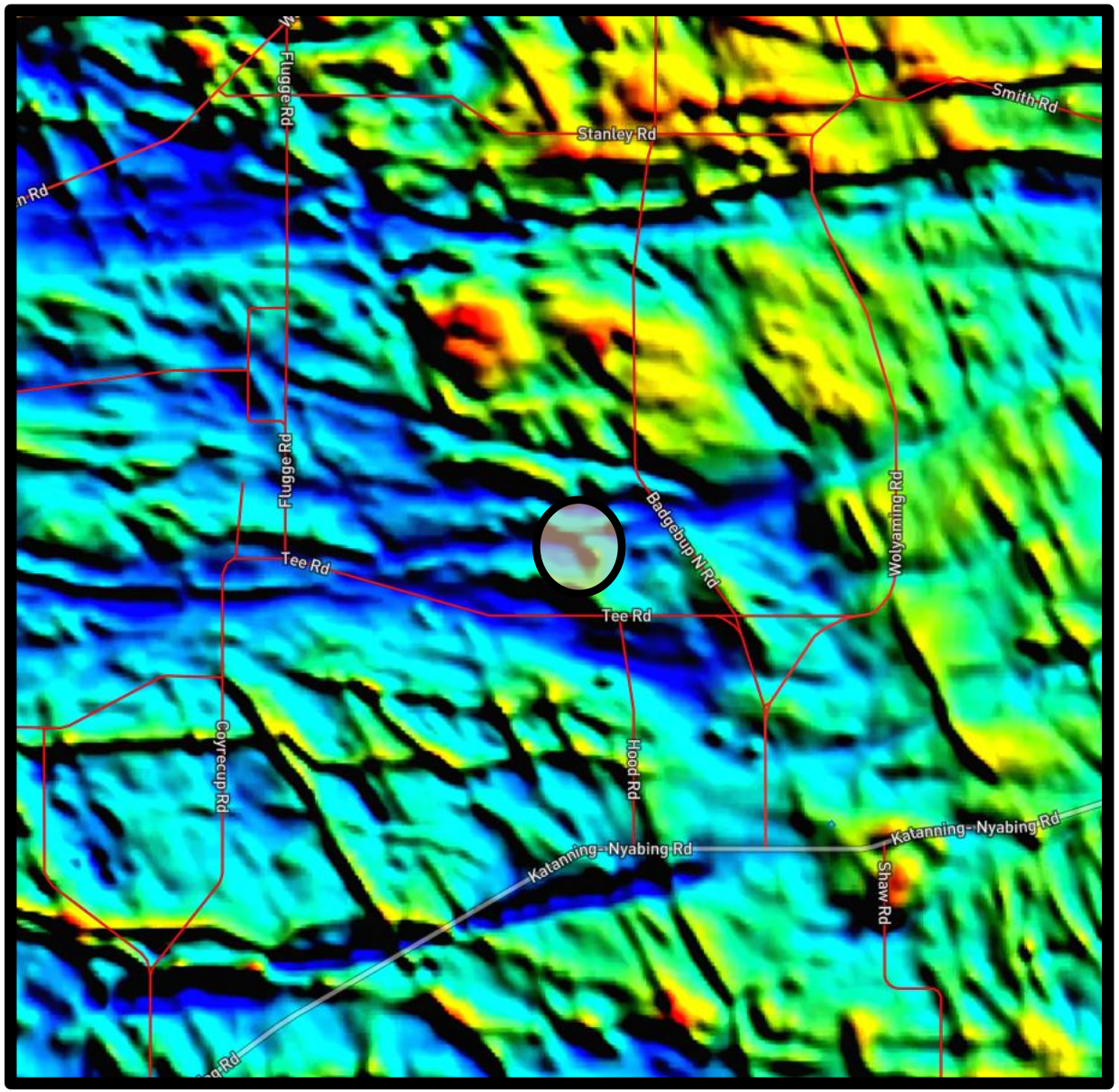
Where do I drill?? (saprock, faults & desalination)


Geomagnetics opacity: 90%
Black and white?
Show structure?
Show dykes?
Lake Grace
Newdegate
Lake King
Kukerin
Dumbleyung
Nyabing
Pingrup
Lake Magenta
Katanning
Broomehill
Gnowangerup
Ongerup
Jerramungup
Fitzgerald River
National Park

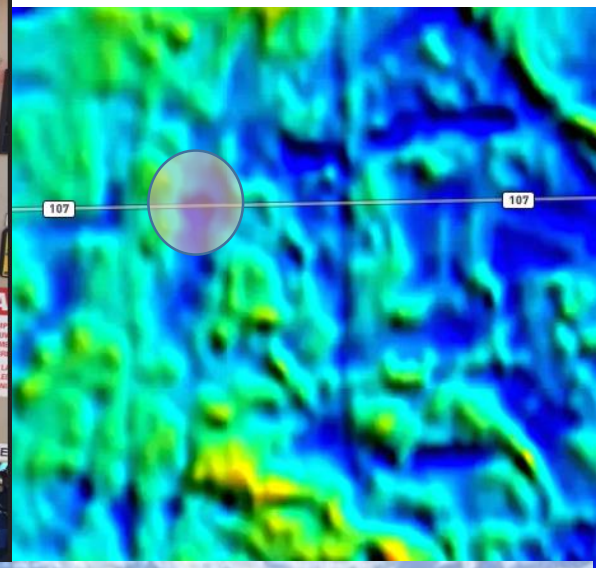
Case study 1 – Newdegate (saprock)



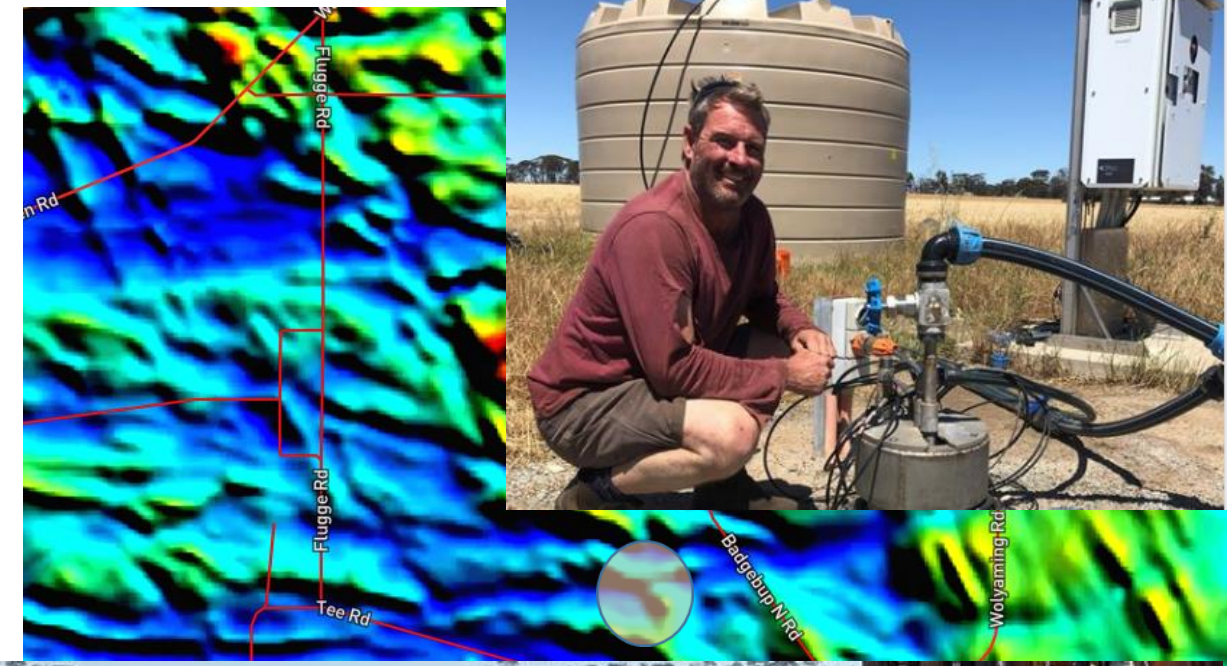
Case study 2 – Badgebup (saprock & hardrock)



Case Study 1



Case Study 2



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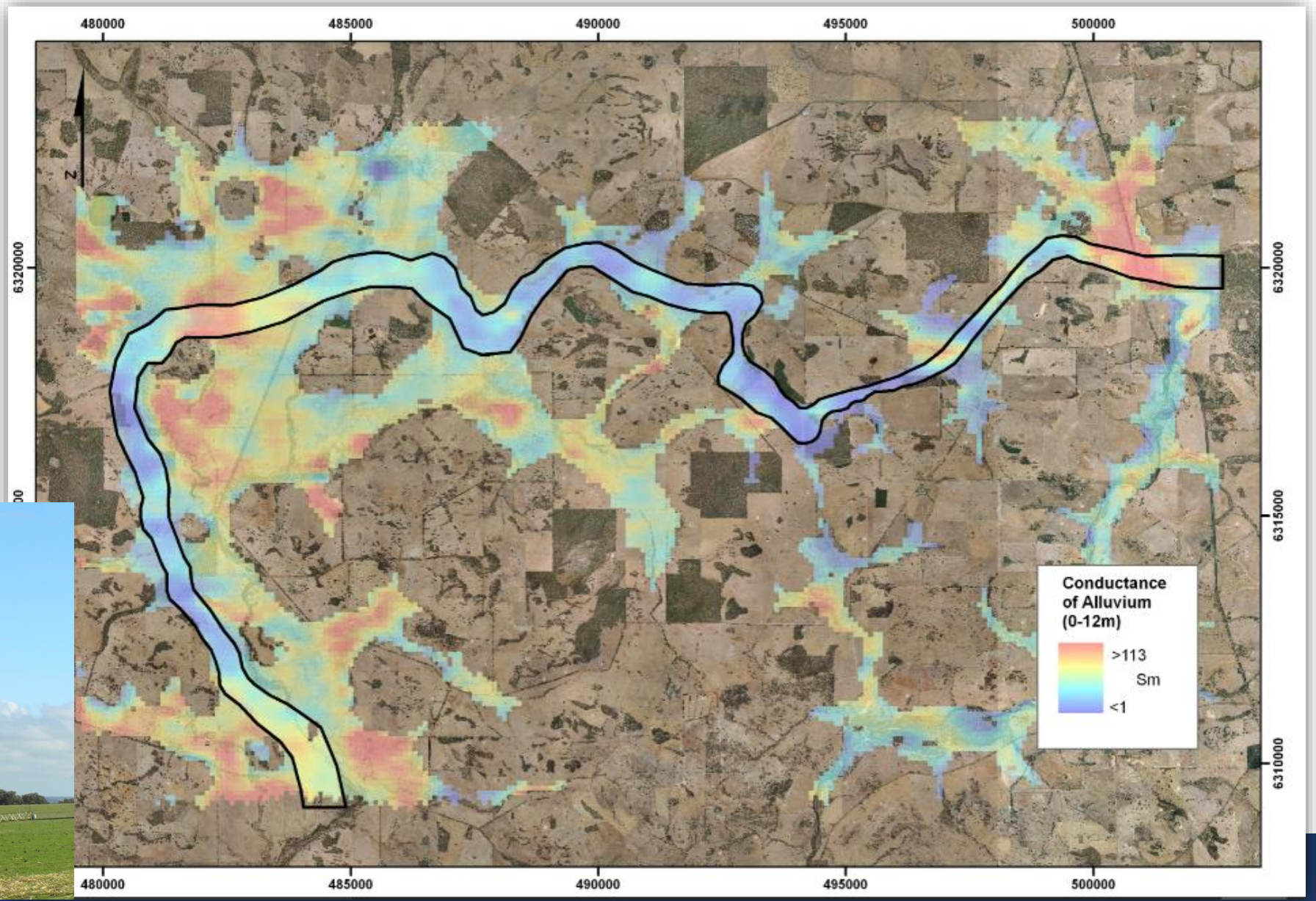
Dardadine palaeochannel



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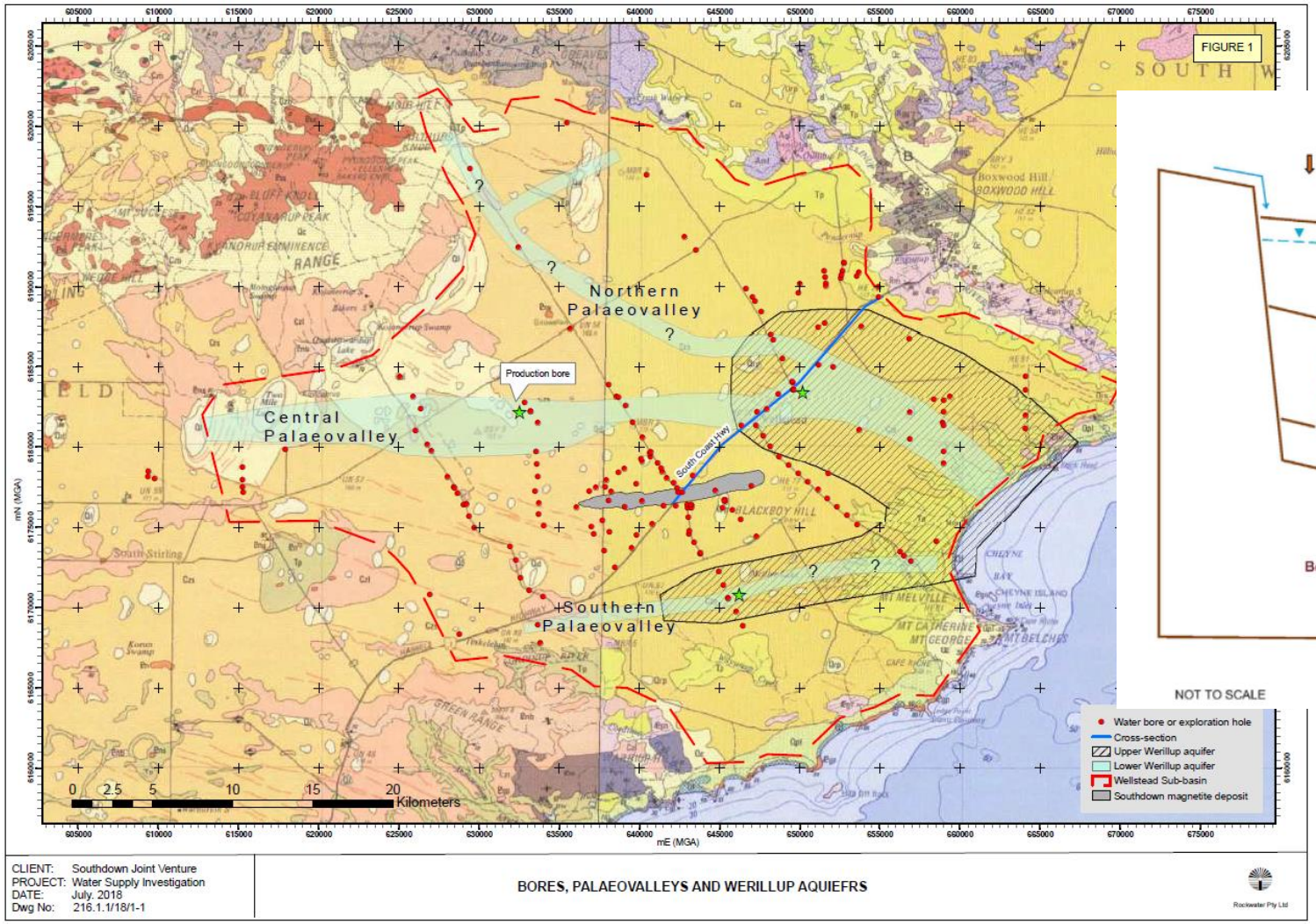
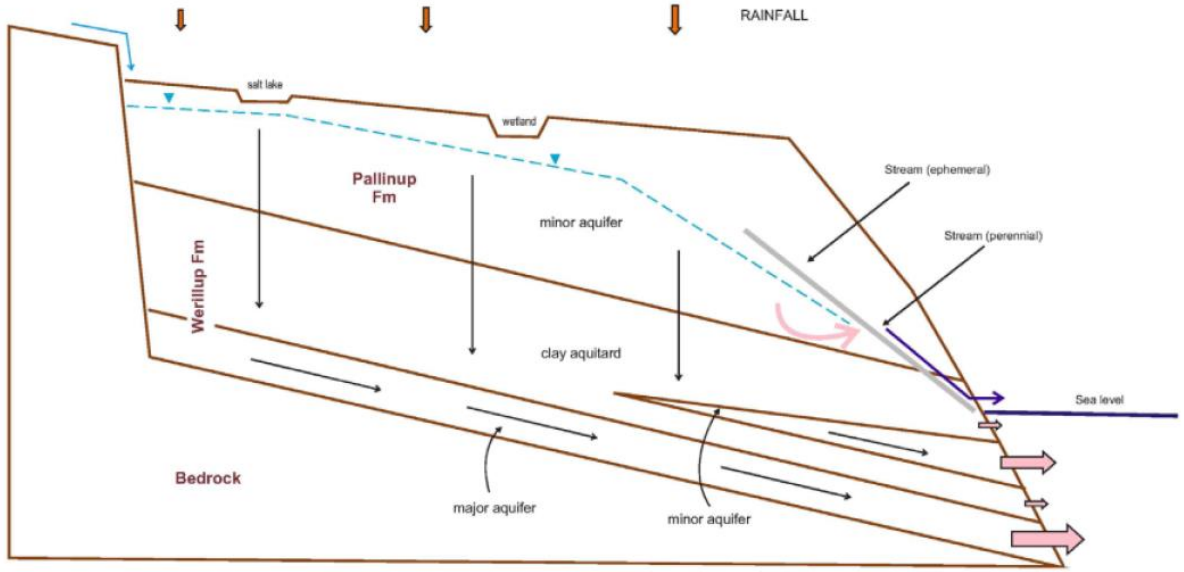
South Coast aquifers





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Pipelines & on-farm supply?

	GAWS (Mundaring to Southern Cross)	GSTWSS (Harris – Binningup)
Length of mains	8800km	3000km
Farmlands customers	**2900** out of 19900 total customers	**1290** out of 37900 total customers
Farmlands usage	**3.85GL** out of a total of 9.9GL	**1.68GL** out of a total of 5.00GL
		Charge $2.66 (~$13 OPEX)

Comparing other sources (on farm)

- 163,000 dams x 1000 m3 = 168 GL/a
- 6000 farms/bores x (20 kL x 365 days) = 44 GL/a
- Sheds/tanks = 6000 x 250kL = 1.5 GL
- Gov. community dams = 130 x 20,000 kL = 2.6 GL

Farm use – 33 GL plus domestic

Assumes: 14 M sheep * 6 litres = 30 GL, Grains - 7 M ha crop = 3 GL, 6000 farms

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Where to get groundwater information?

- DWER - database called Water Information Reporting
- DPIRD – groundwater monitoring AgBores database
  - (Dams app & Geology app soon)

Come and see us at the DPIRD display

- DMIRS – geological related online GIS Geoview
- Consulting hydrogeologists
- Geophysics – tailored to the geology (eg AEM)
- Local drillers
- Your neighbours
- Others…

Desalination NOID Forms – www DPIRD

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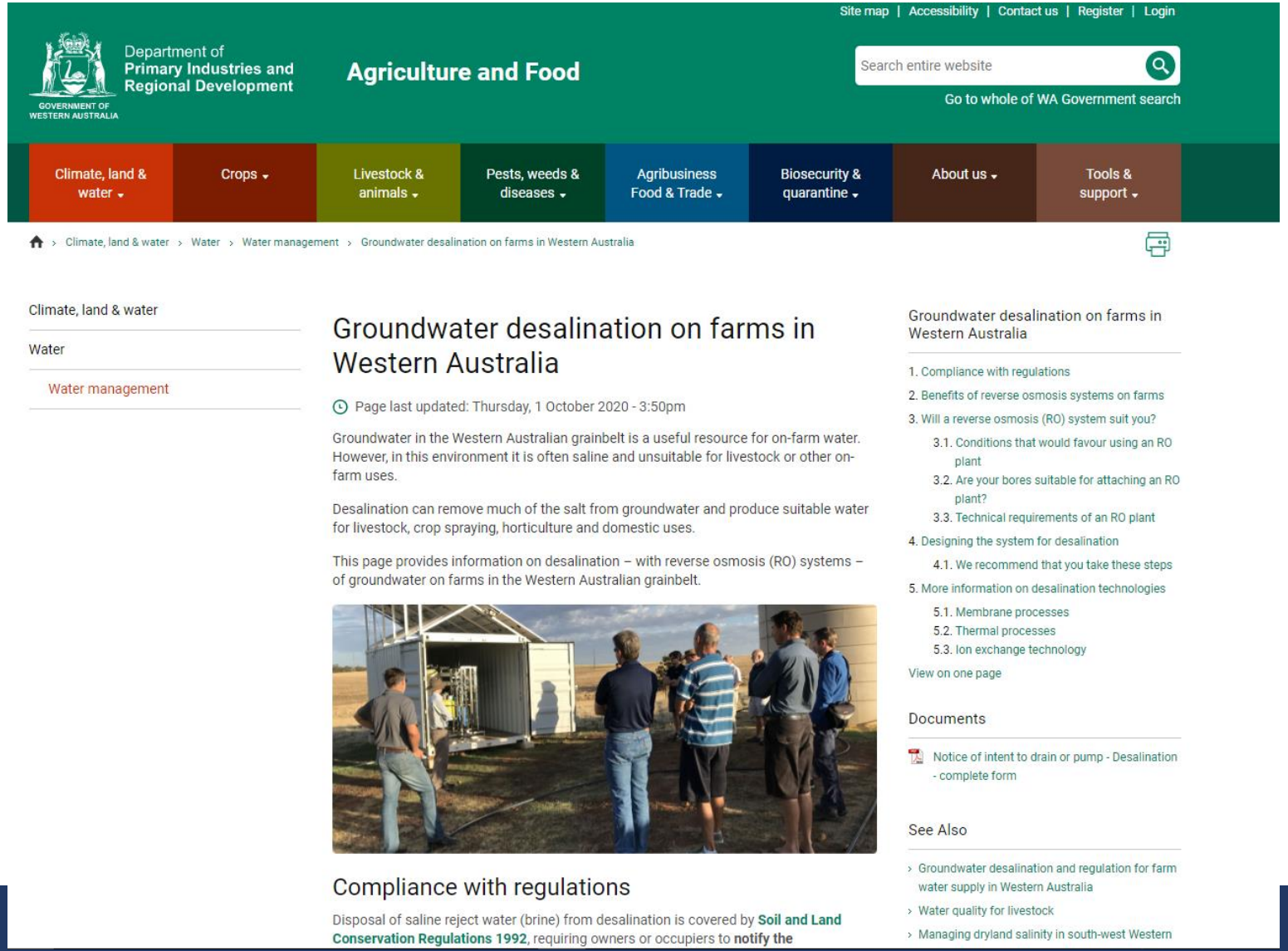
Notice and Intent to Desalinate

https://www.agric.wa.gov.au/water-management/groundwater-desalination-farms-western-australia



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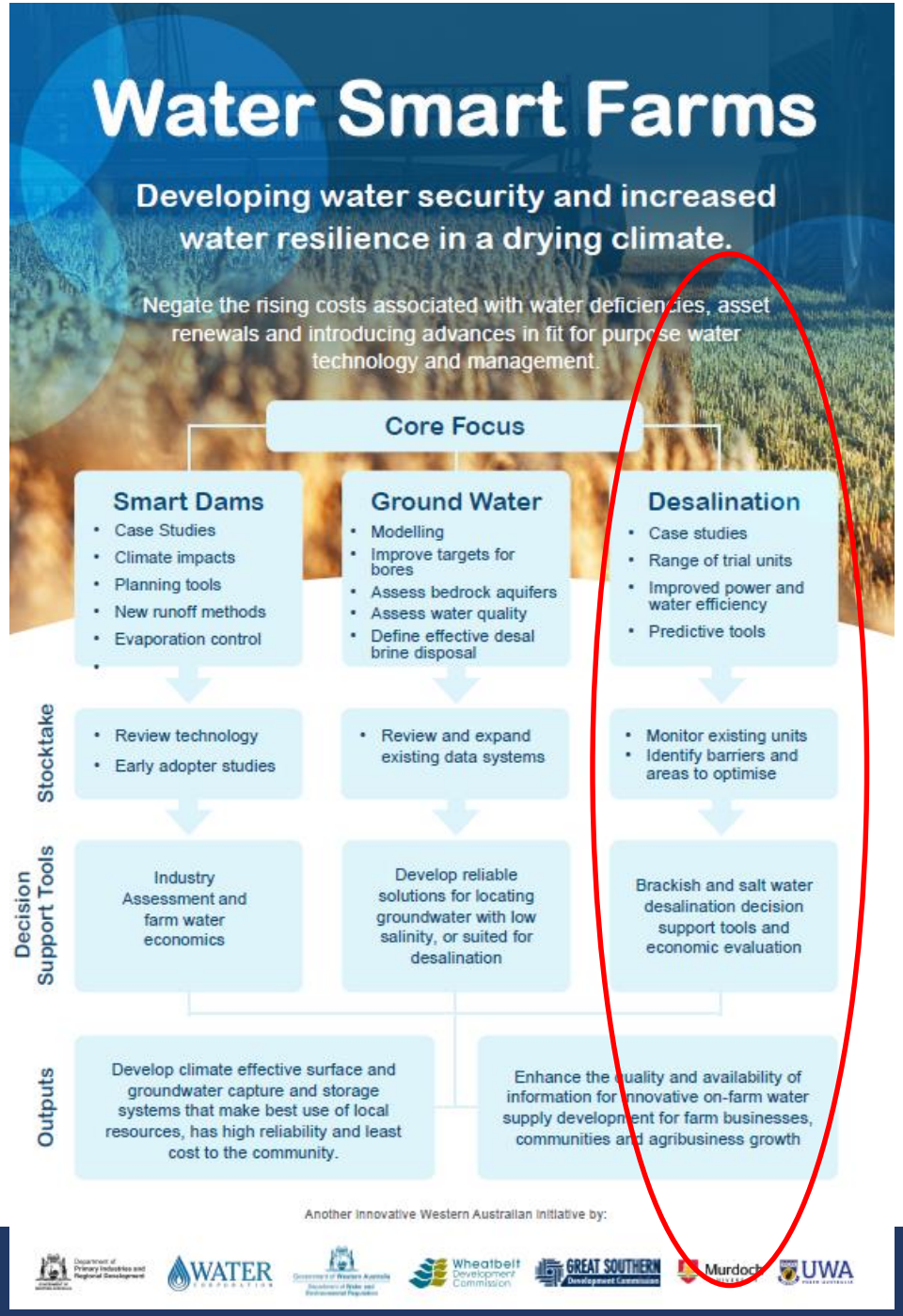
- Part 3 – Desalination

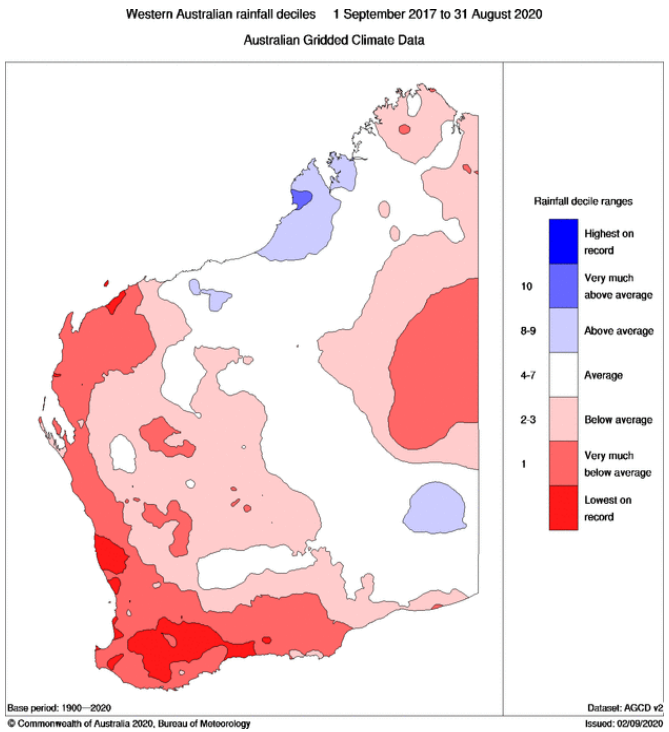
Criteria

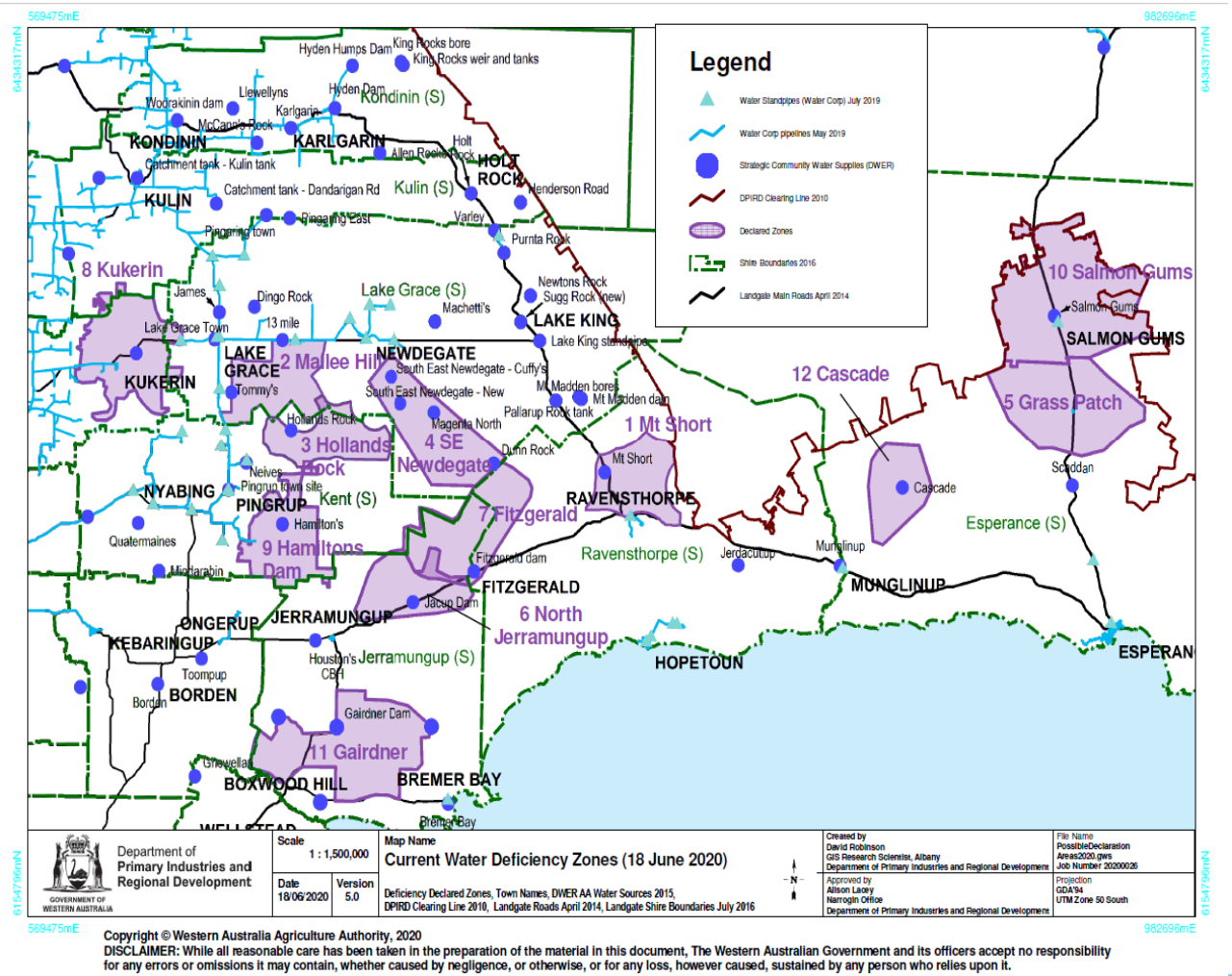
- Supplies farm high quality water
- 10 – 100 kL/day
- Brackish bore water - 3000 to >15,000 mg/L
- Climate independent
- Brine Management
- Target <$2 kL OPEX



Climate Impact

- Rainfall significantly below average across South Coast since 2018 – reduced runoff.
- Water carting at its peak:
  - Potable water: 9ML/week.
  - Agricultural water: 13 ML/week.





Research Focus

1. Water Sources
   - Use of brackish/saline groundwater (TDS 3000 – 15000 mg/L) to provide a major and reliable water source of on farm water.
   - Evaluate potential of higher salinity water (TDS 15000-35000mg/L)
2. Technologies
   - Investigate commercially ready desalination technologies in combination with renewable energy, using WA manufacturers.
   - Emerging technologies to assist brine management
   - Brine Management
3. Liveability
   - Sustainable water, climate independent
   - Adoption

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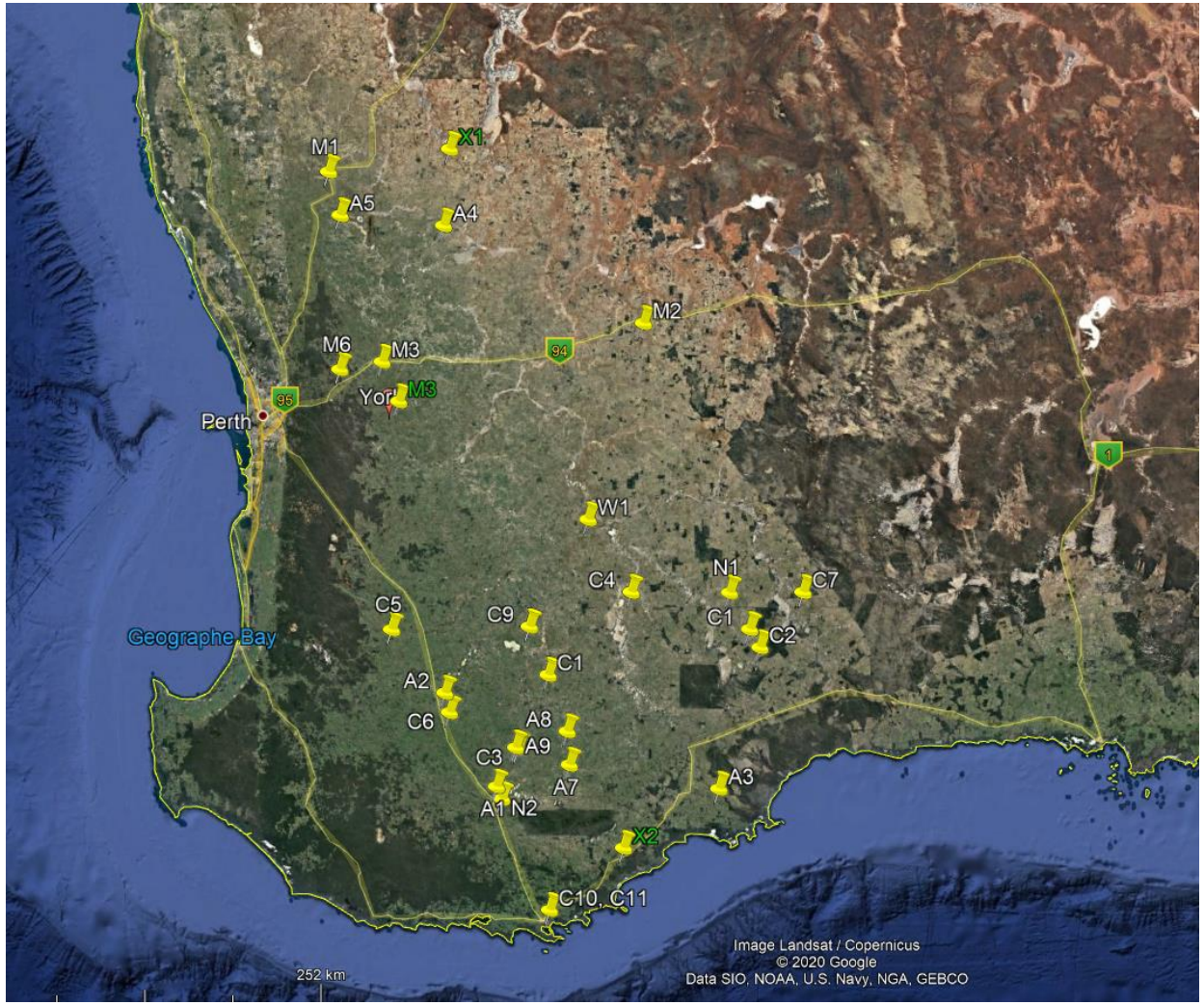
RO Desalination

- First trial mid-1980s
- Initial farmer - 2014
- Build up - 2019-20 with dry seasons

Estimated from industry and NOIDs



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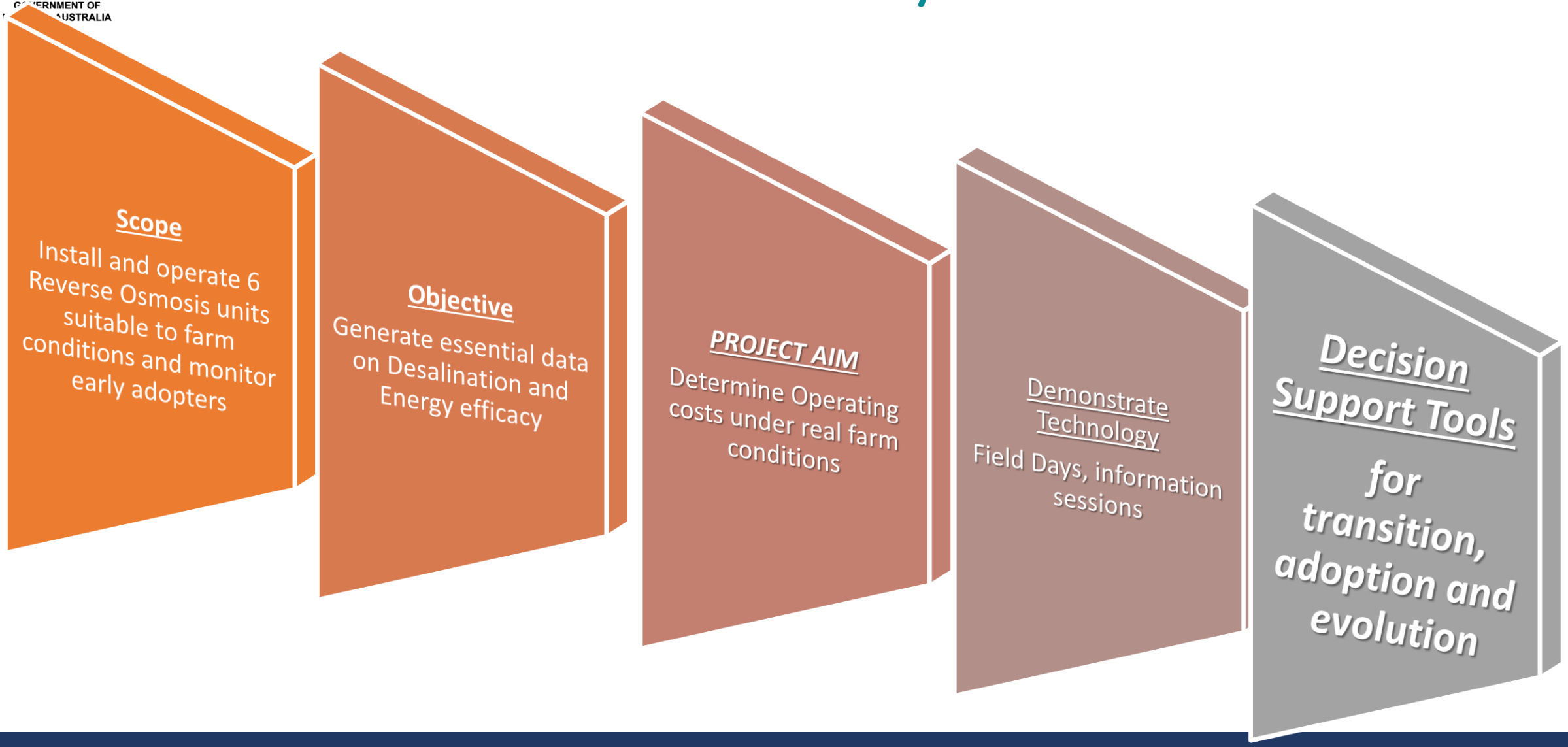
Delivery Method



Pros and Cons - the good news first

Multi purpose water.

Can blend water to be fit for purpose and use for a range of purposes

Climate Independent.

Can hold onto or grow stock levels

Current Investments are being realised.

Full investment is realised if it doesn't rain

Pros and Cons - now the cons

Brine Disposal.

Significant part of study on brine reinjection and pond alternatives

Operating Costs.

Higher than other options and if significant ongoing rain may not realise investment

Opportunity Costs Unknown.

Can be difficult to quantify, eg how many extra stock

Power Options

Costs From Vendors For Desal Technologies

Brackish Water RO (3,000-15,000mg/LTDS)	Unit cost	Solar	Ancillaries (new or existing)
10 kL/day	$18,000 - $50,000	$5,000 - $20,000	Approx. $15,000 - $40,000
50 kL/day	$40,000 - $120,000	$20,000 - $60,000	Approx. $20,000 - $45,000
120kL/day	$80,000 - $200,000	$40,000 - $90,000	Approx. $30,000 - $60,000
Seawater Water RO (15,000-35,000mg/LTDS)	**Unit cost**	**Solar**	**Ancillaries**
10 kL/day	$30,000 - $80,000	TBD	Approx. $15,000 - $40,000

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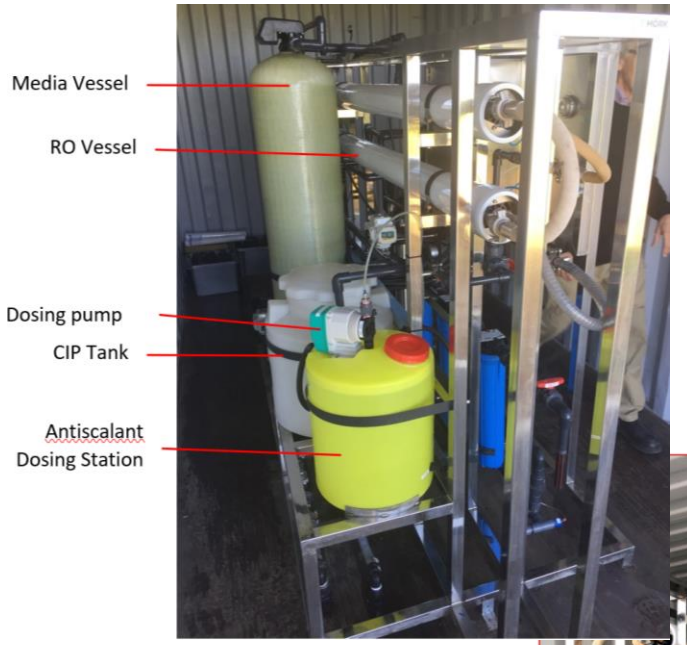
Case Study - Solar Powered Reverse Osmosis Desalination Plant

- 4,000L/d operating 6 to 8hr/day on solar only
- Sand filter with automatic back wash, 20, 5 and 1 micron filters and dosing system for anti-scalant.
- Automatic start at 90% and stop.
- System automatically flushes at each shutdown with permeate.
- 14 Solar panels ~320 Wp each.
- 4 x 12V 120AH AGM batteries to ensure a safe shutdown of the plant



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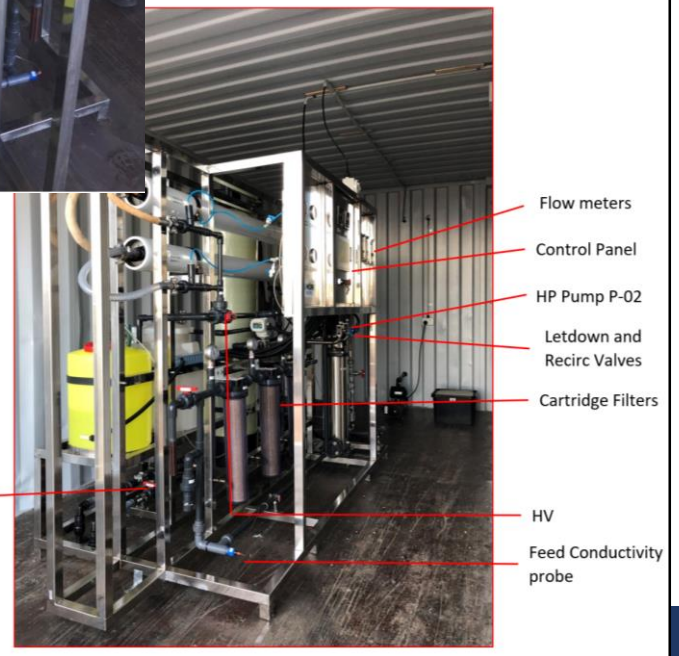

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Initial Results

1. Performs well with solar and the automatic shutdown when sunlight is reduced.
2. Operational adjustments must be carefully monitored,
3. Membrane life projections a key to operating costs
4. Operating Cost approximately $2-2.88/kL
5. Next stage is looking to optimise the plant to improve recovery and lower operating costs.

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The Future

R&D partnerships established - seeking WA technology partners.

Looking at opportunity with $100m Federal Drought Fund

8 x National Research, Adoption and Resilience Hubs

Outcome:

- WaterSmart farms
- Water Forever whatever the weather… and salinity to support industry and regional development