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Coastal Acid Sulfate Soils

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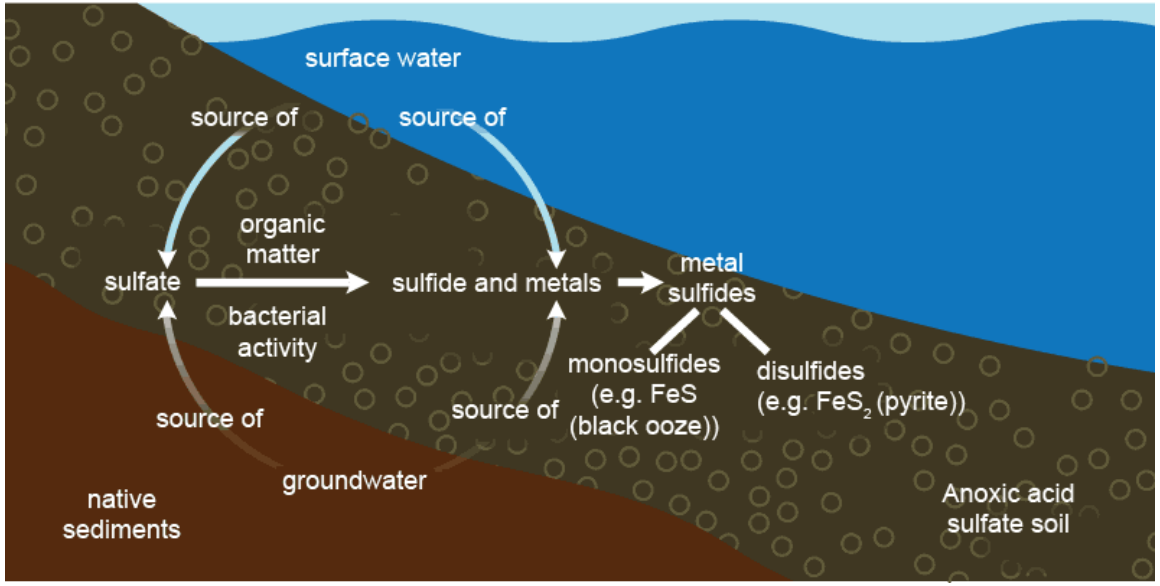
GROUP OF EIGHT AUSTRALIA

What are acid sulfate soils?

- Acid sulfate soils are soils and sediments containing oxidisable or already oxidised metal sulfides (mainly pyrite – FeS_2)
- PASS: potential acid sulfate soil, or ‘sulfidic’ soil when they remain in a waterlogged state
- AASS: actual acid sulfate soil or ‘sulfuric’ soil when exposed to air and oxidised
- These soils are normally found in marshy environments

Formation of acid sulfate soils

- Coastal acid sulfate soils (CASS) formed about 10,000 years ago during periods of higher sea levels (sea levels about 1.5 m higher than today)
- Pyrite forms in saline sediments where there is an accumulation of:
  - Labile organic matter
  - SO_4^{2-}
  - Fe^{3+}
  - An anaerobic environment



- Pyrite is only stable under anaerobic conditions
- Becomes problematic when exposed to oxygen
- Oxidation can be caused by drainage, excavation, dredging, etc

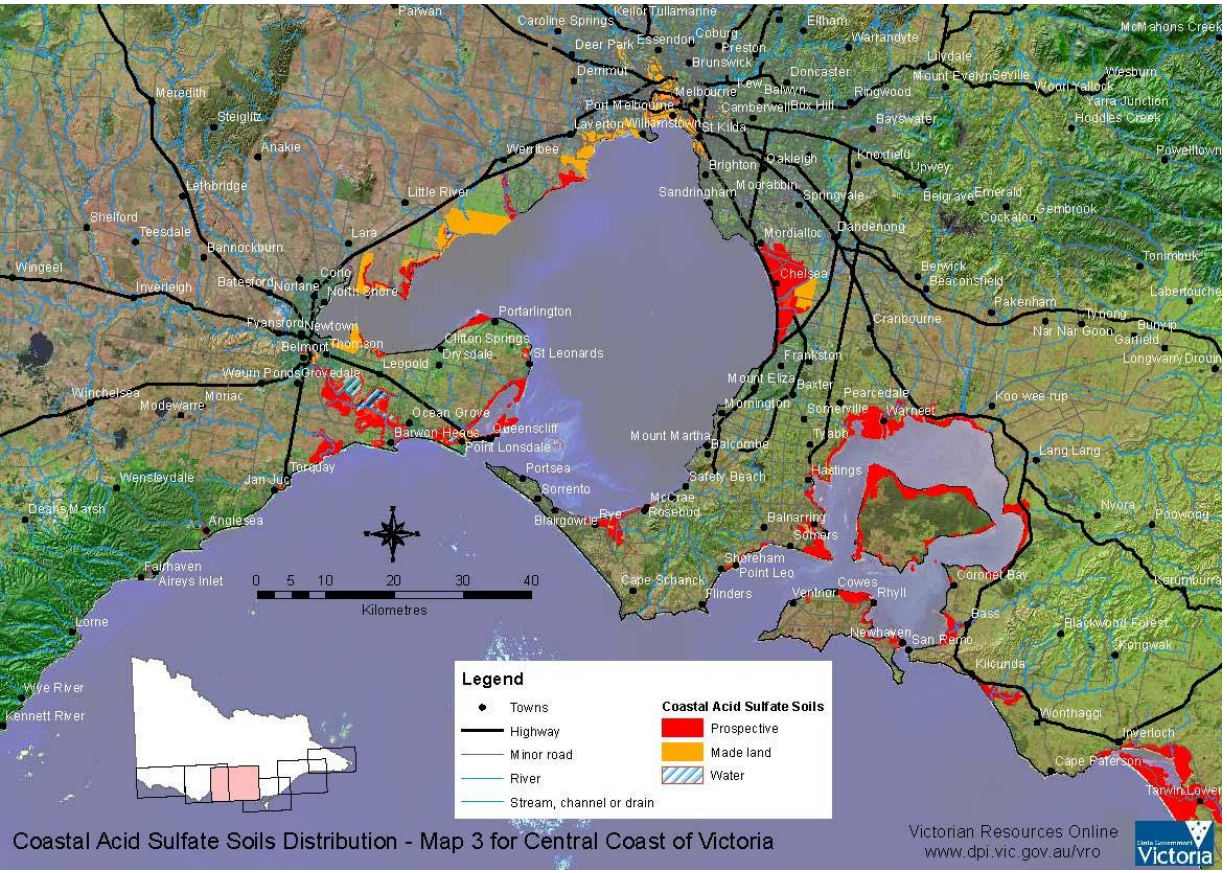
$$FeS_2 + 15/4O_2 + 7H_2O \rightarrow Fe(OH)_3 + 4H^+ + 4SO_4^{2-}$$

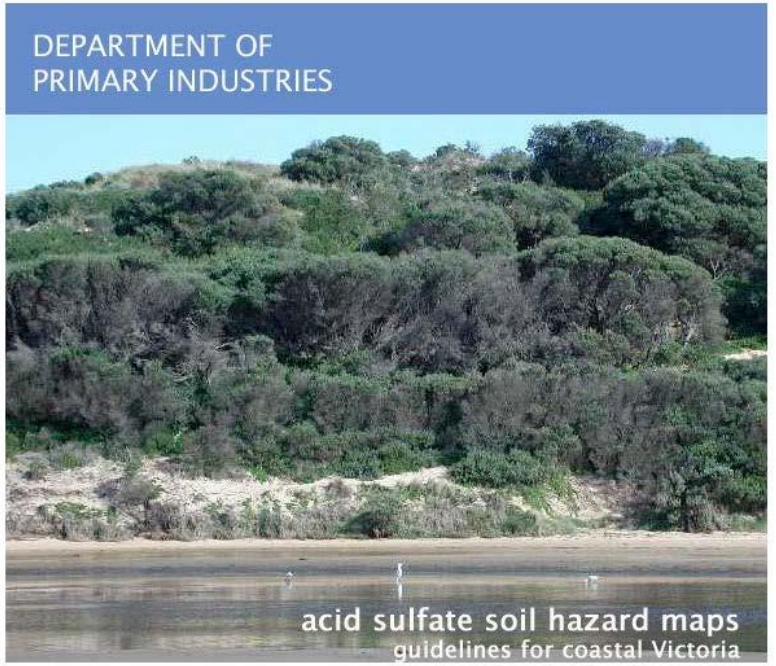
pyrite oxygen Colloidal Fe^{3+} Sulfuric acid

Impacts of acid sulfate soils

- Directly affects aquatic ecosystems
  - Discharges of acidity and rapid drop in pH
  - Discharges of trace metals resulting in metal toxicity, especially Al
  - Crystal clear water
  - In extreme cases, fish kills occurs
- Colloidal iron oxides and iron flocs coat benthos
- Concrete cancer
  - Infrastructure instability
- Soil ripening
  - Occurs as CASS dewater

Where do they occur?





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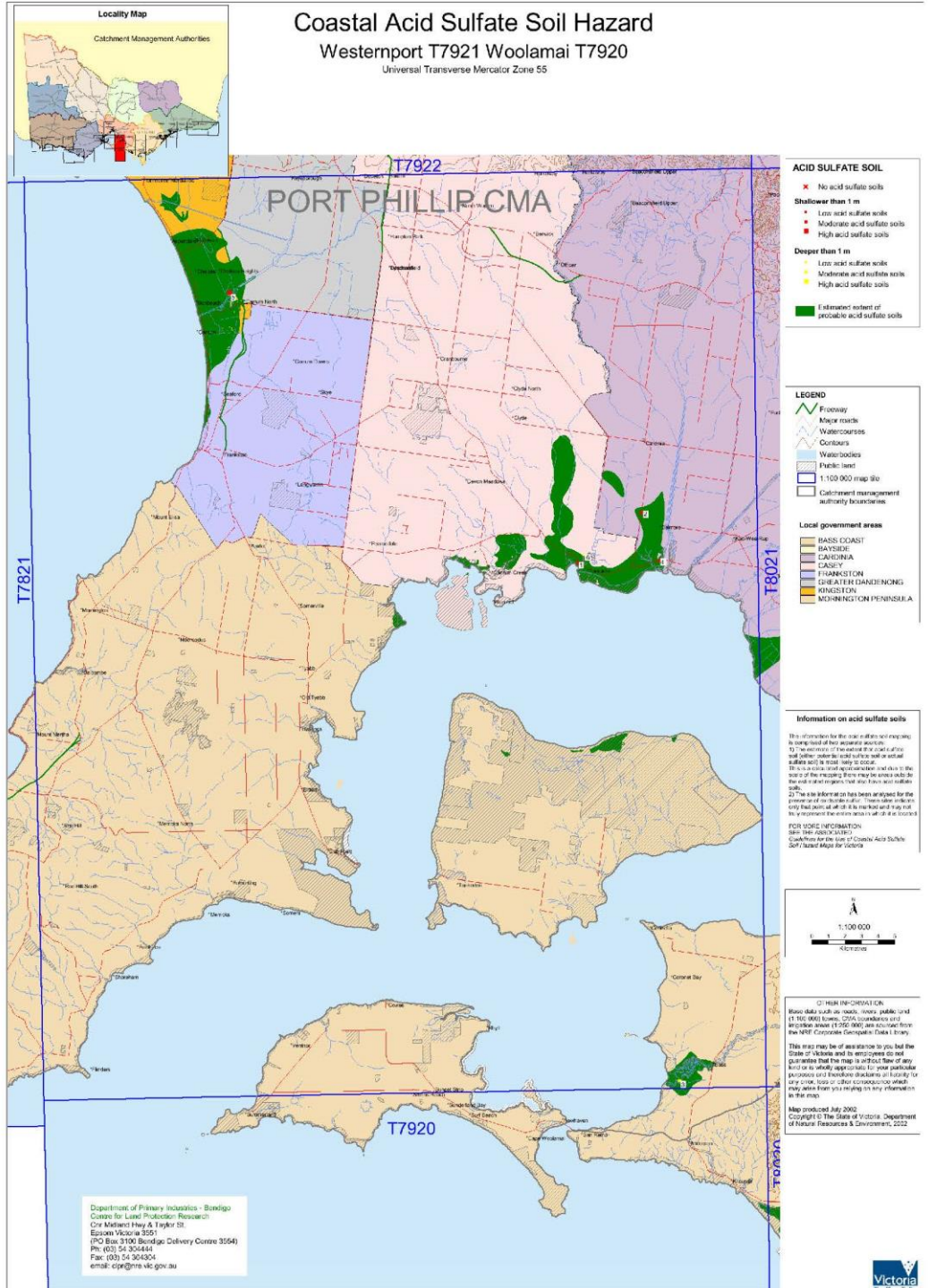
Coastal Acid Sulfate Soil Hazard

Westernport T7921 Woolamai T7920

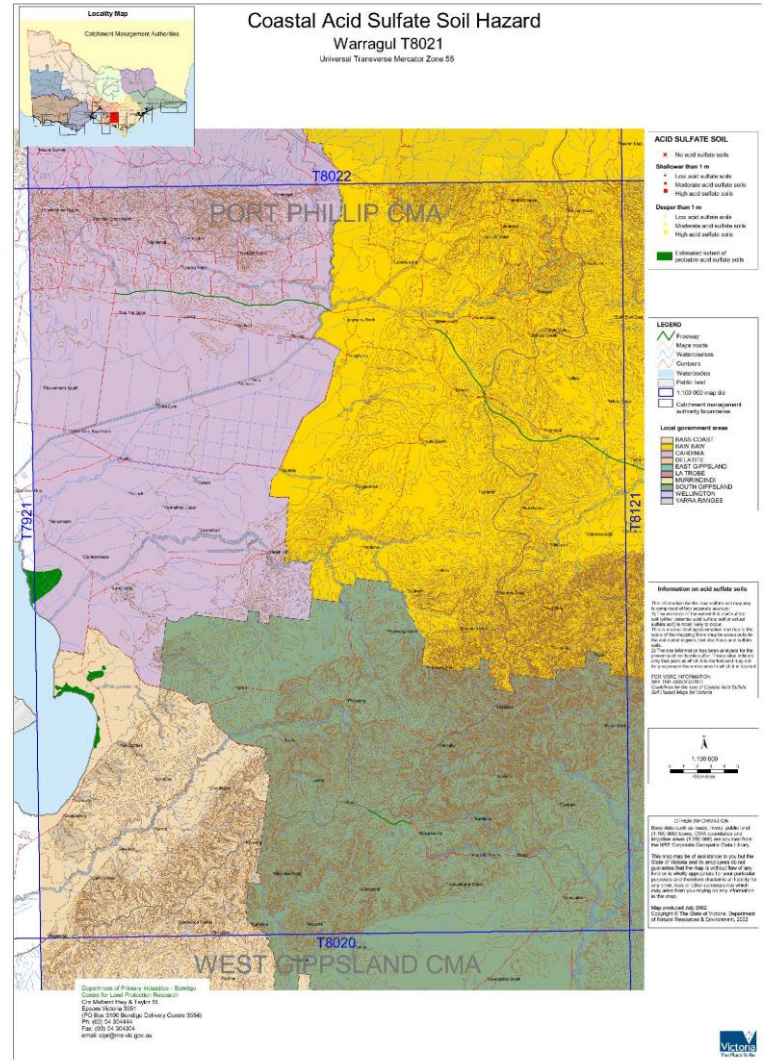
Universal Transverse Mercator Zone 55



Coastal Acid Sulfate Soil Hazard

Warragul T8021

Universal Transverse Mercator Zone 55



Proposal: Presence of acid sulfate soils

- Quantify acidification potential

Proposal

Formation of acid sulfate soils

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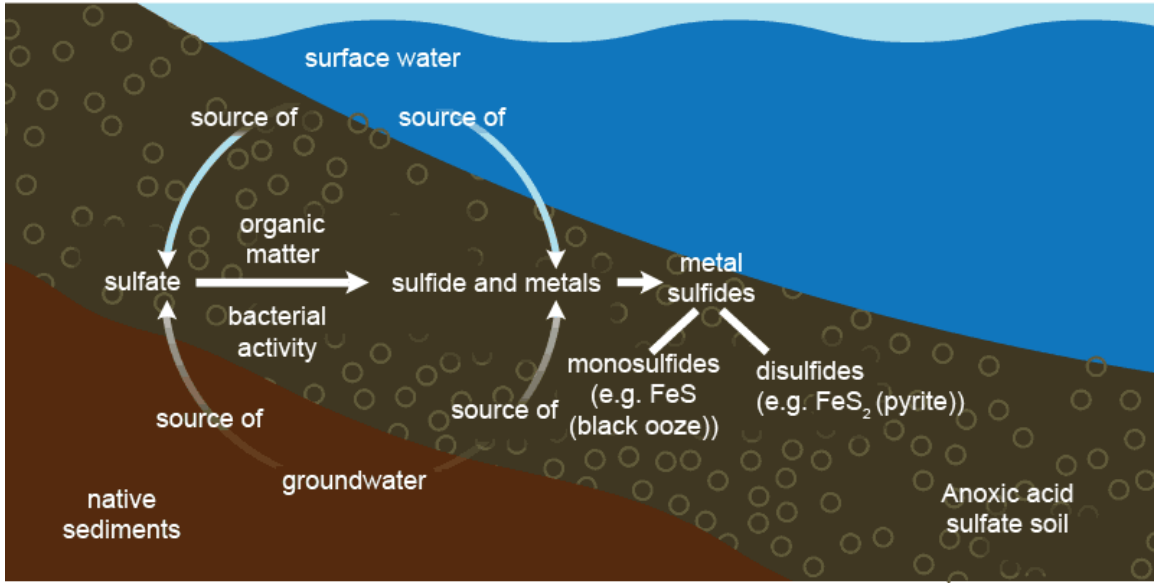
  - Fe^{3+}
  - An anaerobic environment



Proposal: pyrite and monosulfide formation

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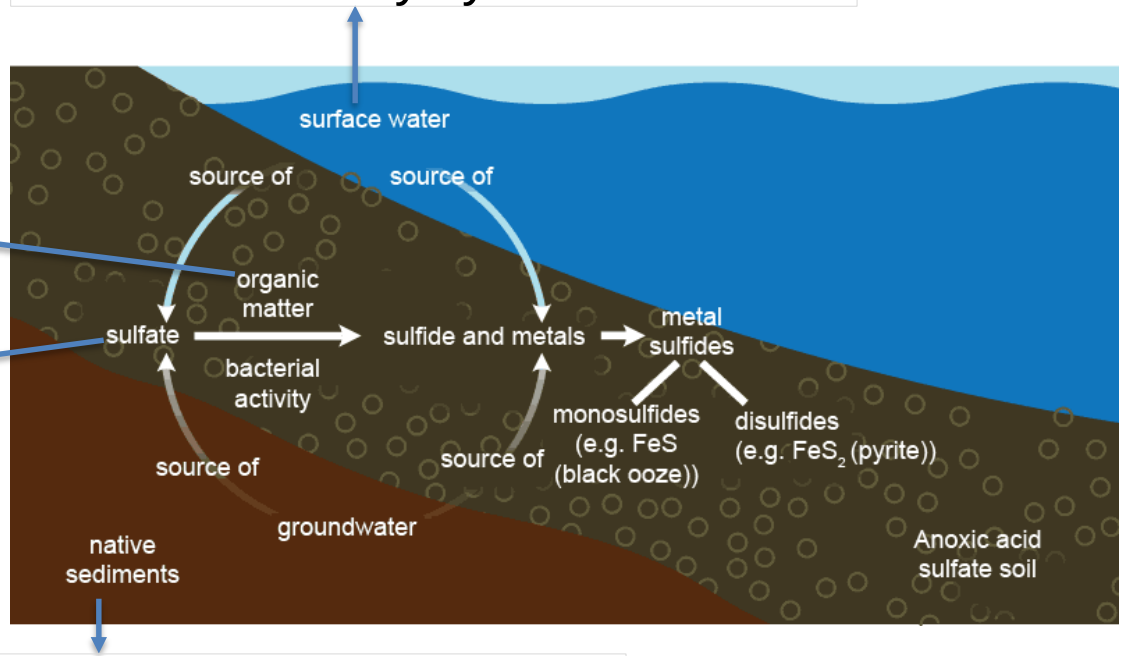
- Incubations
  - Each treatment can be mapped

- Vegetation
  - Saltmarsh
  - Mangrove
  - Seaweed

- Oxygen availability
  - Complete inundation
  - Wet/dry cycles



- Surface water
  - Seawater
  - Brackish water
  - Freshwater

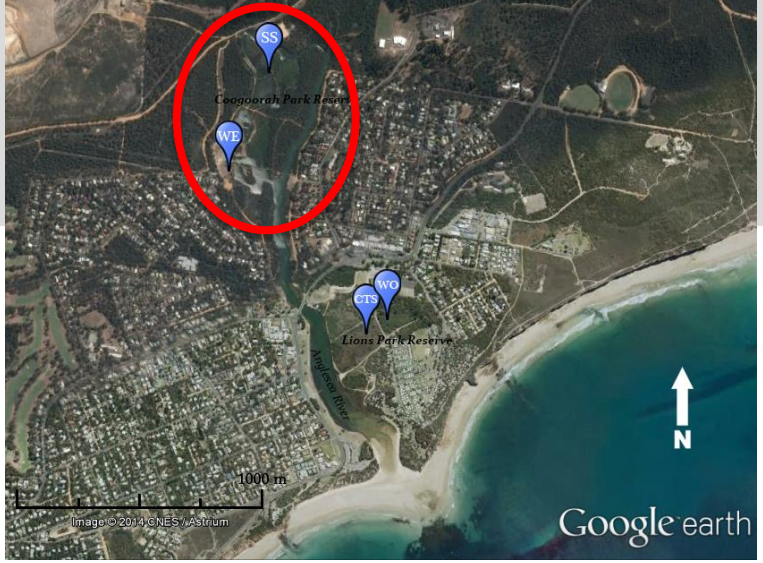
- Sediment compartments
  - High Si
  - High Fe

Proposal: Inundation and resuspension

- Effects of inundation on water quality
- Potential oxidation with resuspension
  - Effects on water quality

Unknowns

- Most of our knowledge on acid sulfate soils comes from the east coast
  - Victorian embayments, estuaries and estuarine floodplains are different to the east coast
- Distribution of coastal and inland acid sulfate soils and how they interact
- Characterisation of acid sulfate soils
- Formation of Victorian estuaries
  - Formation of acid sulfate soils



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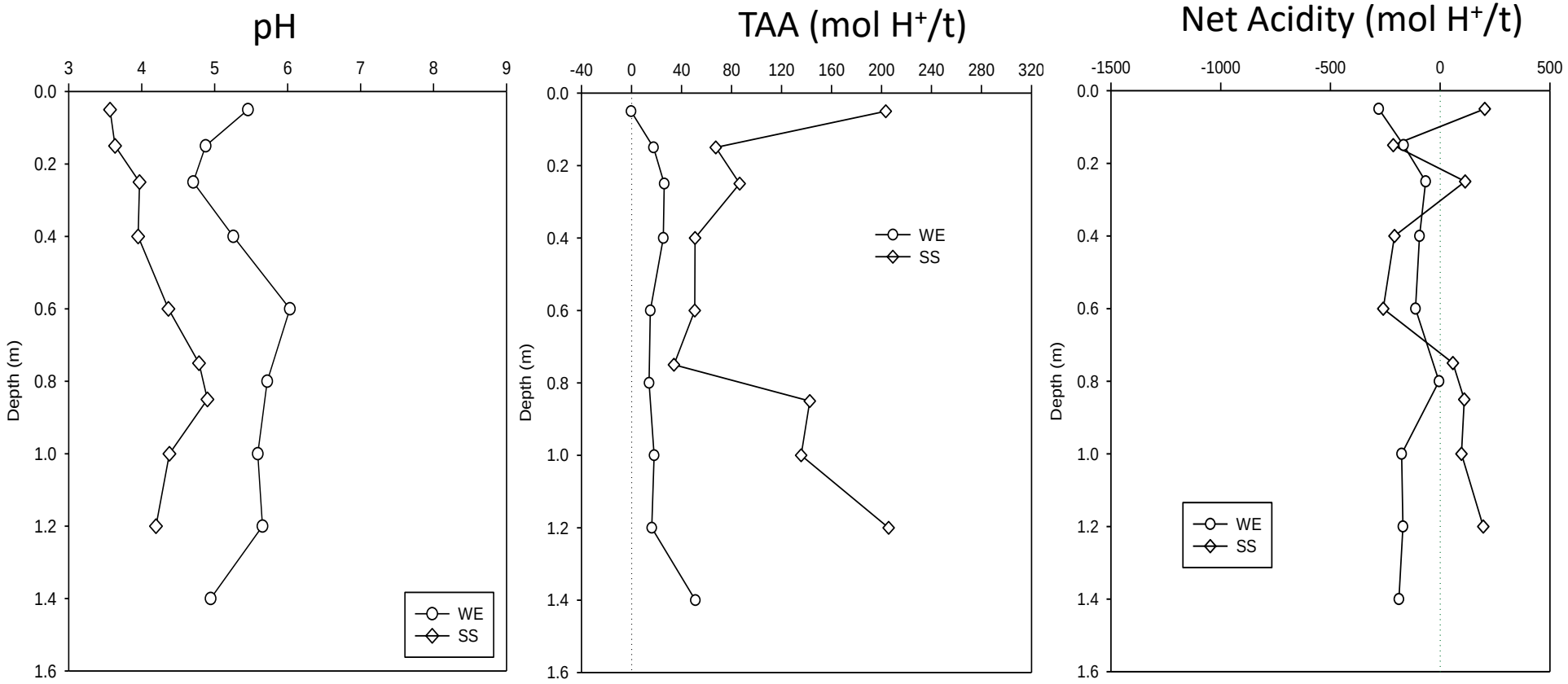
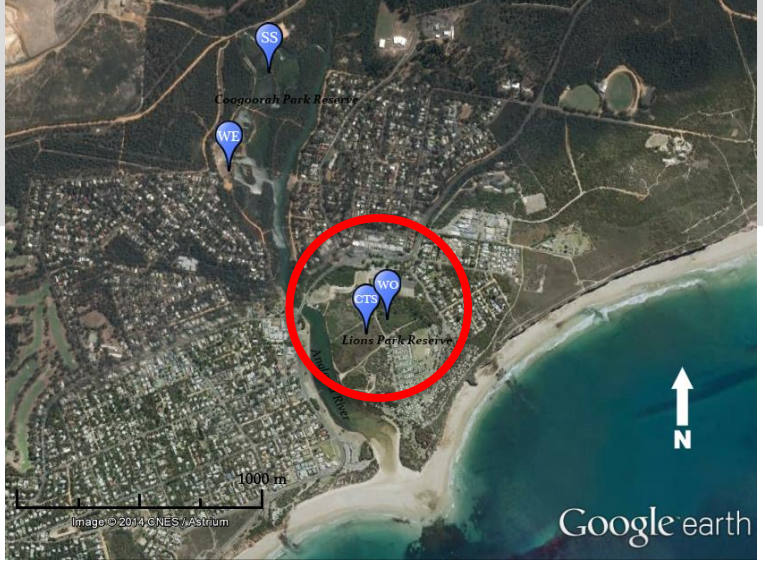
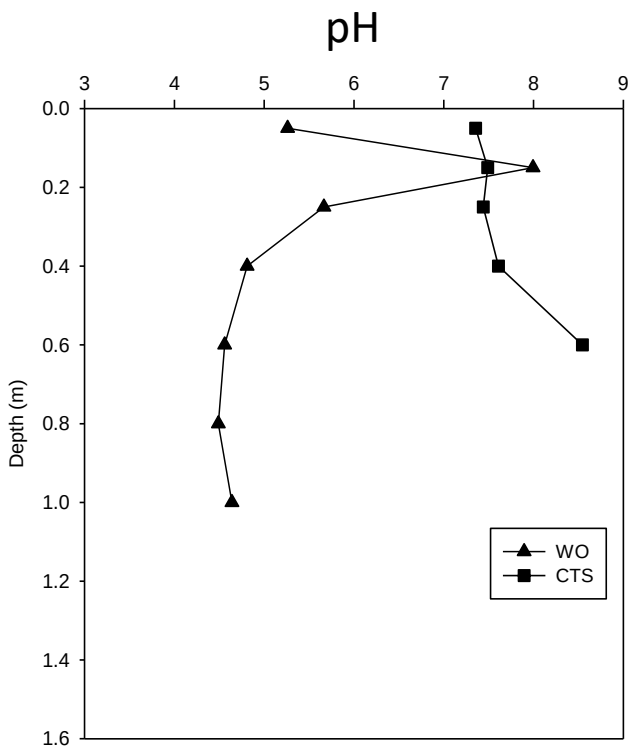
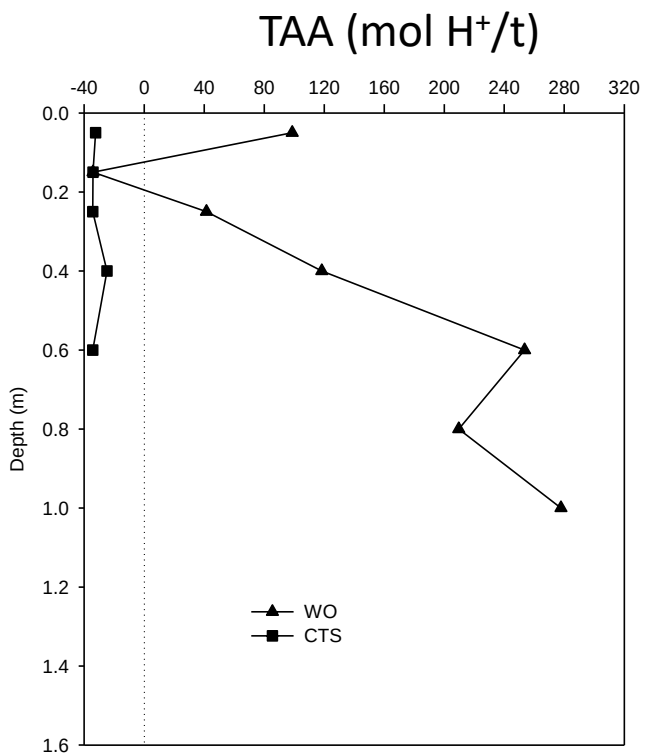
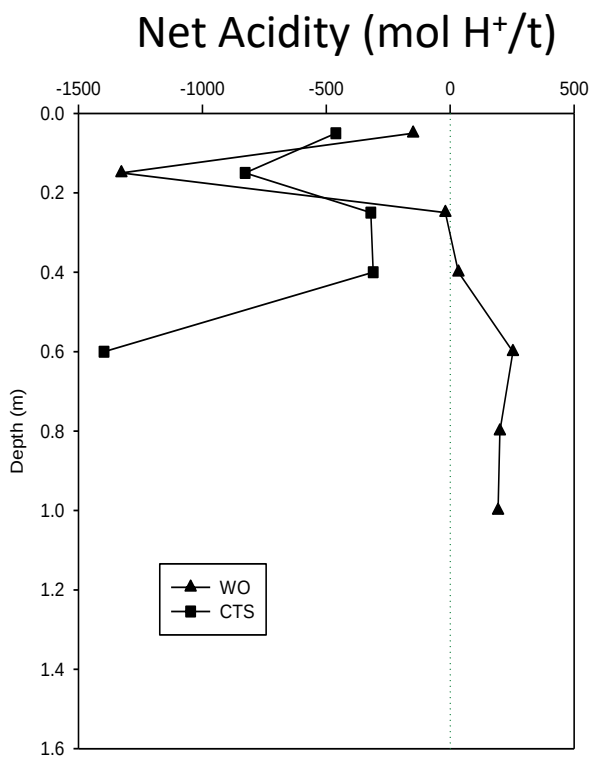



SS
Coogoorah Park Reserve
WE
WO
CTS
Lions Park Reserve
Image © 2014 CNES / Astrium
1000 m
N
Google earth


pH
Depth (m)
WO
CTS


TAA (mol H+/t)
Depth (m)
WO
CTS


Net Acidity (mol H+/t)
Depth (m)
WO
CTS