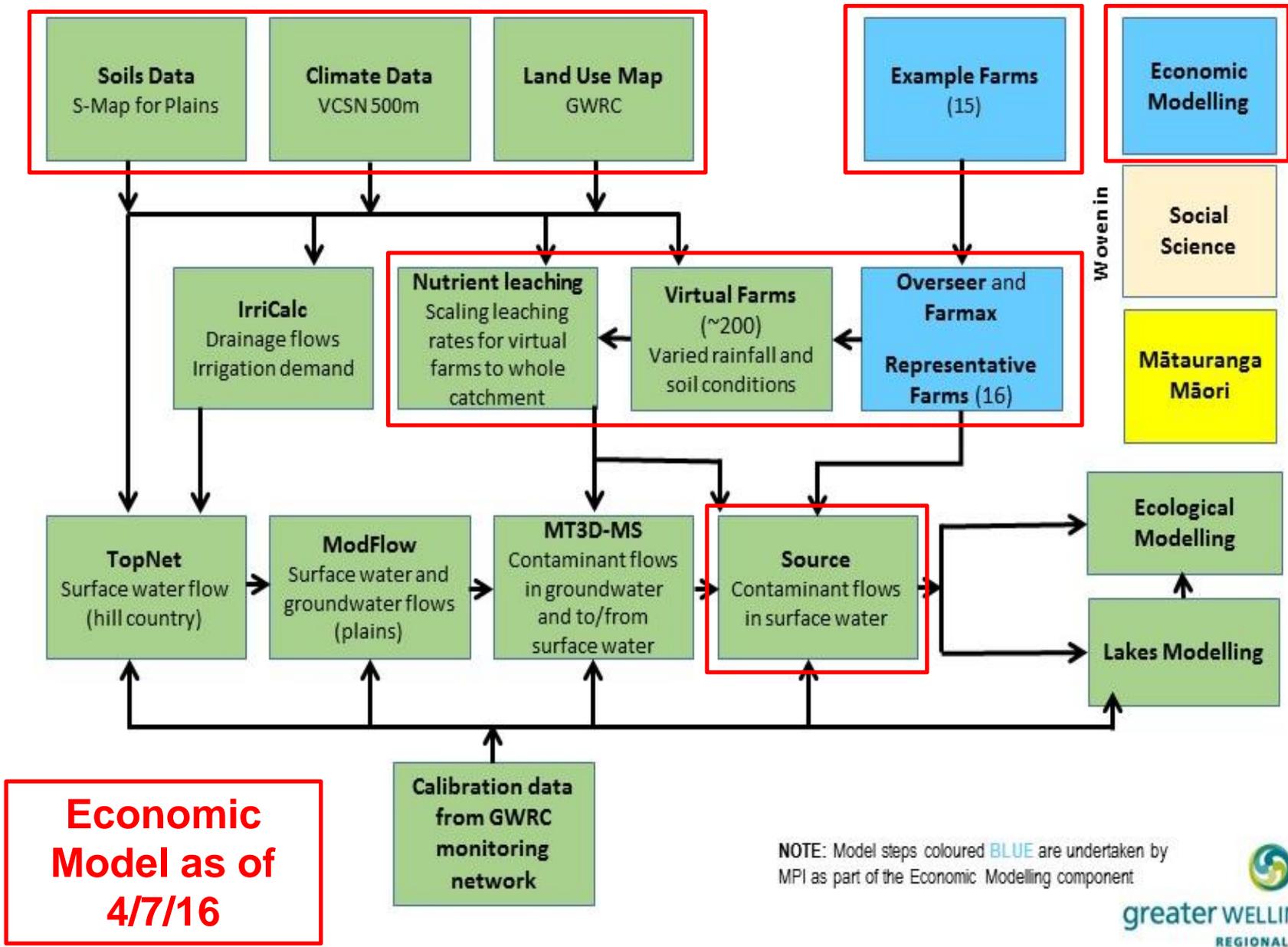# Ruamahanga Economic Catchment Model

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LANDCARE RESEARCH
MANAAKI WHENUA

New Zealand Forest and Agriculture Regional Model (NZFARM)

- A catchment-level economic model of NZ land use

  - Objective is to maximize income from land-based activities

  - Spatial scale at sub-catchment level

  - Models changes in land use and land management

  - Key outputs include changes in farm income, land use/mgmt

  - Can assess trade-off of multiple contaminants and policy approaches

- Designed to consistently compare **the relative economic & environmental impacts** of a range of policy scenarios

Key Model Outputs

$$$ **Net Revenue** (from on-farm production)

Food (meat, milk, fruit, etc.)

Raw materials (timber, pulp, wool, silage, etc.)

Freshwater (N, P, *E.coli*, irrigated area)

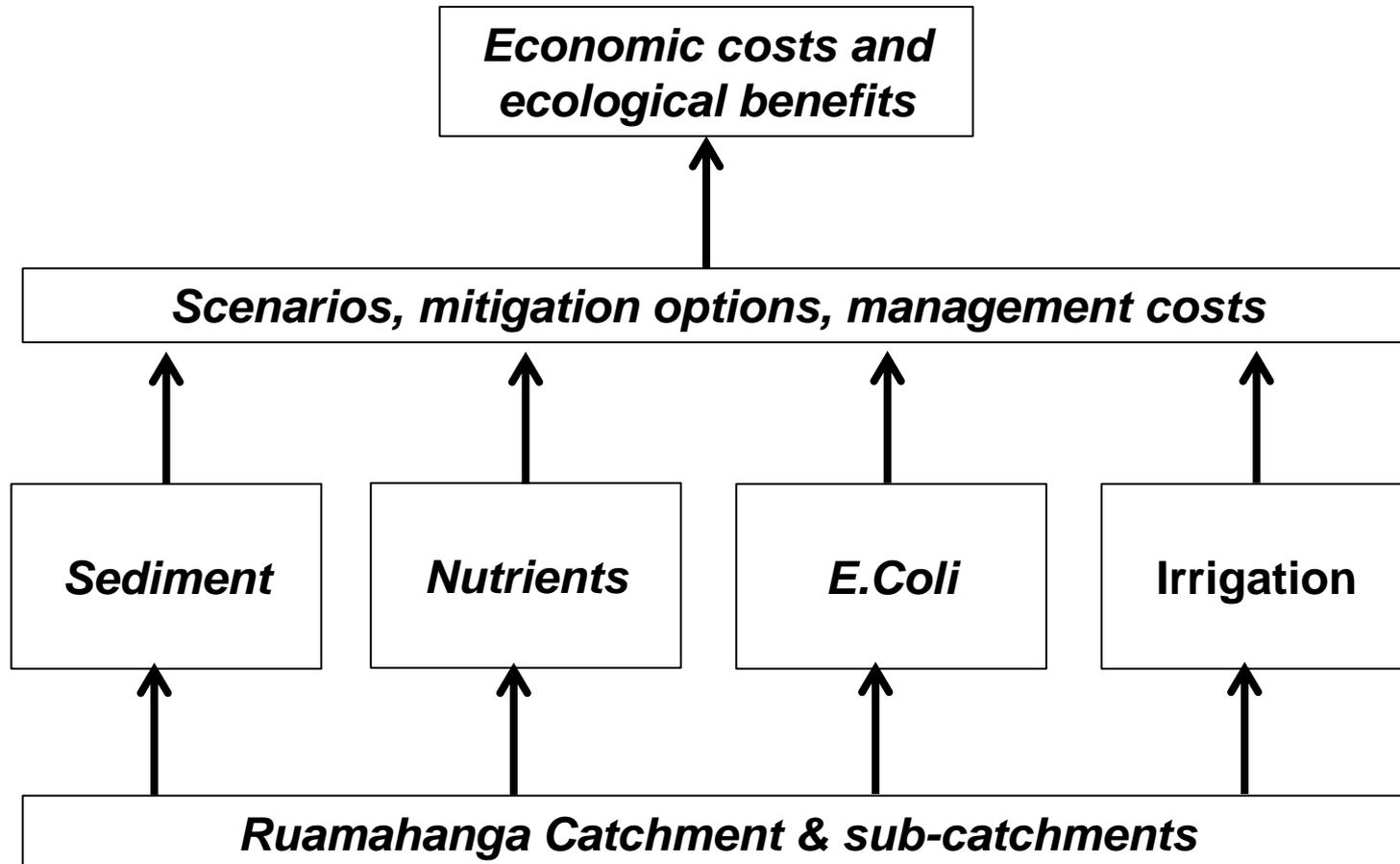**Erosion and Prevention** (soil loss/retain by land use)

Carbon Sequestration (exotic and native forest, grassland, etc.)

Outputs will vary subject to:
- Contaminant load target(s)
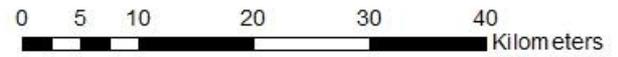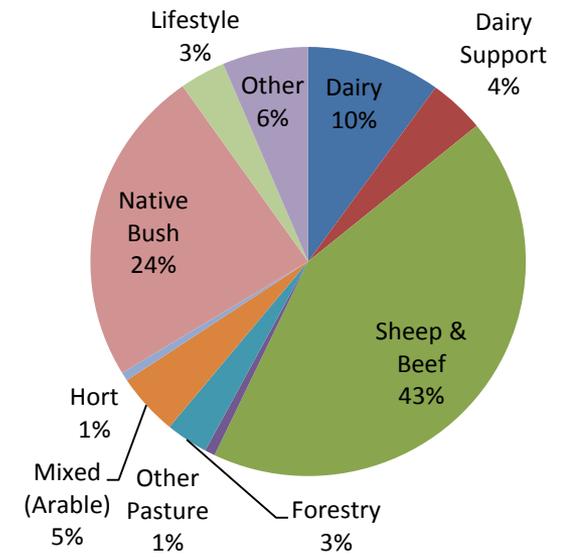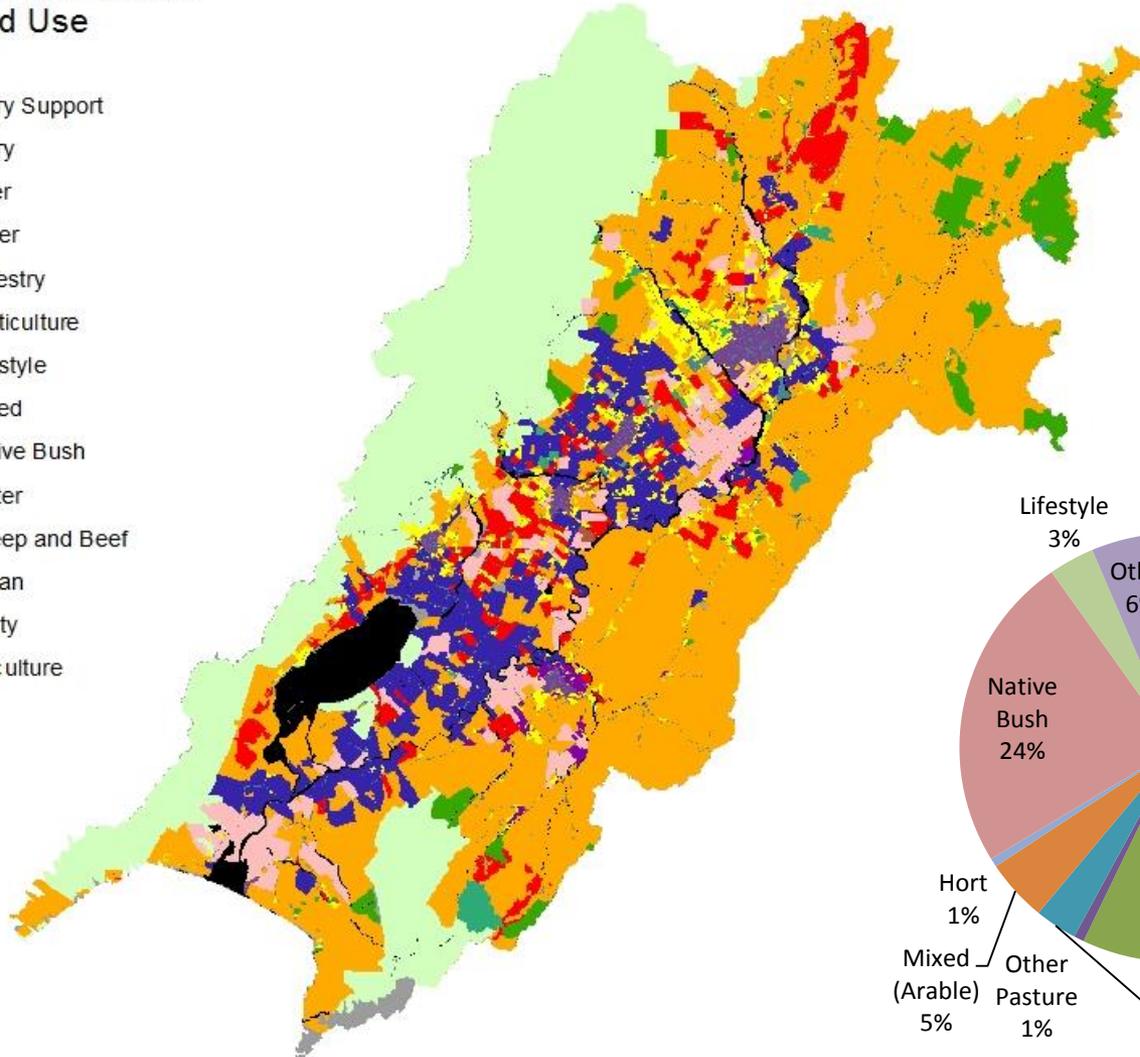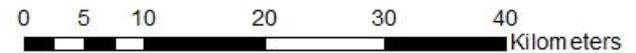- Policy mechanism
- Mitigation cost and effectiveness

Methodology

Ruamahanga Catchment
Land Use

Dairy Support
Dairy
Deer
Other
Forestry
Horticulture
Lifestyle
Mixed
Native Bush
Water
Sheep and Beef
Urban
Utility
Viticulture

Lifestyle 3%
Other 6%
Dairy 10%
Dairy Support 4%
Native Bush 24%
Sheep & Beef 43%
Hort 1%
Mixed (Arable) 5%
Other Pasture 1%
Forestry 3%

0 5 10 20 30 40
Kilometers

Ruamahanga Catchment
Net Farm Revenue ($/ha/yr)
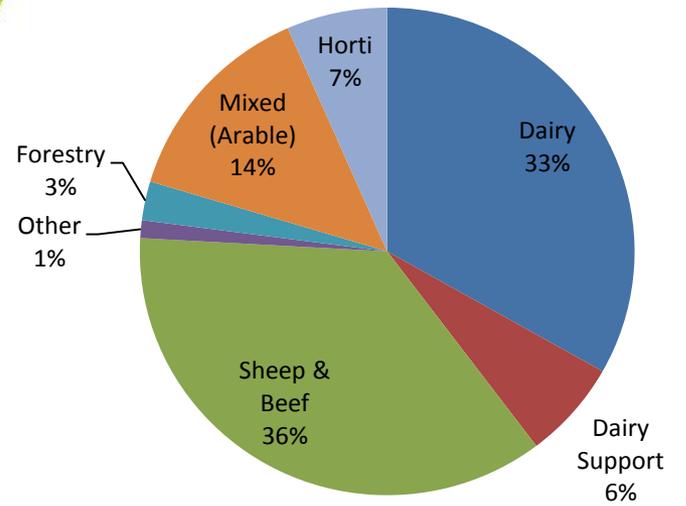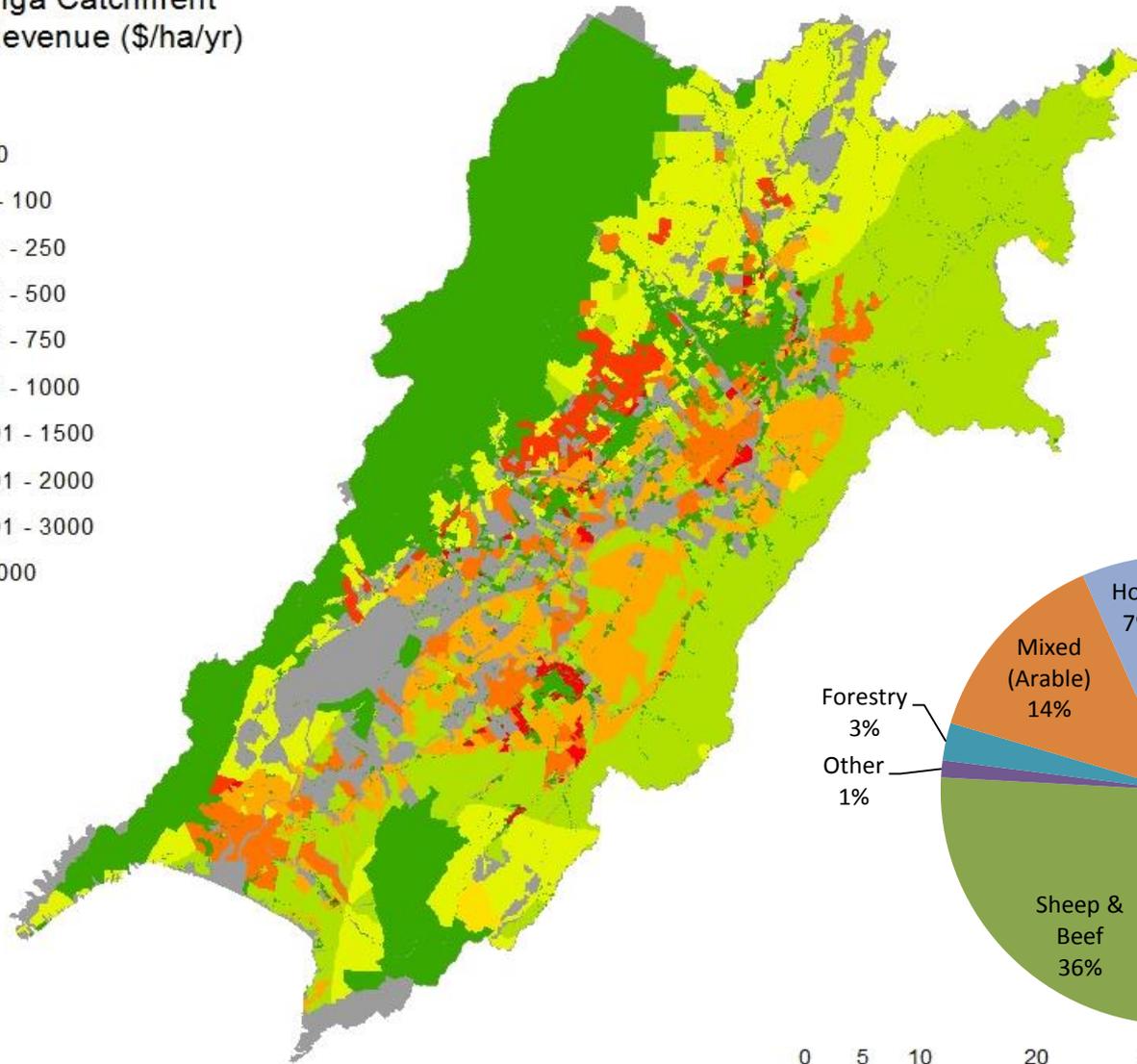
Legend:
- < 50
- 51 - 100
- 101 - 250
- 251 - 500
- 501 - 750
- 751 - 1000
- 1001 - 1500
- 1501 - 2000
- 2001 - 3000
- > 3000

Pie chart:
- Dairy 33%
- Dairy Support 6%
- Sheep & Beef 36%
- Other 1%
- Forestry 3%
- Mixed (Arable) 14%
- Horti 7%

0   5   10   20   30   40
                                    Kilometers

Ruamahanga Catchment
Baseline N Leacing (kgN/ha/yr)

- 0.0 - 4.0
- 4.1 - 8.0
- 8.1 - 12.0
- 12.1 - 15.0
- 15.1 - 19.0
- 19.1 - 21.0
- 21.1 - 24.0
- 24.1 - 31.0
- 31.1 - 60.0
- 60.1 - 103.0

0 5 10 20 30 40 Kilometers

P loss
% Change from Baseline
10% reduction FMU scenario

- < -50%
- -49% - -40%
- -39% - -30%
- -29% - -20%
- -19% - -10%
- -9% - -5%
- -4% - -3%
- -2% - 0%
- No Change
- > 0%

0 5 10 20 30 40 Kilometers
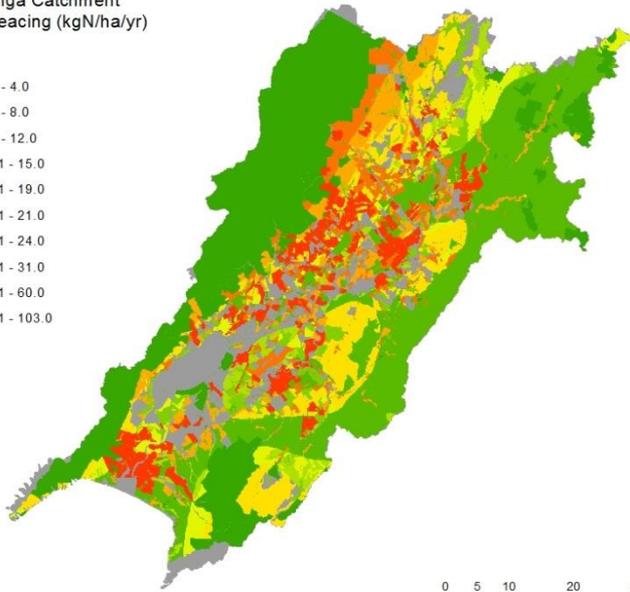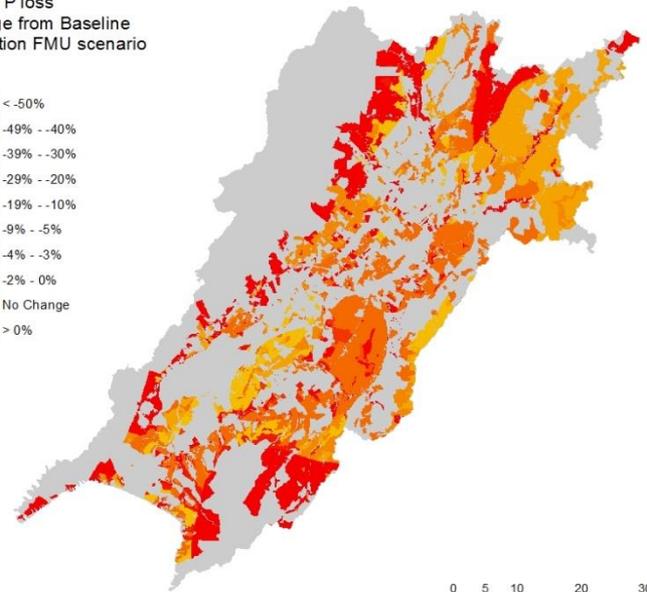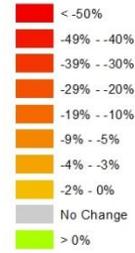
Ruamahanga Catchment
Baseline Sediment Loss (t/ha/yr)

- 0.0 - 0.2
- 0.3 - 0.5
- 0.6 - 0.8
- 0.9 - 1.4
- 1.5 - 2.1
- 2.2 - 3.1
- 3.2 - 5.1
- 5.2 - 8.0
- 8.1 - 13.5
- 13.6 - 22.3

0 5 10 20 30 40 Kilometers
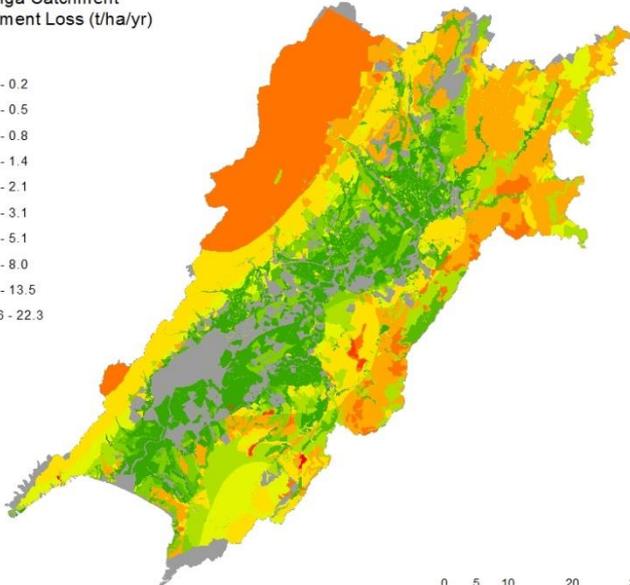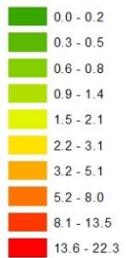
Ruamahanga Catchment
E.coli Loads (peta/yr)

ECOLI
- -0.1 - 0.2
- 0.3 - 0.5
- 0.6 - 1.1
- 1.2 - 2.1
- 2.2 - 3.3
- 3.4 - 5.3
- 5.4 - 10.5
- 10.6 - 19.2
- 19.3 - 32.0

0 5 10 20 30 40 Kilometers
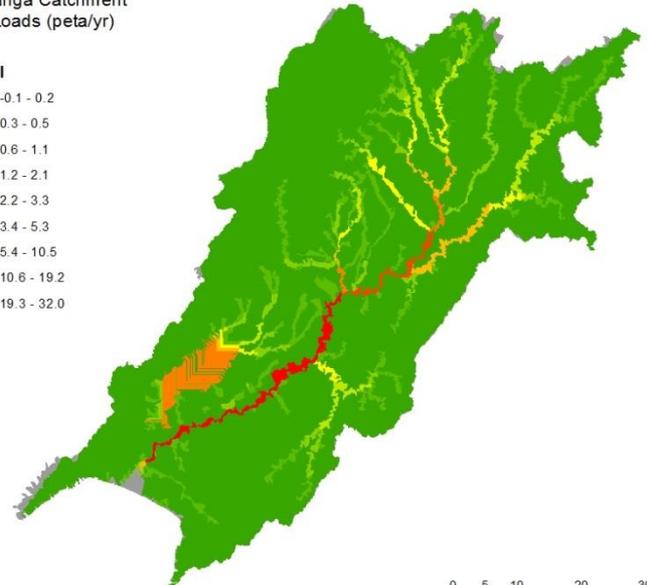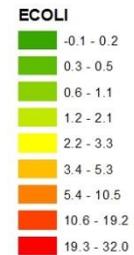
Key Ruamāhanga catchment economic model baseline estimates

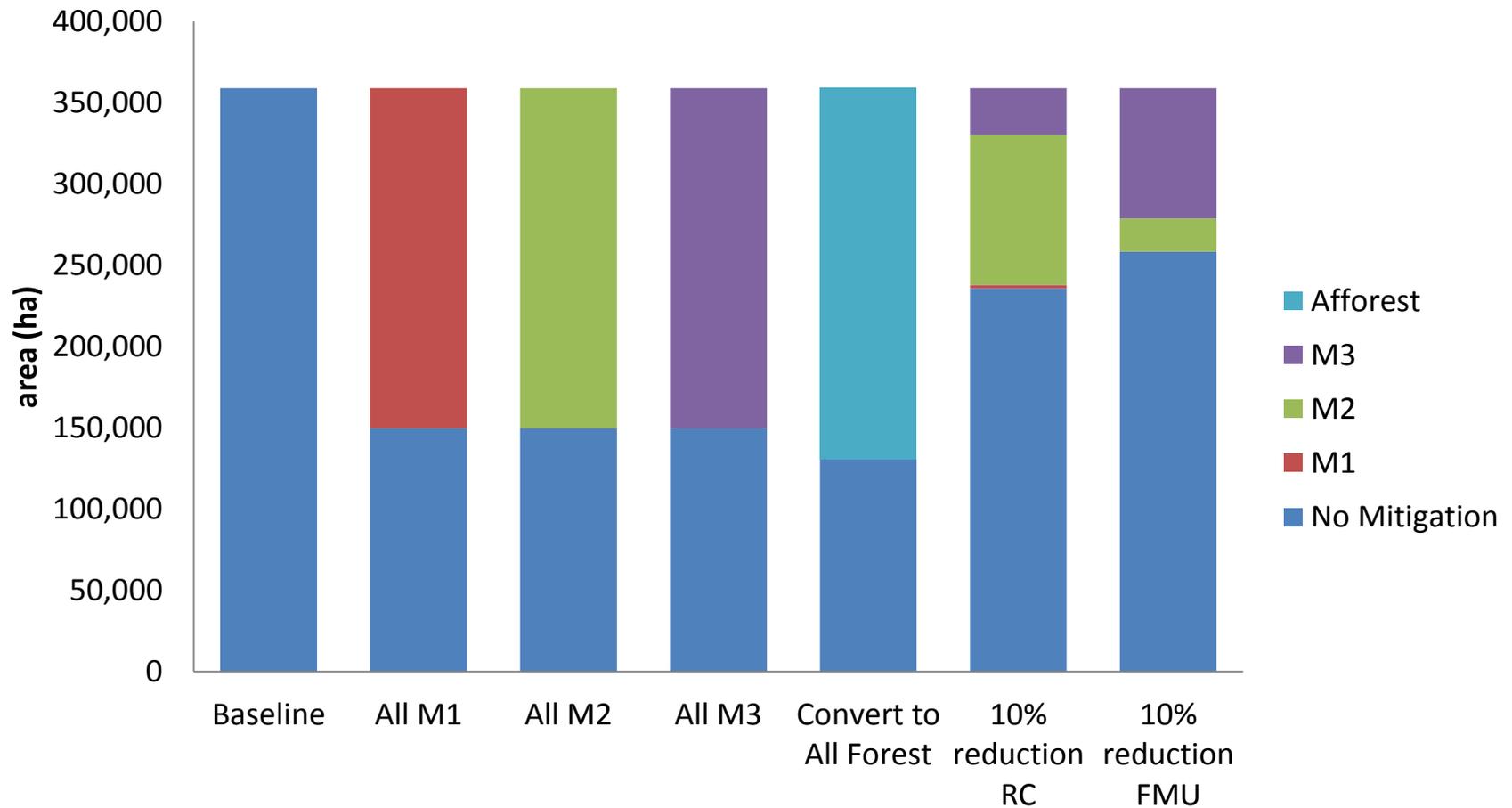| Aggregated Land Use	Area (ha)	Net Farm Revenue ($)	N leaching (t)	P loss (t)	Sediment (kt)	E.coli (peta)
Dairy	35,739	66,499,471	1,045	33	10	28
Dairy Support	14,880	13,066,002	965	16	16	9
Sheep & Beef	154,276	72,496,361	2,045	136	378	74
Other Pasture	2,750	2,354,785	52	1	5	1
Forestry	11,306	5,174,823	34	2	23	3
Mixed (Arable)	16,742	27,623,821	653	7	7	4
Horticulture	2,352	13,202,910	20	0	0	1
Native Bush	85,843	0	86	9	365	4
Lifestyle	12,207	0	330	5	4	7
Other	22,898	0	56	0	4	3
Ruamahanga Total	**358,993**	**$200,417,788**	**5285**	**209**	**813**	**135**

NZFARM test scenarios for the Ruamāhanga catchment

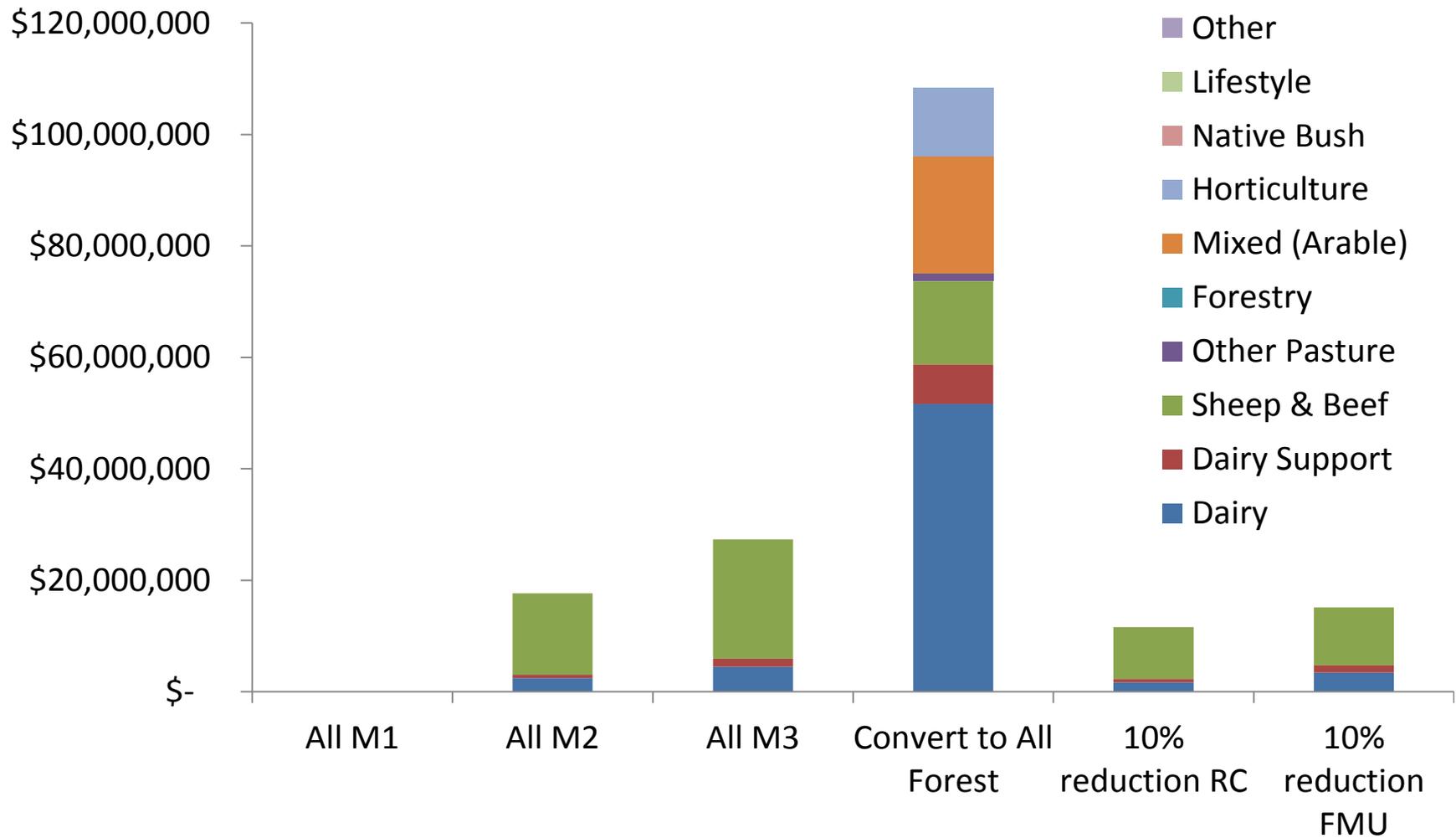| Scenario Name	Description	N Leach Target	P Loss Target	Sediment Target	E. coli Target
Management Actions					
All Farms M1	All dairy, sheep & beef, and dairy support farms implement M1 mitigation bundle	n/a	n/a	n/a	n/a
All Farms M2	All dairy, sheep & beef, and dairy support farms implement M2 mitigation bundle	n/a	n/a	n/a	n/a
All Farms M3	All dairy, sheep & beef, and dairy support farms implement M3 mitigation bundle	n/a	n/a	n/a	n/a
Minimum Feasible Loads					
Convert All to Forest	Afforestation of all non-native land in the catchment to estimate the minimum loads possible	n/a	n/a	n/a	n/a
Contaminant load reduction targets					
10% catchment	10% reduction in N, P, and sediment for entire Ruamahanga catchment	10%	10%	10%	0%
10% FMU	10% reduction in N, P, and sediment for each FMU in the Ruamahanga catchment	10%	10%	10%	0%

Key 'test' model scenario estimates

Scenario	Total Annual Cost ($/yr)	Net Revenue ($)	N Leach (t)	P Loss (t)	Sediment (kt)	E.coli (peta)
Baseline	$0	$200,679,150	5,285	209	814	134.7
% Change from no mitigation baseline						
All Farms M1	$583,436	0%	0%	0%	0%	-4%
All Farms M2	$18,270,930	-9%	-10%	-7%	-9%	-4%
All Farms M3	$27,926,712	-14%	-10%	-48%	-25%	-4%
Convert All to Forest	$108,954,857	-54%	-82%	-82%	-41%	-84%
10% catchment	$12,193,487	-6%	-10%	-15%	-10%	-3.7%
10% FMU	$15,713,580	-8%	-10%	-28%	-10%	-3.0%

Mitigation Practice Area

Annual Cost by Land Use

Legend:
- Other
- Lifestyle
- Native Bush
- Horticulture
- Mixed (Arable)
- Forestry
- Other Pasture
- Sheep & Beef
- Dairy Support
- Dairy

Y-axis: $120,000,000 / $100,000,000 / $80,000,000 / $60,000,000 / $40,000,000 / $20,000,000 / $-

X-axis: All M1 / All M2 / All M3 / Convert to All Forest / 10% reduction RC / 10% reduction FMU

Net Farm Revenue
% Change from Baseline
10% reduction RC scenario

Legend:
- < -50%
- -49% - -40%
- -39% - -30%
- -29% - -20%
- -19% - -10%
- -9% - -5%
- -4% - -3%
- -2% - 0%
- No Change
- > 0%

0 5 10 20 30 40
Kilometers

Net Farm Revenue

% Change from Baseline
10% reduction FMU scenario

Legend:
- < -50%
- -49% - -40%
- -39% - -30%
- -29% - -20%
- -19% - -10%
- -9% - -5%
- -4% - -3%
- -2% - 0%
- No Change
- > 0%

N

0 5 10 20 30 40
Kilometers