Integrated bioenergy tree crops in south-western Western Australia enhance water quality and environmental outcomes

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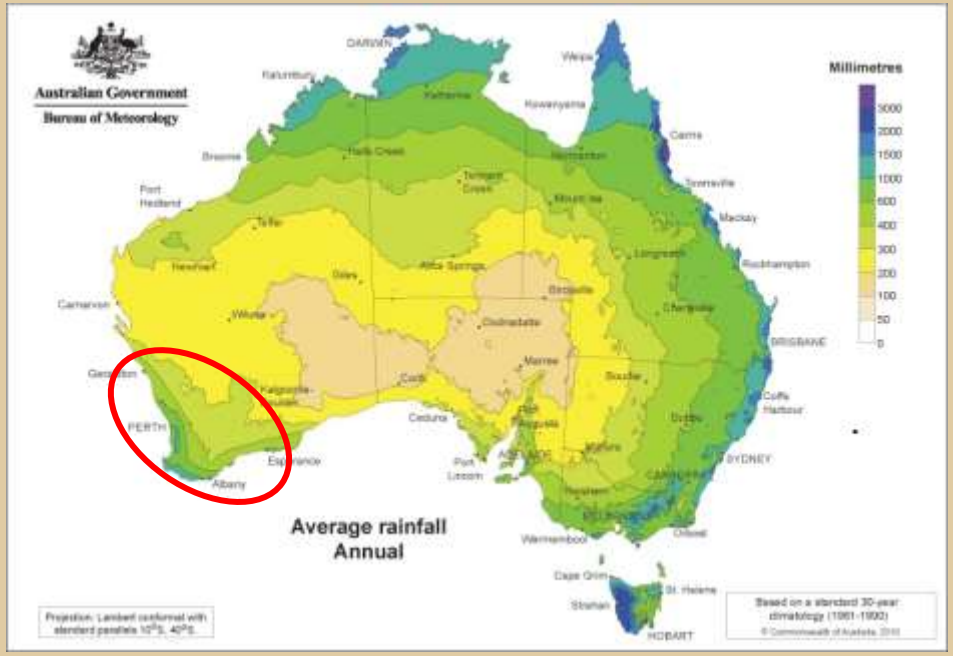
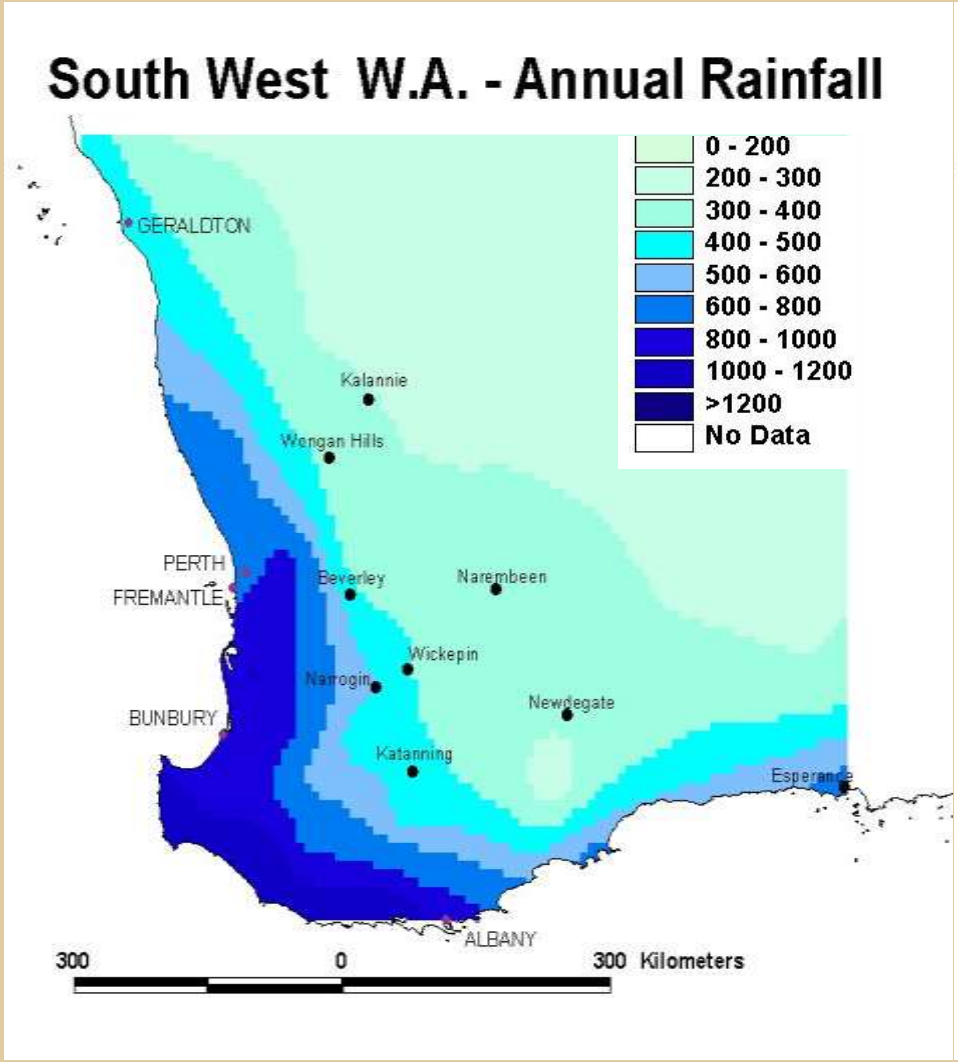
Issues

- Developing biomass production systems
  - Deliver economic biomass &
  - Improve water quality
- The environment of south- west WA
- Dryland salinity: hydrological processes & scale

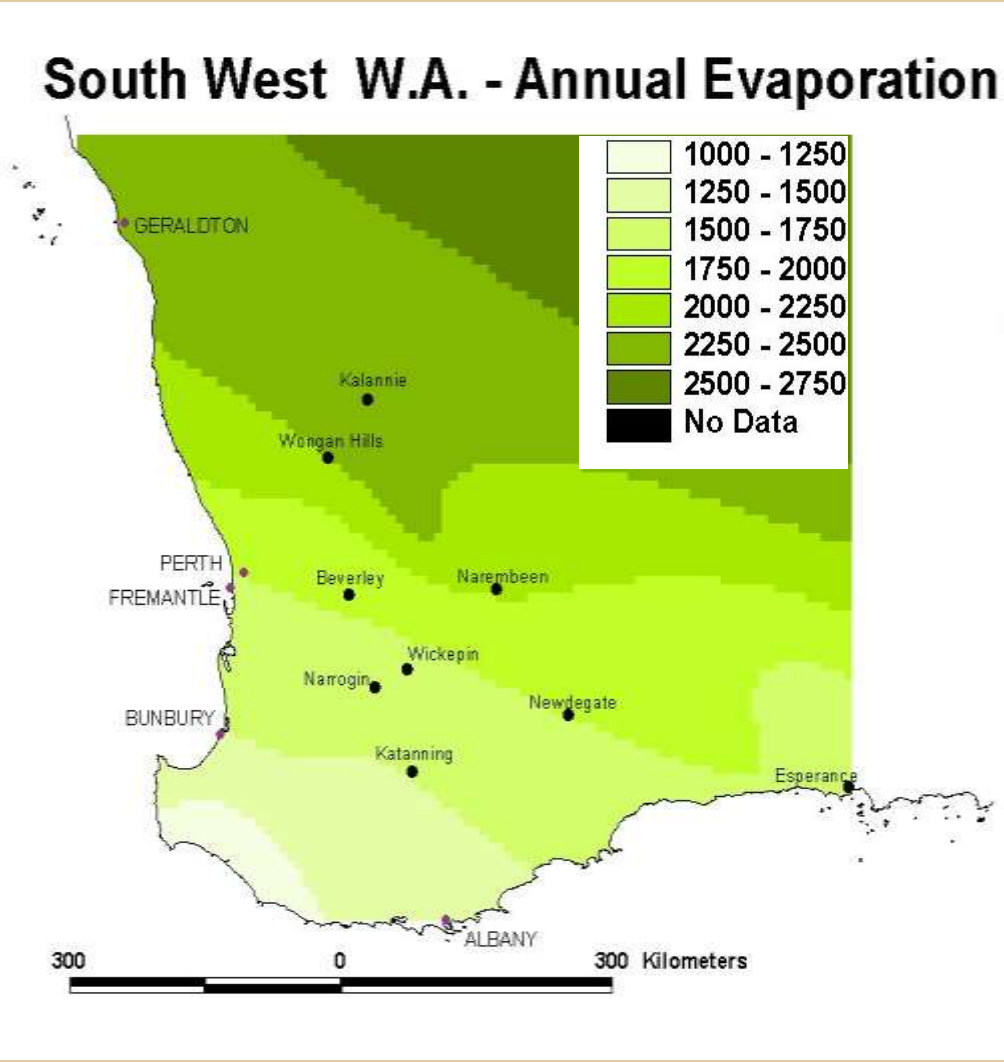


Regional climate variation in southern WA

Rainfall

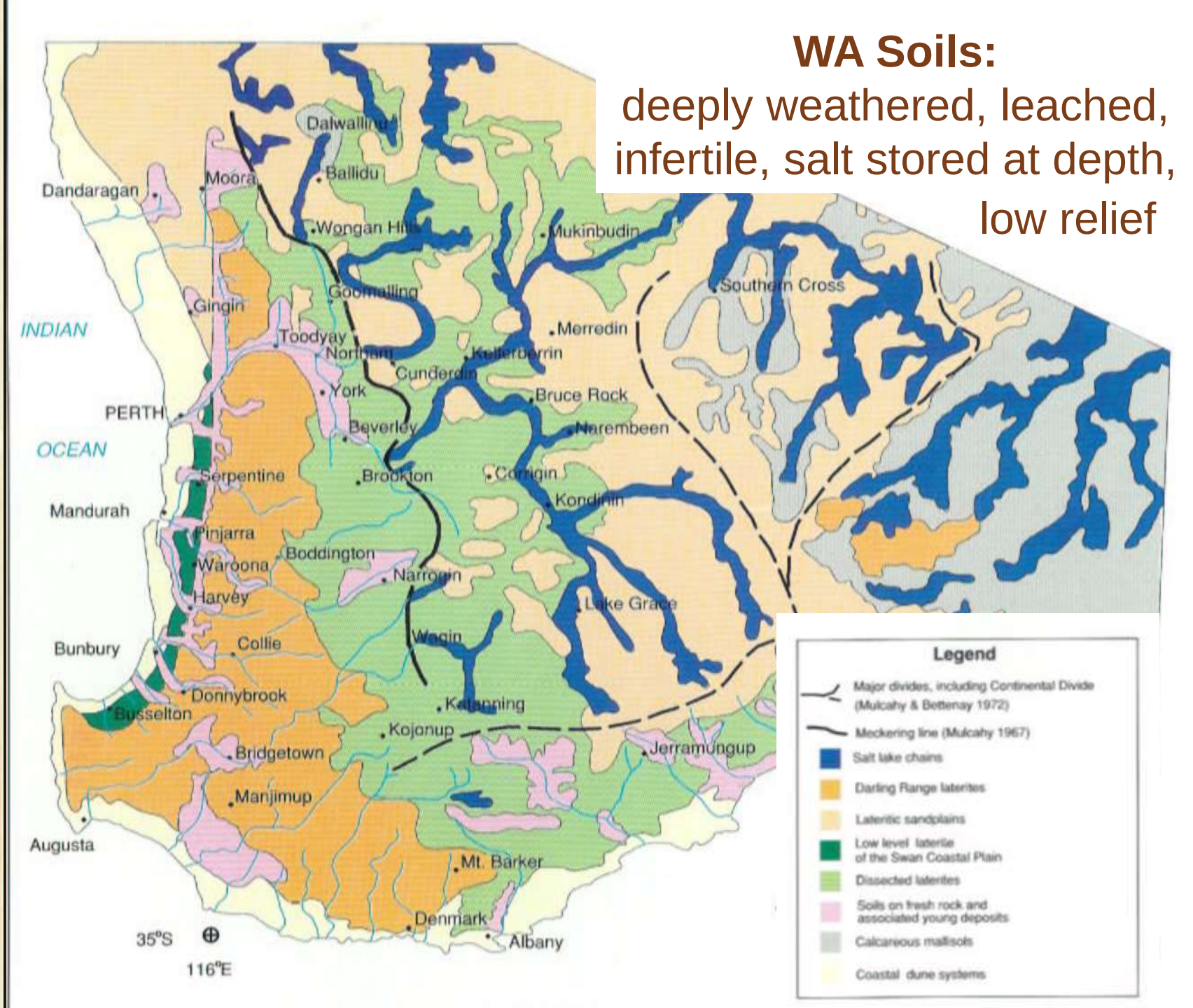


Evaporation



WA Soils:

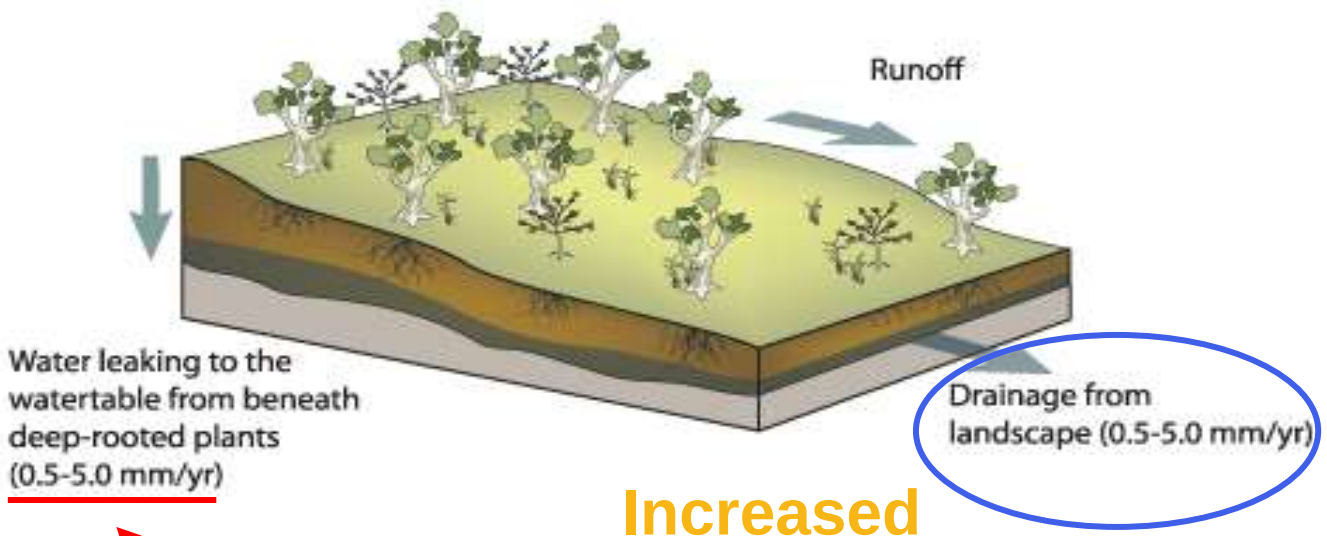
deeply weathered, leached, infertile, salt stored at depth, low relief




Laterite


Sand

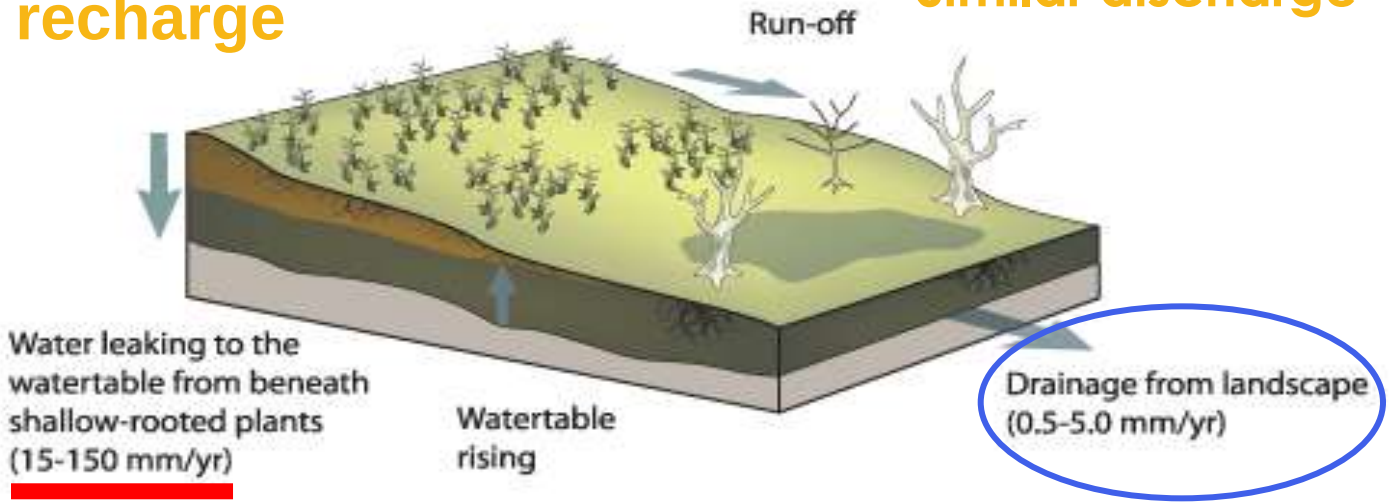
Reduced water use leads to dryland salinity



Natural woodland

Increased recharge

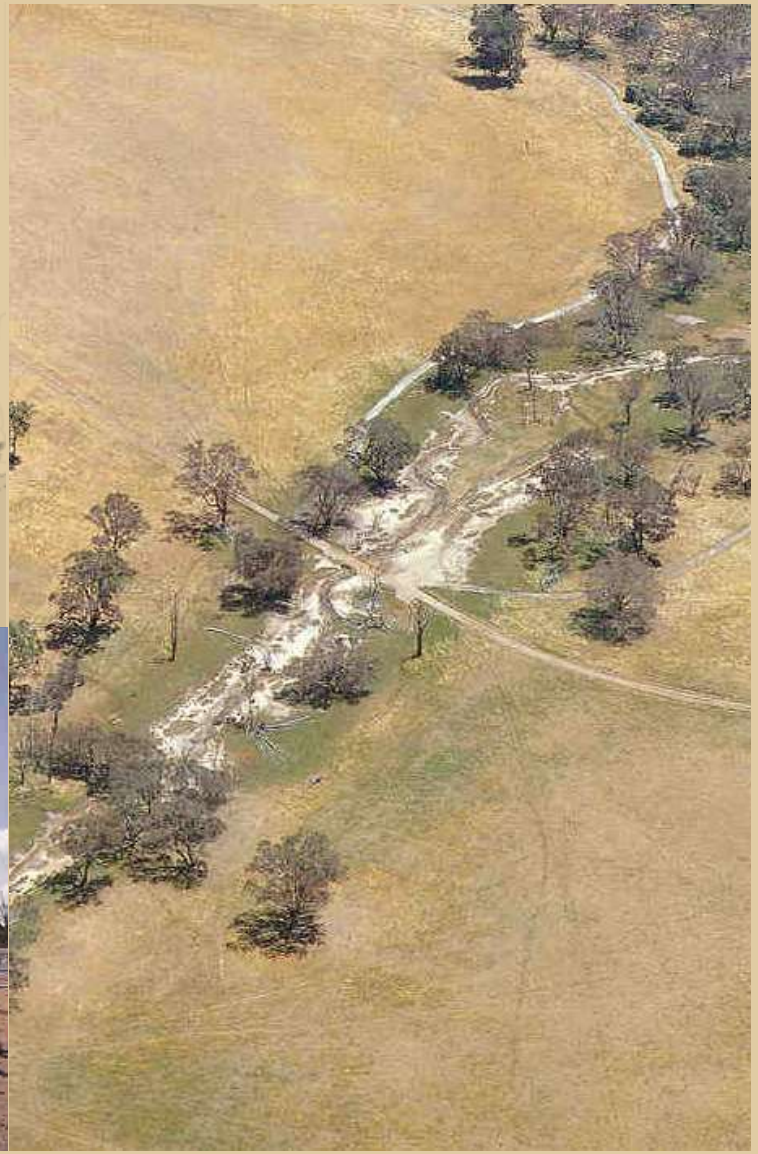
Similar discharge



Annual plants

audit.ea.gov.au/ANRA/land/docs/national/Salinity_Salt_AUS.html

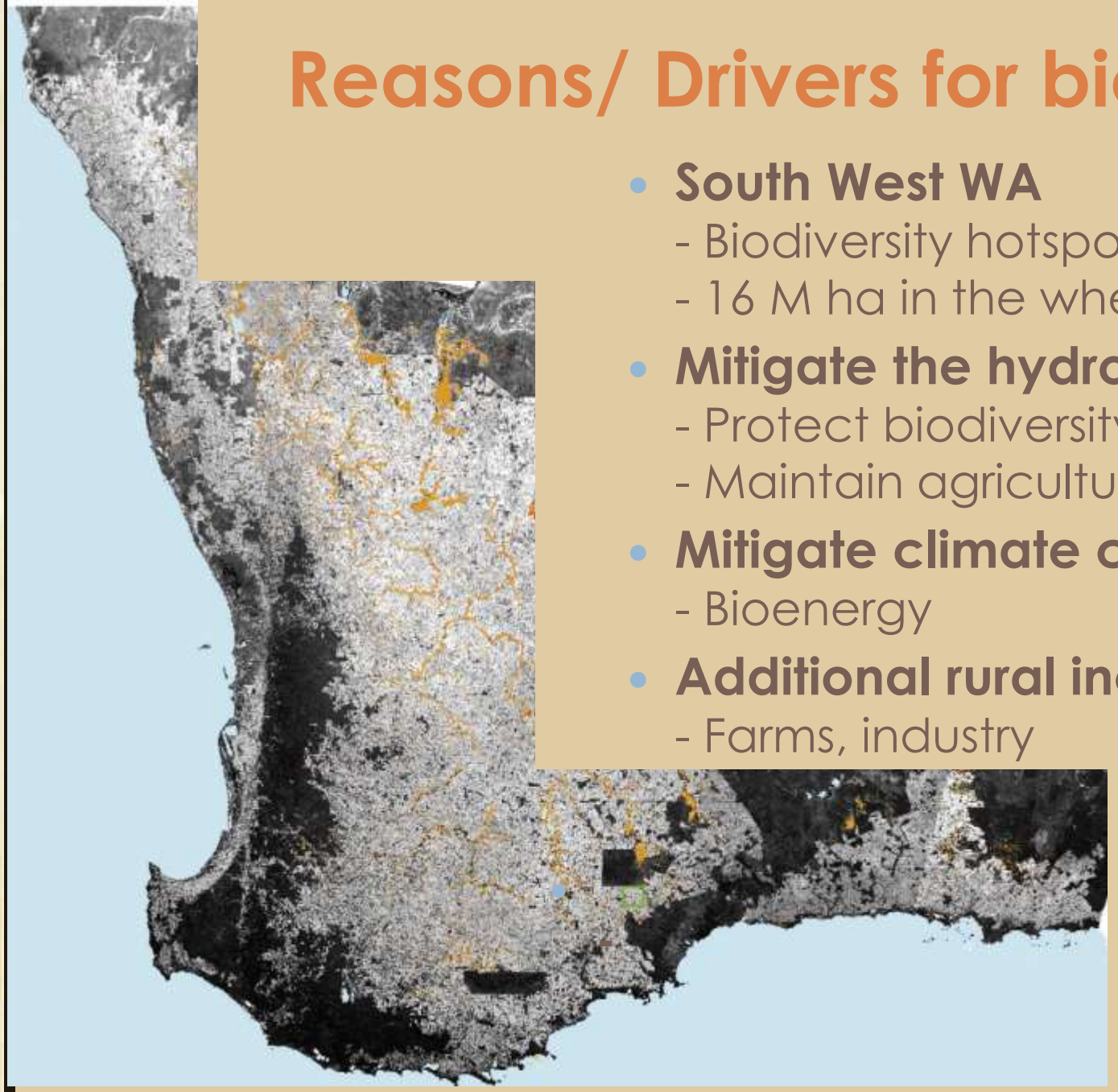
Salinity impacts



Extent of salinization

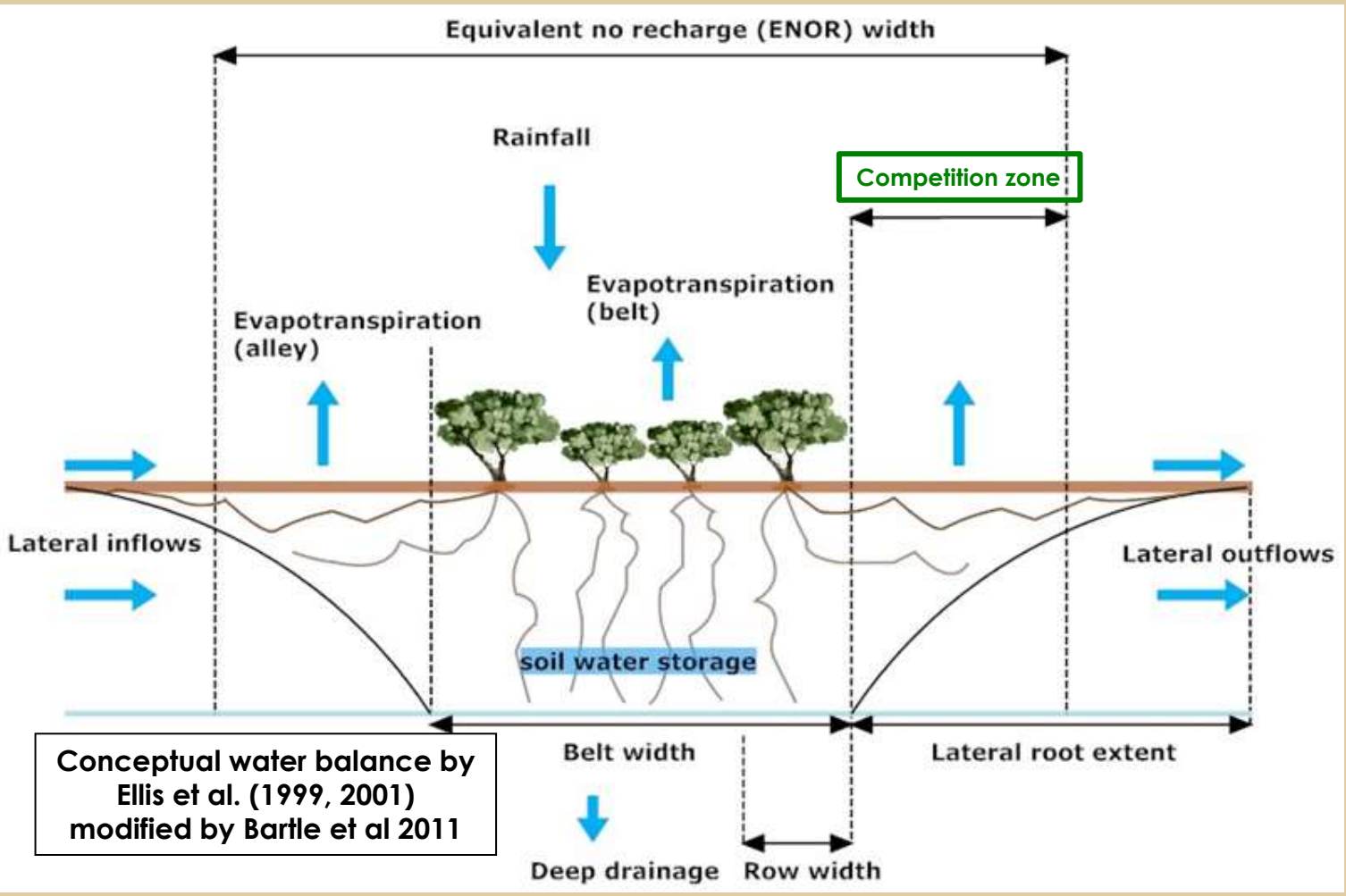
- Currently 1 m ha
- 3.0 – 4.5 M ha predicted
- > 400 species at risk

Reasons/ Drivers for bioenergy programs



- **South West WA**
  - Biodiversity hotspot
  - 16 M ha in the wheatbelt (600-300 mm)
- **Mitigate the hydrologic imbalance**
  - Protect biodiversity
  - Maintain agriculture
- **Mitigate climate change**
  - Bioenergy
- **Additional rural income**
  - Farms, industry

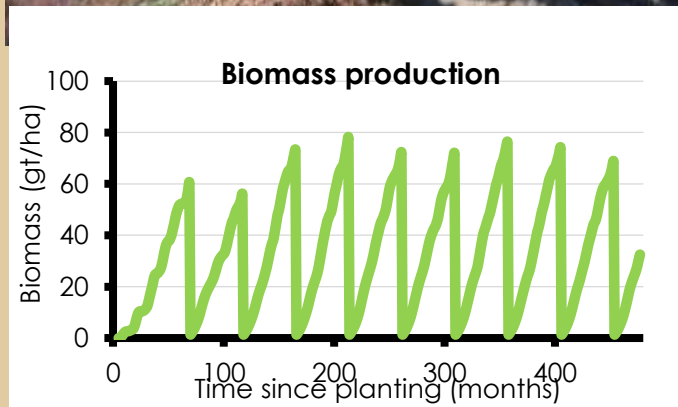
Integrating trees to capture water & maintain production



Conceptual water balance by Ellis et al. (1999, 2001) modified by Bartle et al 2011

Project status (1)
Knowledge

- Extensive R&D (1990 – 2015).
  - Growing & managing mallees
  - Harvest & delivery systems/ supply chain logistics
  - Economic modeling of tree crops in whole farm systems
- Operational practices for large-scale biomass supply can be specified.



Project status (2) Implementation

- Large scale commercial development hasn't eventuated:
  - Current commercial conditions (international/national)
  - Weakening of policy support.
  - Planting stalled since 2007 (13,000 ha)
- Small regional industries - combined heat & power
  - Mallee biomass identified as a prospective feedstock
- WA work on pyrolysis for biofuels (Curtin Uni.)
  - Testing pre-commercial prototypes

Positive impacts on water quality

- **Scale & high cost of salinity**
  - Prioritize valuable and protectable assets,
- **Multiple treatments required**
  - Single actions won't prevent salinization:
  - Combined; wetlands remain fresh
- **Improved aquatic and wetland systems**
  - Natural Diversity Recovery Catchments, Toolibin Lake (RAMSAR wetland), protected by:
  - Diverting saline inflows (early season)
  - Pumping keeps groundwater suppressed
  - Planting integrated trees reduces groundwater recharge

Positive impacts for water availability

- **Low rainfall areas (<600 mm)**
  - Reduced salinity increases farm water availability
- **Higher rainfall areas (>600 mm)**
  - Water supply catchments have marginal salinity (TSS >500 ug g^{-1}) from clearing
  - Revegetation reduces overall water flows, **but increases the supply of potable water**

Key enabling factors

- **Broad recognition of dryland salinity:**
  Rural communities, policy, NRM & water professionals
- **Governments prioritized natural resource management:**
  - 1980-2010 favorable policies & funding
  - Expertise in government agencies
- **Climate change:**
  - Trees provide opportunities for renewable energy
- **Economic analysis demonstrating that:**
  - Farm businesses alone can't fund salinity mitigation
  - Trees provide viable mitigation at the necessary scale

Achieved outcomes

- **Understand the role of trees in salinity control**
  - Multiple perennial systems and engineering required to rebalance hydrology
- **Developed effective mallee production systems.**
  - Systems produce biomass & improve water quality
  - Design criteria for integrating mallee into agriculture,
- **All components of the supply chain investigated**
  - Combined chipper/harvester
    - an operational prototype is under construction
- **Understand prospective biomass processing options and likely early commercial developers**

Main challenges

- **Policy challenges**
  - Maintaining positive policies (salinity, renewable energy and carbon)
  - Multiple policy layers (State and Commonwealth)
- **Technical challenges**
  - Reducing the cost of biomass: (species, productivity, systems)
  - Quantifying competition with crops
  - Developing a biomass supply chain
- **Financial challenges**
  - Variable environment funding (policy changes)
  - Uncertainty for farmers and environmental programs
  - Competition: solar and wind
  - Decline in oil prices

BILATERAL AGREEMENT BETWEEN

THE COMMONWEALTH OF AUSTRALIA

AND

THE STATE OF WESTERN AUSTRALIA

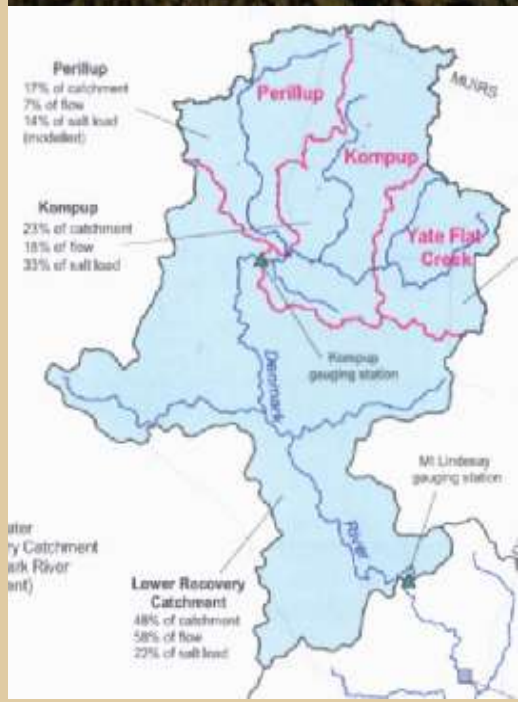
FOR THE IMPLEMENTATION OF

THE INTERGOVERNMENTAL AGREEMENT ON A NATIONAL ACTION PLAN FOR SALINITY AND WATER QUALITY

Potential for scaling-up & replicability

- **Salinity requires large scale response**
  - Existing mallees ~13,000 ha
  - Potential Woody biomass - WA wheat belt: ~1.5 - 2 M ha; ~10 M tonnes dry biomass/year
  - Use of cropping residues? - several million tonnes of biomass
- **Adoption across Australia's cropping regions**
  - Multiply the potential resource 3-5 fold
- **Reduce salinity in WA water supply catchments**
  - Land clearing increased salinity (same process)
  - Integrated systems may be applicable ~100,000 ha, 100 – 200 Gl water with lower salinity


Image:C.Winfield, DPaW



Summary

- Dryland salinity is extensive across southern Australia
- Understand hydrological processes
- Large scale and cost of mitigation mean multiple actions required
- High water use systems are an important component of salinity mitigation
- Effective biomass production systems developed
- Current political and economic uncertainties have restricted expansion

Woodline train 1940

1200 tonnes per day

Eucalypts for bioenergy

Goldfields ‘Woodlines’ 1900 -1965

- Primary energy source 1900 -1945
- 3 M ha of woodlands harvested
- ~30M tonnes of wood

Kalgoorlie mines firewood & mining timber 1935

Acknowledgements

- Commonwealth and WA State governments
- Department of Environment and Conservation(DEC)/ Department of Parks and Wildlife
- Department of Agriculture WA
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