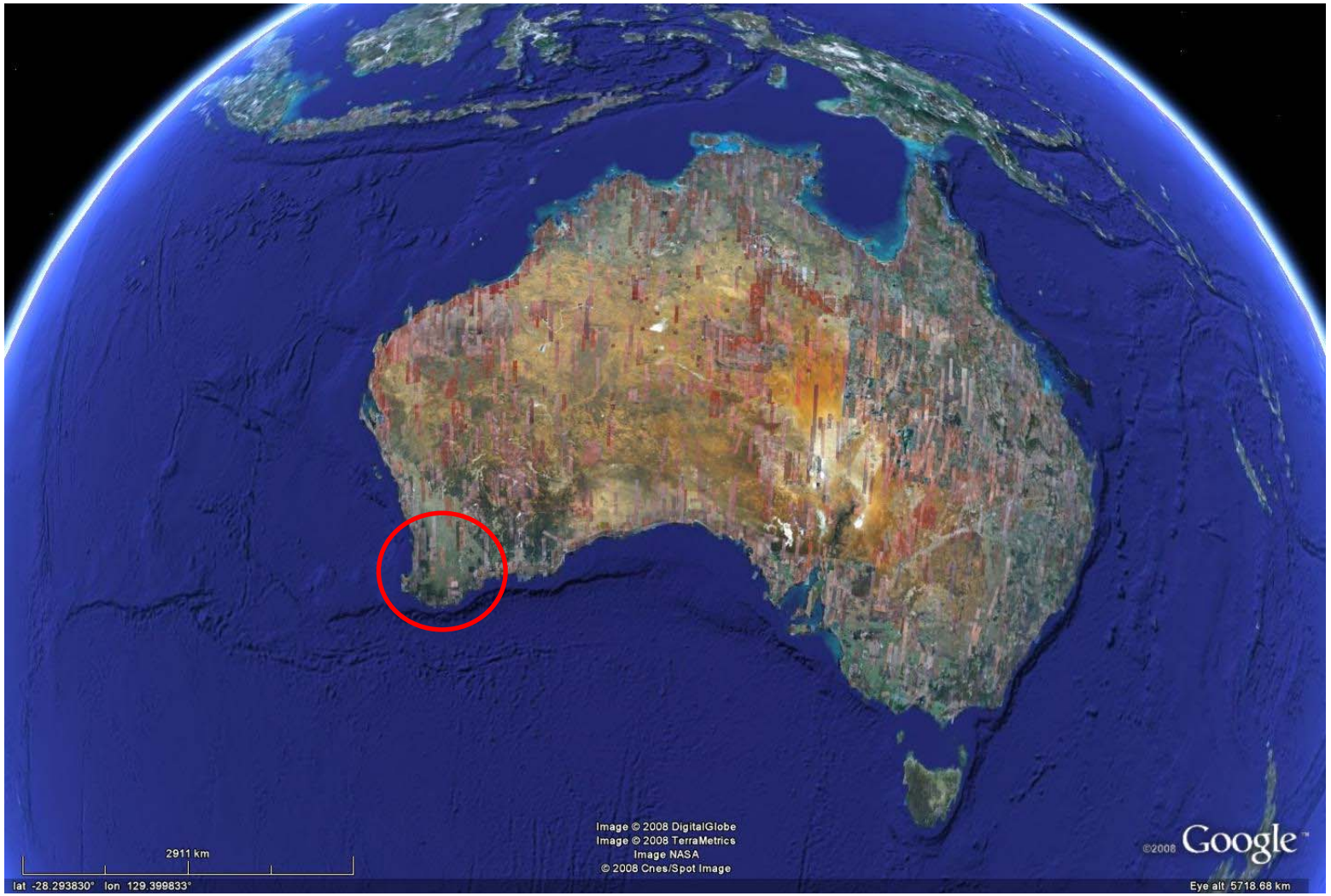
Flux Towers in Coastal Heath, Gnangara, WA

Richard Silberstein, Craig Macfarlane, Tom Van Niel, Chris Johnstone, *et al.*

Barbara Wilson (DEC), Dept Water, etc

National Research FLAGSHIPS

CSIRO



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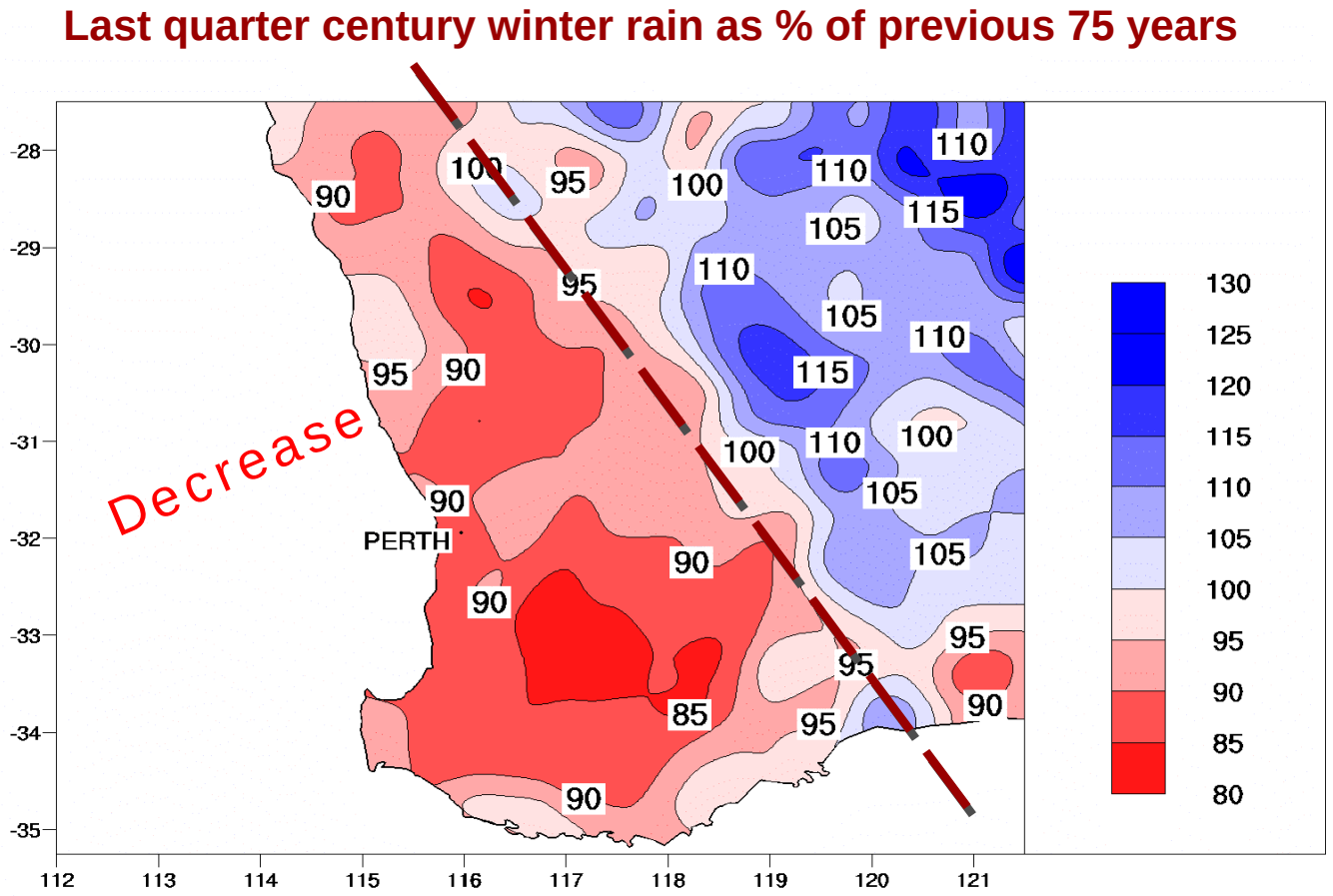
Local issues
- declining rainfall

- Major reduction in rainfall over extensive areas of the south-west



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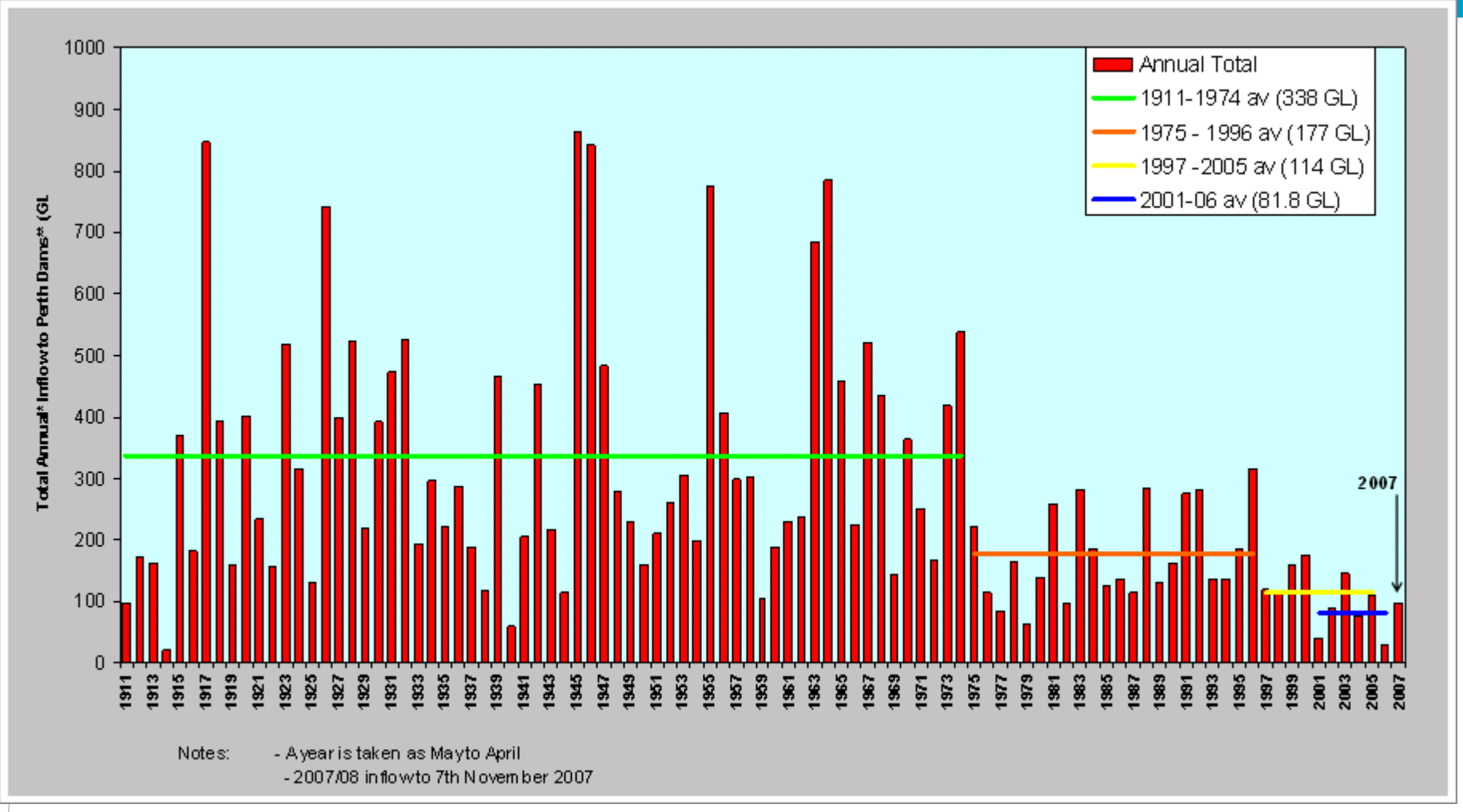
Climate change on streams
- less flow in streams and hence to dams



Data from Water Corporation

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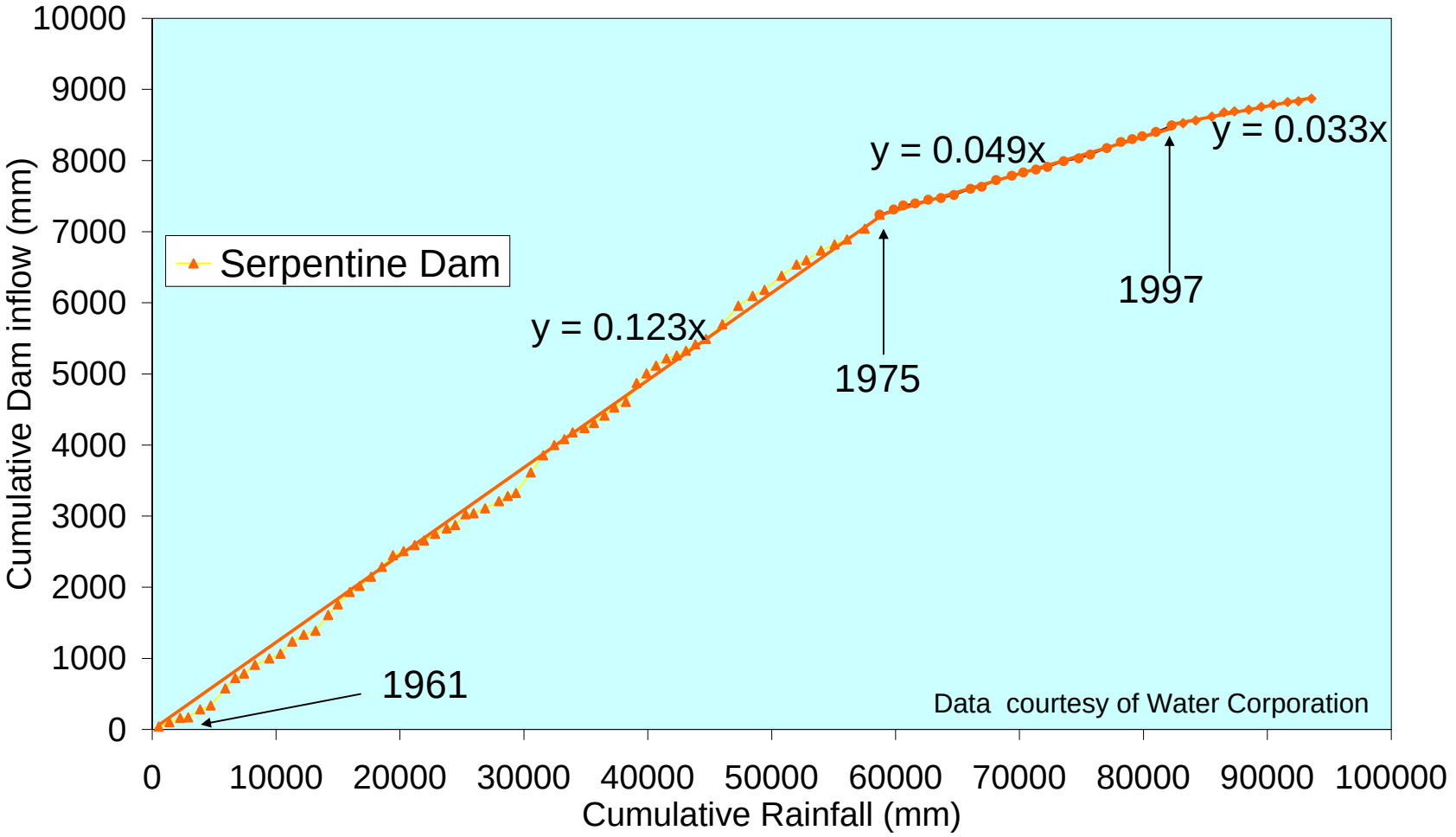
Proportion of Rainfall in stream flows has changed in the last 30 years



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Local Issues

- Drying climate is reducing stream flows to dams
- Drying forest soils, reducing stream flow periods, threatening aquatic ecosystems
- Changing forest structure – thinning or thickening?
- Changing evaporation-transpiration balance
- Declining surface water has moved dependence to groundwater and now seawater desalination

Local Issues

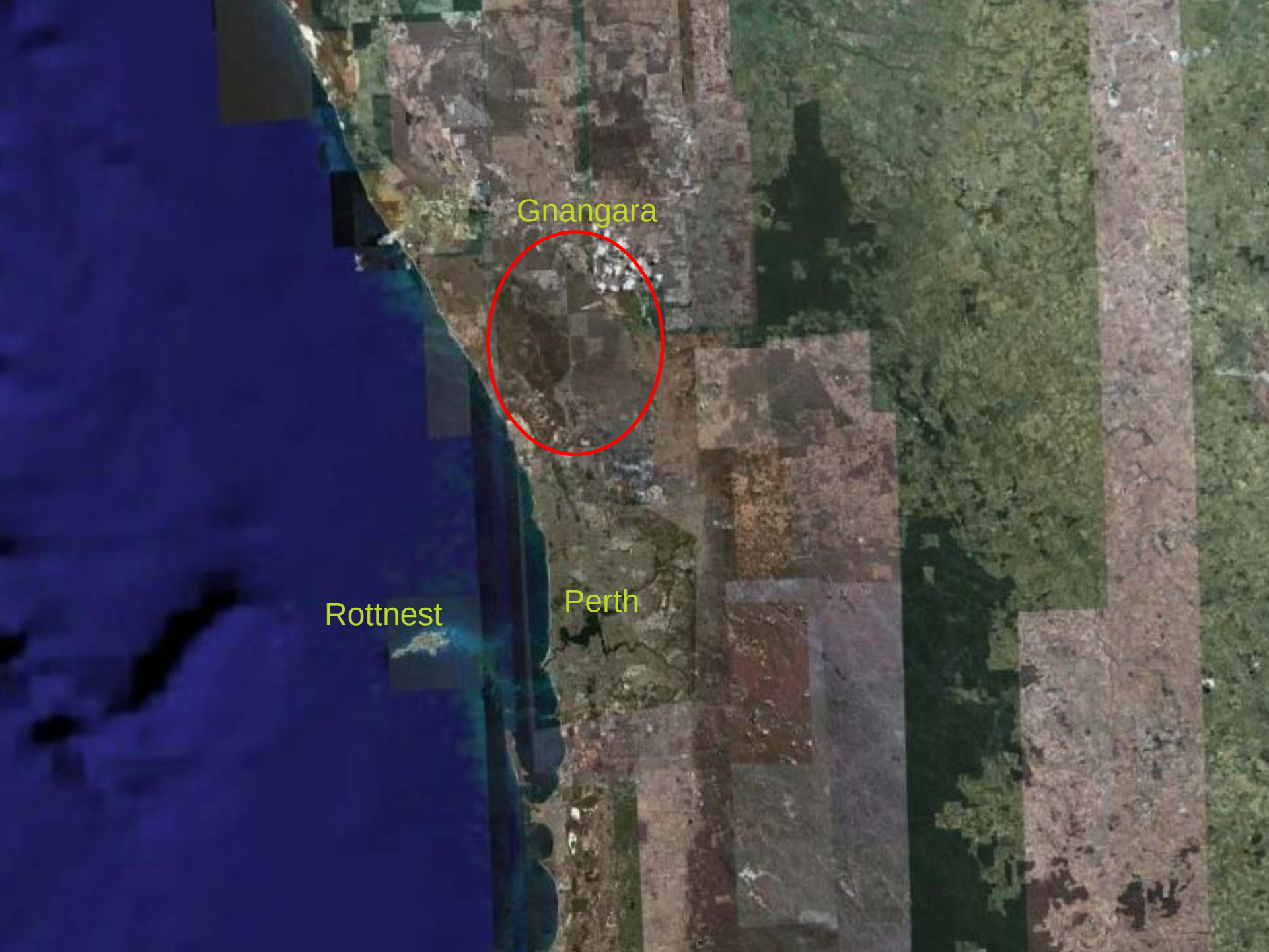
- Coastal sandplain woodland is the major cover on the recharge area for Australia's most important water resource
- South-west WA is international Biodiversity "hotpot"
- Internationally significant wetlands under threat from warming and drying climate, and increased water demand.
- Long-term groundwater monitoring shows decline in aquifer storage at 50GL/yr ~ $1b NPV based on next available water source (sea-water desalination)

Local Opportunity

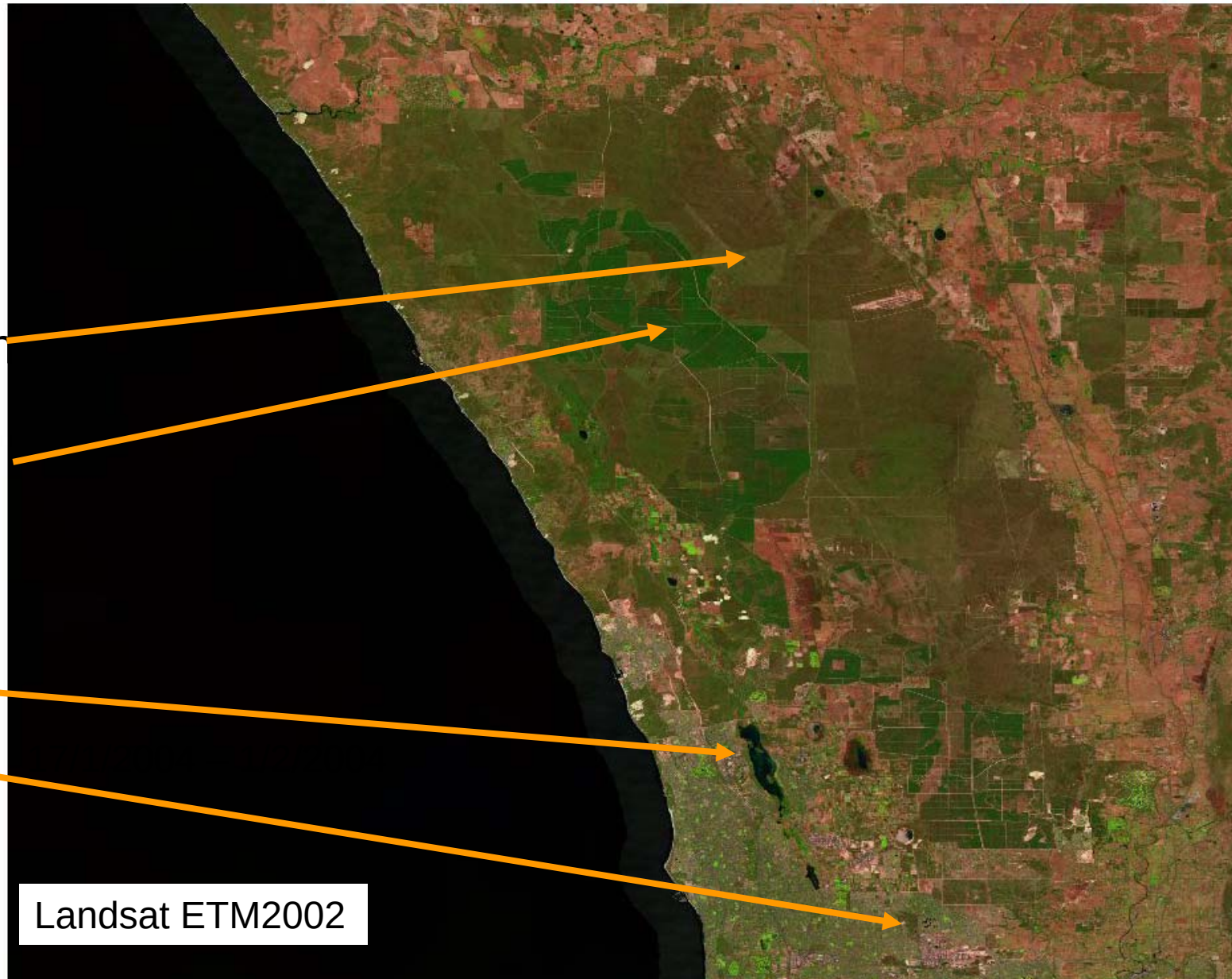
- Major program ($7M) by WA State Government to determine sustainable management of the Gnangara groundwater mound.
- Infrastructure builds on research on recharge following fire
- Instrumentation to monitor ecosystem change as well as physical and chemical fluxes
- Provide a basis for development of new landscape monitoring techniques with satellite and airborne imagery by providing comprehensive ground-based measurement to test new theories and models for vegetation monitoring.
- Local long-term ecosystem and floristic surveys over 30 years
- These data will assist development of spatial and temporal models of ecosystem response to climate, fire, etc

Outputs

- Water flux – recharge, sap flow and evaporation
- Carbon flux
- Ecosystem function
- Water flux, carbon flux and ecosystem response to fire


Gnangara
Rottnest
Perth

Gnangara Mound



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Water balance of Gnangara Mound

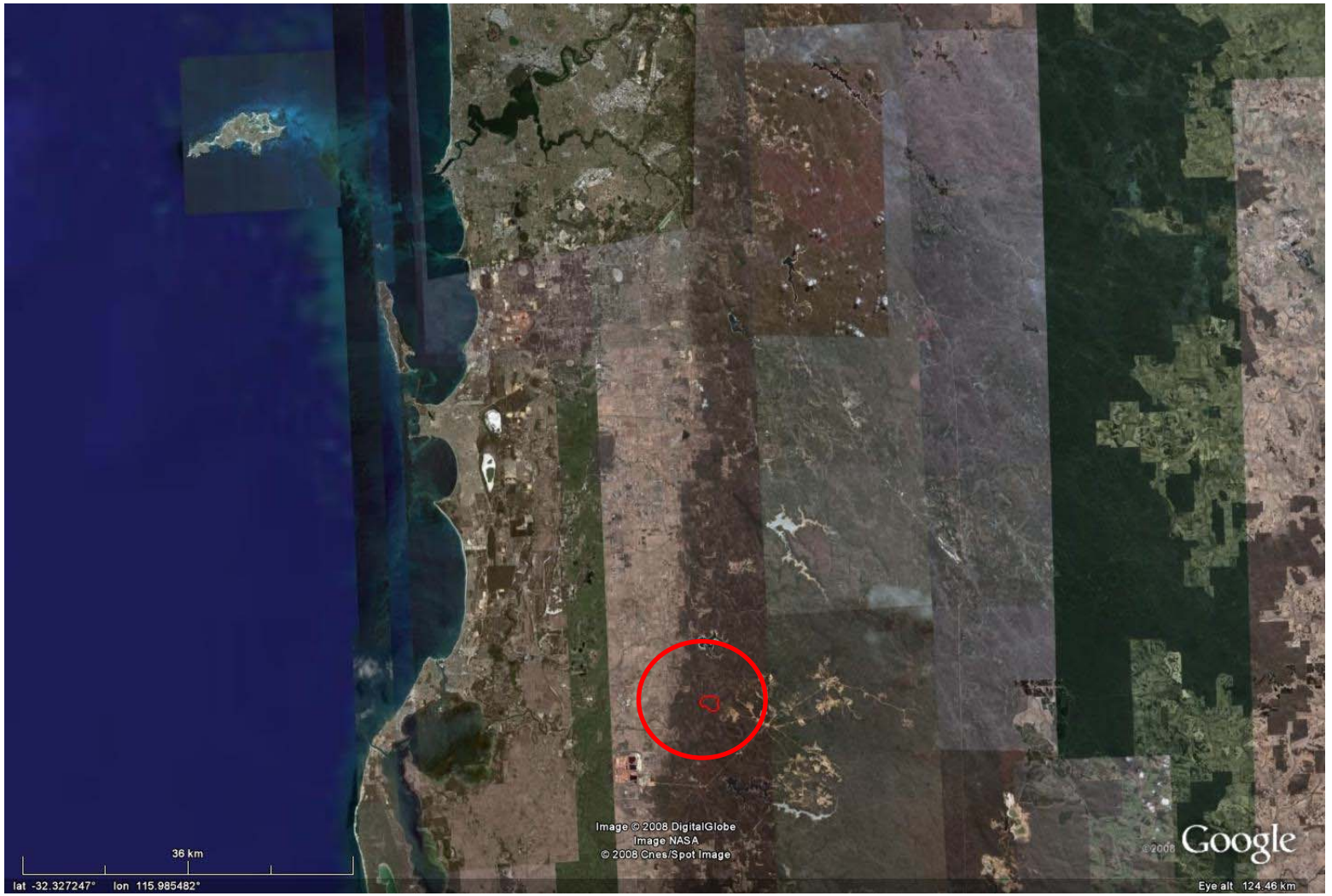
	Area (km^2)	mm	GL/yr
Input rainfall	2194	750	1646
Land use	Evaporative Water Use		
Native Bush	1048	600	629
Pasture	540	400	216
Parks & hort.	14	600	8
Pines	225	850	200
Urban resid.	309	0	0
Urban comm.	48	0	0
Wetlands	12	800	10
Total Evap	2194	500	1094

Extractions GL/yr	License	Est. net
Water Corp	149	149
Irrigated hort.	92	46
Industrial	46	46
Parks	46	23
Total lic. self extraction	185	115
Garden bores		50
Ocean discharge		
Drains		120
Superficial aquifer		183
Total extractions		617
Total discharge		1712

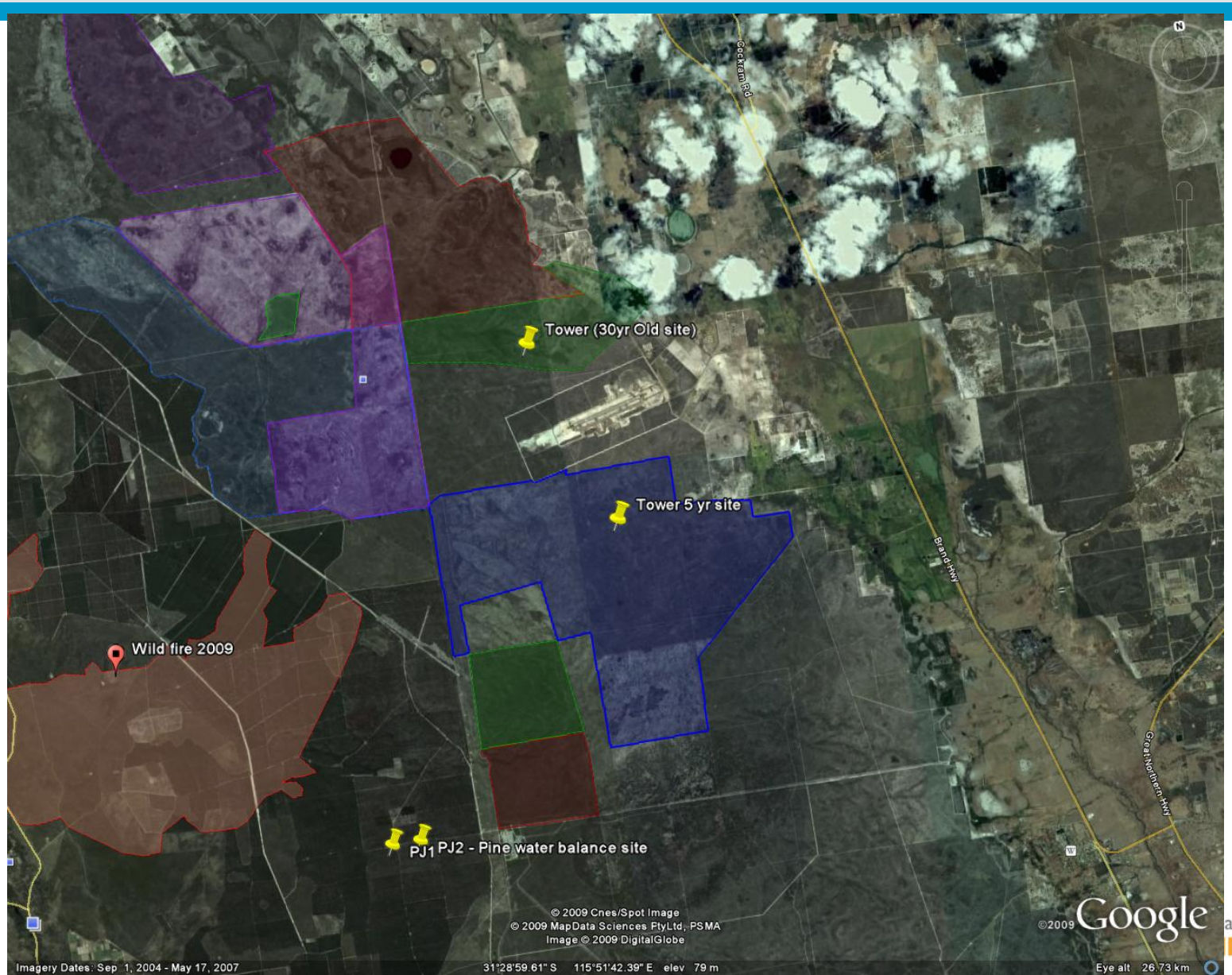
Gnangara Banksia woodland

- Approx 7m canopy
- LAI ~ 0.8
- Rainfall ~ 750mm
- Recharge ~ 150mm and falling
- Average fuel age 10yrs

Possible future tower site in undisturbed jarrah forest



Two flux towers on Gnangara Mound



Summary

- Two Towers - (1 TERN, 1 CSIRO)
- CRC Post-doc (proposed)

- Instrumentation:
- Eddy fluxes – H_2O, CO_2, momentum
- Energy, G, surface radiative Temp, multispectral reflectance
- Air temp and humidity above and below EC
- Soil moisture and T, groundwater
- Animal tracking
- Groundwater geophysics – soil moisture tomography
- Broadband radiometer (NDVI) and IR thermometer (canopy temperature) to assist remote sensing of latent heat flux

Finally – a possible opportunity

- Likely CSIRO capital expenditure (CAPEX) grant to fund a network of cosmic ray sensors
- Measure soil water content
- Uses neutrons that are produced near ground level by energetic secondary cosmic rays
- Footprint is supposedly tens of hectares
- Any body interested in hosting a cosmic ray sensor?

- Contact Albert van Dijk
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Thank you

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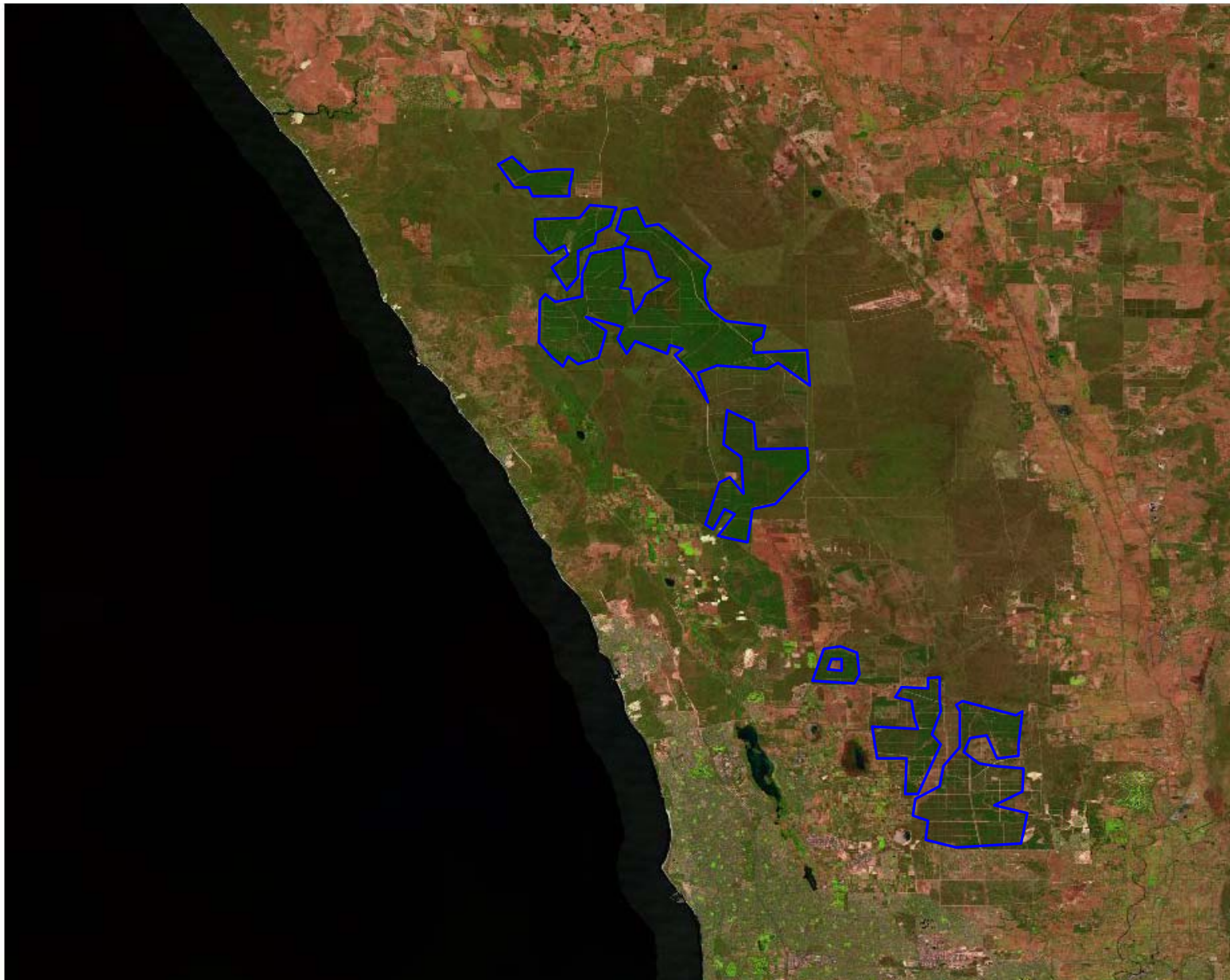
Sap flow, soil moisture, watertable monitoring

Gnangara Mound - Pine plantations
Satellite observation of surface temperature



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Gnangara Mound
Satellite observation of surface temperature