DRP and SSC Modelling in Ruamahanga

Technical Overview

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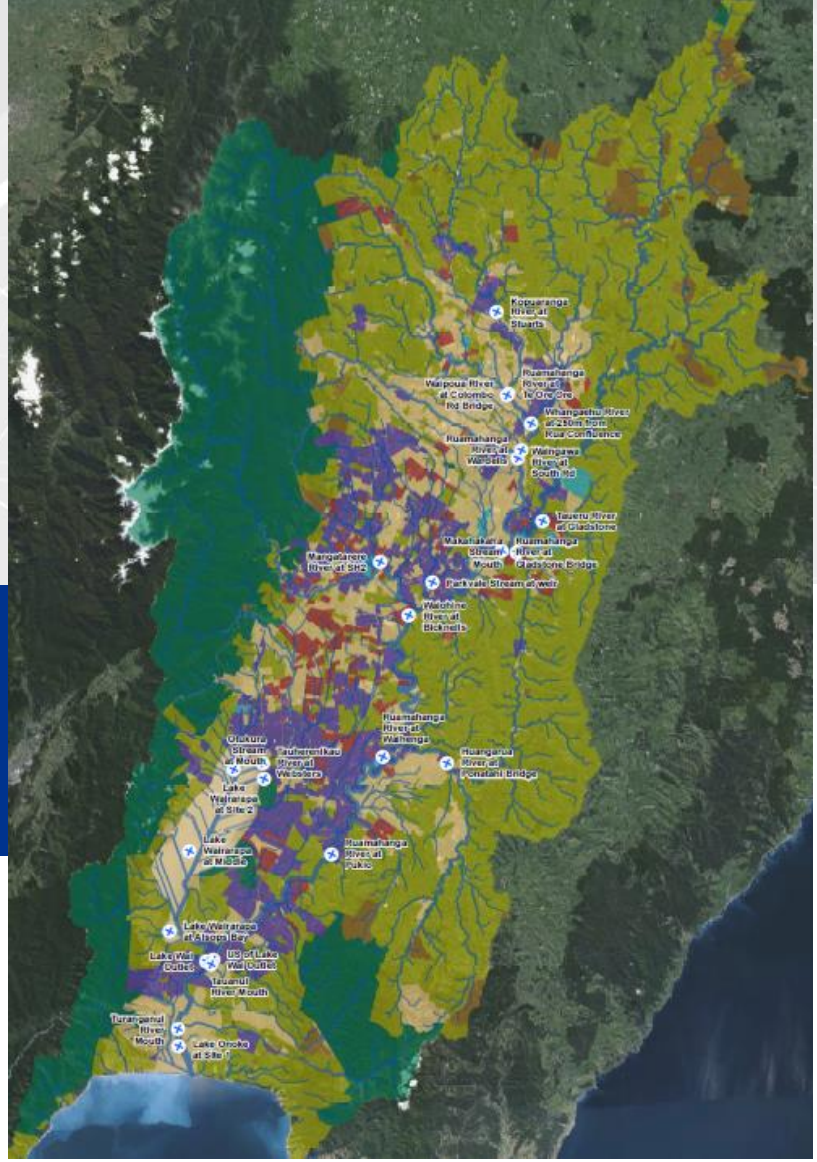

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What should you consider from the modelling results?

- These are a guide to help inform your decisions
- The results will not always be a perfect match to the observed data
- The model is calibrated as close as possible to observed data, with the aim of representing the natural system
- The relative changes (i.e. percentage reductions and swimming categories) provide the most useful information about how a catchments concentrations may change, depending on its landuse and the mitigations applied

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Background to catchment modelling-DRP

- Landuse/soil classes defined in the catchment
- Apply input data (DRP nutrient generation rates) to these landuses using an EMC/DWC approach

  - EMC - Event Mean Concentrations.
    - Applied to the quickflow/runoff during storm events

  - DWC – Dry Weather Concentrations
    - Applied to the baseflow that occurs as regular inputs to a stream

Background to catchment modelling

- Flows generated off each landuse are partitioned into baseflow and quickflow.
  - The partitioned flow has either EMC's or DWC's applied to generate load
- Point source inputs (i.e. WWTP) added as a daily DRP and SSC concentration
- Model is calibrated at various river sites to observed data, by incorporating 'attenuation factors'

Background to catchment modelling-SSC

- Different methodology for modelling suspended sediment concentration (SSC) compared to all other nutrients
- Utilises a GIS method adapted for New Zealand by Landcare Research called SedNetNZ, linked to the Revised Universal Soil Loss Equation (RUSLE) and NZLRI LUC maps
  - This GIS model maps sediment annual average yields (tn/ha/yr)
  - Calibrated to observed SSC data NZ wide, where available
  - May not reflect current landcover

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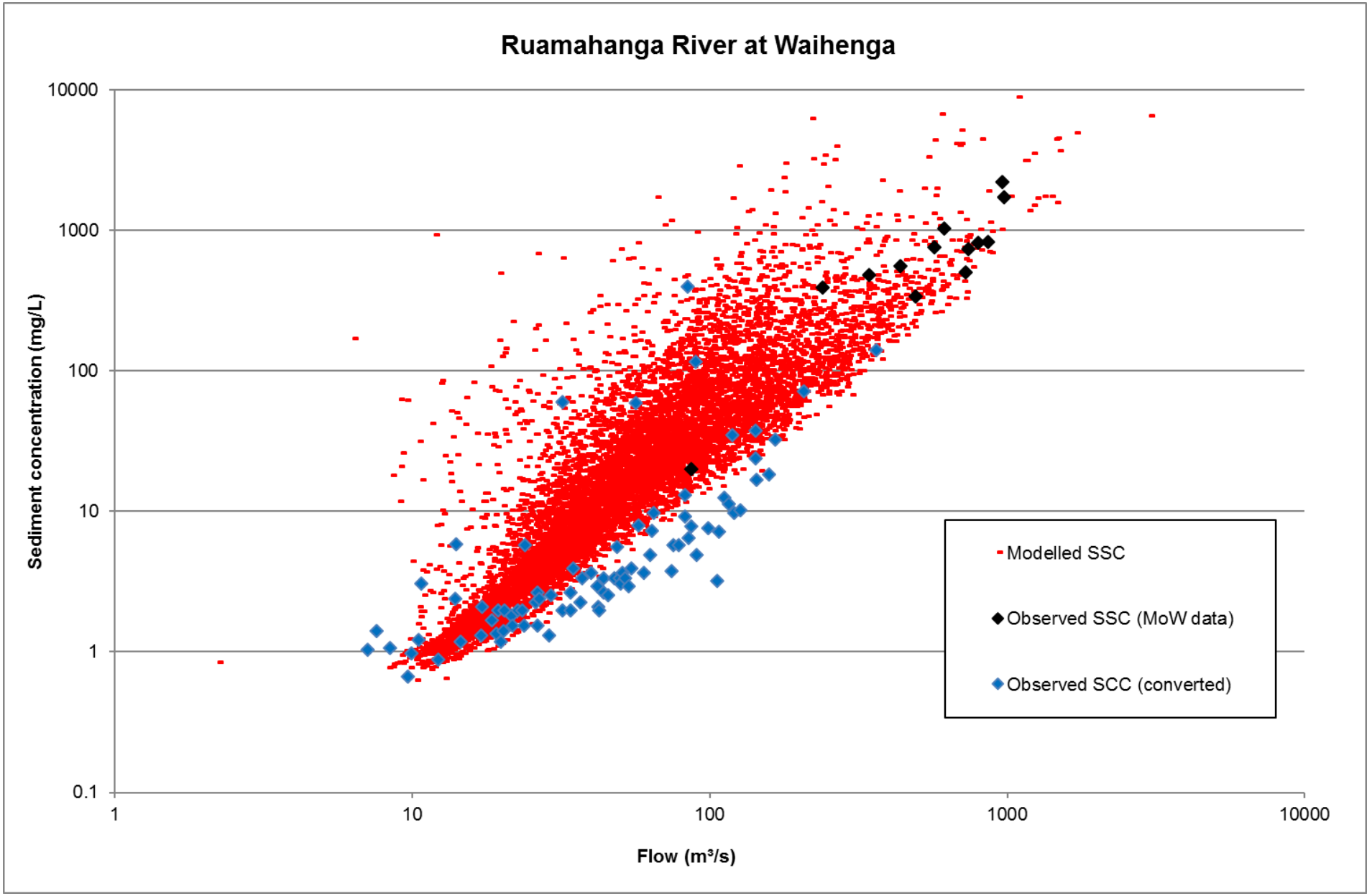
Background to catchment modelling-SSC

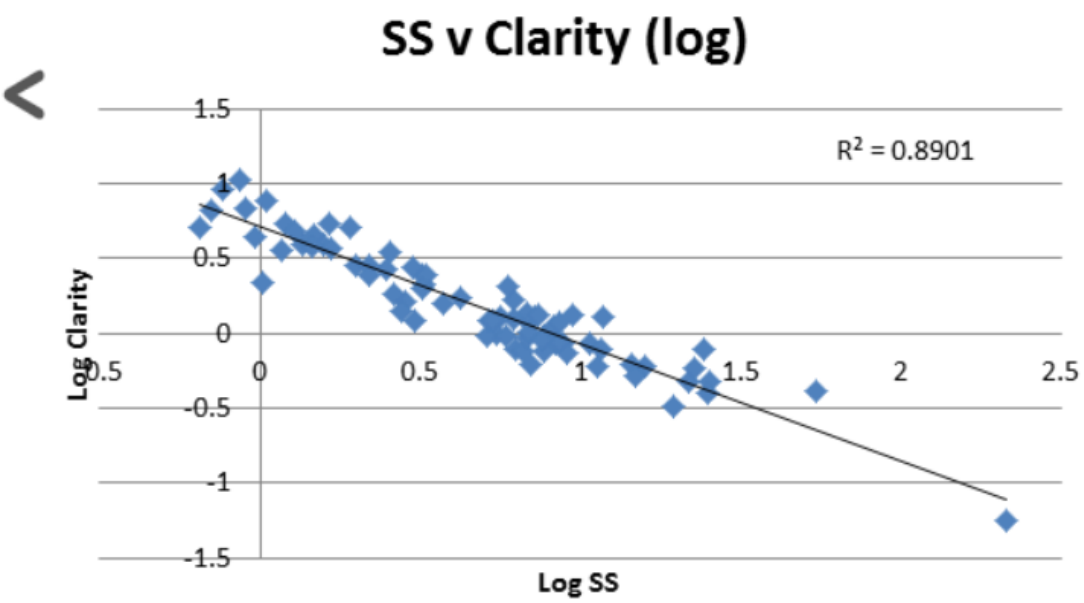
- Source model utilises an SSC power curve for every catchment, which predicts daily sediment concentration (mg/L) based off simulated flows.
- Each catchments power curve has been ‘calibrated’ to ensure SSC simulated concentrations match SedNetNZ annual average loads

Background to catchment modelling-SSC



SSC and Clarity

- NIWA added SSC sampling in 2012 to National Rivers Water Quality Network (NRWQN) which covers 77 sites across New Zealand.
- Can compare to clarity.
- A reduction in SSC leads to an increase in clarity, all sites show a strong correlation (r^2 of 0.89 on the log scale). Beneficial for light penetration, aquatic ecosystems, aggradation, macrophytes etc.



Relationship between suspended sediment and clarity.

https://www.niwa.co.nz/environmental-information/update/environmental-information-update-3-august-2012/monitoring-suspended-sediment-to-better

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Assumptions/Limitations to modelling

- Most DRP input concentrations are taken from literature data not always from the study area, and instream concentrations
- Flows (from external models) have a significant impact on concentrations. Poor flow calibrations mean nutrient calibrations may be poor, although buffered out by ‘attenuation’ factors.
- Water quality data to calibrate was from 2000-2014 (same as flow data). SSC data was limited, and turbidity was converted to SSC where possible

Mitigations applied- DRP

- All mitigations were modelled and reported by agresearch/MPI for 16 representative farms in the catchment
- The nutrient reductions were converted to weighted average % reductions to apply to appropriate landuse types within the catchment

Mitigations applied- DRP

Mitigations applied to input concentrations		Percentage (%) reduction from baseline concentrations			
Species	Scenario	Dairy	Sheep and Beef	Arable Farm	Dairy Support
Cumulative Weighted Average TP, DRP reductions (applied to EMC's)	Baseline	-	-	-	-
	Tier 1	16.8	1.5	0	5.9
	Tier 2	26.6	13.3	0	11.9
	Tier 3 5m buffer	27.5	80.1	20	23.8
	Tier 3 10m buffer	29.8	80.1	20	23.8

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Mitigations applied- SSC

Mitigations applied to input concentrations		Percentage (%) reduction from baseline concentrations			
Species	Scenario	Dairy	Sheep and Beef	Arable Farm	Dairy Support
Individual SSC reductions (applied to streambank or hillslope erosion layers in SedNetNZ)	Baseline	-	-	-	-
	Tier 1 (stream bank erosion layer)	80	80	80	80
	Tier 2 (hillslope erosion layer)	6.40	20.70	0.00	5.80
	Tier 3 5 and 10 m buffers	-	-	-	-

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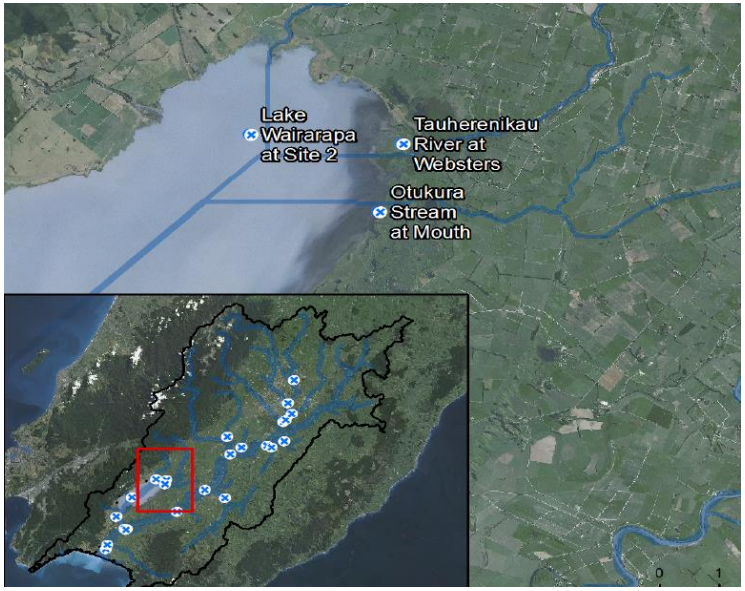
Scenario Results- Example Western Sites

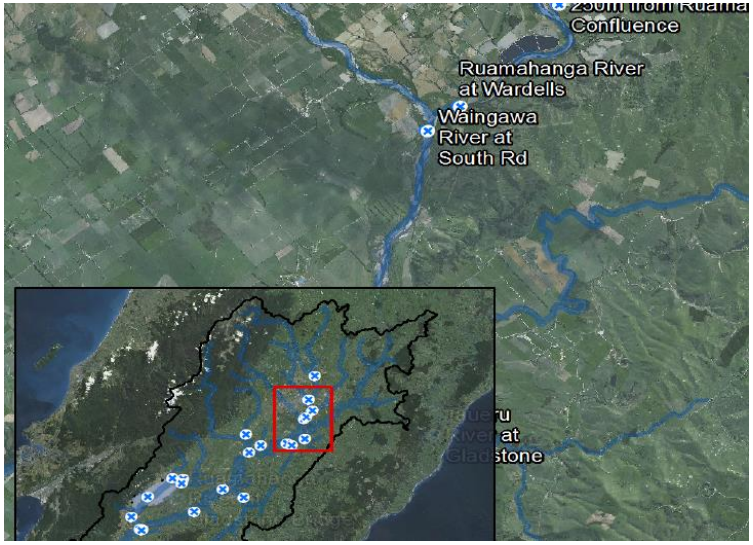
Tauherenikau at Websters

Scenario	DRP % reduction (median)	SSC % reduction (median)
BAU 2080	0.9	-12.7
Silver 2080	-3.3	-13.6



Waingawa at South Road

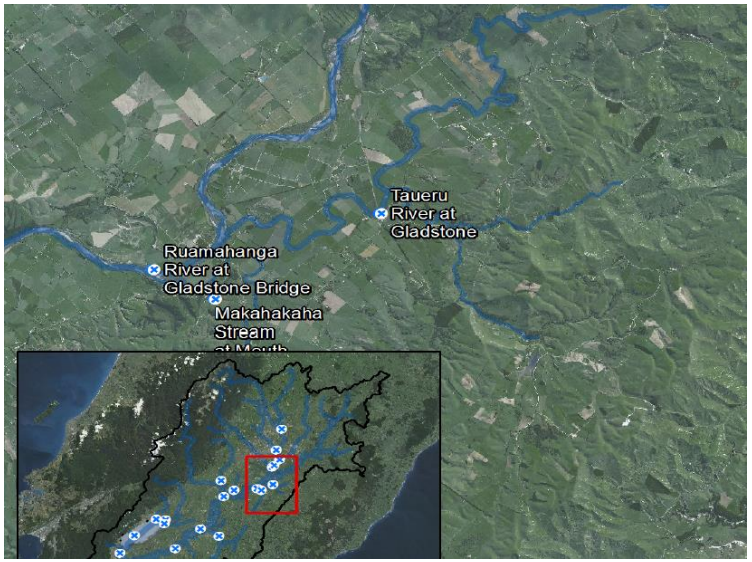
Scenario	DRP % reduction (median)	SSC % reduction (median)
BAU 2080	-3.8	-10.5
Silver 2080	-26.3	-14.6



Scenario Results- Example Eastern Sites

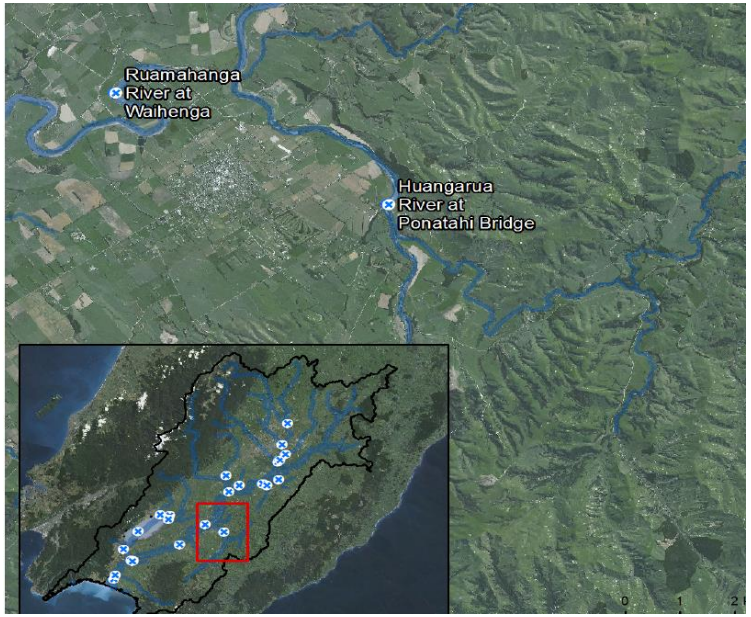
Taueru River at Gladstone

Scenario	DRP % reduction (median)	SSC % reduction (median)
BAU 2080	-3.0	-36.7
Silver 2080	-52.0	-67.4



Huangarua at Ponatahi Bridge

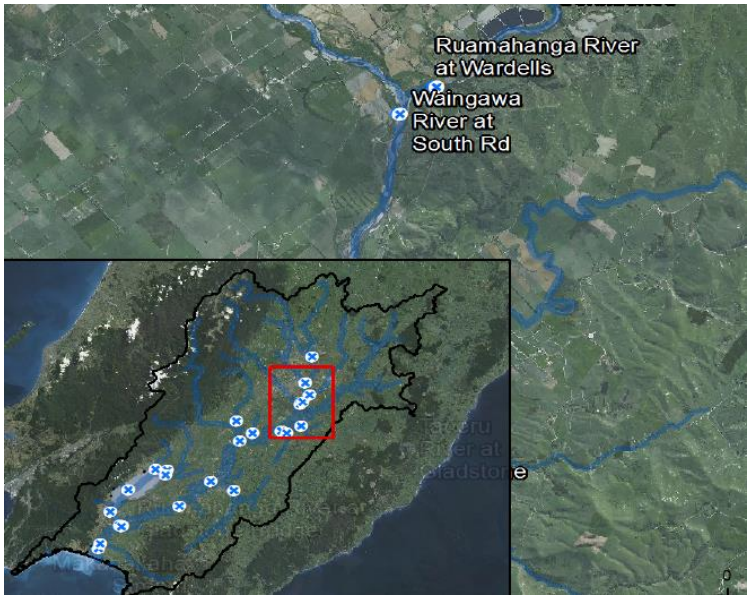
Scenario	DRP % reduction (median)	SSC % reduction (median)
BAU 2080	-0.1	-18.0
Silver 2080	-34.9	-64.0



Scenario Results- Ruamahanga River

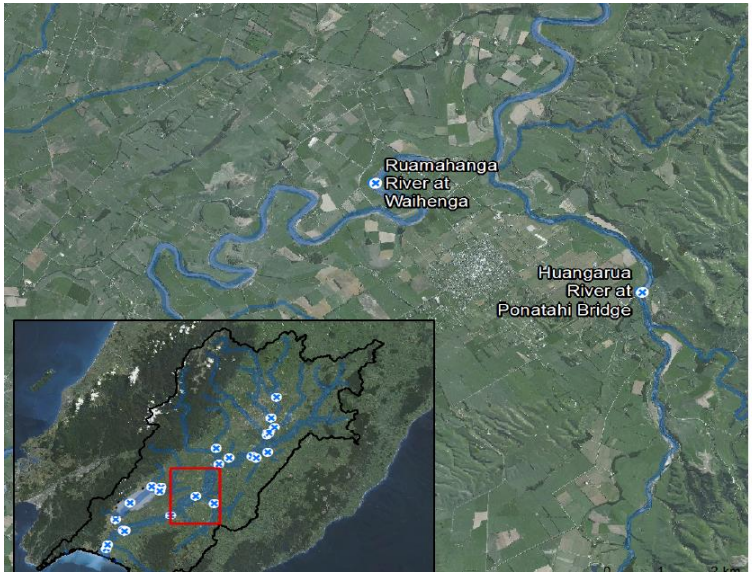
Ruamahanga River at Wardells

Scenario	DRP % reduction (median)	SSC % reduction (median)
BAU 2080	-57.5	-13.5
Silver 2080	-71.2	-37.8



Ruamahanga River at Waihenga

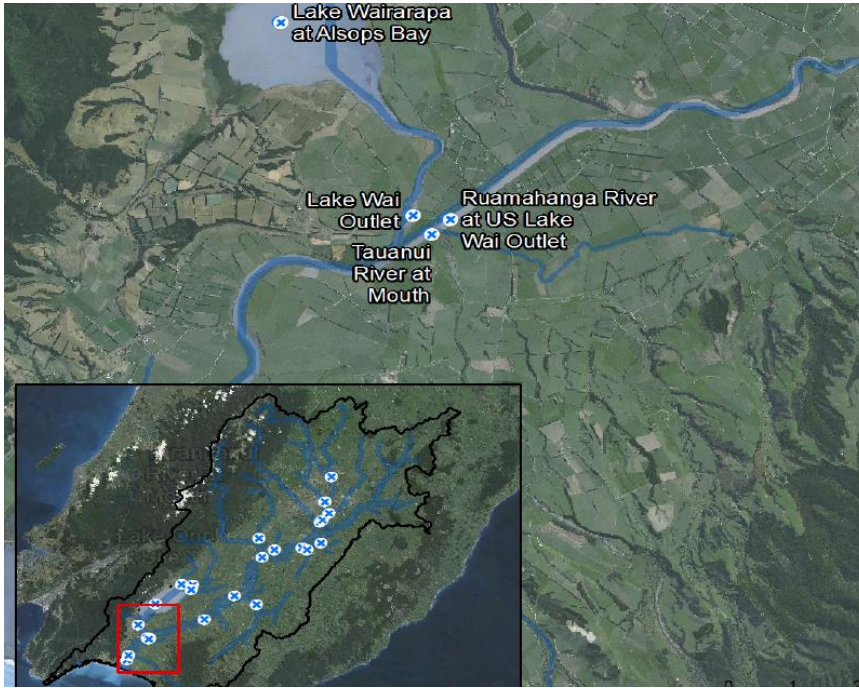
Scenario	DRP % reduction (median)	SSC % reduction (median)
BAU 2080	-46.5	-20.4
Silver 2080	-60.6	-41.4



Scenario Results- Ruamahanga River

Ruamahanga River Upstream of Lake Wairarapa Outlet (most downstream reporting site)

Scenario	DRP % reduction (median)	SSC % reduction (median)
BAU 2080	-47.1	-19.1
Silver 2080	-61.4	-41.6



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Summary

- Significant reductions in DRP are attributed to:
    - Land treatment of WWTP
    - Pole planting and land retirement
    - Optimal fertiliser use, stock exclusion and riparian planting/buffer strips
- Significant reductions in SSC are attributed to:
    - Stock exclusion/riparian planting reducing net bank erosion (significant load reduction especially in lowland catchments)
    - Pole planting and land retirement in the upland/steeper catchments
    - Constructed wetlands (tier 2)

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