THE POTENTIAL FOR MANAGED AQUIFER RECHARGE IN THE NORTHERN TERRITORY: a new focus on an old paradigm.

Dr Rick Evans, Des Yin Foo

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What is Managed Aquifer Recharge ?

MAR is the purposeful recharge of water to aquifers for subsequent recovery or environmental benefit.

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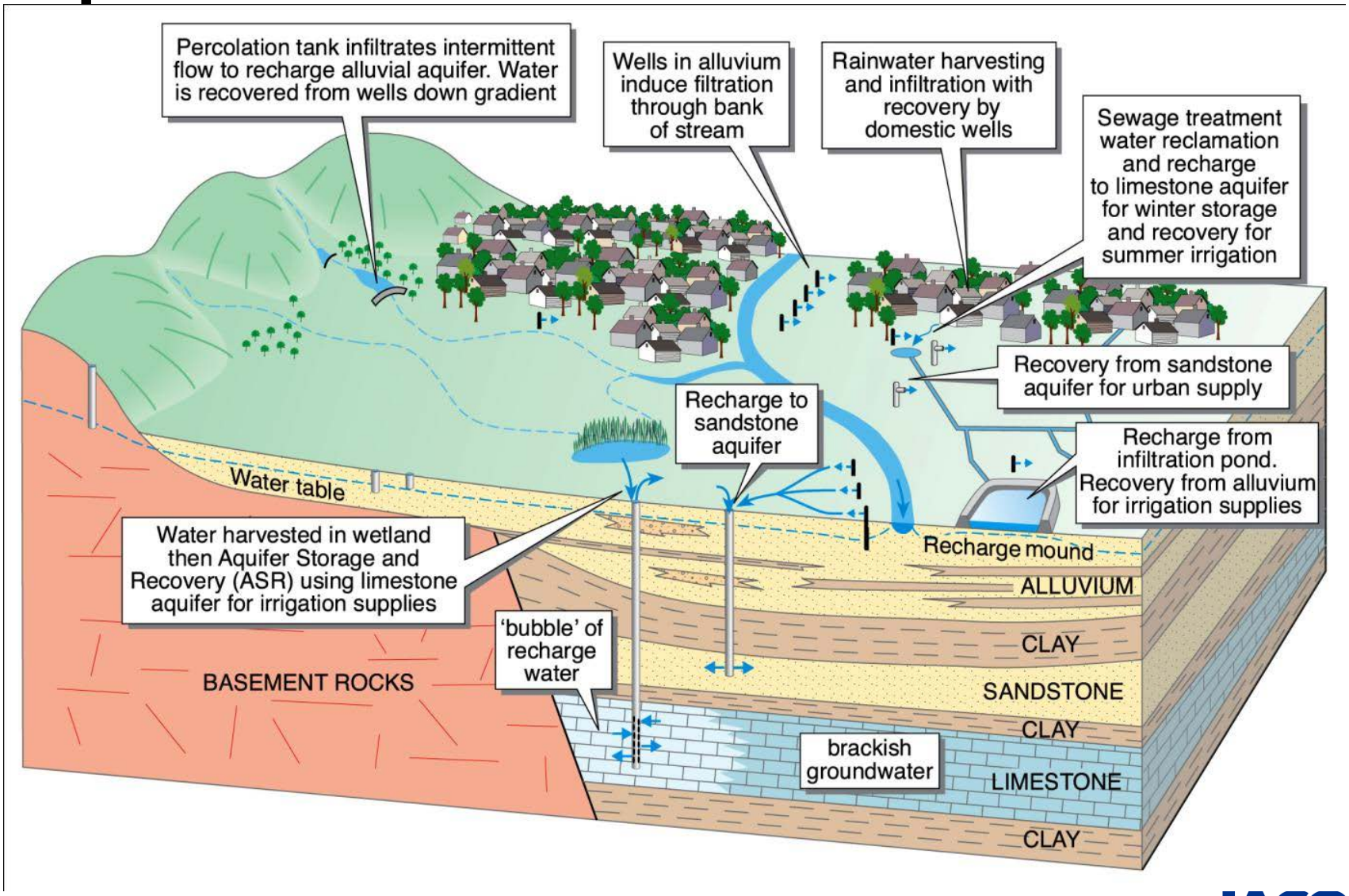
Aquifers – ‘nature’s hidden treasures’- places to store and treat water



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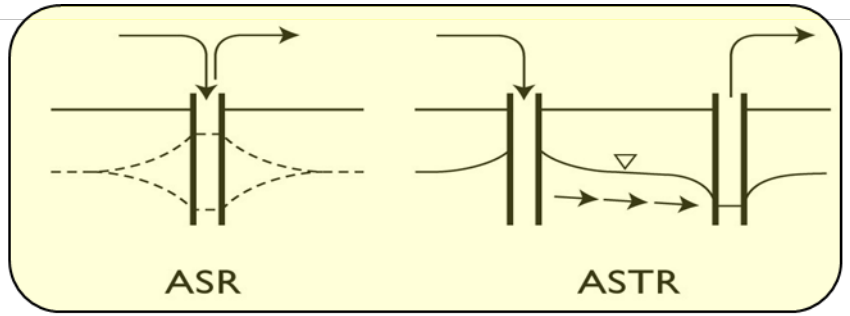
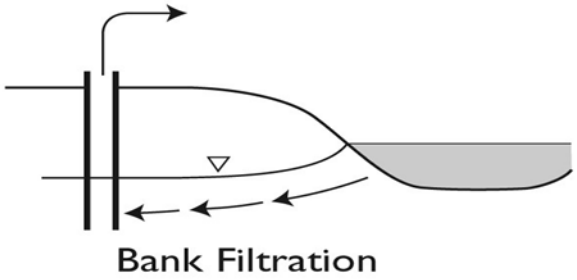
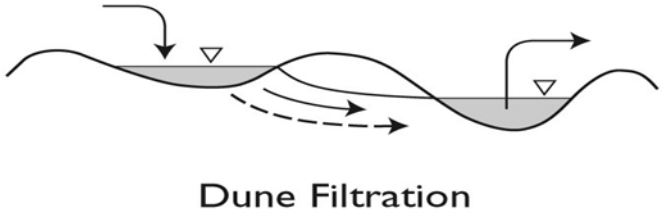
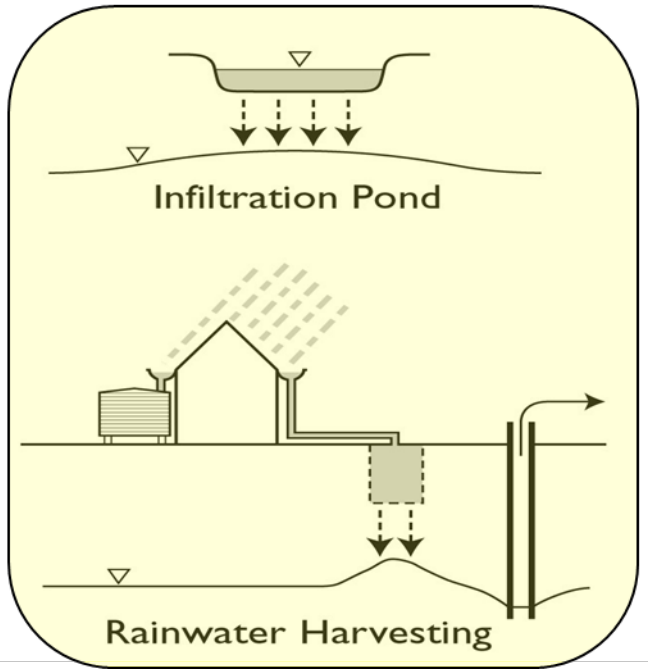
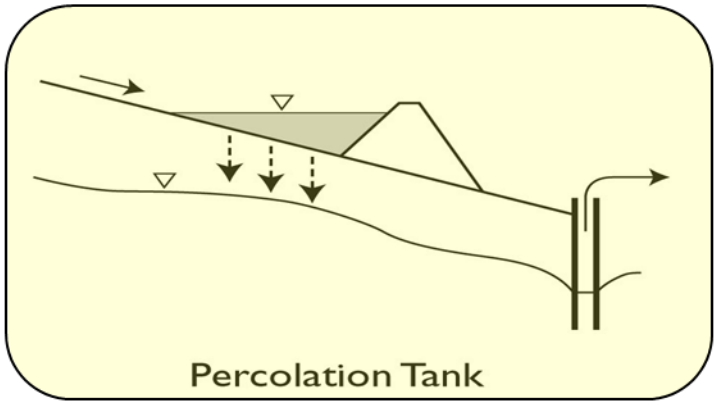
MAR Systems (1)











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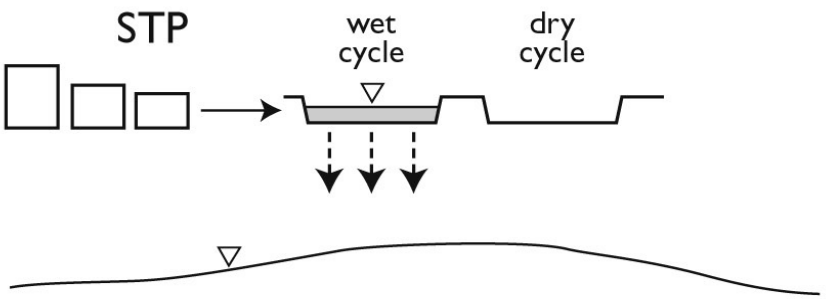
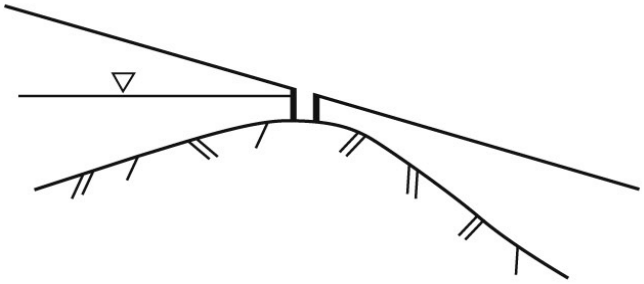
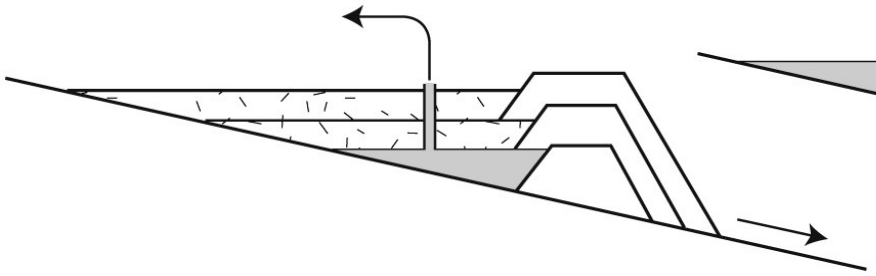
MAR Systems (2)



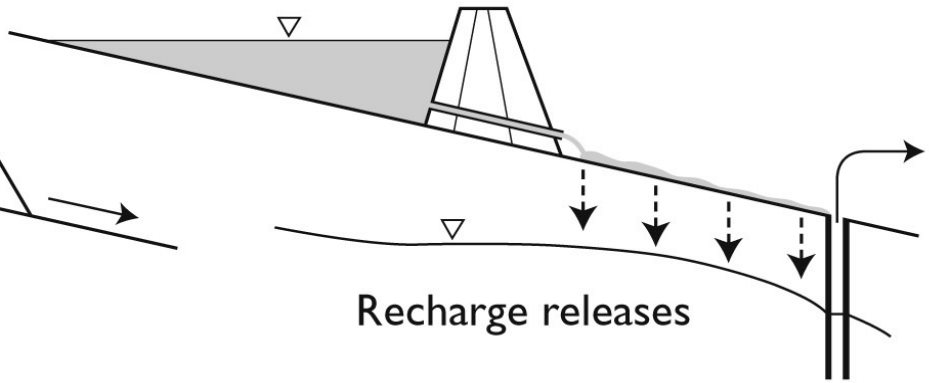
Soil Aquifer Treatment



Underground Dam



Sand dam



Recharge releases

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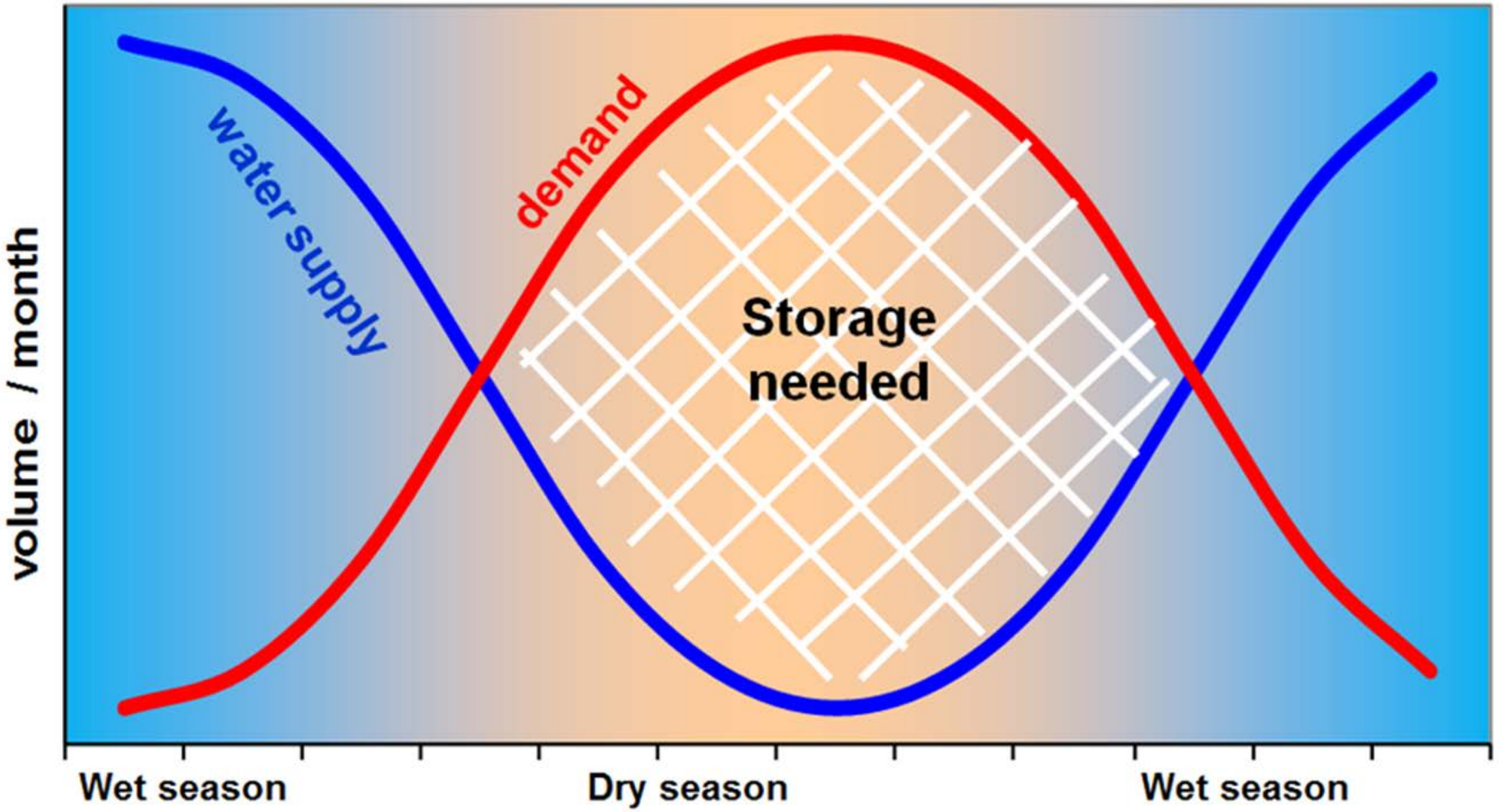
The Need for Storage



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MAR Storage

MAR stores 10 times volume of the two tanks

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MAR Economics (NWC, 2009)

- The average cost of 8 urban stormwater ASR projects (75 - 2000 ML/yr): $1.12/kL.
- For agricultural recharge with infiltration basins cost can be order of magnitude less, eg. Burdekin Delta, $0.07/kL.

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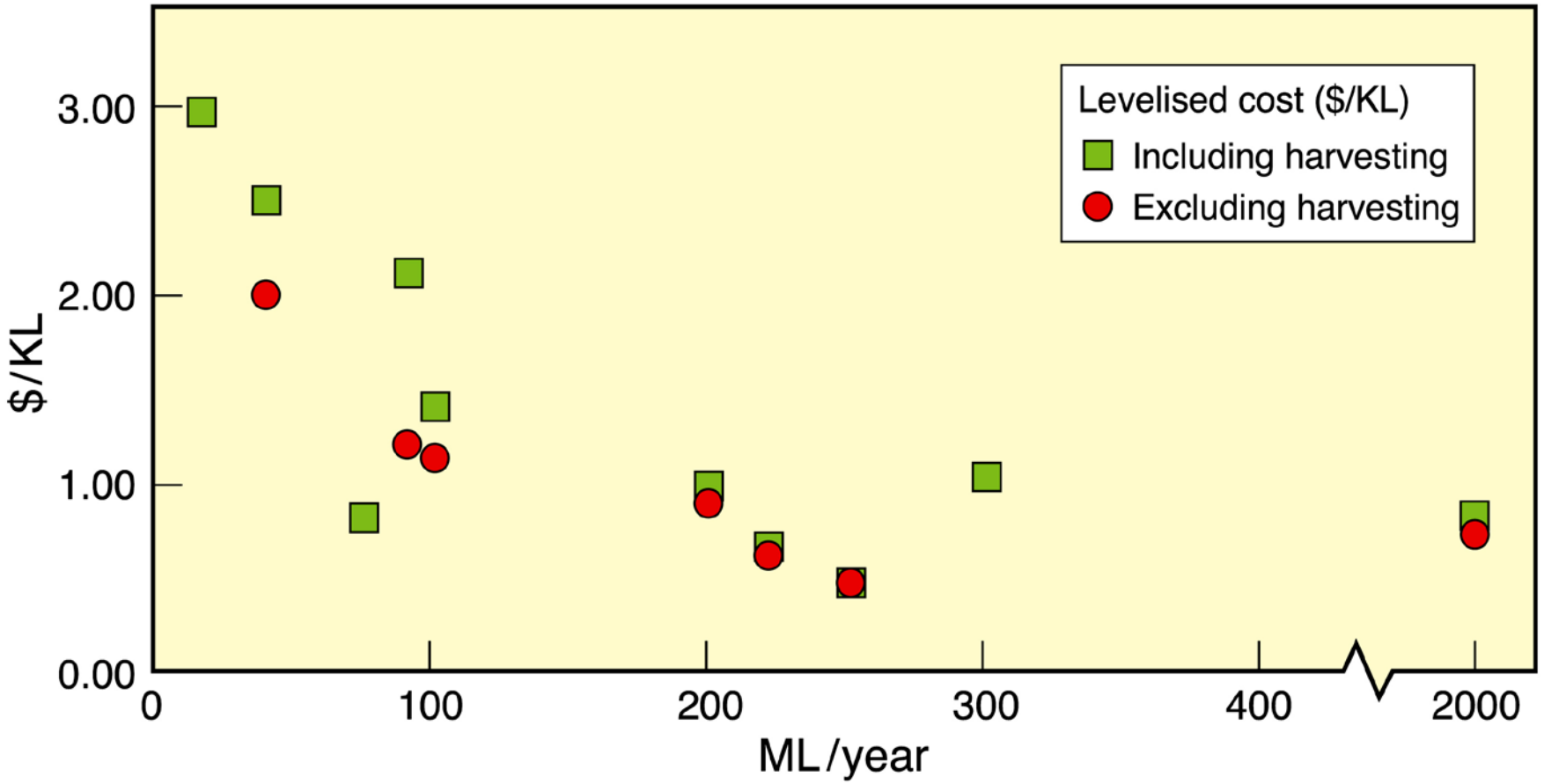
MAR Economics



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Applications for MAR

1. Securing and enhancing water supplies
2. Improving groundwater quality - water treatment
3. Reducing evaporation of stored waters
4. Increase / maintain stream baseflow
5. Preventing salt water from intruding into coastal aquifers
6. Permits staged development.

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Impediments to Adoption of MAR

1. Initial cost estimates have a high variability / uncertainty compared to alternatives.

2. Relatively high upfront costs to evaluate feasibility.

3. Poor understanding of groundwater processes by water authorities / councils.

4. Untested, sometimes conflicting and overly conservative regulations / regulators unfamiliar with MAR and hydrogeology.

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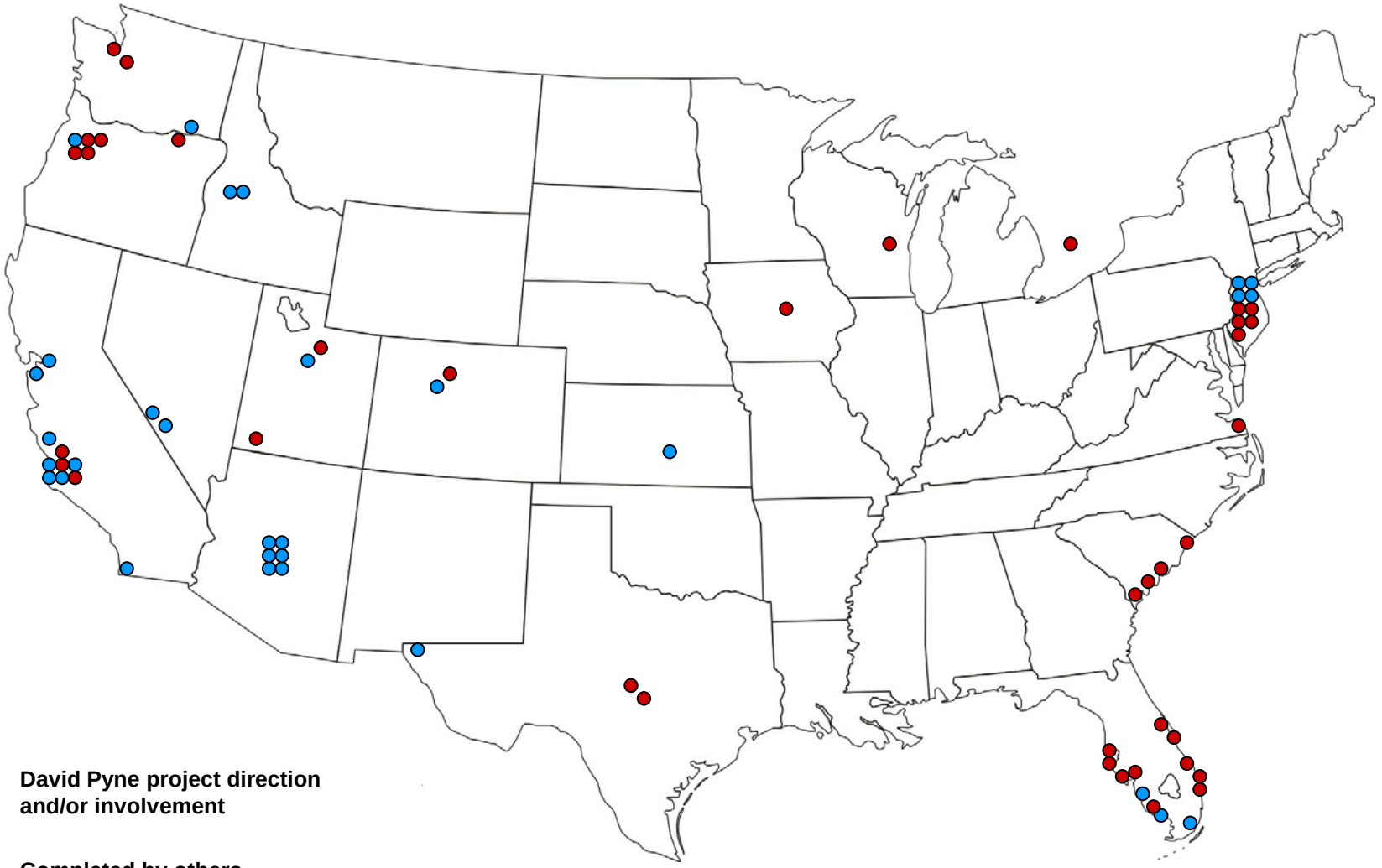
95 ASR wellfields are known to be operating in the U.S. as of 2015.



- David Pyne project direction and/or involvement
- Completed by others

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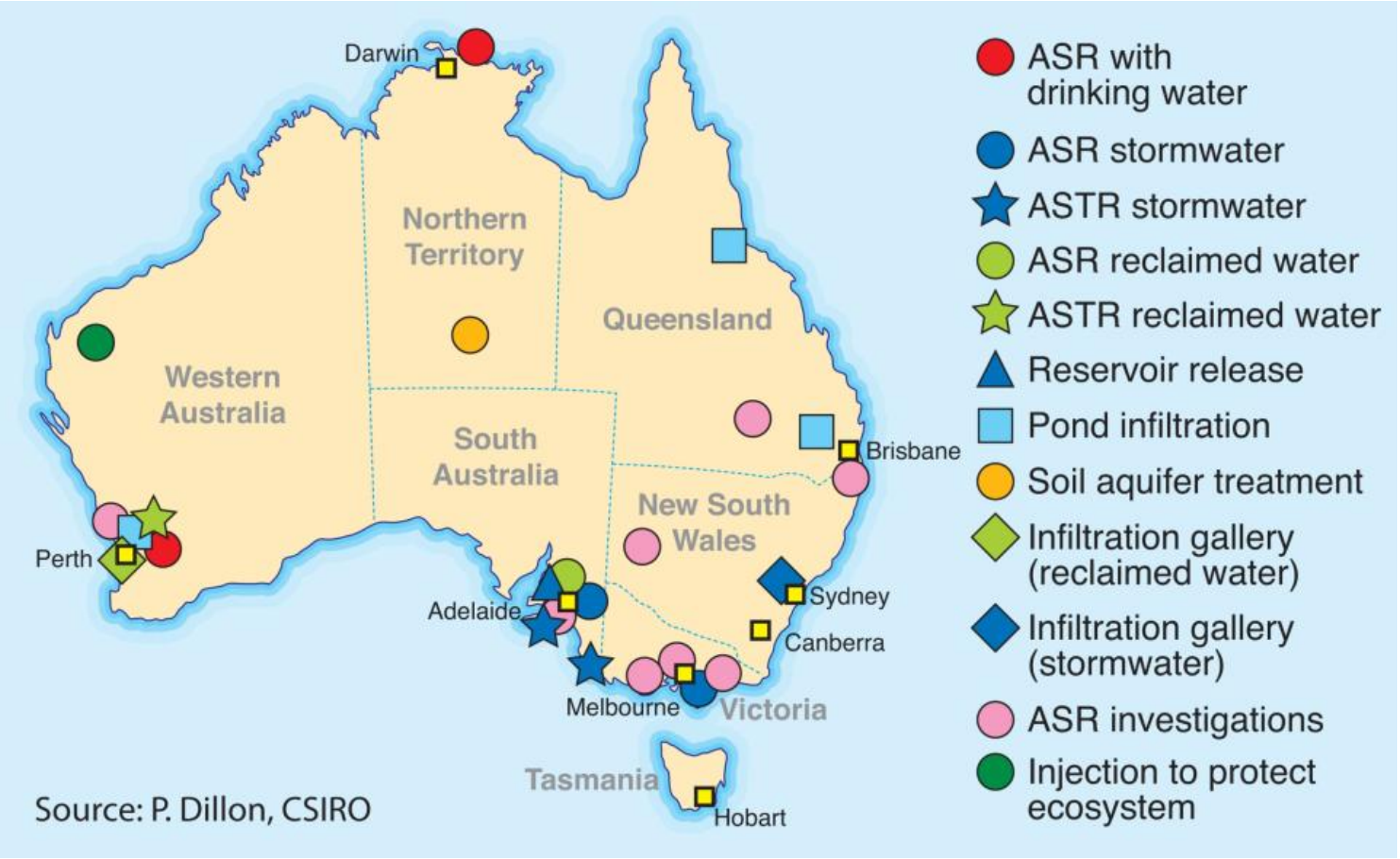
Status of MAR in Australia (2012)

Location and type of current MAR schemes in Australia



ASR – Aquifer storage and recovery

ASTR – Aquifer storage, transfer and recovery

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Burdekin Delta (Qld) ~ 45,000 ML/yr

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Alice Springs MAR; ~ 1,000 ML/yr

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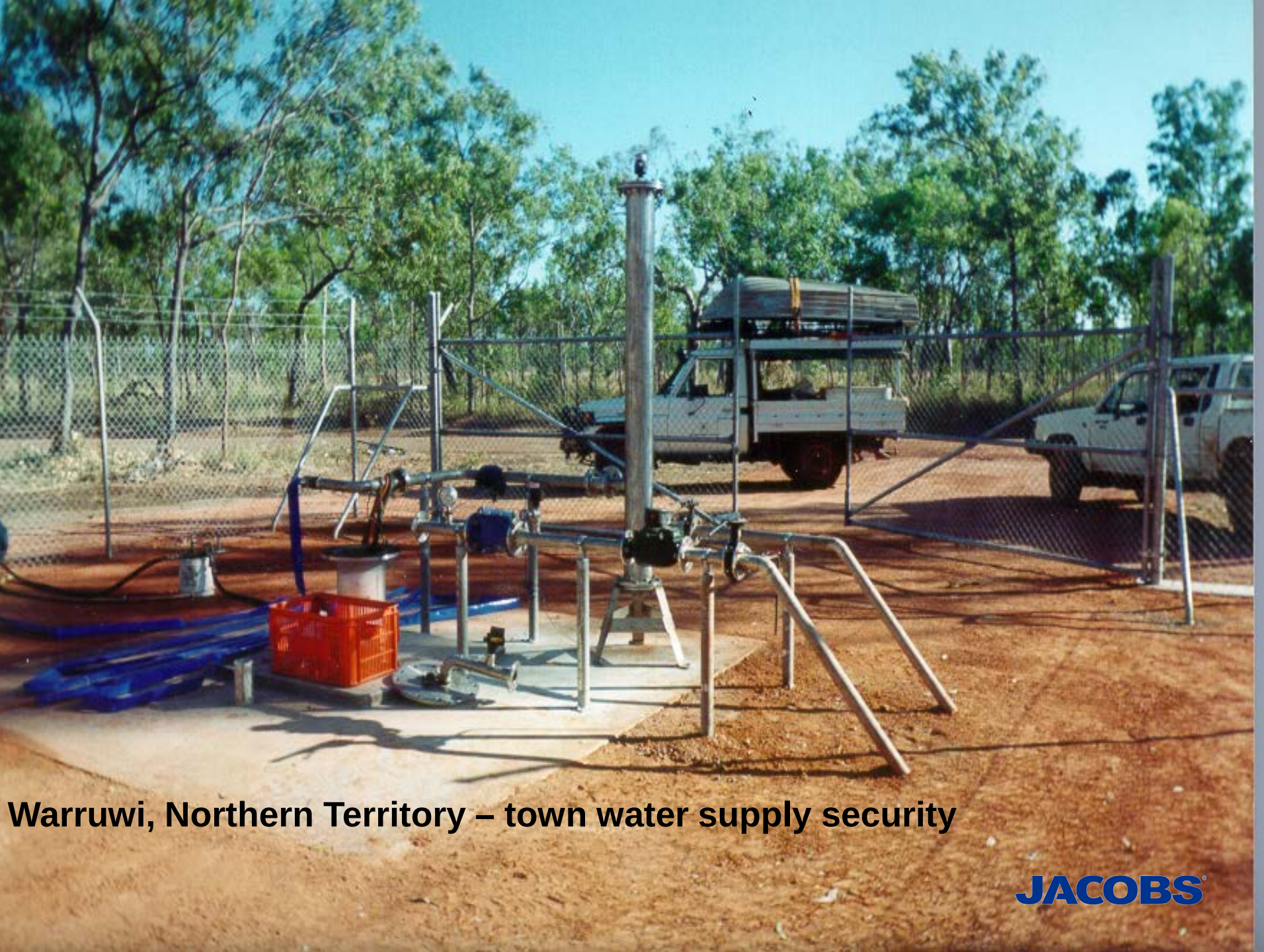
MAR Examples
Soil Aquifer Treatment, Alice Springs

Dissolved air flotation water reclamation plant adjacent aeration lagoons at Alice Springs STP (NT PowerWater)

SAT basins first fill in June 2008

(NT PowerWater)



Warruwi, Northern Territory – town water supply security

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Managed Aquifer Recharge Weir – W.A.

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Centre Pivot based on MAR weir

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Source Water Diversity

- Burdekin – river
- Alice Springs – sewerage
- Warruwi – shallow seasonal groundwater
- Recharge weir (W.A.) - river

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OUR MAR VISION

To significantly expand economically viable groundwater, managed aquifer recharge and low cost surface water based irrigated agriculture in the Northern Territory.

Water Source Philosophy

1. Transporting water is very expensive.
2. Surface water bodies in Northern Australia (ie dams) lose a lot of water to evaporation.
3. There is considerable variation in the timing, magnitude and intensity of the wet season across Northern Australia.
4. Water resource development must be scalable.

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VISION ACHIEVED BY:

- Groundwater only
- Groundwater augmented by Managed Aquifer Recharge (MAR) schemes.
- The conjunctive water use (CWU) of groundwater and low cost surface water schemes. (CWU can increase dry season environmental flow and security of supply to existing license holders).

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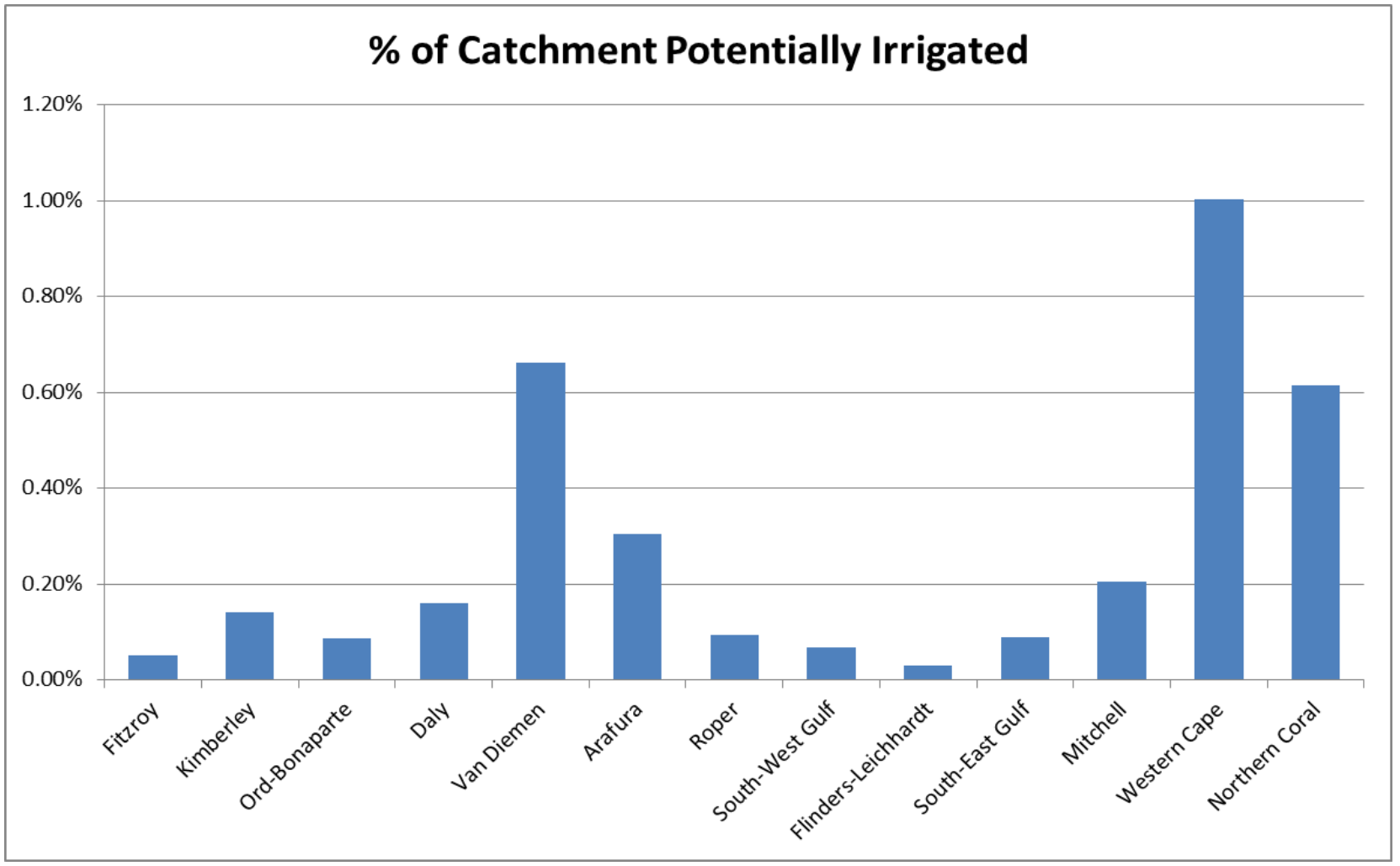
Area that could be irrigated



Based on 1% of wet season flow

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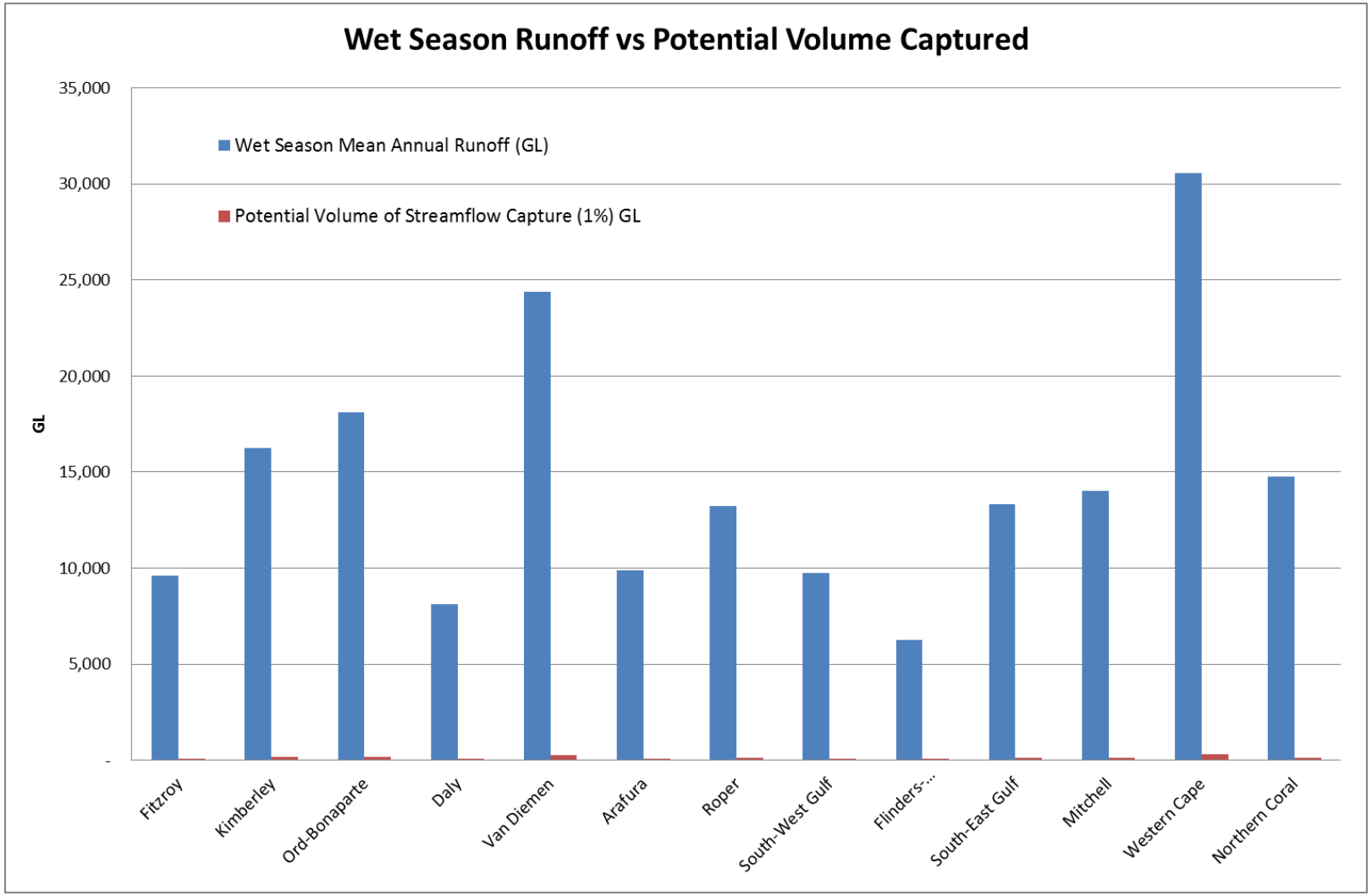
Water availability



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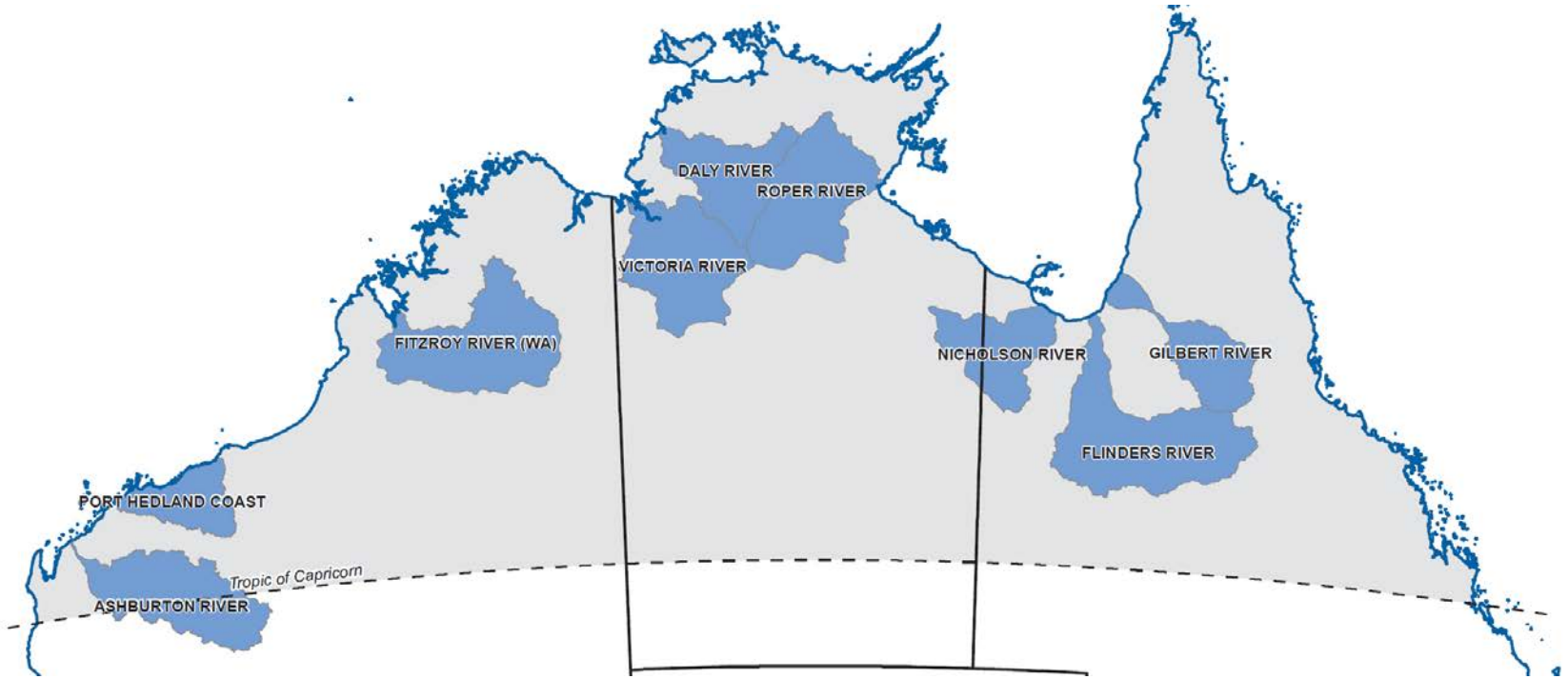
Nine Focus Catchments



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Available water resources in the 9 catchments

Assessed a low estimate (high confidence) and a high estimate (to be proved).

- Groundwater: 115 GL/yr to 640 GL/yr.
- MAR: 280 GL/yr to 1390 GL/yr.
- CWU: 410 GL/yr to 2140 GL/yr.

Based on mosaic irrigation (i.e. distributed).

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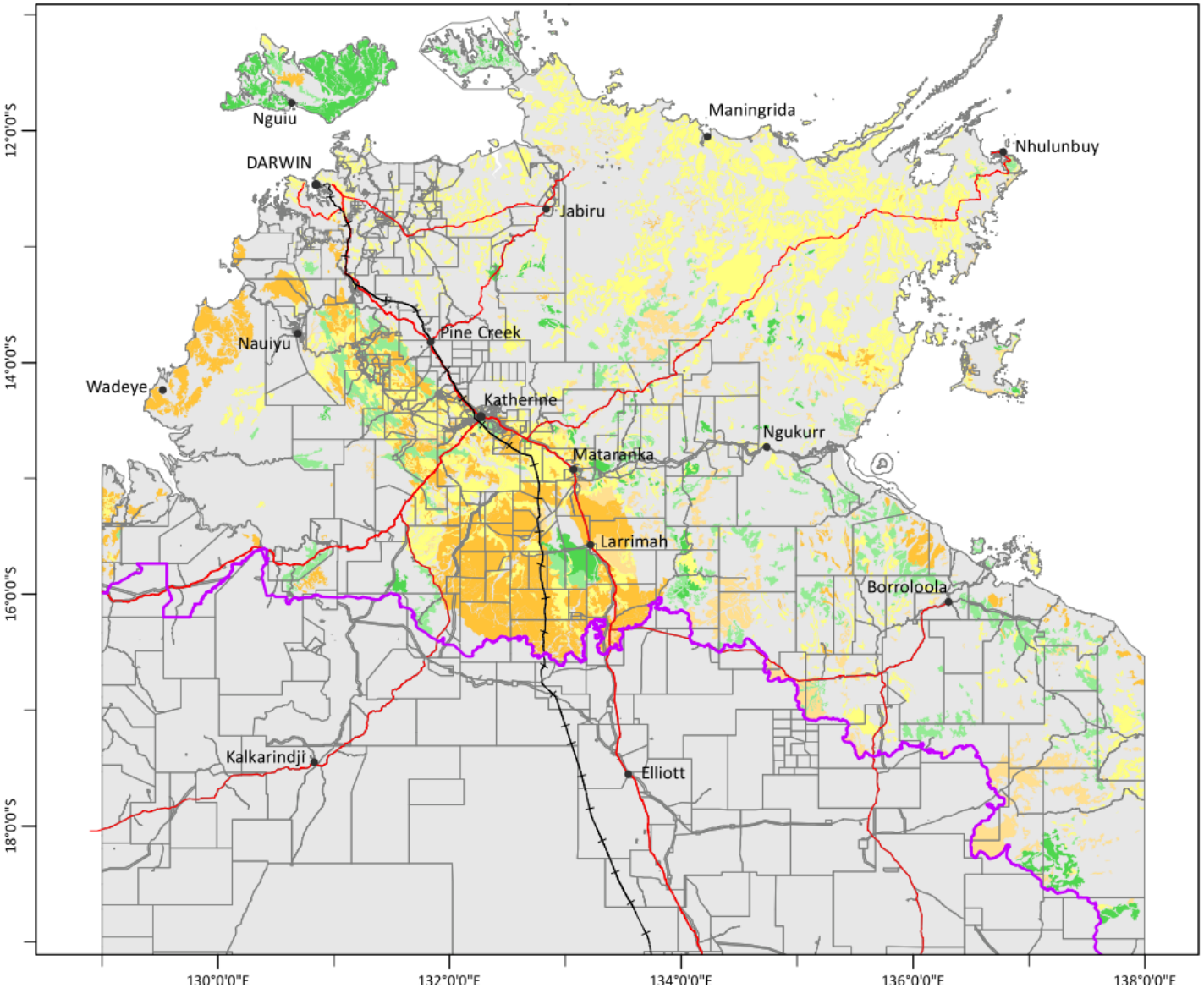
Soil suitability for irrigation



Suitable Soils

Proportion of Land System

- 1 - 20%
- 21 - 40%
- 41 - 60%
- 61 - 80%
- 81 - 100%

Suitable soils criteria (Case 1):

Rock outcrop <= 10%
Depth >= 90cm
pH 4.5 - 8.0
Slope <= 2%
Well Drained

Boundary extent of Northern Land System mapping (scale 1:250,000)

km 0 50 100 150 km

Data Source -
Land Systems Northern NT 1:250,000: DLRM
Roads, Rail, Parcels, Towns : DLPE

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This map must be read with the report:
Potential Land for Long-term Sustainable Food Production; Soil and Water Suitability Assessment, 2nd Edition 2014.
Dept Land Resource Management (DLRM)

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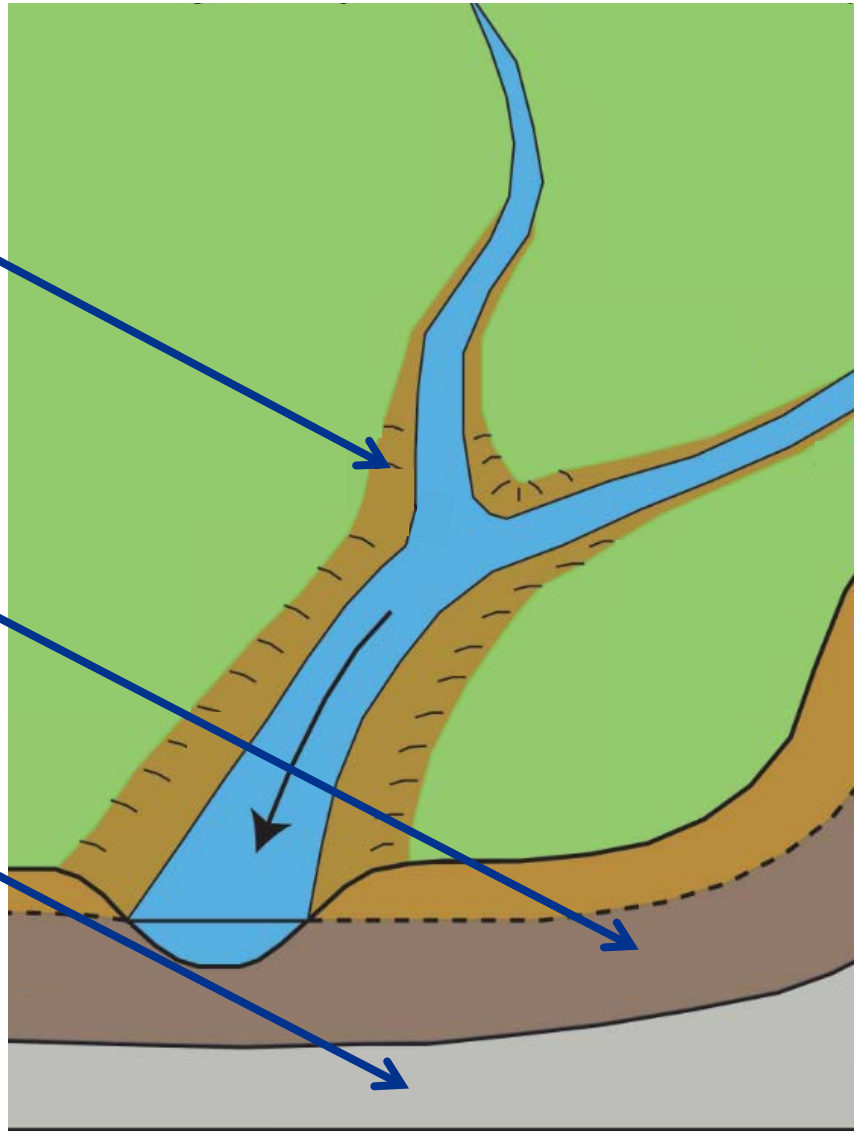
Groundwater sources

1. Shallow alluvium
   - Suitable for MAR
   - Almost all northern rivers

2. Shallow regional aquifer
   - W.A. eg: La Grange
   - N.T. eg: Darwin
   - Qld. eg

3. Deep regional aquifer
   - W.A. eg: Canning Basin
   - N.T. eg: Tindal Limestone
   - Qld. eg: parts of GAB



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Identified Conjunctive Water Use opportunities in the NT

- Katherine/Daly Basin

    1. Katherine/Tindall Limestone
    2. Daly/Oolloo, Northern Zone
    3. Daly/Oolloo, Southern Zone

- 4. Tindall Limestone / Mataranka
- 5. Wildman River
- 6. Ti Tree
- Note CSIRO are considering the Darwin Rural Area.

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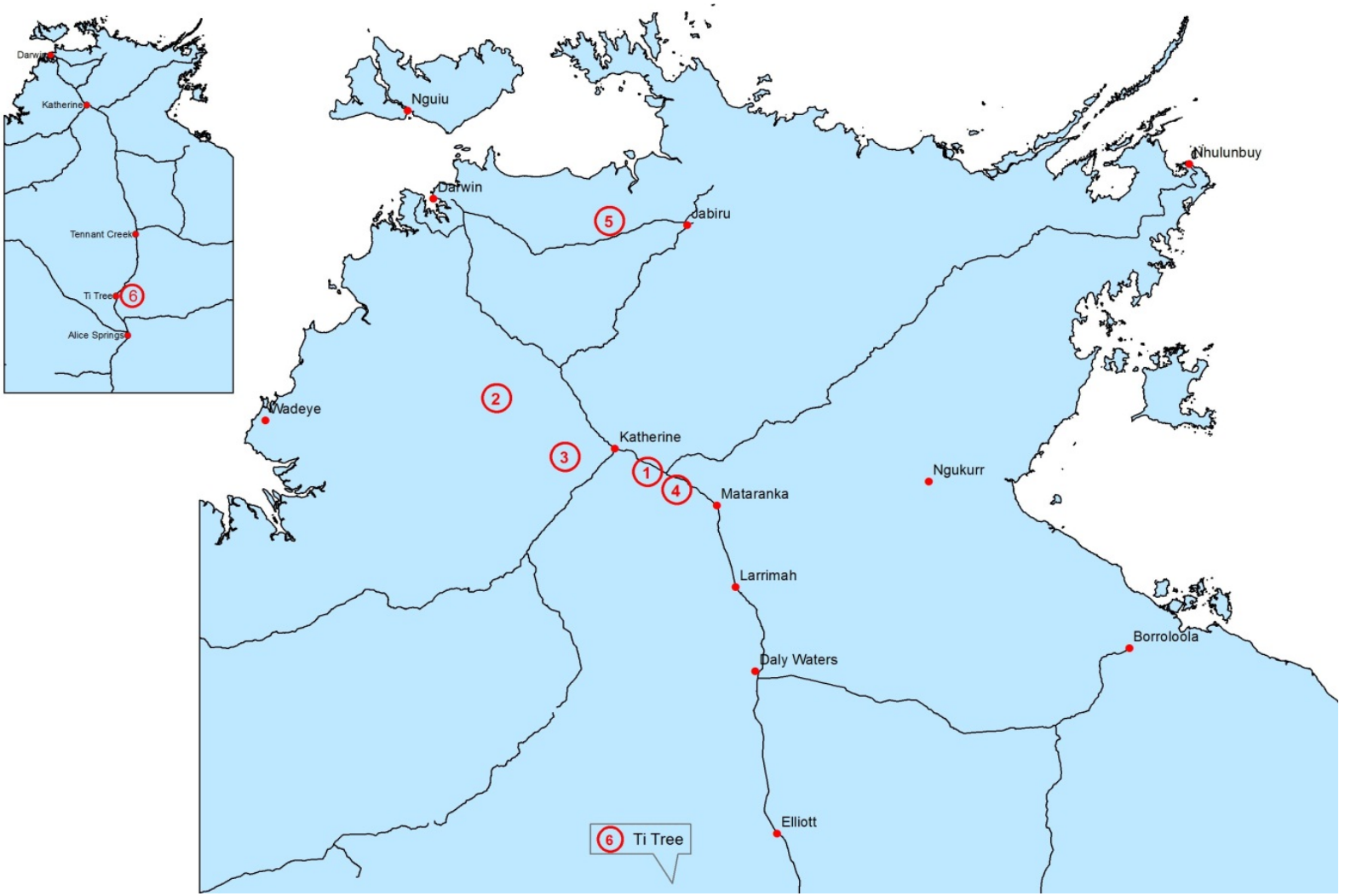
MAR / Conjunctive Water Use Opportunities



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MAR approach in Katherine/Daly region

	Title	Possible Site Location	Geology/ Hydrogeology	Likely MAR approach
1	Tindall Limestone Aquifer (Katherine)	• Most likely site upgradient of the Venn Farms district – proposed to be in the King River area.	• Area is underlain by Tindall Limestone Formation.	• Groundwater level below the MAR site is approx. 60m. • Source water could be wet season flows in the King River or from Leach Lagoon.
2	Oolloo Northern Zone	• Suitable site would capture wet season flood flows into an offstream storage structure north of the Stray Creek area.	• Area is underlain by Oolloo Dolostone aquifer.	• Need to locate a suitable offstream storage facility for injection unto underlying aquifer.

Continues on the following page

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MAR approach in Katherine/Daly region

	Title	Possible Site Location	Geology/ Hydrogeology	Likely MAR approach
3	Oolloo Southern Zone	• Suitable sites would either capture wet season flood flows into an offstream storage structure from the downstream Fergusson River or other ephemeral rivers in this region.	• Area is by the Oolloo Dolostone aquifer.	• Seek to locate a suitable offstream storage facility for injection into underlying aquifer.
4	Tindal Limestone Aquifer	• Most likely site for an MAR project is upgradient of the Mataranka town area – proposed to be in the upper catchment area of the Roper River such as Roper Creek.	• Area is underlain by Tindall Limestone Formation.	• Groundwater level below the possible MAR site is approx 60m below surface. • Injection regime would appear to be most suited. • Source water could be wet season flows in Roper Creek or other streams in this part of the aquifer.

Key hydrogeological requirements for MAR to be effective for irrigation in the NT

- High permeability aquifers ie high recharge rate
- Relatively shallow water table – ie not too high pumping heads (approx. < 30m, but may be more); depends on recharge method.
- Close to surface water source – eg within 2 km of rivers
- Surface water source - low salinity and low turbidity at some times.
- Push/pull heads of approx. <50m, prefereably.
- Relatively close to suitable soils.

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Phase 1: Concept Development

- Review and access the possible schemes
- Assess the wet season flood harvesting potential
- Identify feasible MAR opportunities
- Identify suitable soils
- Undertake scheme basic designs and basic costing
- Short list best schemes

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Phase 2: Site Feasibility Studies

- Undertake field drilling investigation
- Undertake field soil surveys
- Propose conceptual designs
- Undertake feasibility level costing
- Undertake economic assessment of various irrigated agricultural enterprises.

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Phase 3: Business Case

- Identify and assess impediments
- Consider land ownership options
- Identify investment options
- Recommend economically feasible schemes

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KEY CONCLUSIONS

- There is sufficient water- MAR & CWU can significantly increase the water yield

- MAR & CWU is economic for certain crops and specific situations.

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