Predicting Salinity and Hydrological Impacts of Strategic Tree Plantations in Small Catchments

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Common questions about plantation effects

- Where in a catchment is it best to establish new forests?

- What is the best design and management to be adopted?

- What are the likely tree growth rates?

- What are the impacts of these new forests on stream flow and salt export ?

- How much can climate change affect growth and stream flow?

➡️ Australian Government Project 2003-2007

'Commercial Environmental Forestry (CEF)'
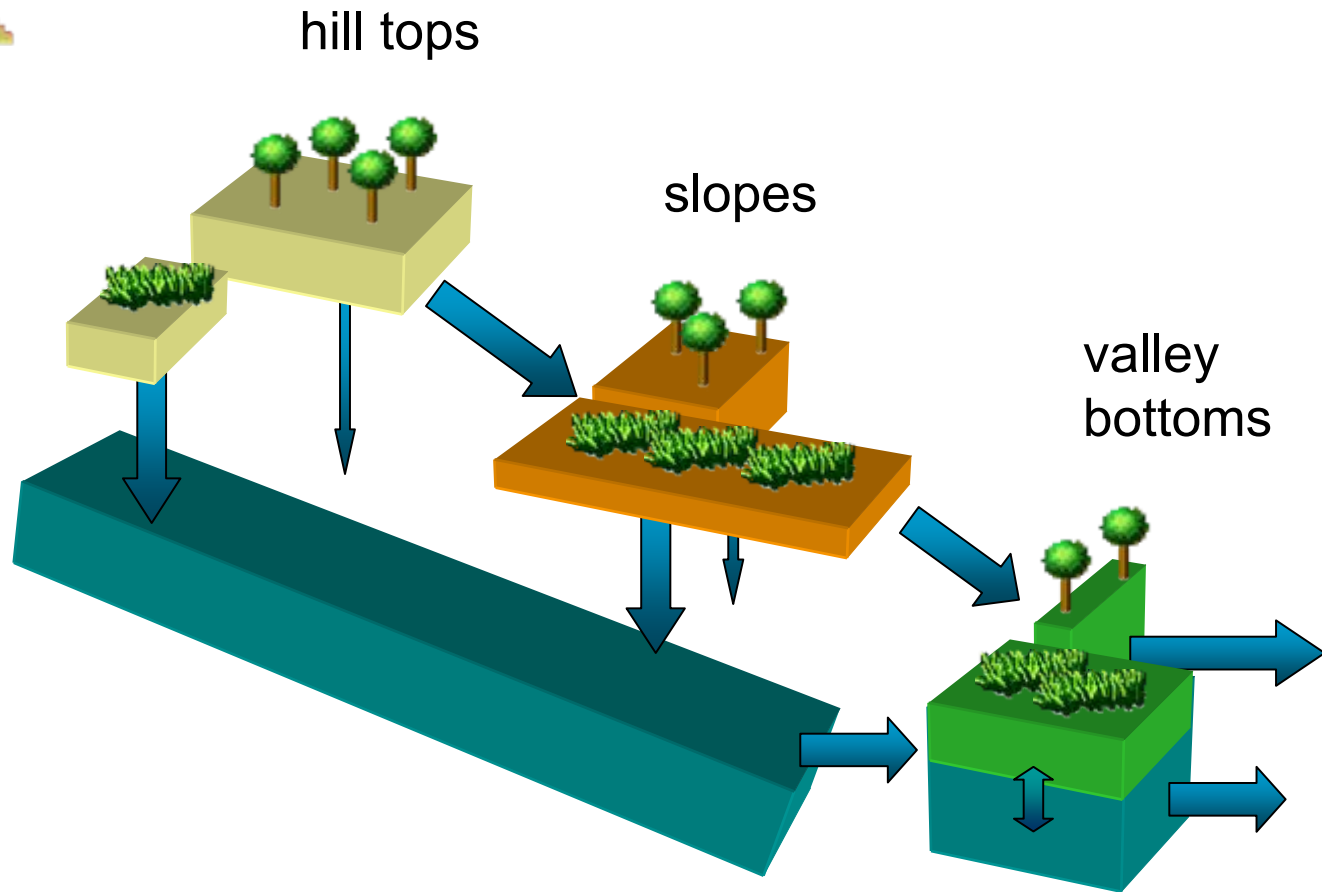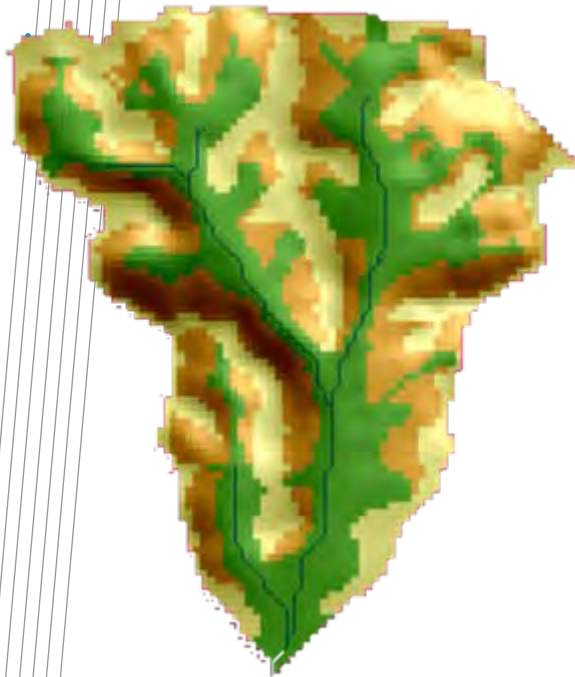
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FLUSH Modelling Framework

Several models were linked in spatial framework:

- Forest growth and water use (3-PG)

- Crop or pasture growth and water use (PERFECT)

- Water and salt export to a stream (3Store, 2CSalt)

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3-PG Model Structure

FLUSH Schematic

hill tops

slopes

valley bottoms
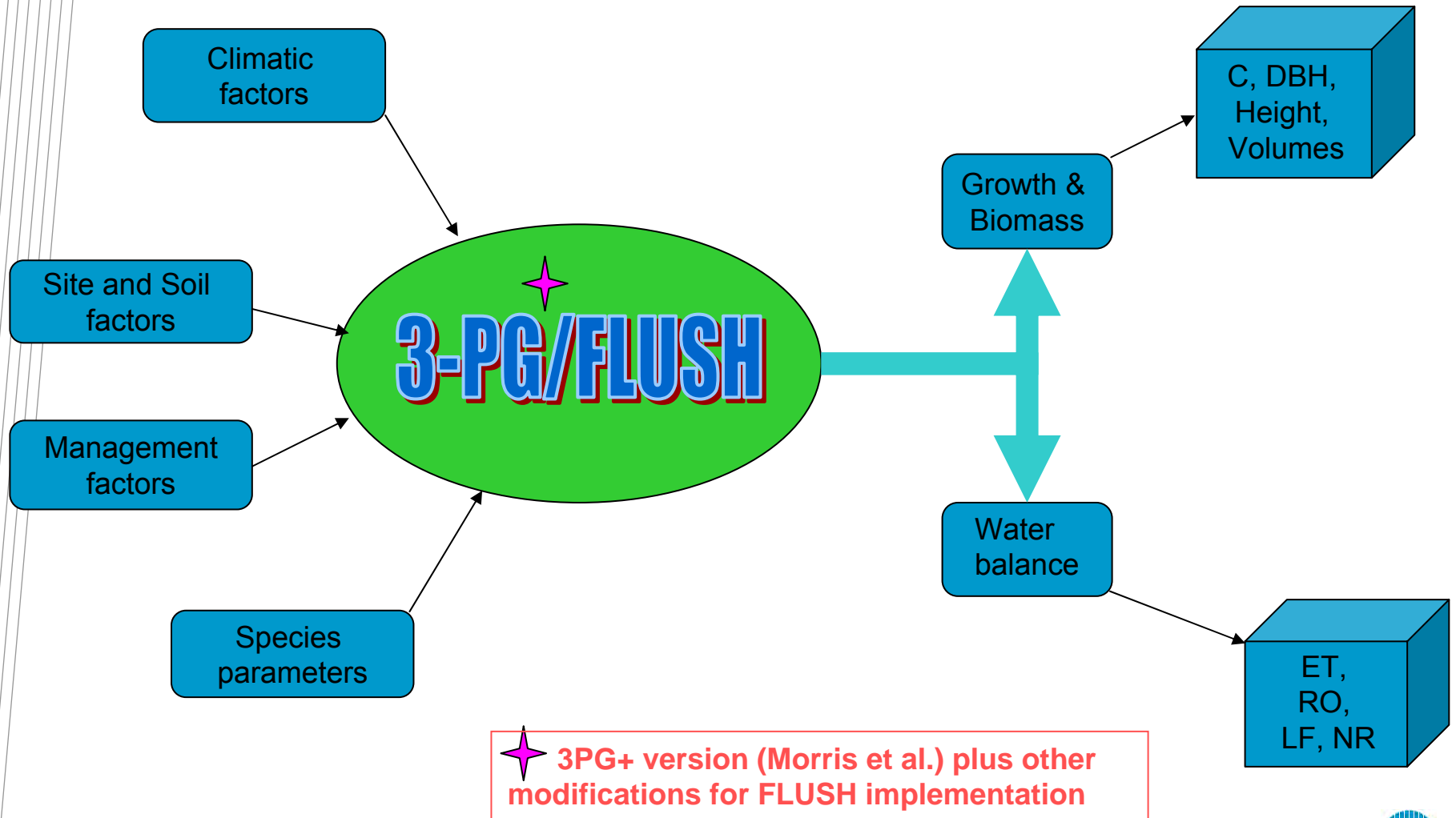
Pine Creek, Victoria, Australia

Rainfall	**768 mm/y**
Potential ET	**1150 mm/y**
Area	**3 km^2**
***P. radiata* (100%)**	**1986-88 planted**

# FLUSH application to Pine Creek catchment

- One-time measurements
  - Soils (depth, WHC, texture, fertility index)
  - tree growth and physiology

- Time series measurements
  - Stream flow
  - Salt load

- Modelling
  - Tree growth, water use
  - Stream flow and salt load

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Model predictions versus observations

Stream salinity (EC)

Salt yield
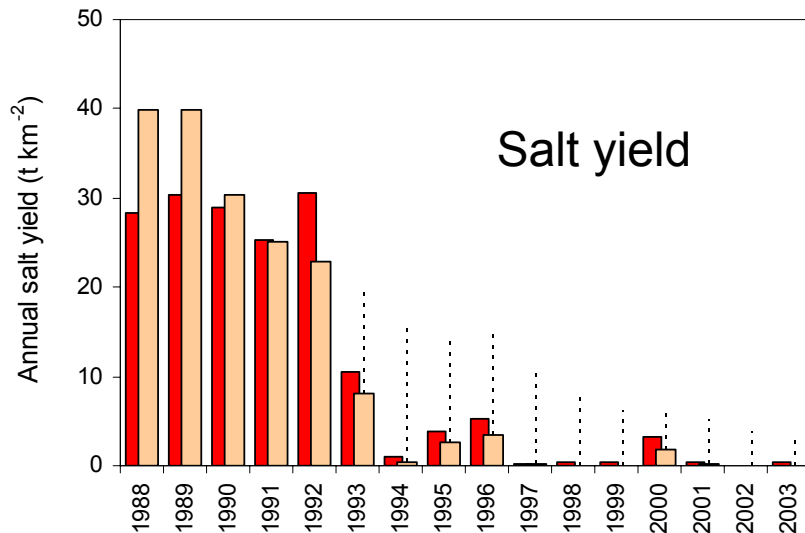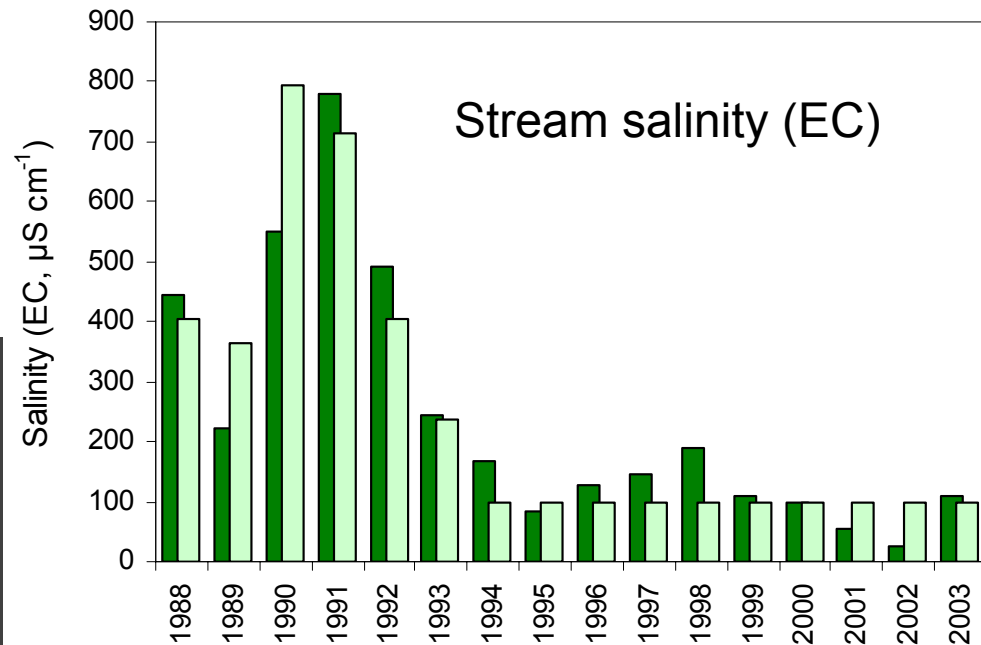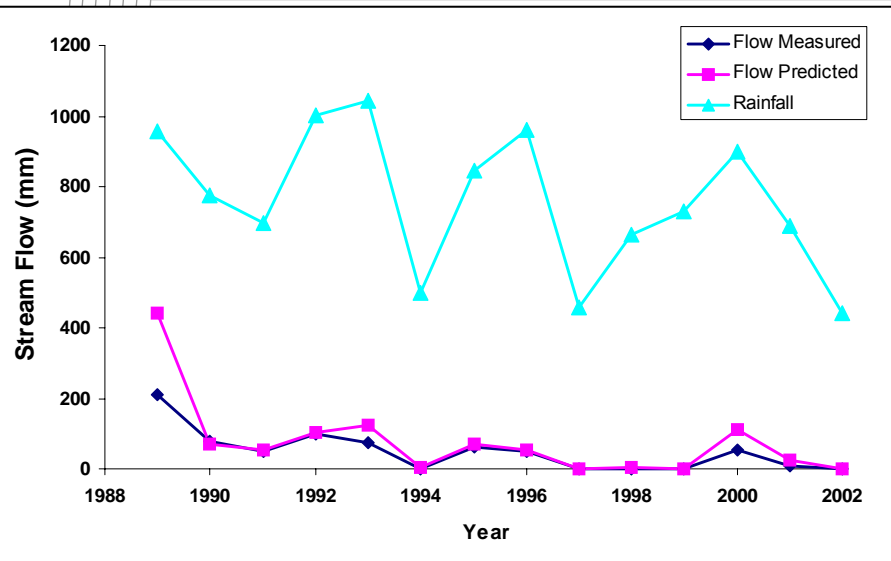
dark bars = measured, light bars = modelled
(1988 data only 3 months)

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Tree growth
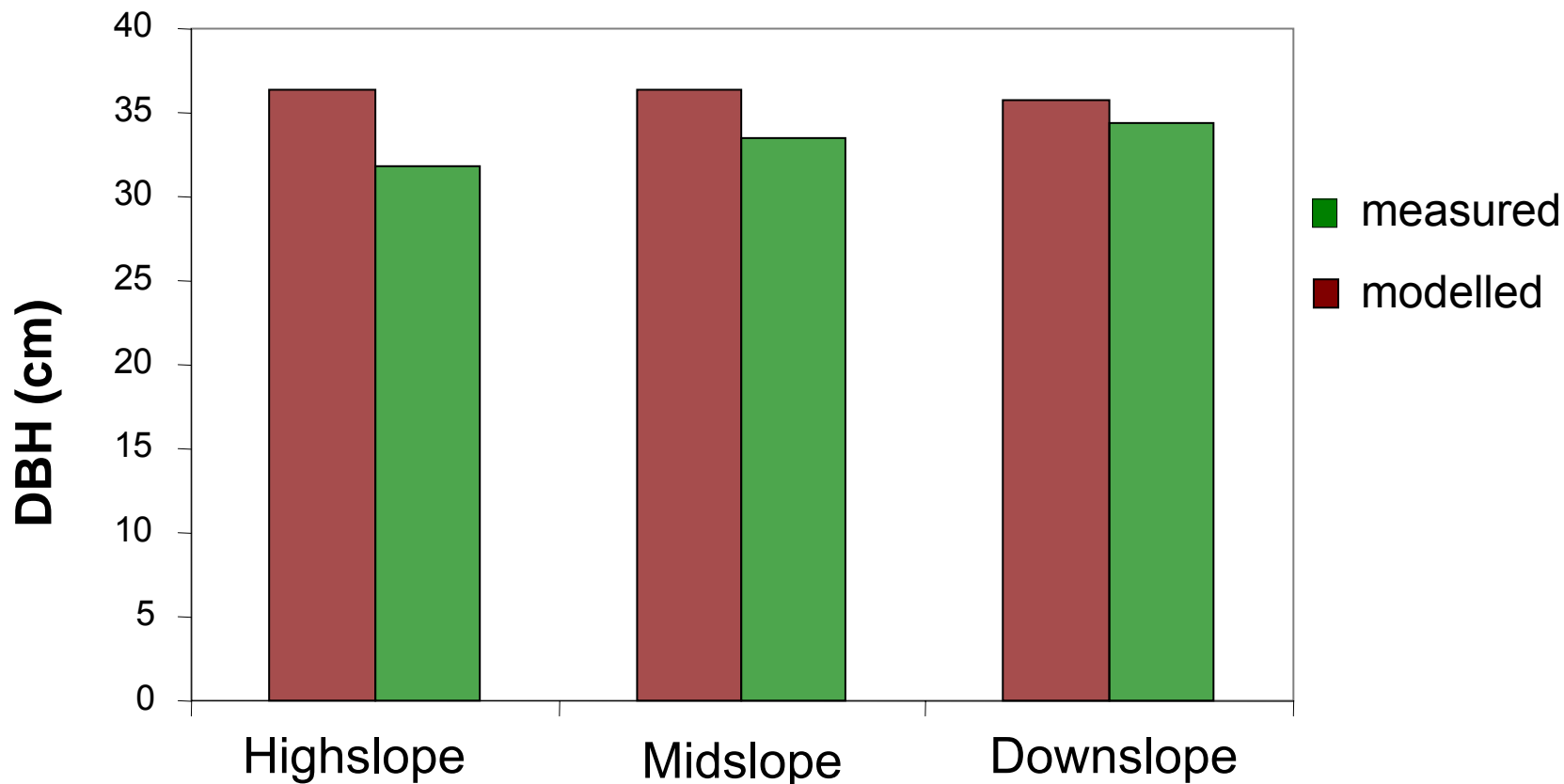
Observed differences in $DBH_{20 \text{ years}}$ between land units were small and the model overestimated DBH by 4%

FLUSH Improvements Required

- FLUSH performed fairly well at Pine Creek site, where growth on different landscape positions was similar – not a good test

- Further testing is therefore required in a site where differences in growth between land units are more prominent (e.g. Willow Bend Farm)

- Some improvements can also be made in the water balance component within 3PG:

    - Estimation of evapotranspiration

    - Root development, and root pruning (waterlogging)

    - Groundwater use by trees

    - Soil layering (A and B)

FLUSH - summary

- FLUSH has the ability to model interactions between patches of landscape

- The model can be best used for design and management assessment and for testing various scenarios and guidelines

- Improvements in the water balance component of 3PG would help better simulate hydrological impacts

- The model needs to be tested at another site where differences in growth between land units is expected

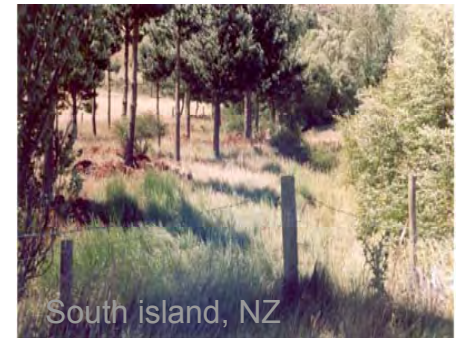# Examples of Stream-Side Forest Plantation Buffers – but stream flow questions

Pet River, Tas
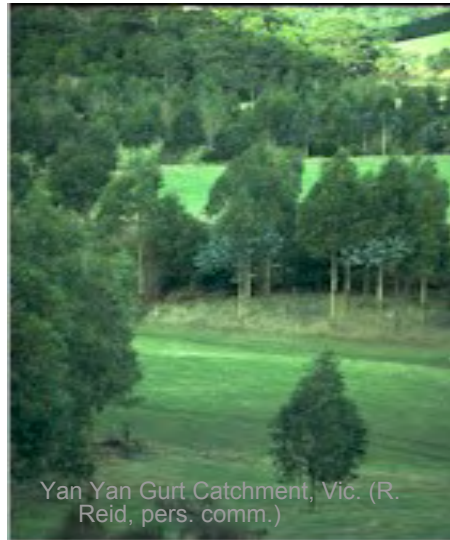
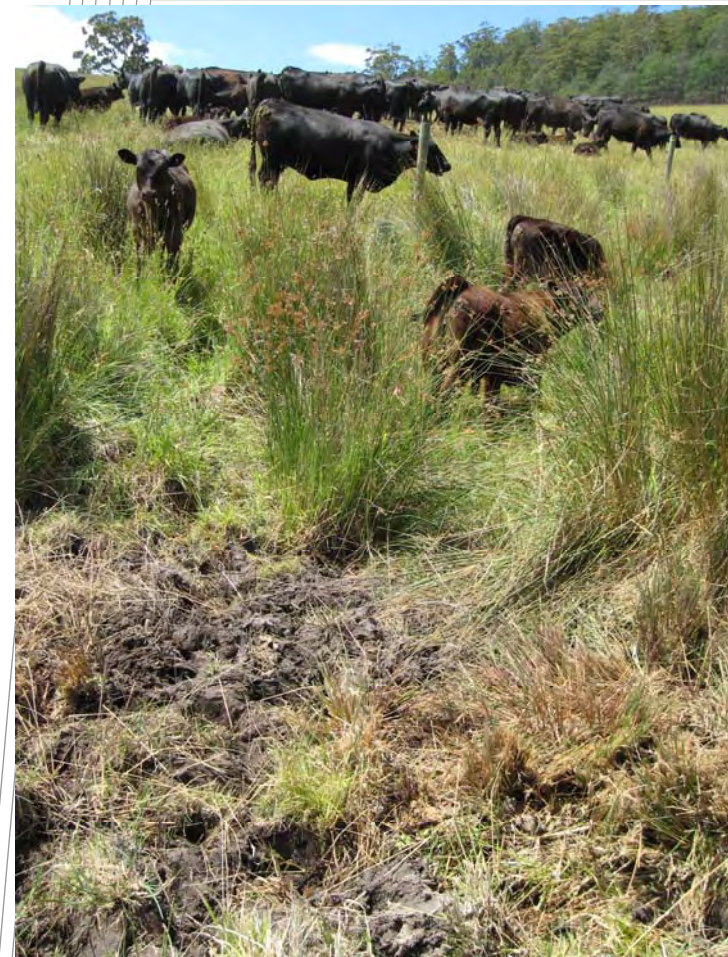Yan Yan Gurt Catchment, Vic. (R. Reid, pers. comm.)

South island, NZ

Albany, WA

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Willow Bend Farm Paired-Catchment Experiment

Willow Bend Farm, Wattle Grove
Proposed operations:
Stream plantings & Plantations

N

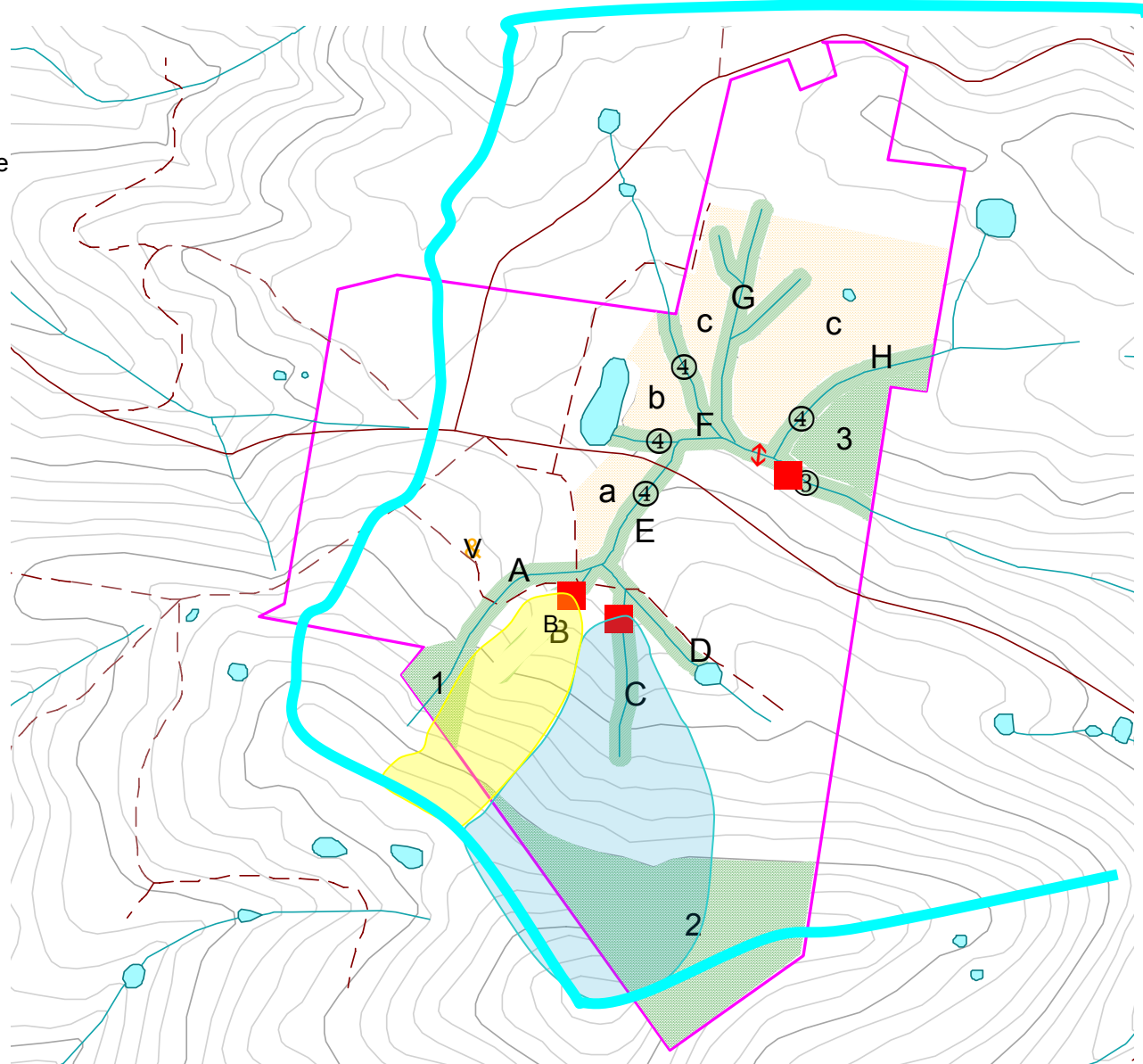| 0 | 100 | 200 | 300 | Meters |

Scale 1 : 7 500

Arterial Road
Access Road
Vehicular Track

③ Class 3 Stream
④ Class 4 Stream
↔ Ford
House

Access Track
Drainage Line

Property Boundary
Proposed Plantation
Streamside Planting
Native Forest

Paired catchments

E. nitens, E. globulus
Acacia melanoxylon
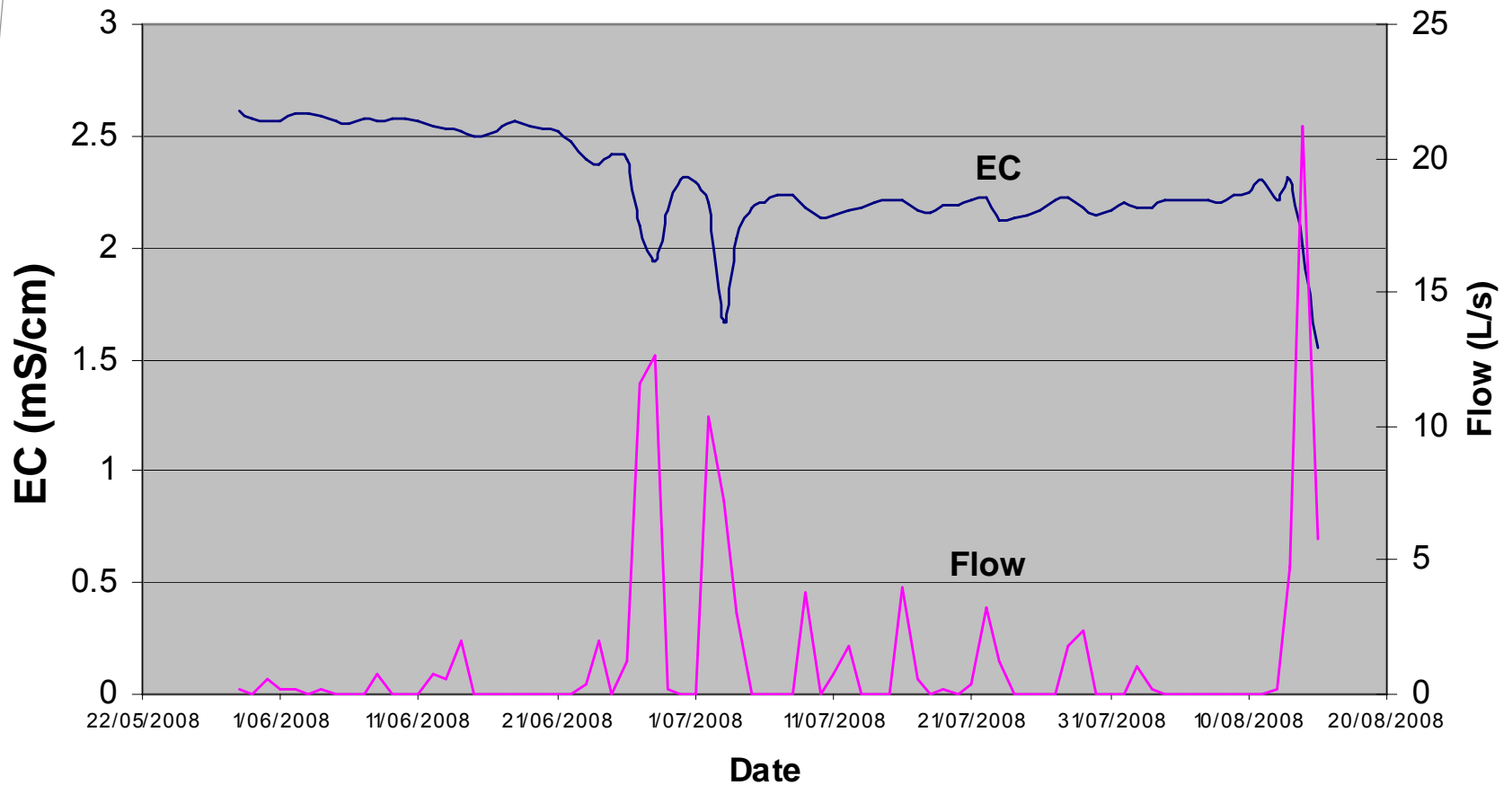Plantation (2008)

Untreated

Modelling
• 3-PG/FLUSH (water, salinity)
• Hydrus-CW2D (N dynamics)

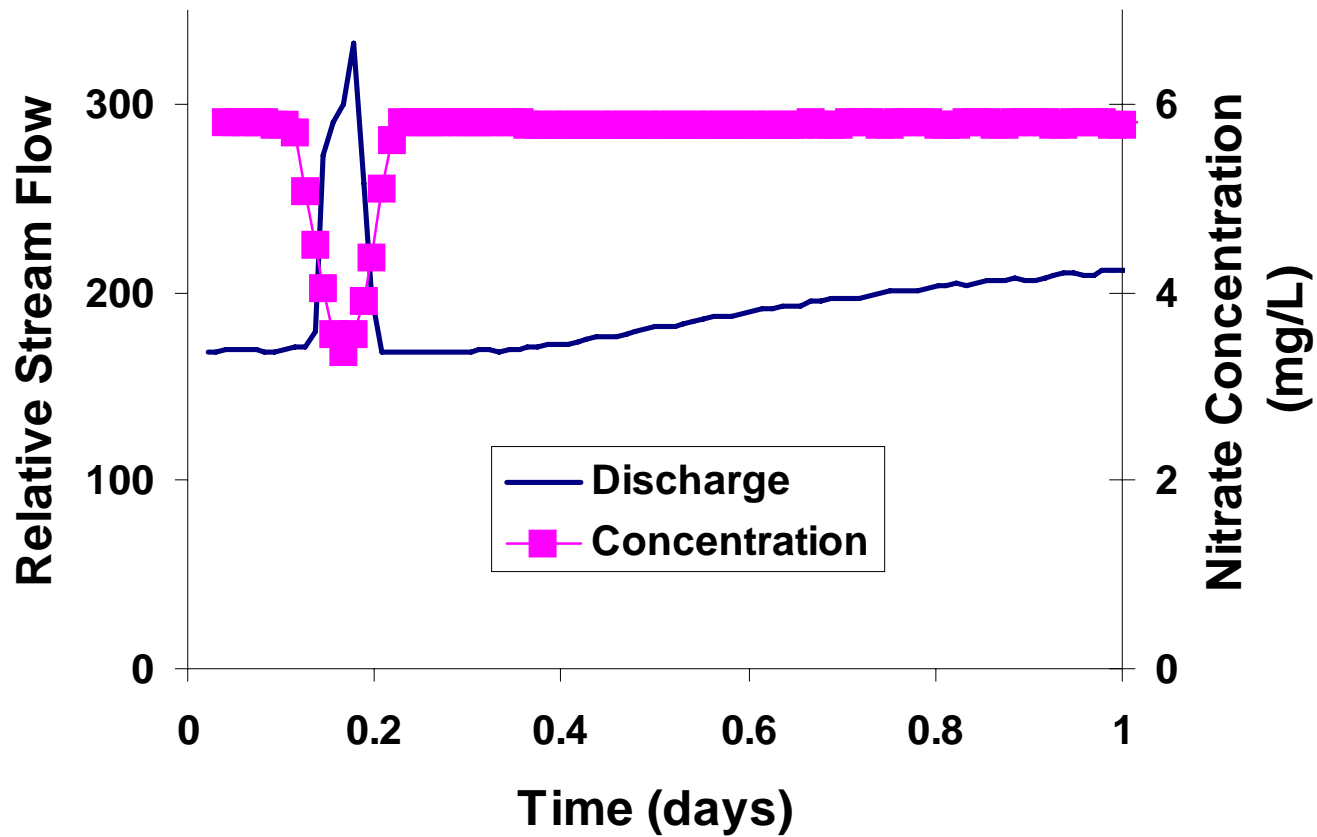# Plantation Buffer 2008 in Paired-Catchment

- By how much will the plantation buffer reduce stream flows?
- Can the variation in tree growth be simulated?

Measured Salinity and Flow (May-Aug 2008): seasonal decrease and storm-event dilution

Simulation of dilution during a storm event using the HYDRUS 2D model

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Thank you

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