Department of Primary Industries and Regional Development

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Distribution and variability of sandy soils in Western Australia

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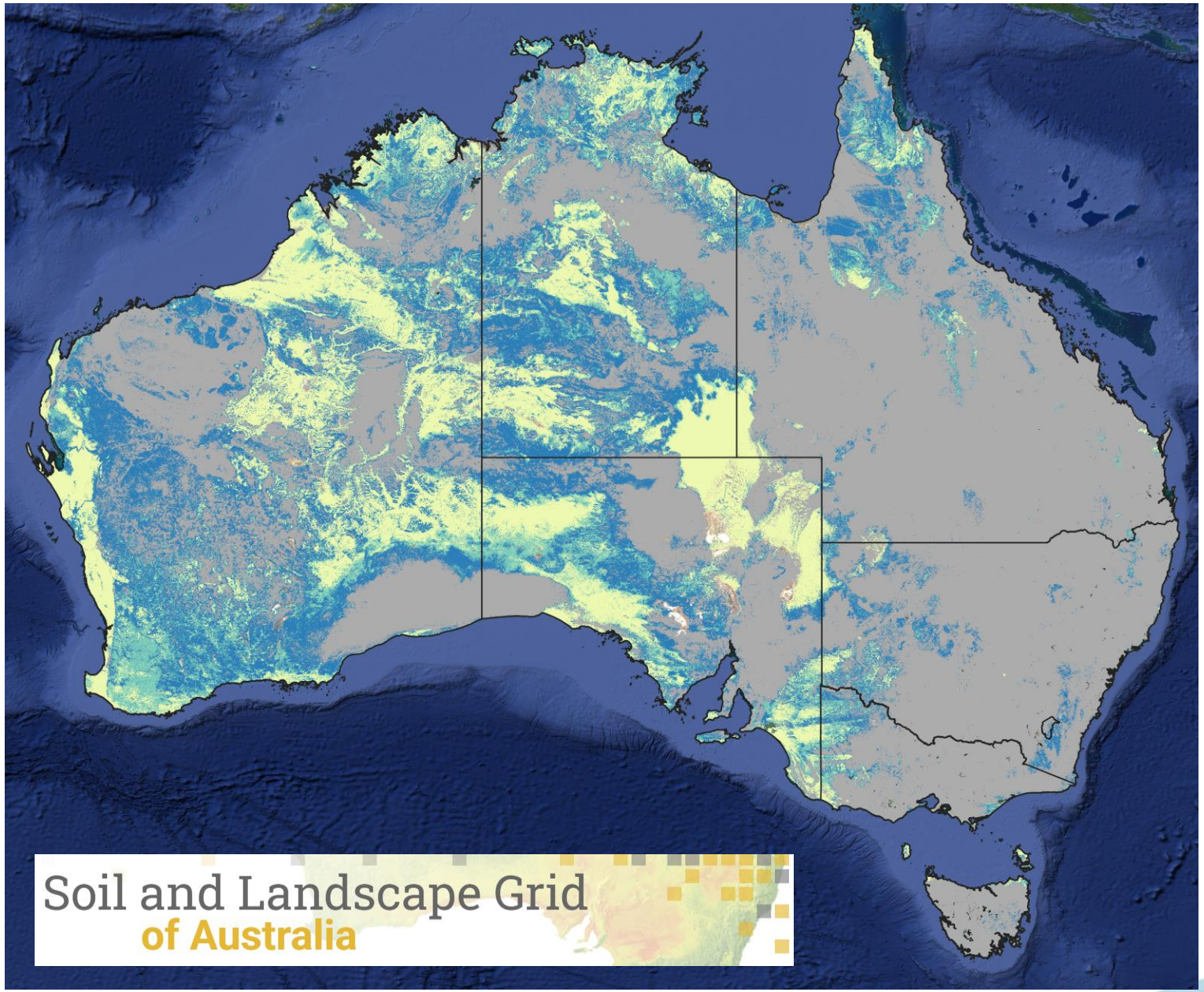
^retired

Data Modelling & Analysis / Soil Science
Ag Resource Management and Assessment
Soil and Land Conservation

Big picture distribution of sandy soils

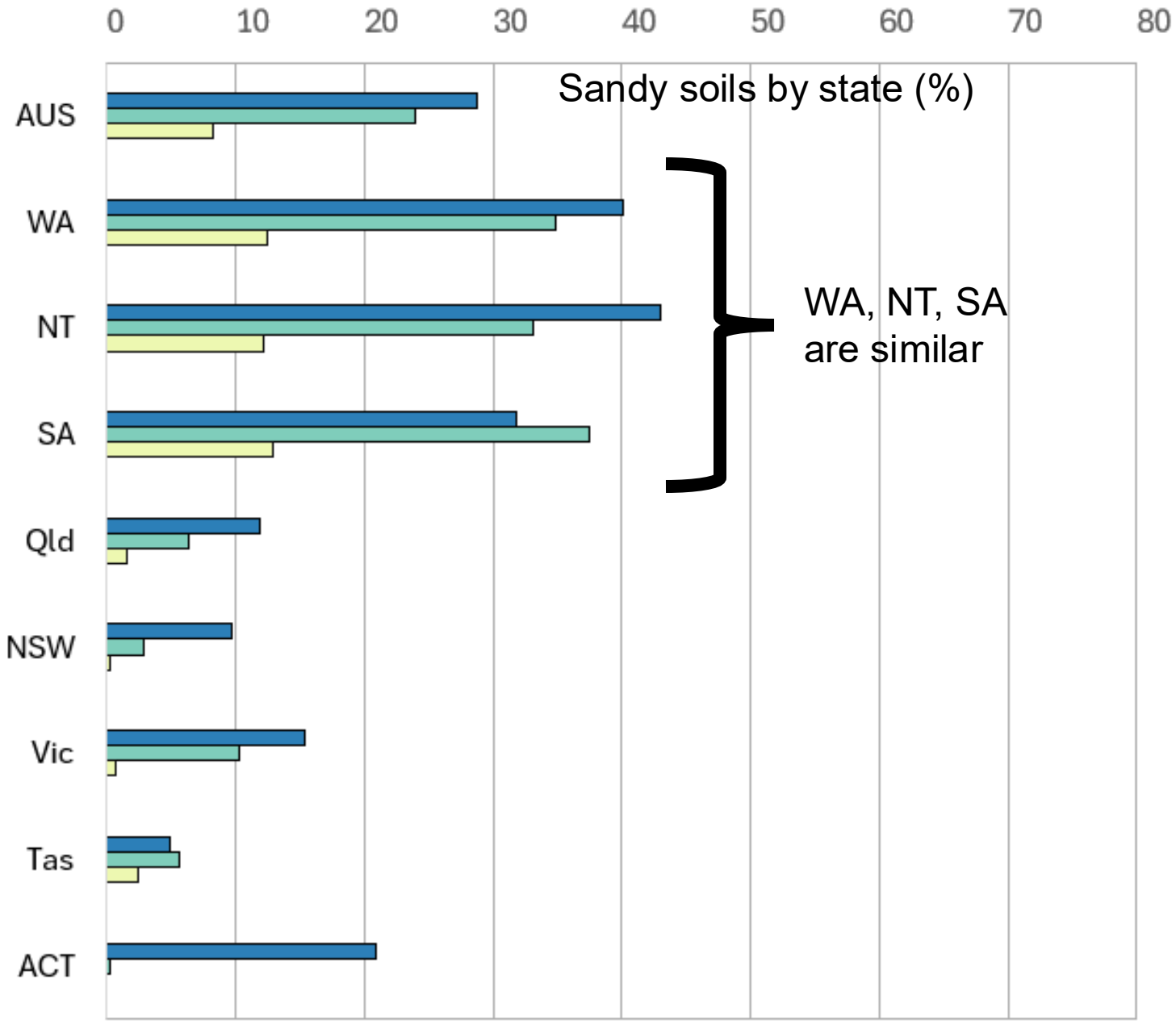


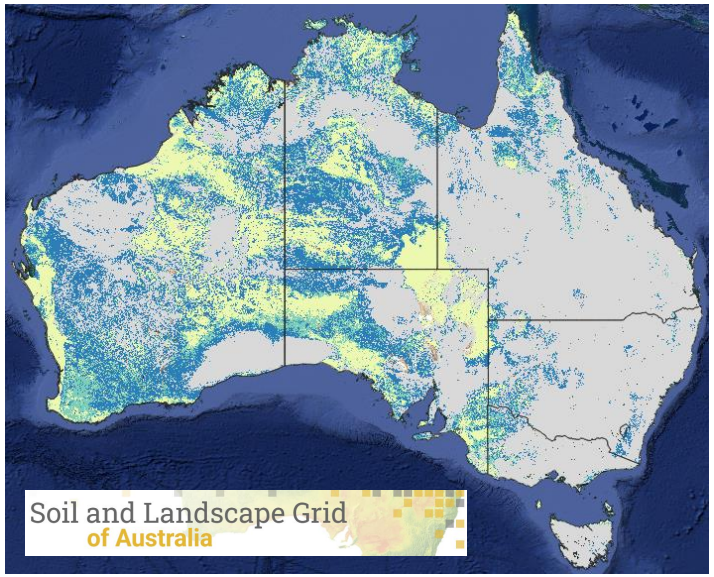
- Not sandy
- Sandy surface: 0 – 30cm
- Sandy subsurface: to 30 – 100
- Deep sand: sandy to 100cm +

Sandy (< 12% clay) from the surface (0 cm) to various depths. National model.

Malone & Searle, 2022: https://researchdata.edu.au/soil-landscape-grid-release-2/3305015?source=suggested_datasets

Big picture distribution of sandy soils





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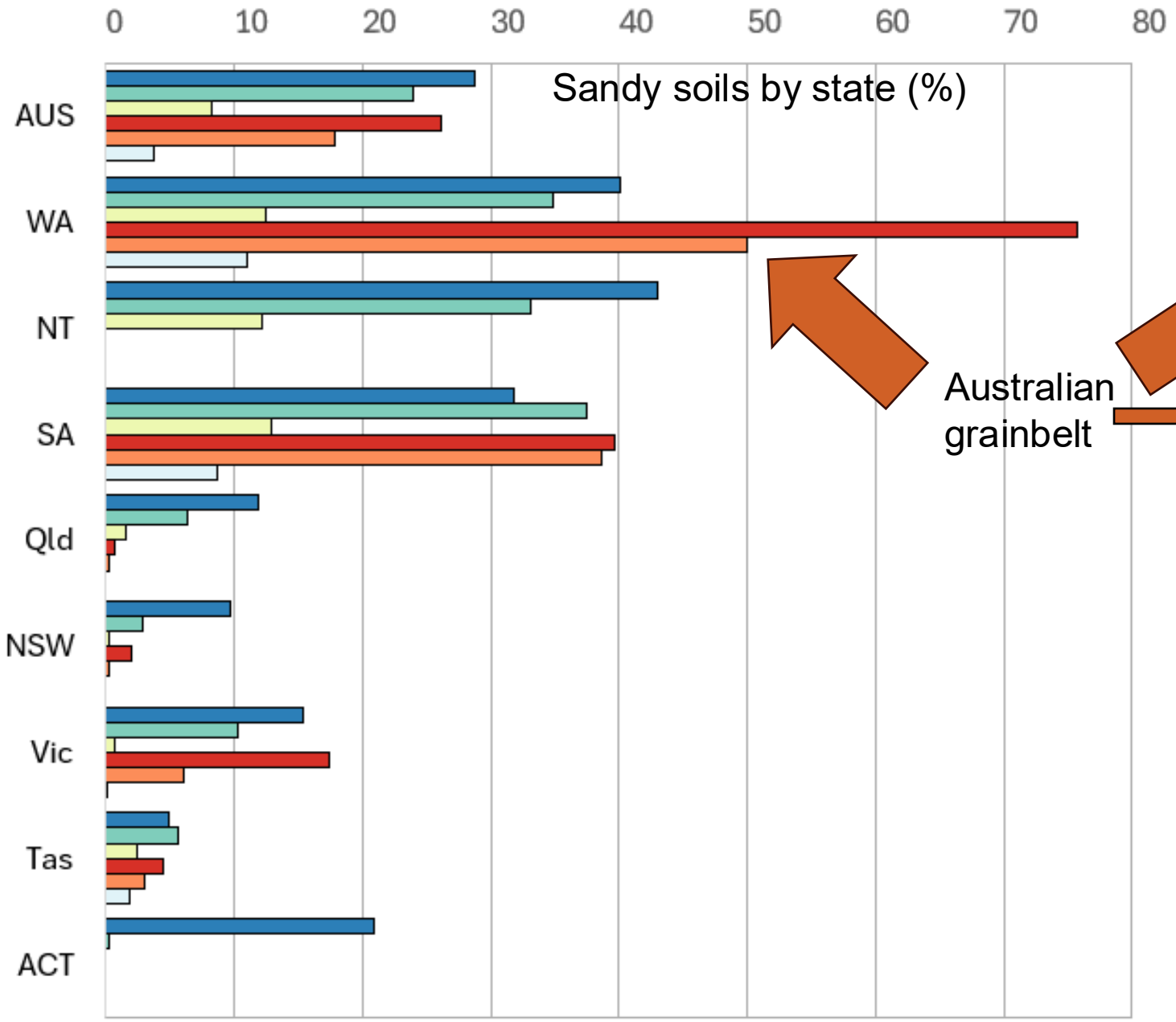
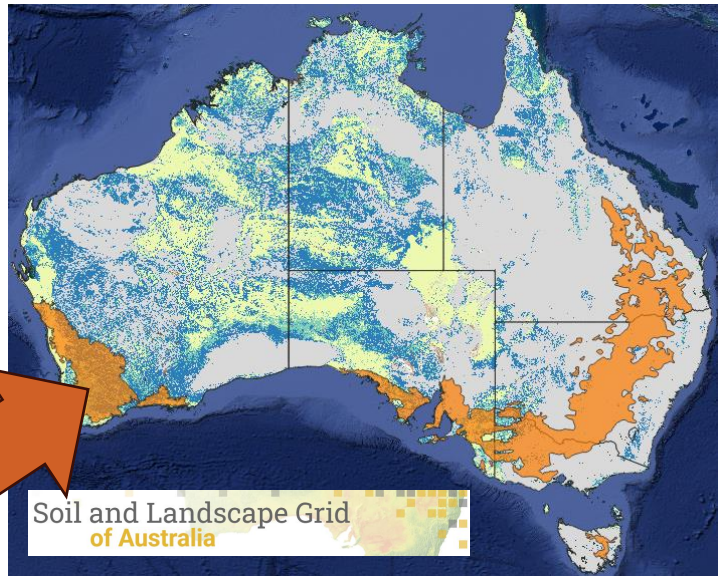


Australian grainbelt



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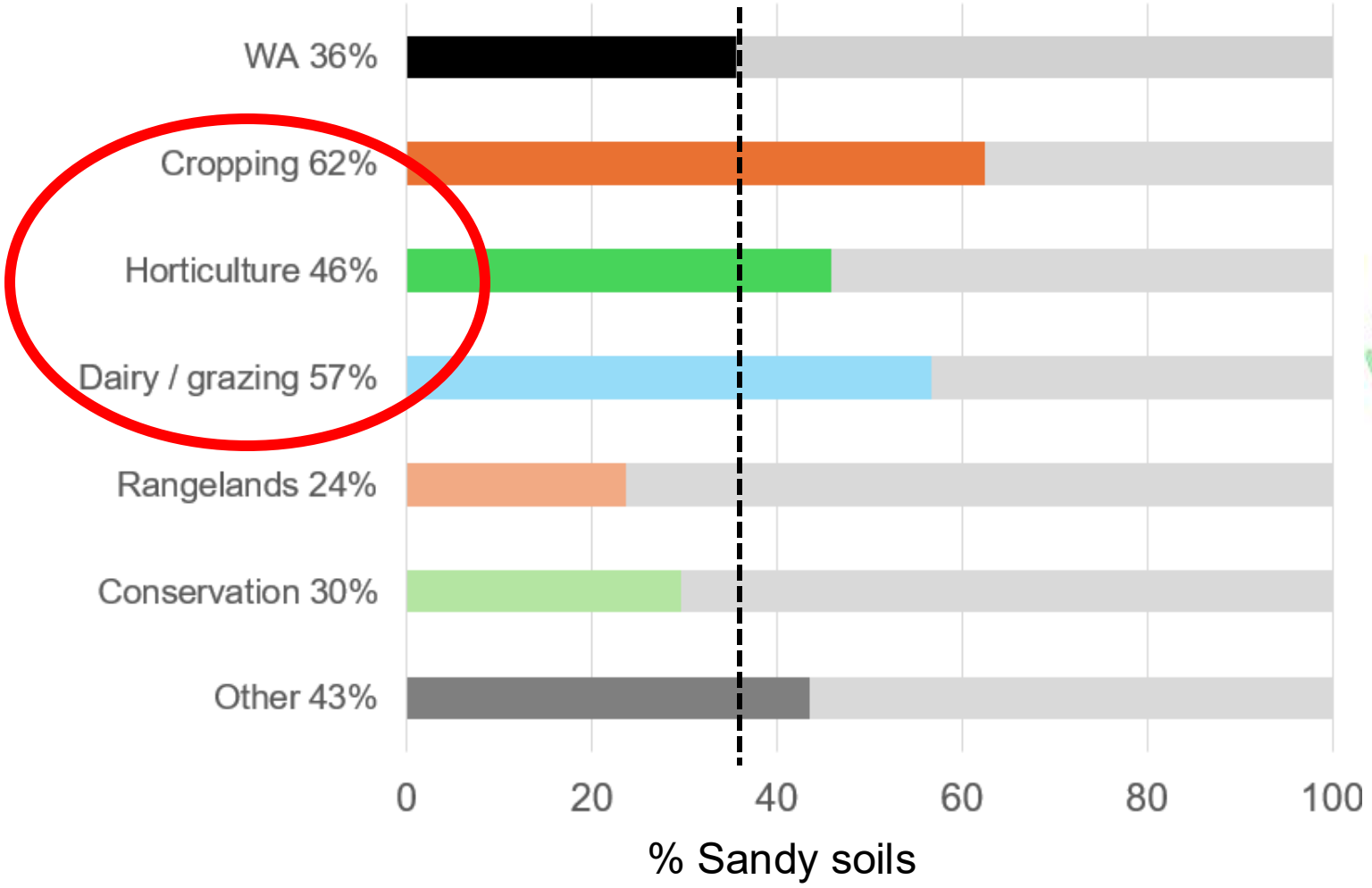
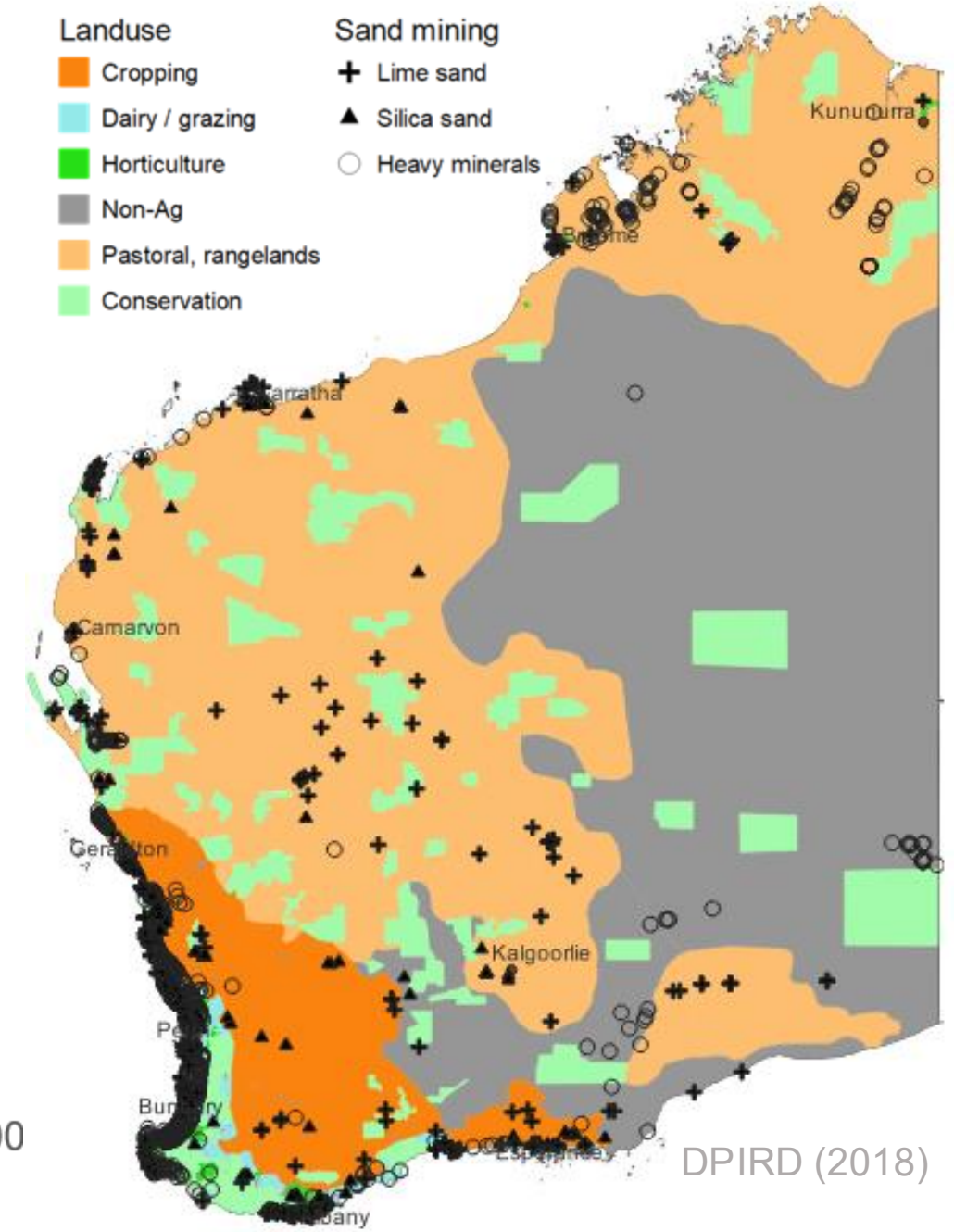
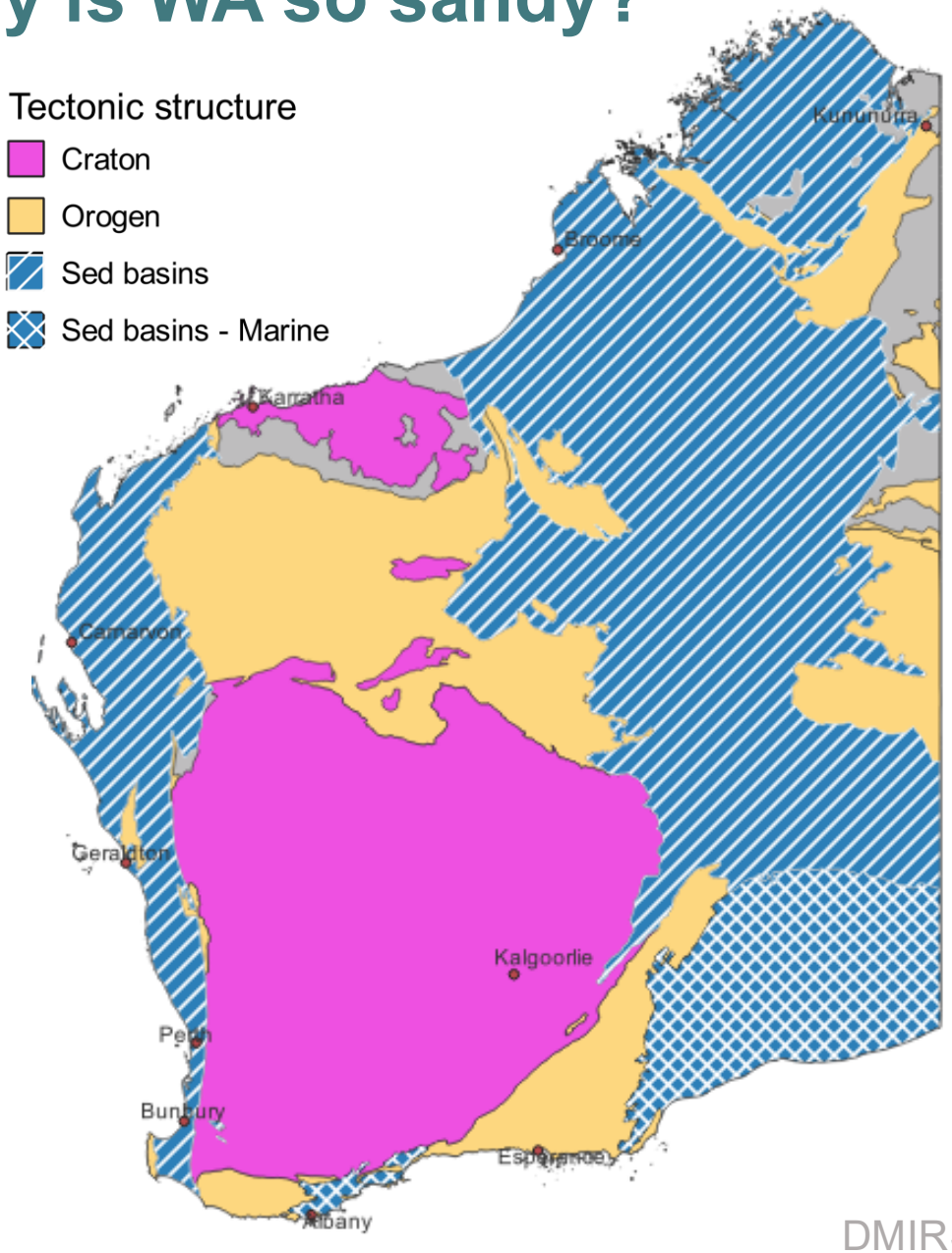
Sandy soils in relation to landuse in WA



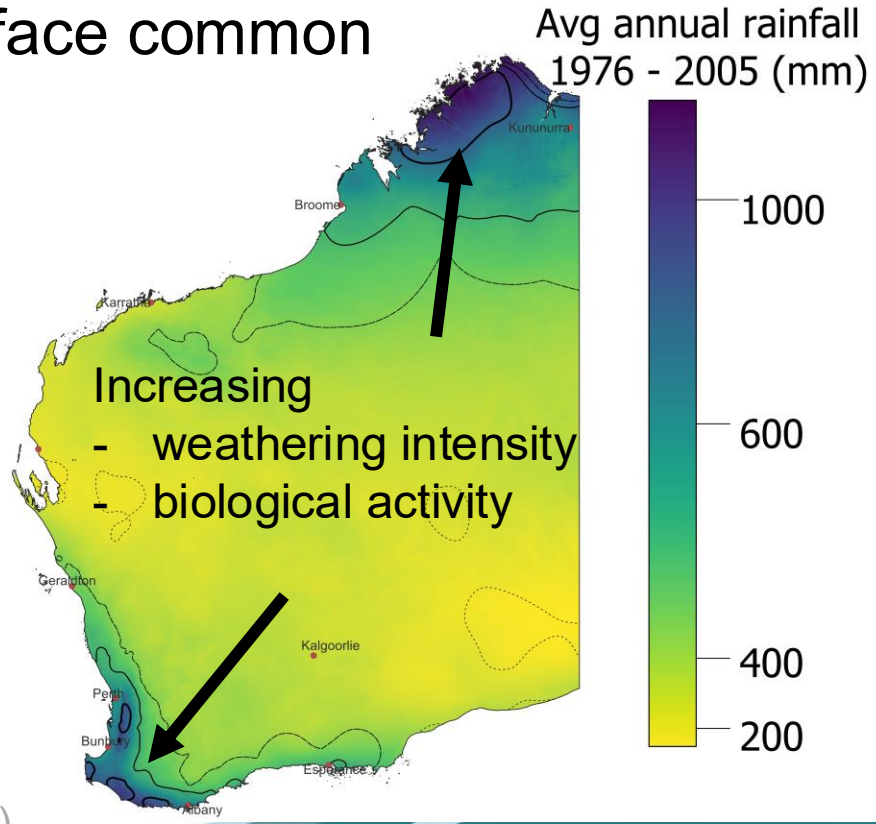


DPIRD (2018)

Why is WA so sandy?



- Quartz-rich cratonic terranes
- Deeply weathered materials
- Multiple weathering cycles
- Large sedimentary basins
- Sandy surface common



DMIRS (2023), Harwood (2019)

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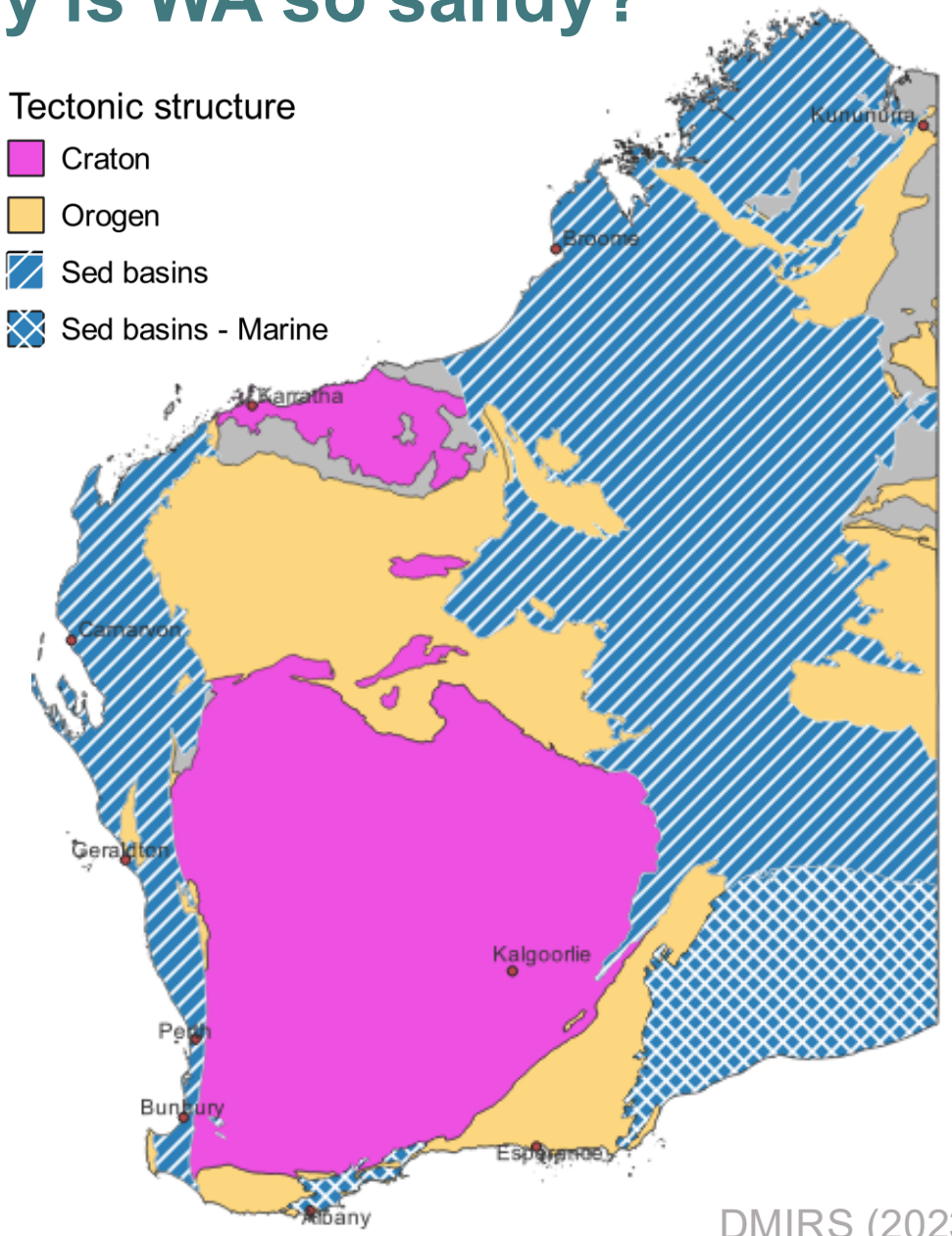
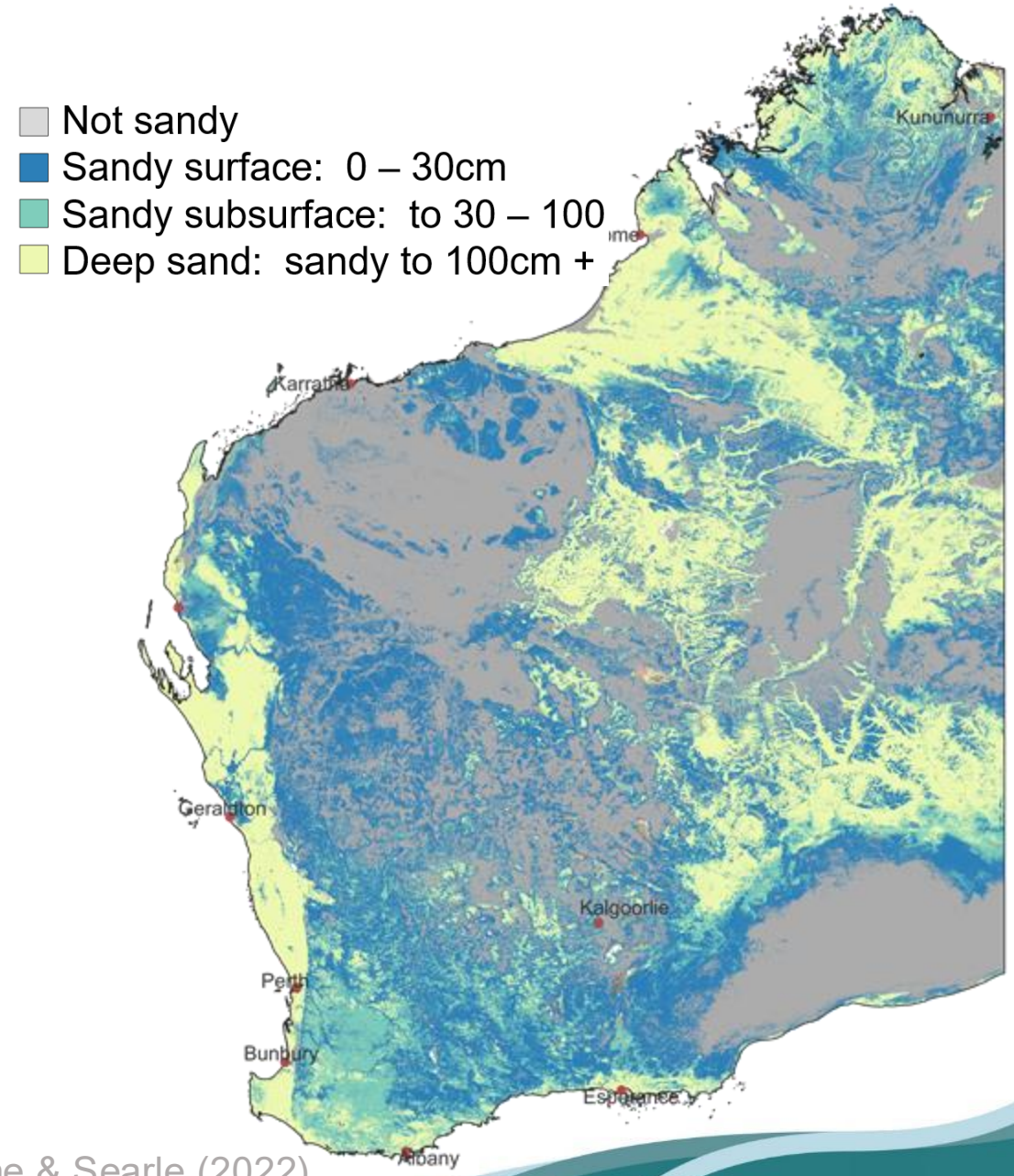
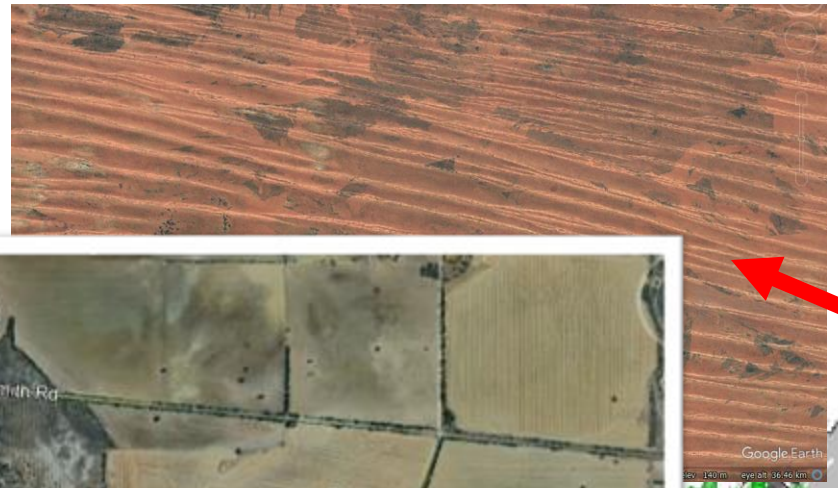


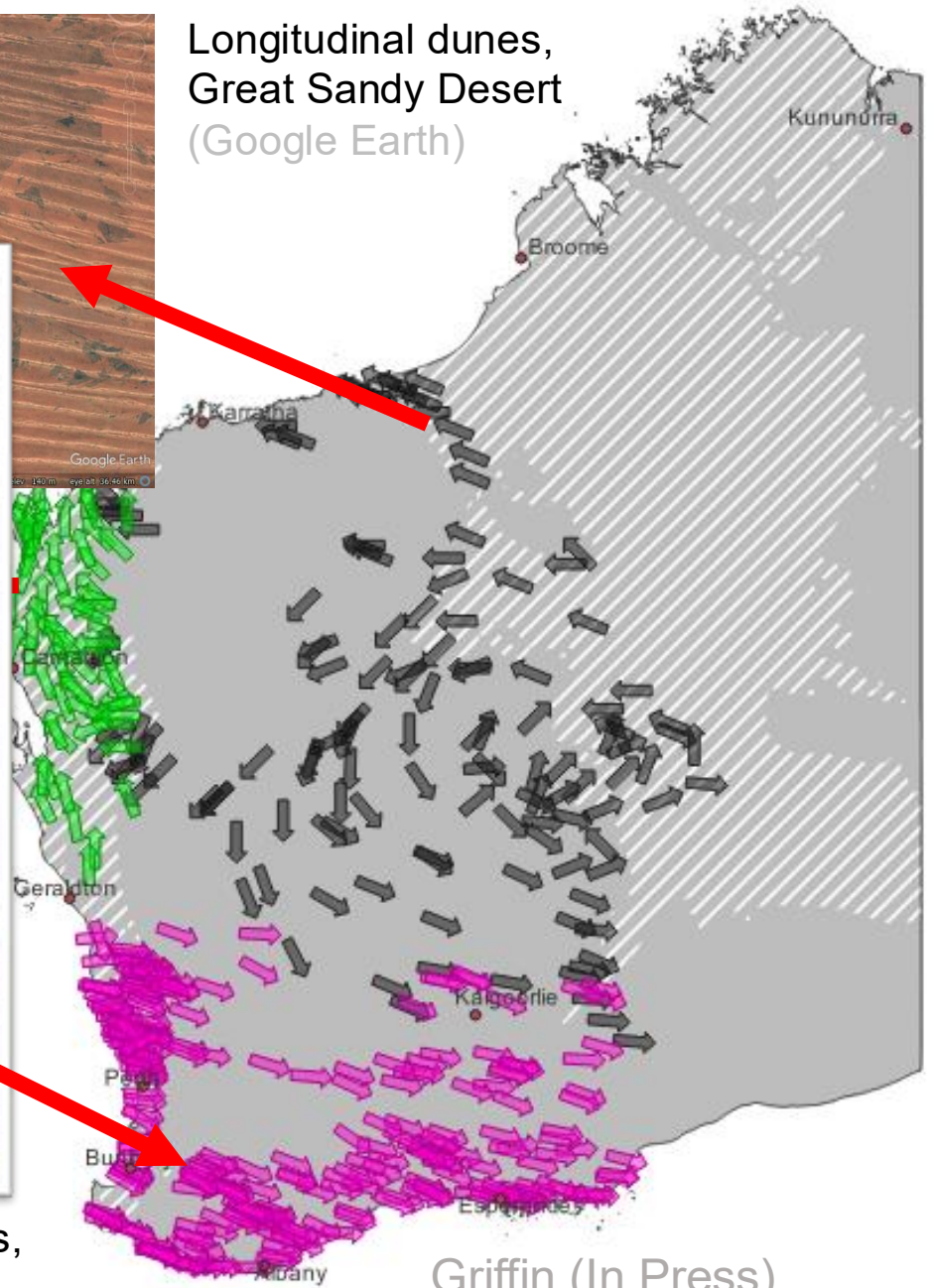


DMIRS (2023); Malone & Searle (2022)

Why is WA so sandy? Landforms



Longitudinal dunes, Great Sandy Desert (Google Earth)



Griffin (In Press)

Source bordering dunes, Toolibin Lake (Google Earth)

Longitu
North o

Why is WA so sandy?

Dunes not always “young” soils

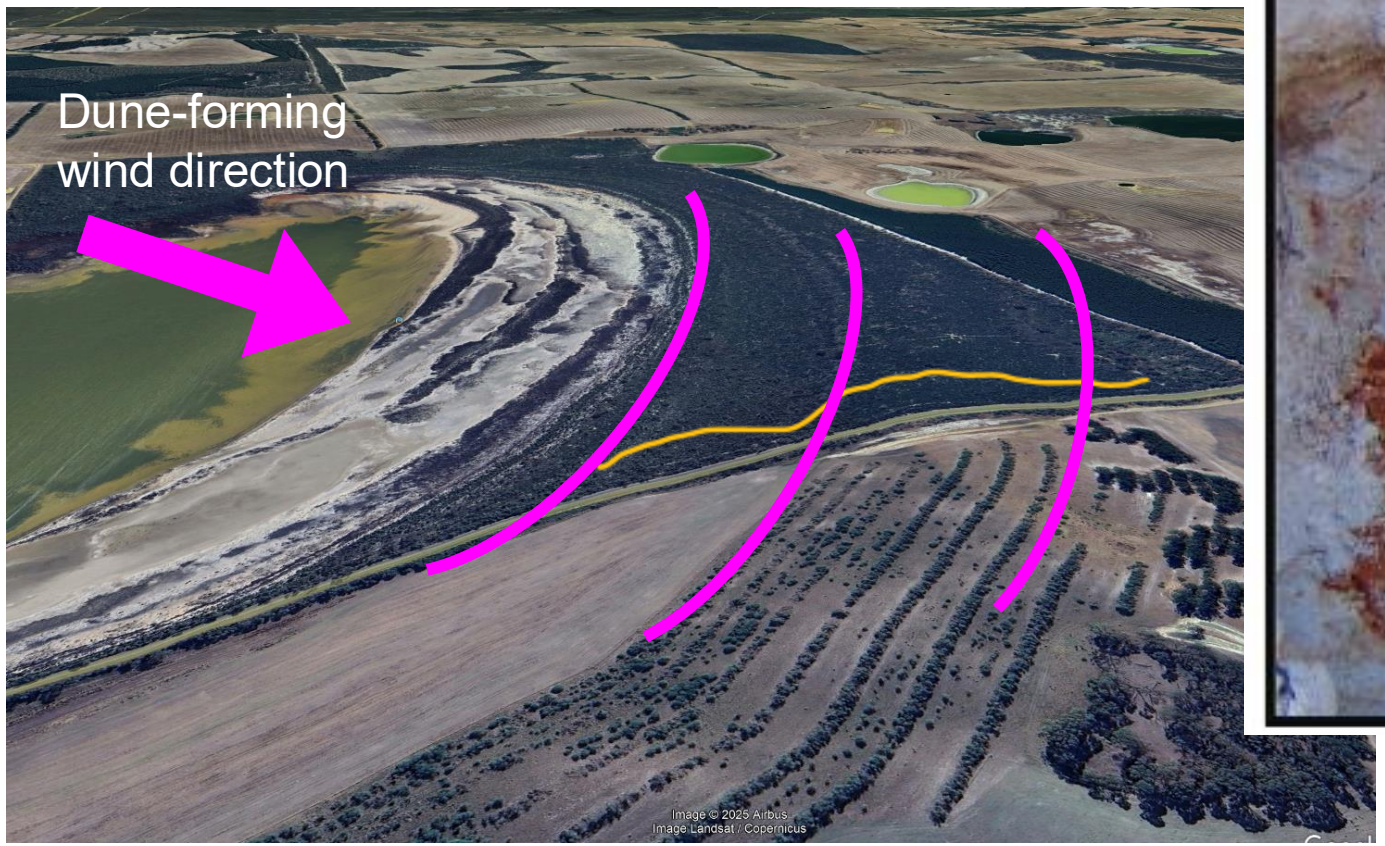
- Multiple episodes of
  - Sand deposition and redistribution
  - Soil formation (podzolisation)
- Not influenced by watertable
- Active plant / microbial processes in soil formation

Jandakot, WA

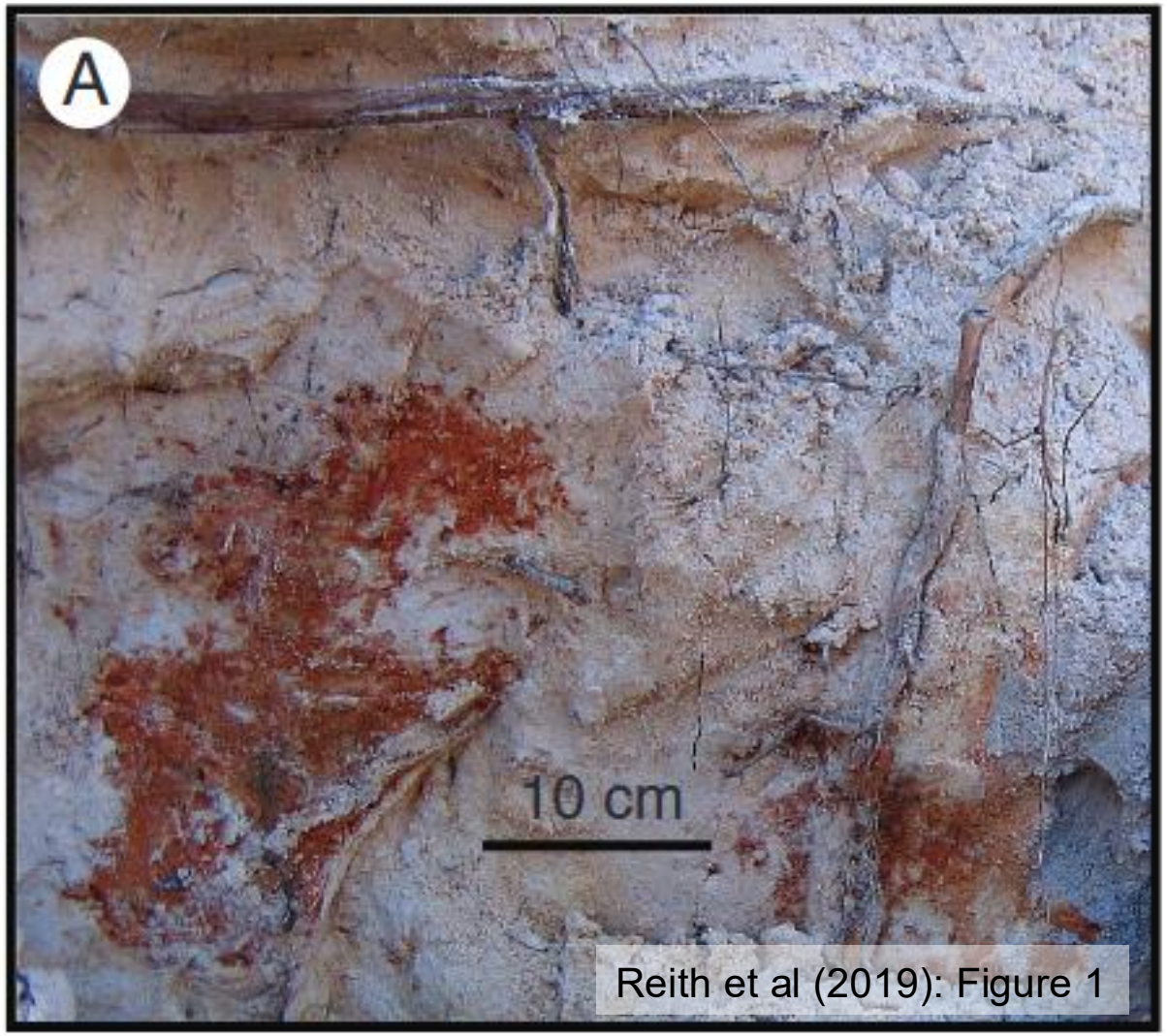
Reith et al (2019): Figure 6

Why is WA so sandy?

Soils forming in dunes



Source bordering dunes
Lake Chillinup, just south of Stirling Range

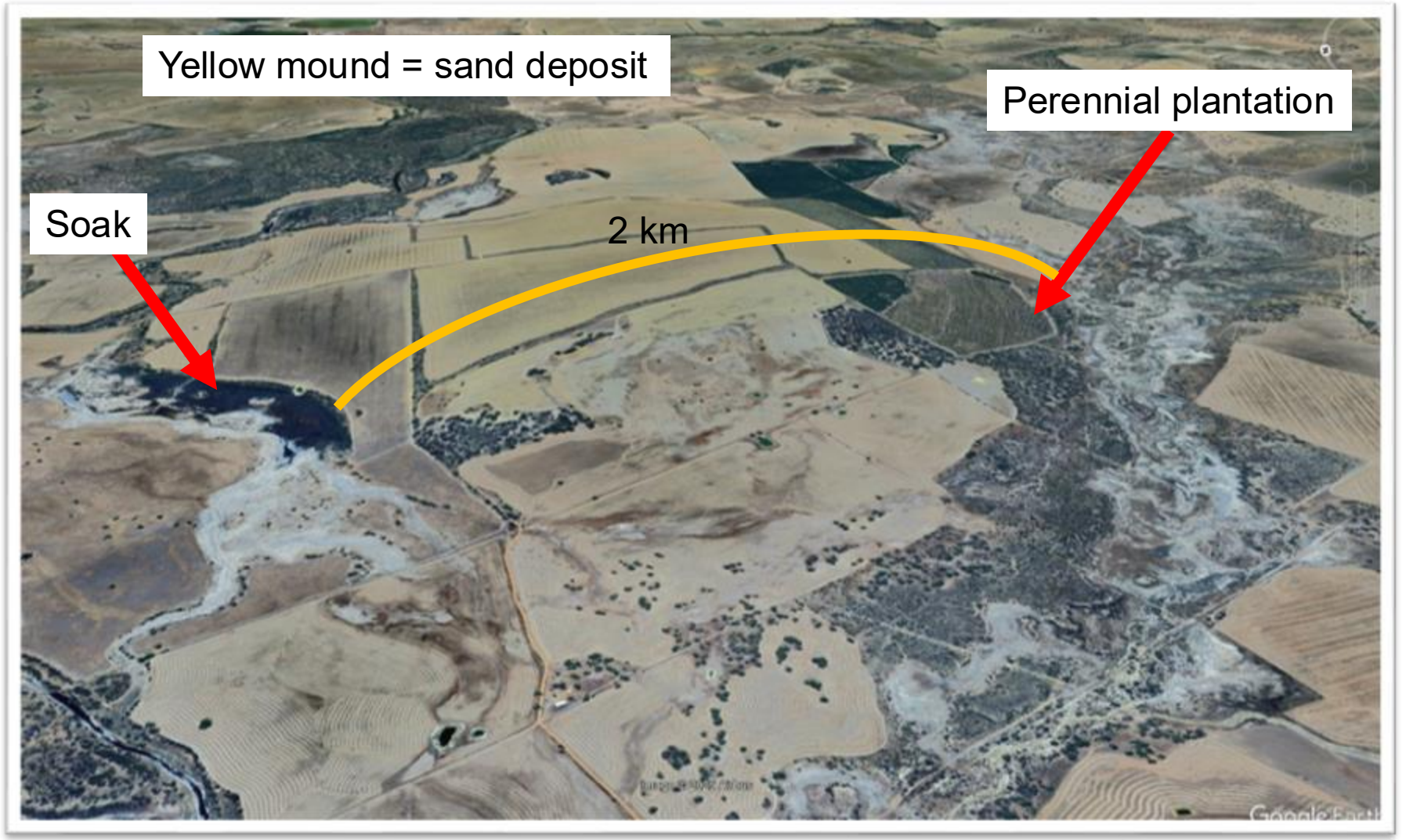


- Pale deep sands with clay forming around native veg roots
- Soil bioengineering by plants and associated microbes

Why is WA so sandy?

Landforms

- Aeolian sand deposit
- Redistributed sand from ancestral river valley
- Landform controls drainage, and affects land use



Southern arm of the Avon River near Brookton (Google Earth)

Sands can be complex

CHM0266
Pale deep sand
Grey arenosol
poor subsoil with minimal clay and rock substrate.
Very low fertility, soil water storage and nutrient retention.

CHM0231
Yellow deep sand
Yellow arenosol
with slight clay increase with depth. Moderate fertility, soil water storage and nutrient retention.

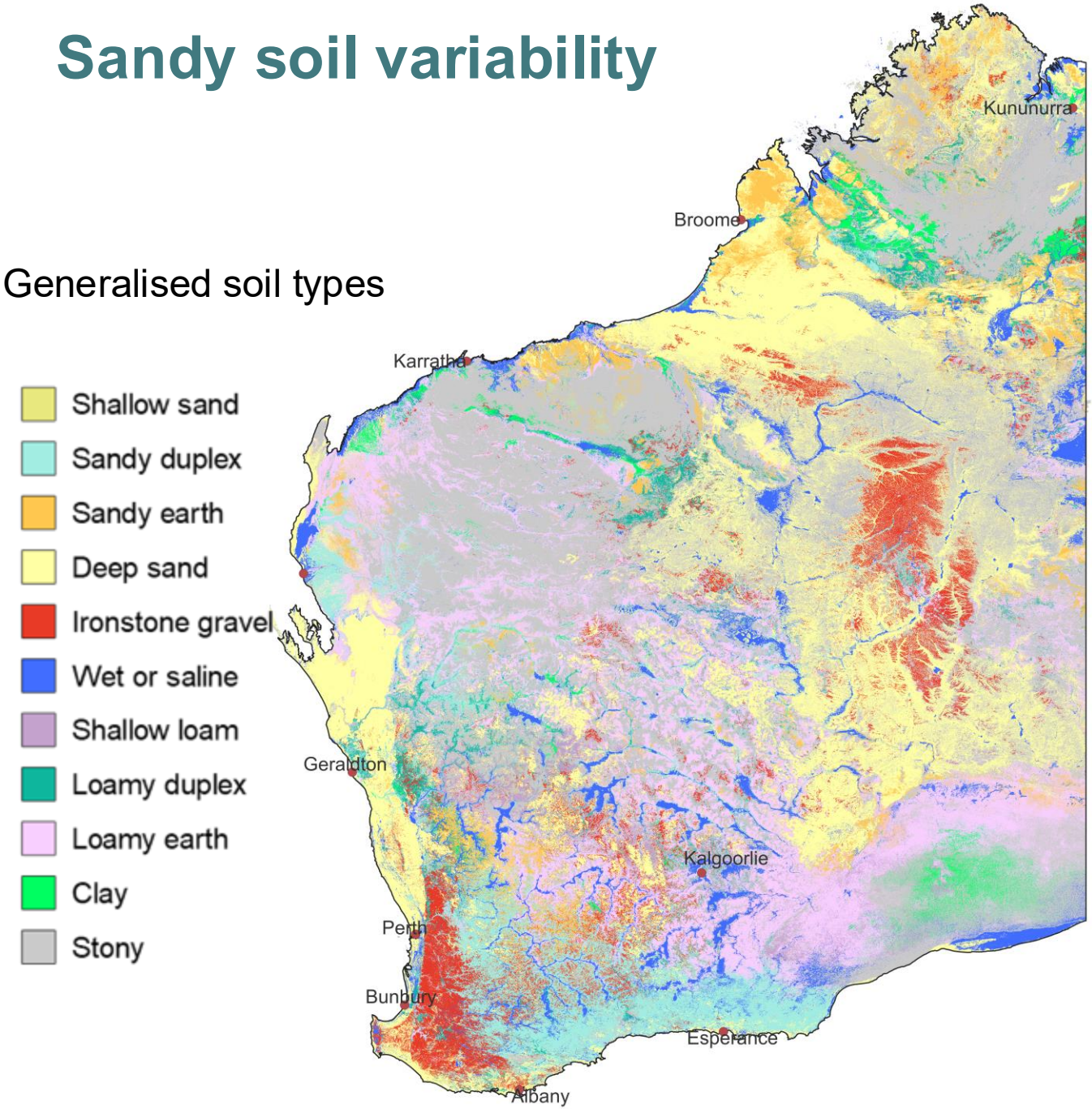
CAR0323
Red deep sand
Red arenosol
Moderate fertility, soil water storage and nutrient retention.

SWL0125
Acid deep sand
Grey arenosol with clay below 2 metres. Low soil water storage but prone to seasonal waterlogging.

NCP0513
Deep sandy gravel
Grey tenosol
Very low fertility, soil water storage but high nutrient retention.

Sandy soil variability

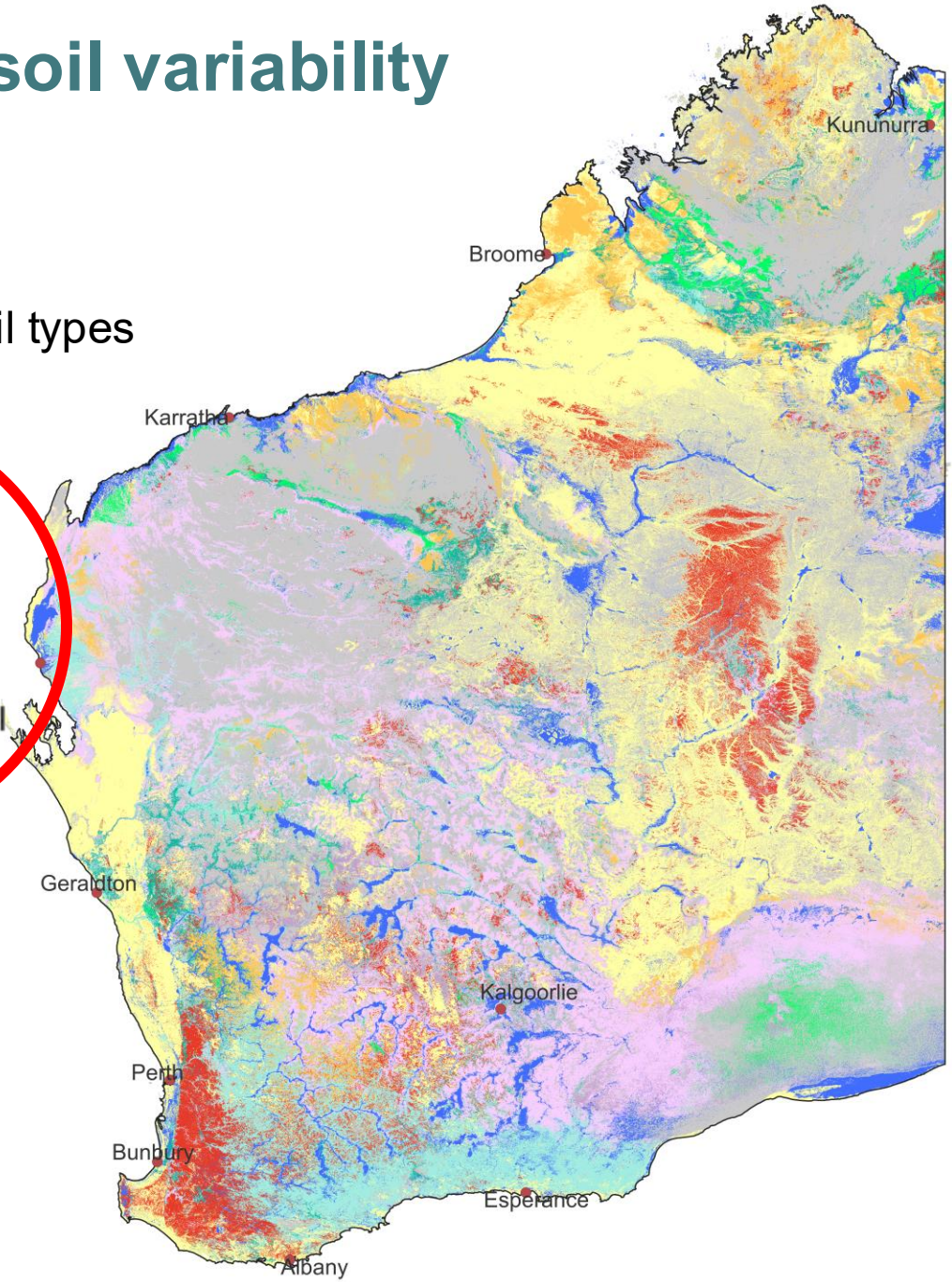
Generalised soil types



Sandy soil variability

Generalised soil types

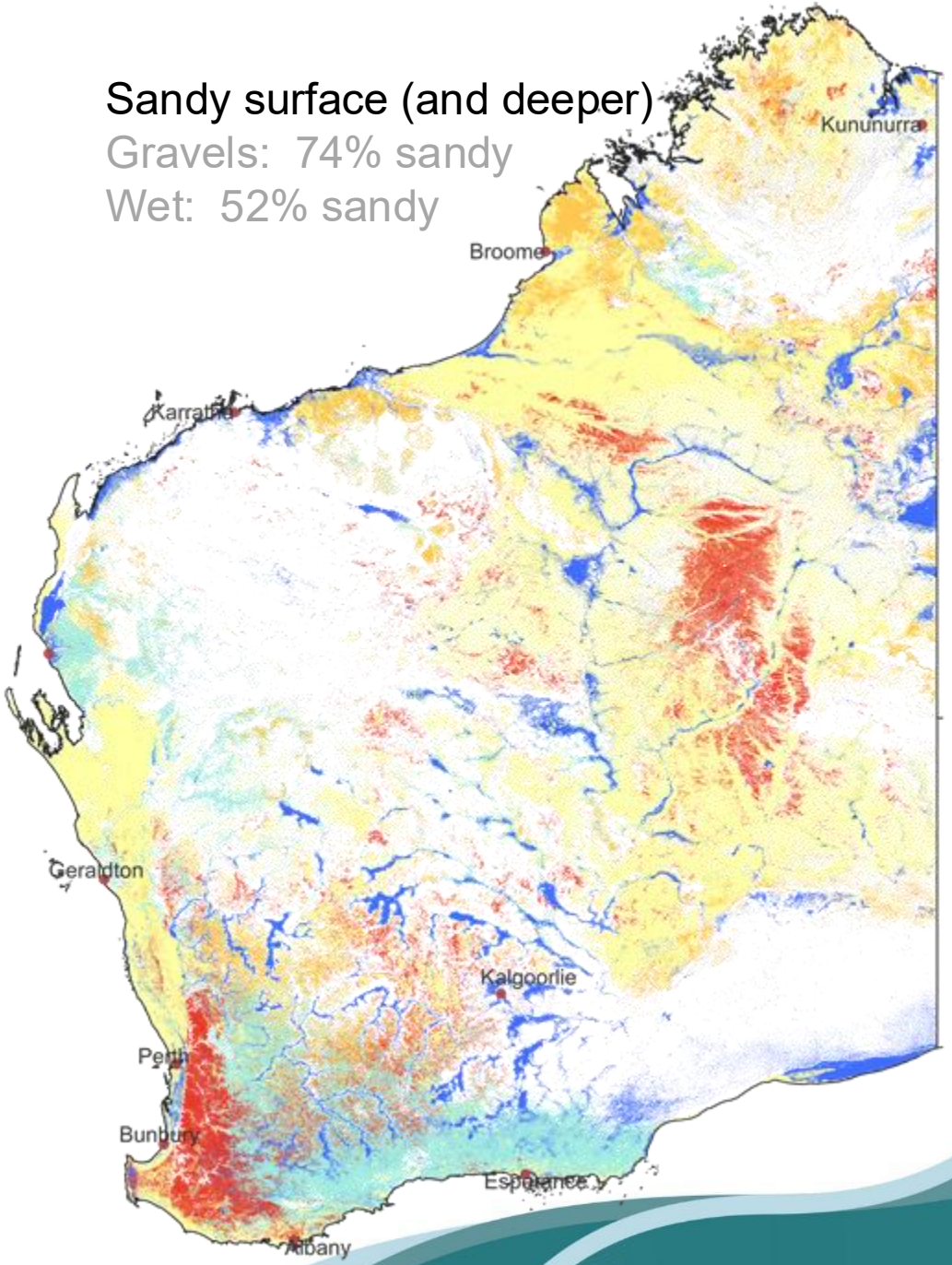
- Shallow sand
- Sandy duplex
- Sandy earth
- Deep sand
- Ironstone gravel
- Wet or saline
- Shallow loam
- Loamy duplex
- Loamy earth
- Clay
- Stony



Sandy surface (and deeper)

Gravels: 74% sandy

Wet: 52% sandy



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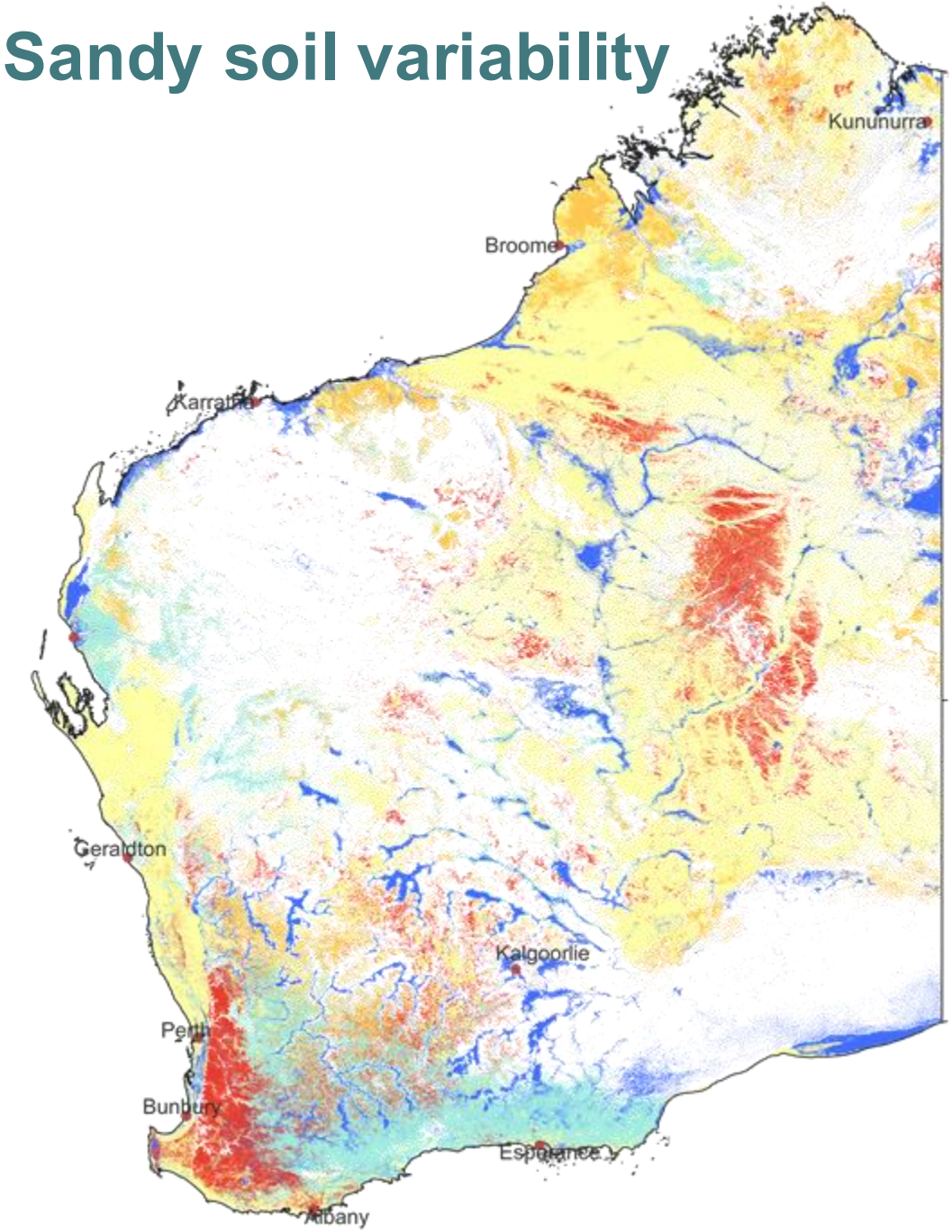
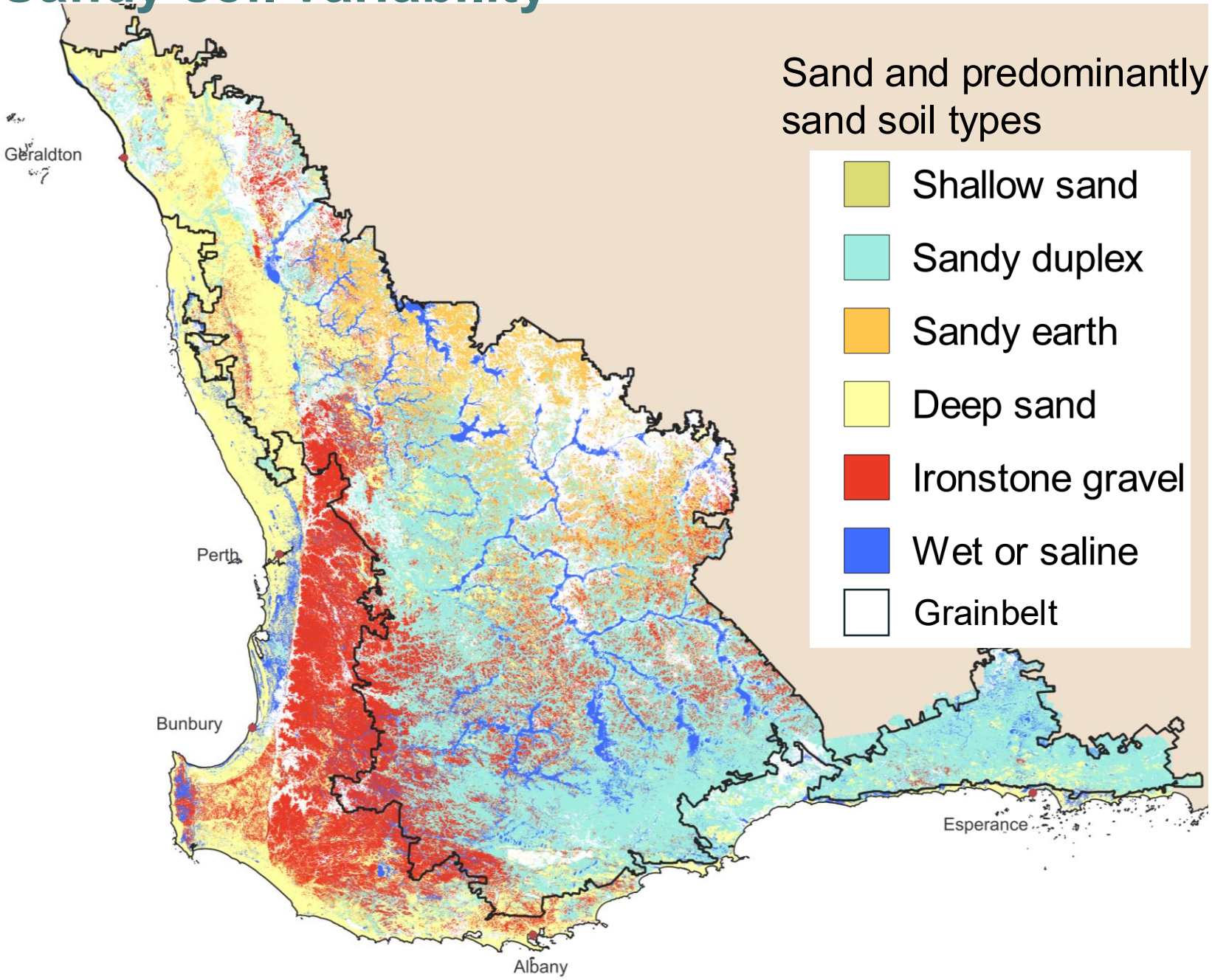


Sandy soil types (WA)	Australian soil classification
Shallow sand	Rudosol, Tenosol, Calcarosol
Sandy duplex	Sodosol, Chromosol, Kurosol
Sandy earth	Kandosol, Calcarosol
Deep sand	Arenosol, Calcarosol, Kandosol, Podosol
Ironstone gravel	All Orders (Tenosol, Rudosol, etc.)
Wet or saline	Hydrosol, Organosol, Podosol

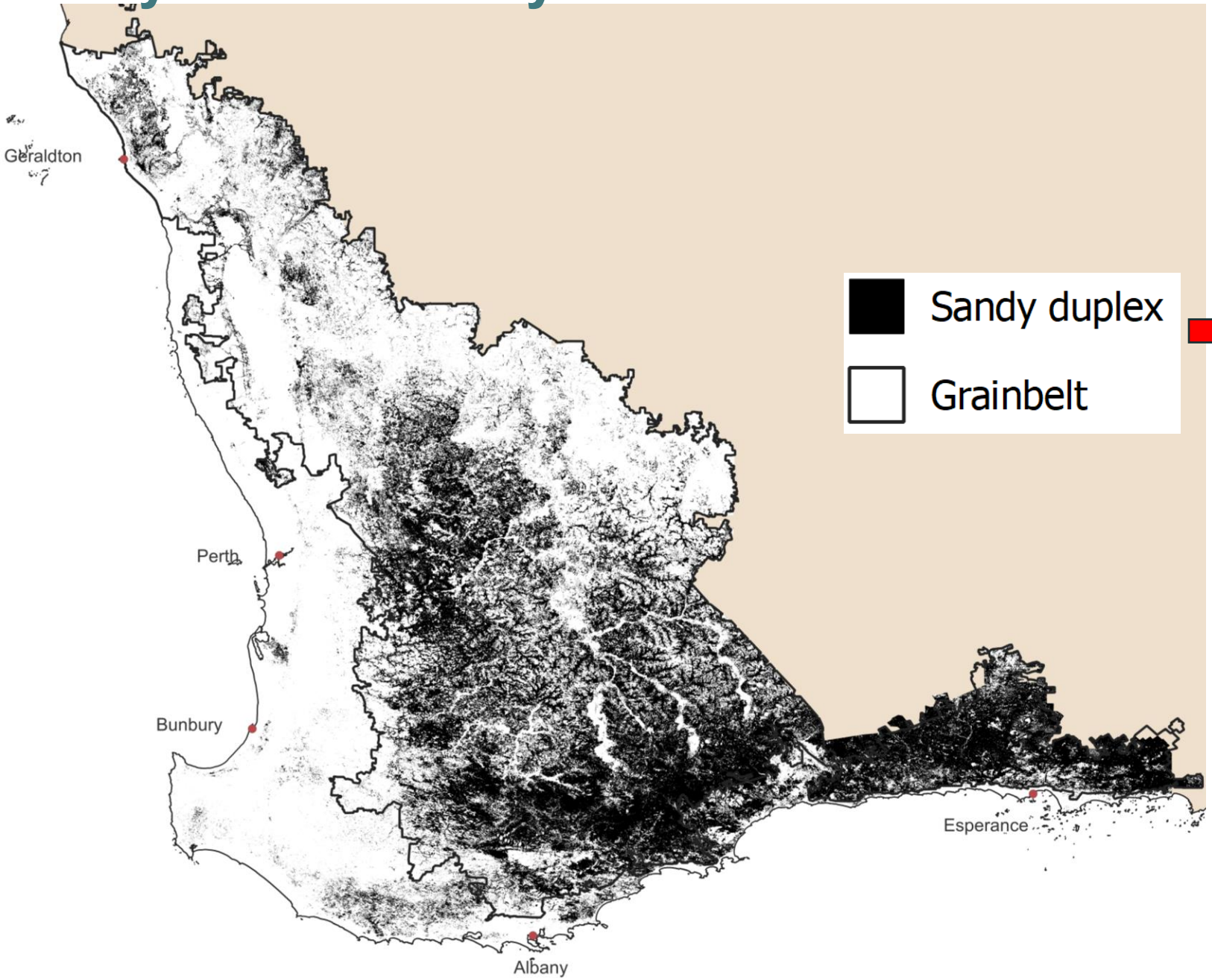
Gravels: 74% sandy
Wet: 52% sandy

Galloway et al (2024); Isbell & NCST (2021)

Sandy soil variability



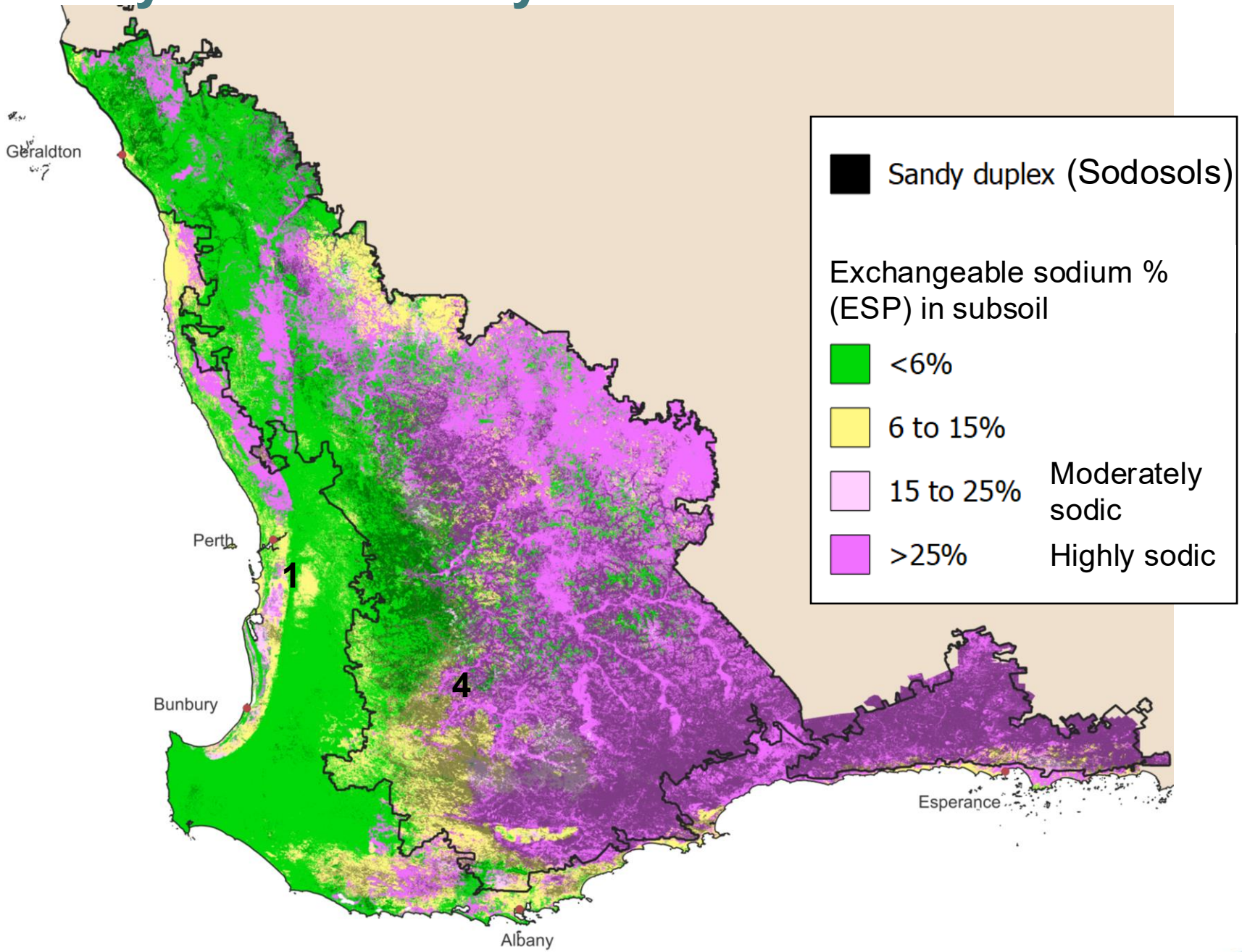
Sandy soil variability



- Shallow or deep?
- Coarse or fine sand texture?
- Red, yellow, grey, brown, black?
- Sodic subsoil?
- Acid, neutral, alkaline?
- Degree of waterlogging (landscape position)

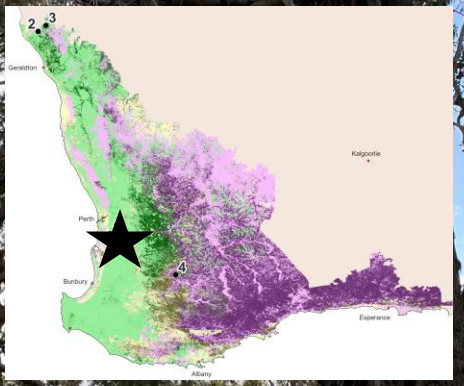
* There are 10s of thousands of combinations for ASC and 870 sandy soils in our simplified local classification.

Sandy soil variability



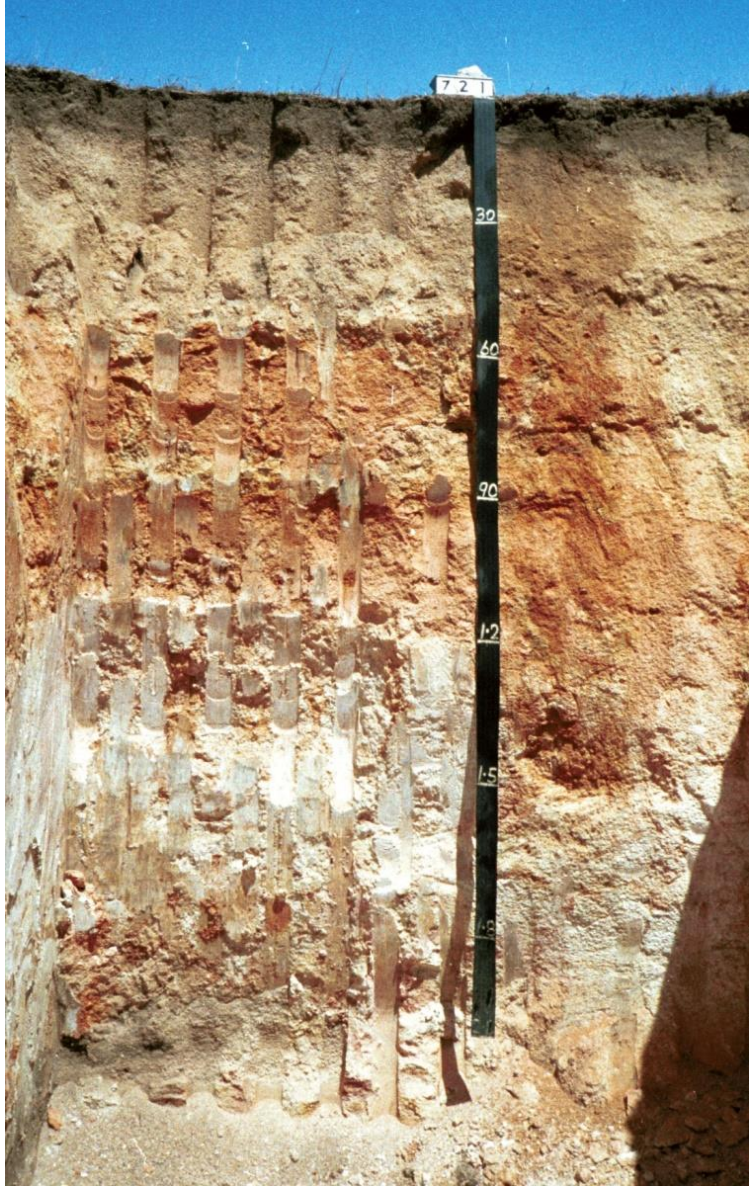
Sandy soils can have poor drainage!?!

1 Ironstone gravelly deep sandy duplex Chromosol (Jarrahdale area)



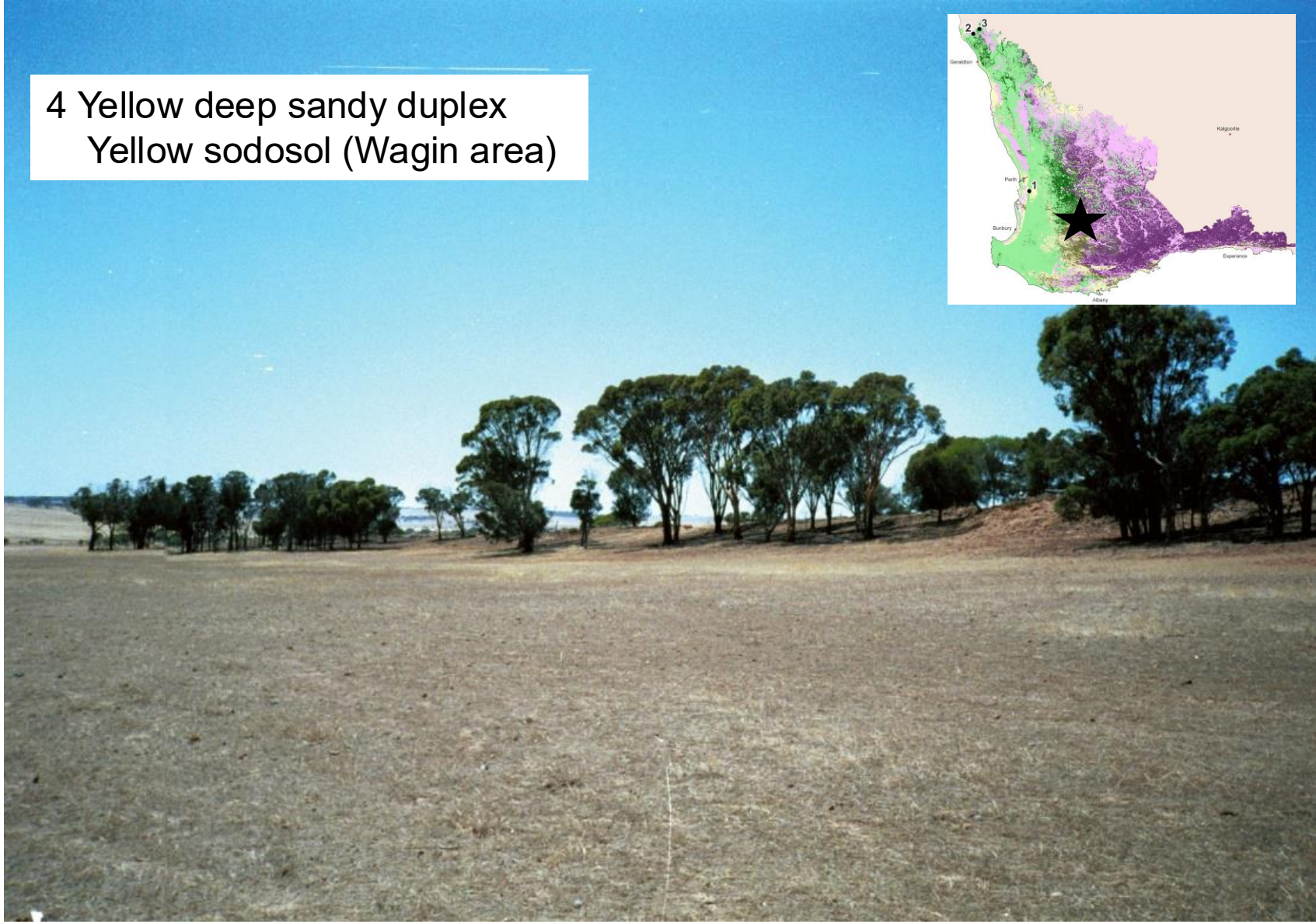
Loamy sand with gravels over neutral **non-sodic** clay. (bright whole subsoil colour)
Moderately well drained soil profile on sloping land

Moderately well drained soil
Neutral pH, non-sodic
Gravels reduce soil water storage a little



Pale sand over poorly permeable sodic clay, trending towards alkaline. Salinity on the surface.

4 Yellow deep sandy duplex
Yellow sodosol (Wagin area)



Salinity
Surface acidity
Subsoil alkalinity
Waterlogging

Sandy soil variability: 4 flavours of sandy duplex soils

1 Ironstone gravelly deep sandy duplex: Chromosol

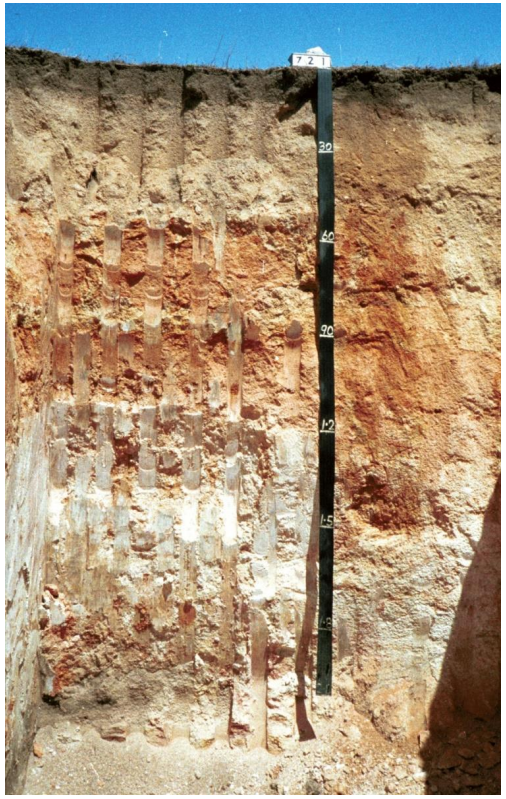
Loamy sand with gravels over neutral non-sodic clay.

2 Ironstone gravelly deep sandy duplex: Salic petroferric ferric-sodic hydrosol

Grey gravelly sand over poorly drained gravelly sodic clay.

3 Acid shallow sandy duplex: Red Kurosol

Red sand over whole coloured clay.

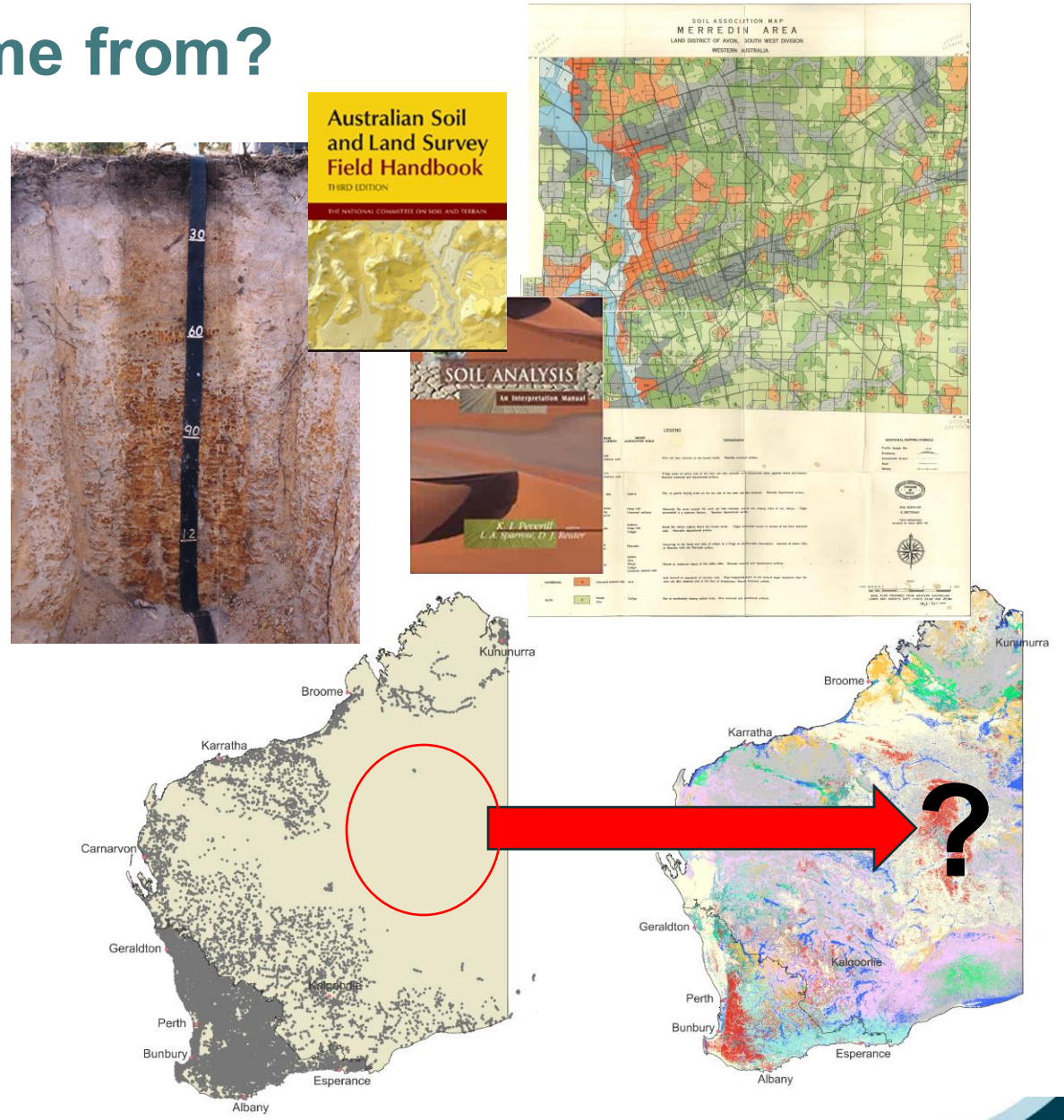


4 Yellow deep sandy duplex: Yellow sodosol

Pale sand over poorly permeable sodic clay, trending towards alkaline. Salinity on the surface.

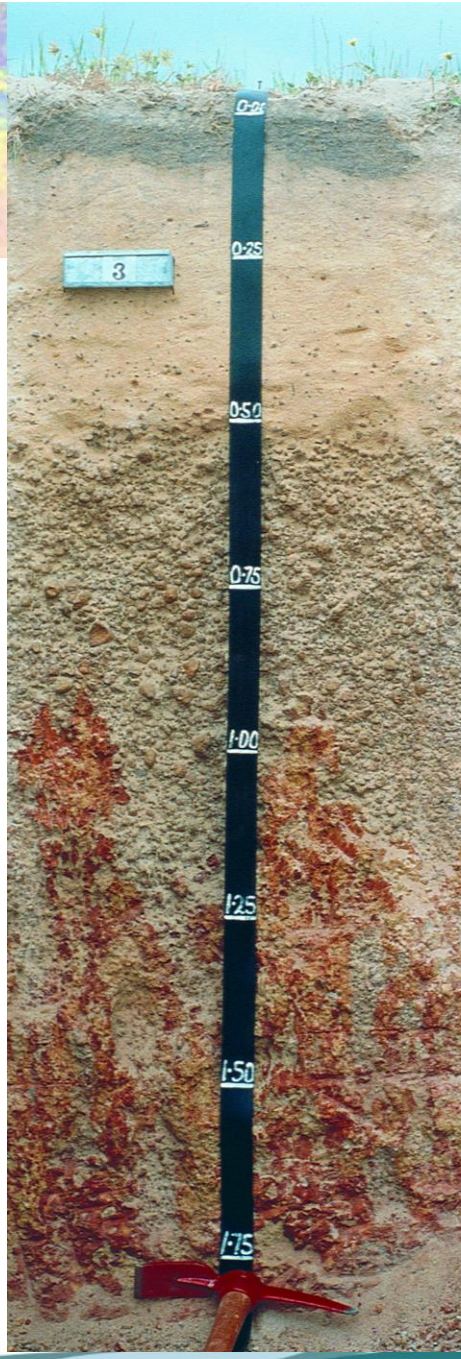
Where does soils information come from?

- Legacy soil information
  - Site observations, and often lab analyses (a hole dug by someone, usually with a hand auger)
  - Traditional soil maps and reports
  - Data-driven maps (digital soil maps)
- Soil data is valuable, but variable
- Maps == Models == Simplifications
- Maps + high quality sites + local knowledge = improved decisions



How do you define ‘sandy’?

- WA is sandy -- including majority of agricultural land
- “Sandy” describes many different soil types
  - Differing cropping constraints and management
- Get soil type and reliable soil data > 30cm deep
  - Agronomic advice often focused on sandy in top 10 or 20cm
- Hydrological processes important in sandy soils
  - Dry or wet (rainfall, topographic position, subsoil)
- Formal soil classification helps communication and impact in research and management



Thank you

dpird.wa.gov.au

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- Reith, F., Verboom, W., Pate, J., Chittleborough, D., 2019. Collaborative involvement of woody plant roots and rhizosphere microorganisms in the formation of pedogenetic clays. Annals of Botany 124, 1007–1018. https://doi.org/10.1093/aob/mcz065 [Figure 1a; Figure 6]
- Access to some WA soil data:
  - NRinfo: https://www.dpird.wa.gov.au/environment-and-sustainability/nrinfo-for-western-australia/
  - ANSIS: https://portal.ansis.net/
  - dataWA: https://www.data.wa.gov.au/