AusIMM | New Zealand Branch

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Unlocking the Secrets of Wetlands:

Use of Environmental Tracers as Low-cost Tools for Groundwater Effect Assessment

Ryan Burgess and Wijnand Gemson

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PRESENTATION OUTLINE

- What is a Wetland?
- Wetland Conceptual Models
- Characterisation Methods
- Tracers as Tools for Characterisation
- Take Home Points

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WHAT IS A WETLAND?

- U.S. Fish and Wildlife Service (Cowardin et al., 1979) define at 'Wetland' as
  - *"…. lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water."*
- RMA (1991) 'Wetland' definition:
  - *"Wetland includes permanently or intermittently wet areas, shallow water, and land water margins that support a natural ecosystem of plants and animals that are adapted to wet conditions."*
- NPS-FM (2020) 'Natural Wetland':
  - Same as RMA, but exclusions for artificial, geothermal, or exotic pasture dominated wetlands.

wetlandtrust.org.nz

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WHAT IS A WETLAND?

- National Wetland Trust define a number of different types including:
  - Swamps, bogs and tarns
  - Lakes, rivers and streams
  - Estuaries and intertidal areas
  - Geothermal pools
  - Underground wetlands
- Wetlands are greatly valued for social, ecological, and cultural significance.

wetlandtrust.org.nz

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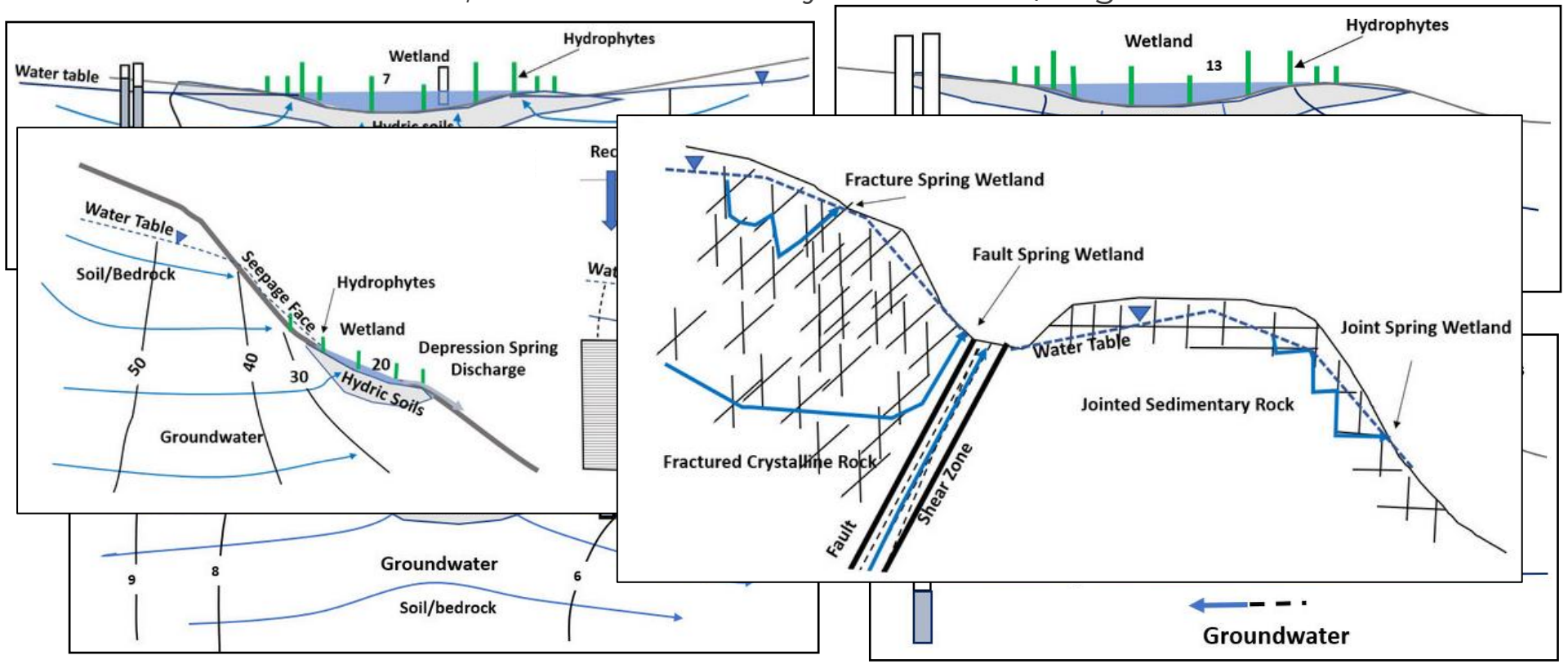
CONCEPTUAL MODELS

- Wetland hydrology and environmental function, can be influence by surface and/or groundwater.
  - GW fed
  - GW losing
  - Flow through
  - Disconnected
- Transience
- Geological controls



Woessner, 2020

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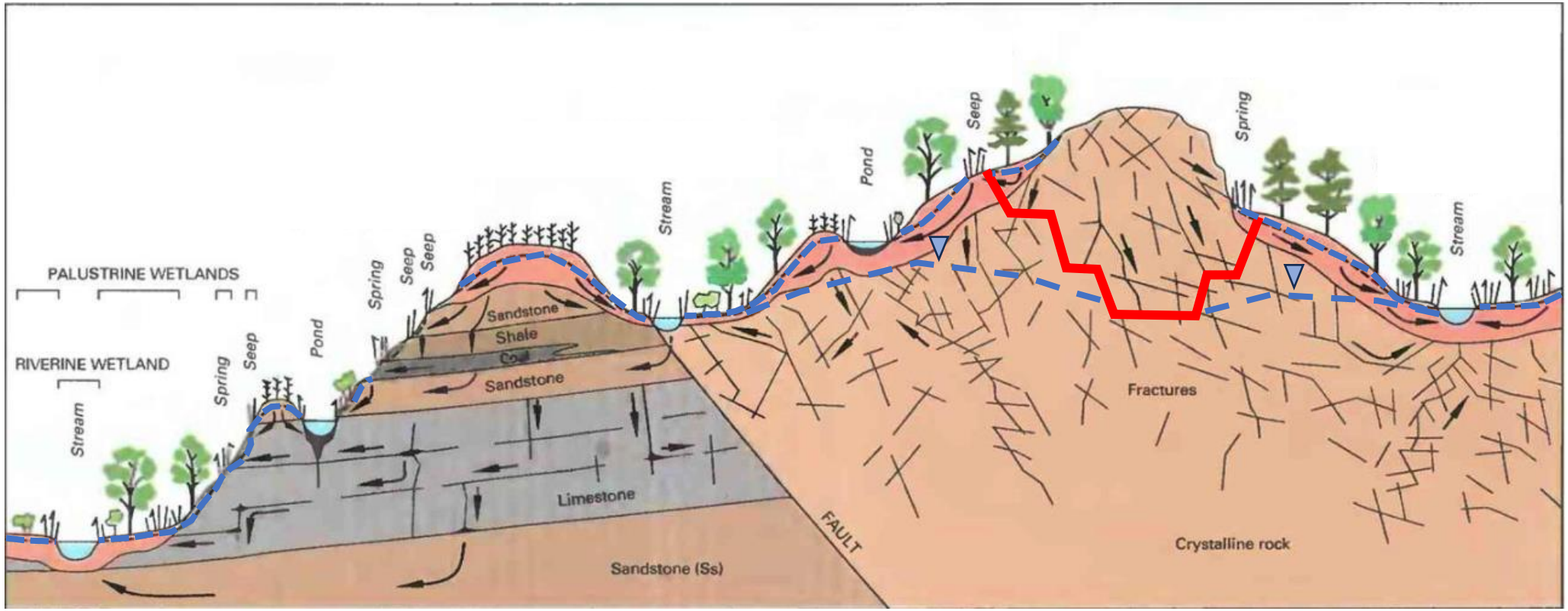
WETLAND LANDSCAPE

- Wetland hydrology, and environmental function, can be controlled by surface and/or **groundwater**.



Modified from:
Fretwell et al., 1996

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WETLAND LANDSCAPE

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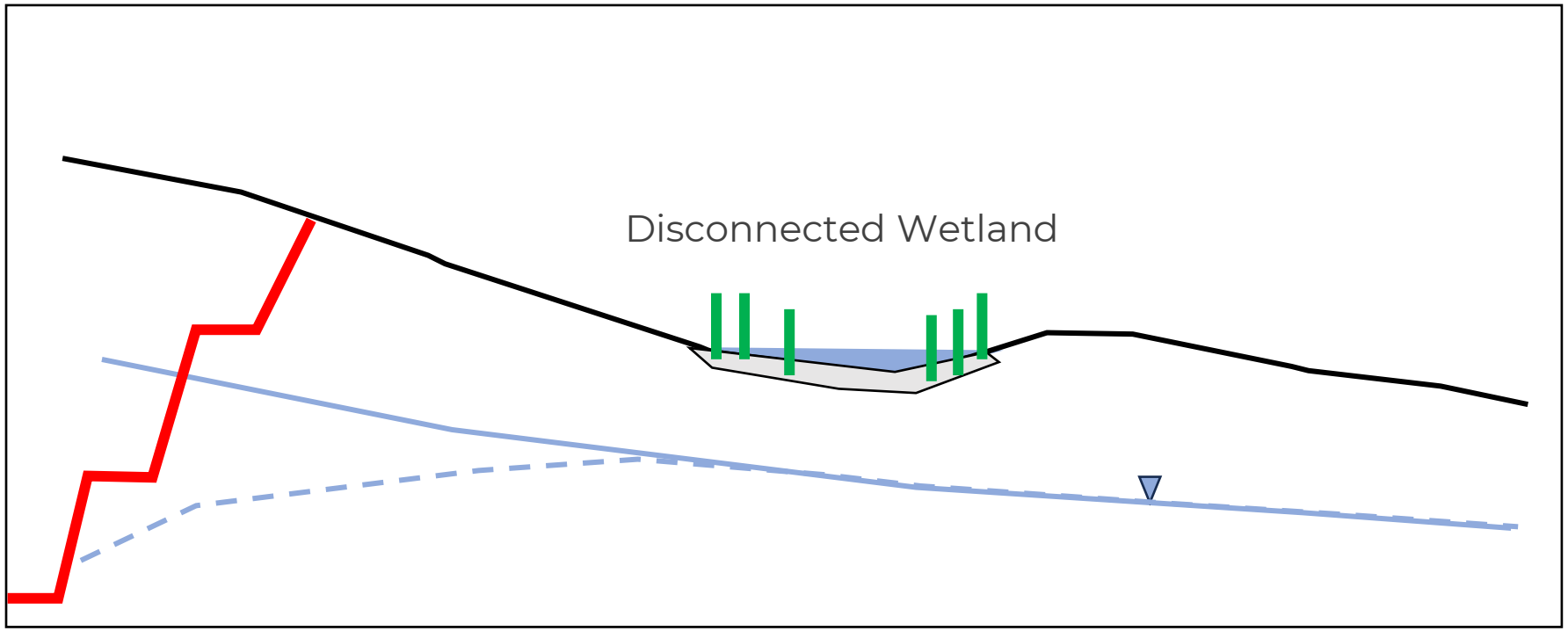

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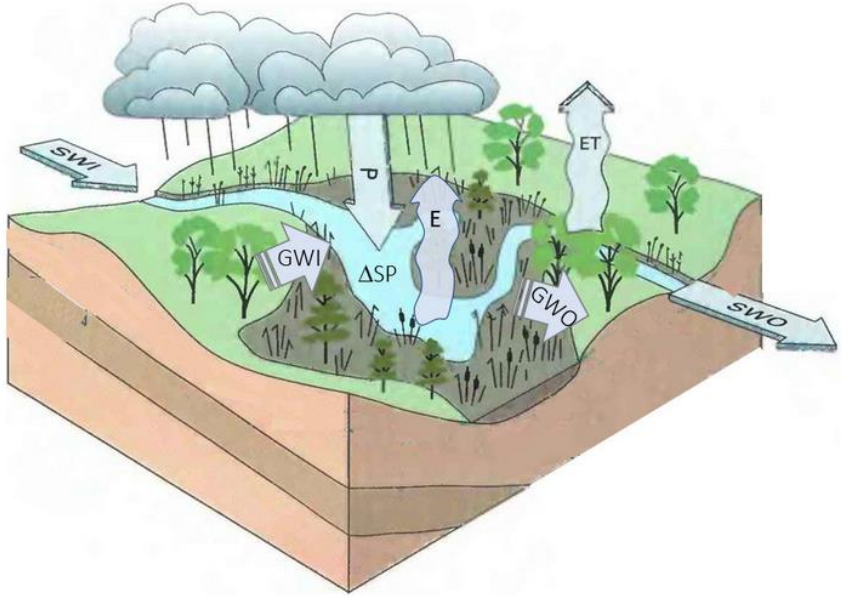
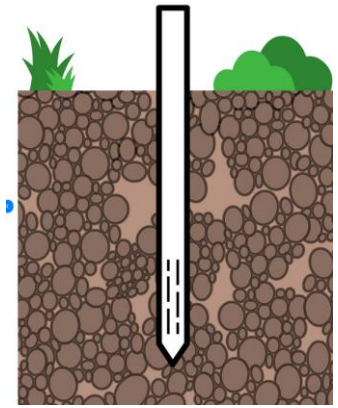
CHARACTERISATION METHODS

- Physical measurements
  - Water levels
  - Water balance
- Easy to interpret but can be expensive data to collect and can involve ground disturbance (e.g., drilling).

boartlongyear.com



modified from Tiner (1996) by Woessner (2002)



Coluccio, 2018

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TRACERS AS TOOLS

- Hydrogeochemical tracers by comparison:
  - Non-intrusive.
  - Typically, routine samples to collect.
  - Relatively low analysis cost.

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TRACERS AS TOOLS

- Naturally occurring tracers:
  - Stable isotopes of H, O, N, C, S, etc.
  - Radioactive isotopes (e.g., ^{222}Rn ^{14}C, ^{3}H).
  - Major ions (e.g., chloride).
  - Dissolved noble gasses (e.g., He).

Tracers typically used

- Artificial tracers:
  - Fluorescent dyes (e.g., uranine, pyronine).
  - Introduced ions (chloride, bromide, strontium).
  - Unintentional anthropogenic labelling (i.e., contaminants).

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TRACERS AS TOOLS

- First step entails developing preliminary conceptual model and evaluating:
  - Which tracers may show sufficient differentiation in water input sources (“end members”) to be useful tracers.
  - Requires understanding of climatic conditions and solute source inputs to system.

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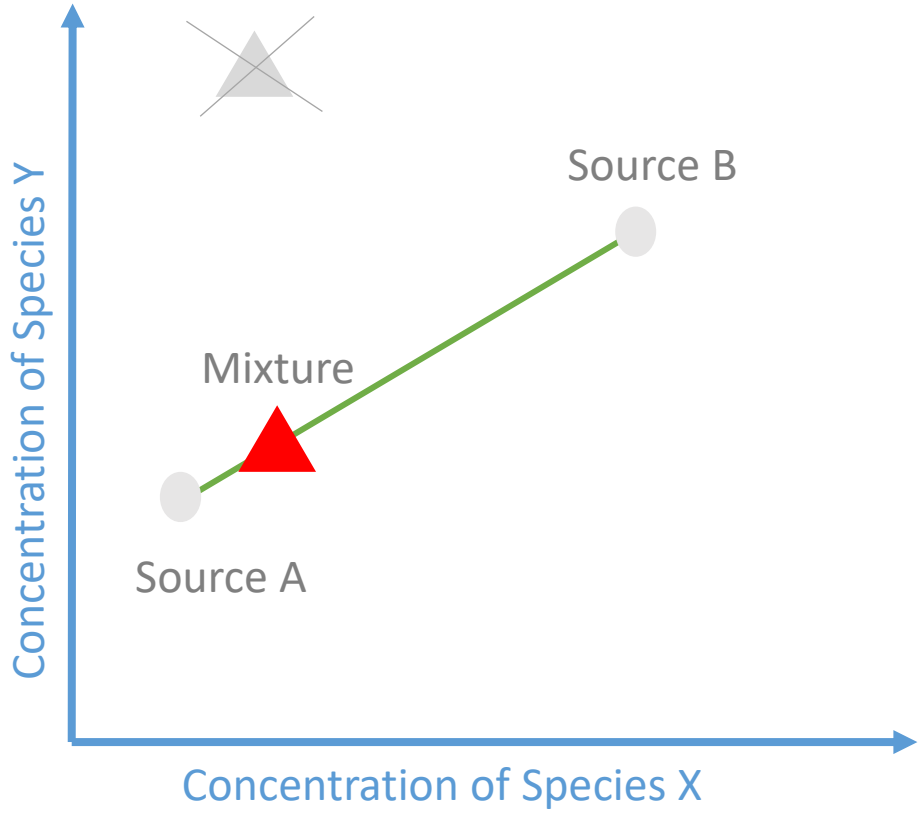
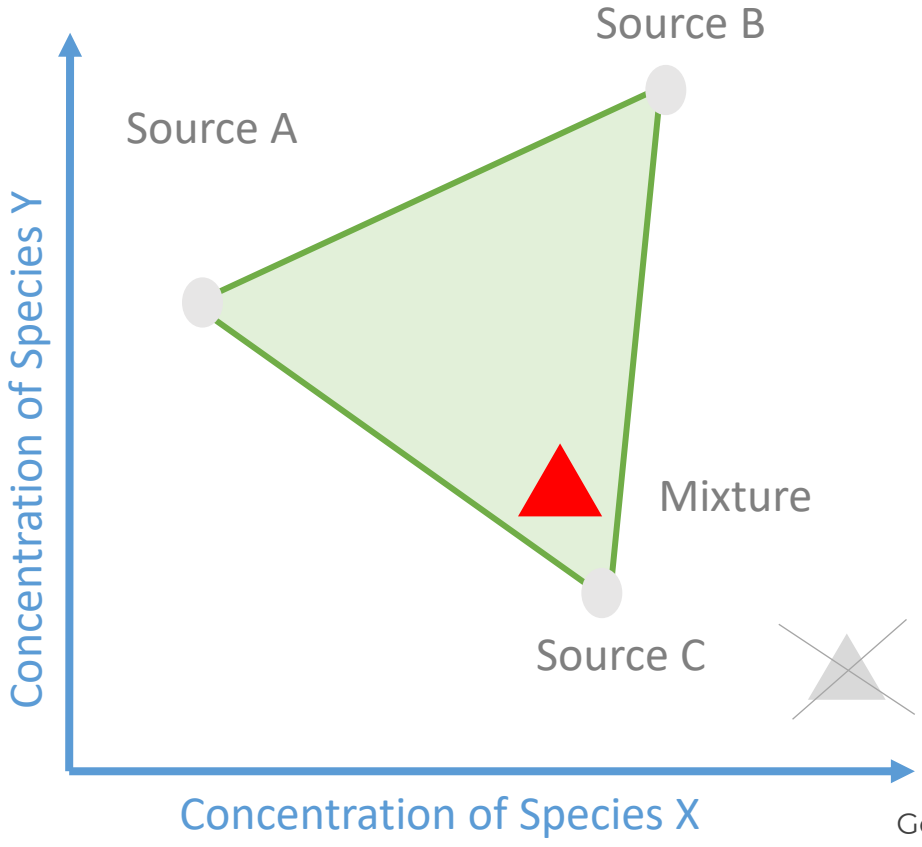
TRACERS AS TOOLS

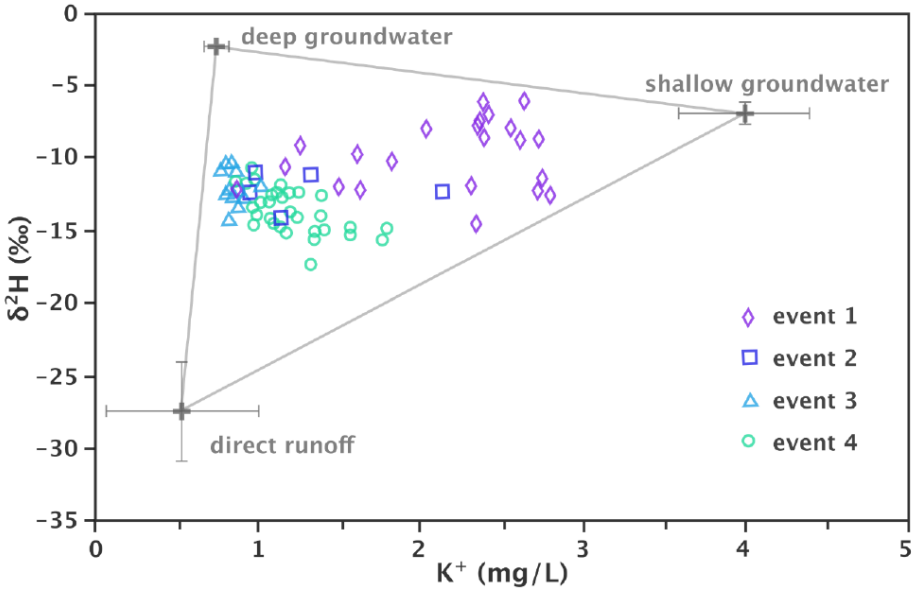
- Where significant hydrochemical difference in end members exist, possible contributions to a mixture (e.g., a wetland) can be assessed.



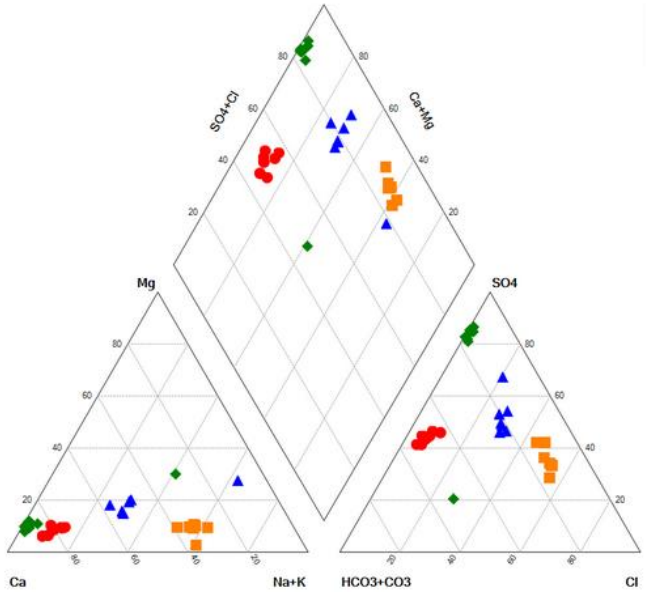


Gemson et al, 2018

TRACERS AS TOOLS



Camacho Suarez et al., 2015



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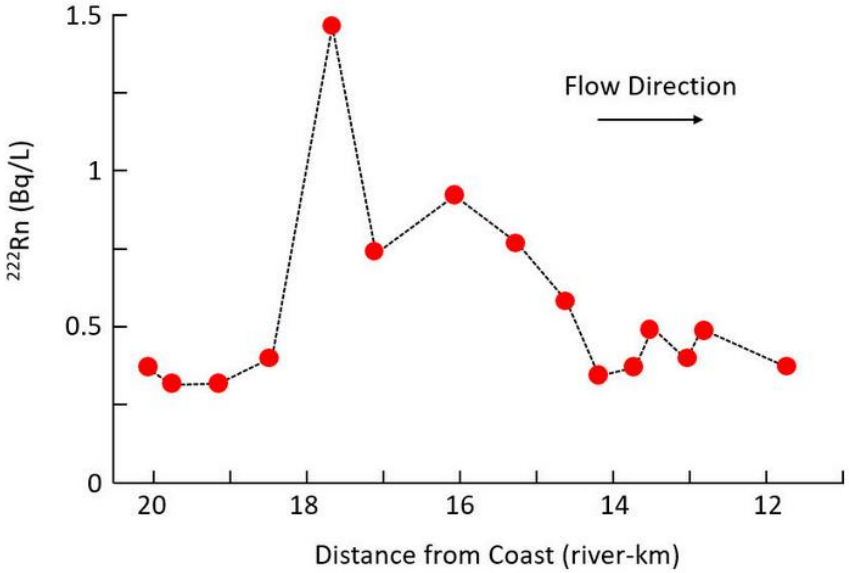

Ellins et al., 1990

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TAKE HOME POINTS

- Wetlands are a valued part of the environment.
- They occur in many different locations across our landscape.
- Can be connected or disconnected from groundwater.
- Traditional characterisation methods can be useful, but often prove expensive.
- Tracers can provide a low-cost tool to evaluate the connection with groundwater.

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