Landcare Research
Manaaki Whenua

Allocation:
A policy dilemma

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Landcare Research

Links Seminar
MfE
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Why do we allocate?

- A scarce resource is being demanded by many
- Scarcity comes from, e.g.
  - Declining resource availability
  - Regulating use of a resource
  - Regulating impact of resource use
- For water it is used when
  - Demand for water exceeds supply (quantity)
  - Declining resource condition leading to regulation of impact of resource use (quality)

Allocation & water

- Focus today is on quality
- Our context
  - Deteriorating water quality
  - Setting catchment cap & regulating pollutant discharge to water
  - Allocating pollutant load between sources & individuals
- Regulating pollutant loads = a constraint
- Therefore, it is a ‘lose’ situation for current & future users relative to no policy/business as usual (BAU)

Why is it a dilemma?

- Types of losses
  - Opportunity cost
    - Inability to expand/intensify in future
    - Inability to enter catchment
  - Actual financial cost
- Dilemma: how to allocate the catchment load between current & future users

  ….. there is no right or wrong way
- Allocation is fairness & equity decision

Making the decision

- Using principles to compare options, e.g.:
  - Equity/fairness incl. intergenerational equity
  - Extent of immediate impact
  - Public & private benefits & costs
  - Future vision for landscape
  - Iwi land ownership & status incl. any Crown obligations
  - Cultural values
  - Resource use efficiency
  - Existing land use
  - Existing farm capital investment
  - Ease of transfer of the allocation

RPS Policy WL 3B, Bay of Plenty Regional Council, 2013

Making the decision

- Additional principles e.g.:
  - No major windfalls for any sector
  - Existing investment will be recognised
  - Least overall economic impact
  - Practices with high nutrient discharge are not rewarded

Lake Rotorua StAG, 2013

Your Task Today

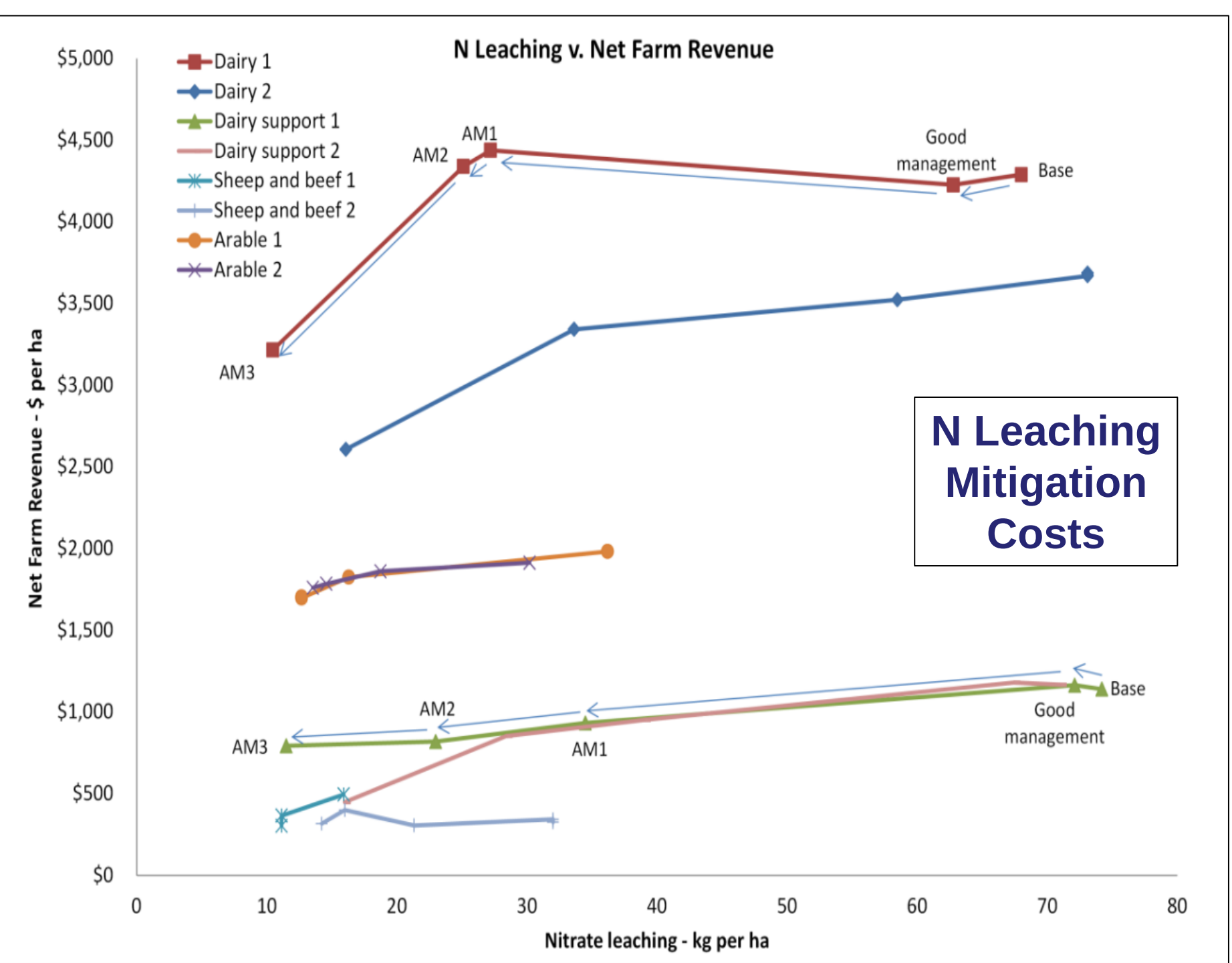
Based on the following economic analysis determine what approach you would recommend for a 25% reduction in N leching?

Allocation approaches

- Approaches compared:
  - Regulation only
    - Grandparenting
    - Land use capability
    - Nutrient vulnerability
    - Catchment averaging
    - Pastoral/land cover averaging
    - Sector averaging
    - Any initial allocation
  - Regulation + trading
    - Applicable to any initial allocation approach

Mitigation Costs

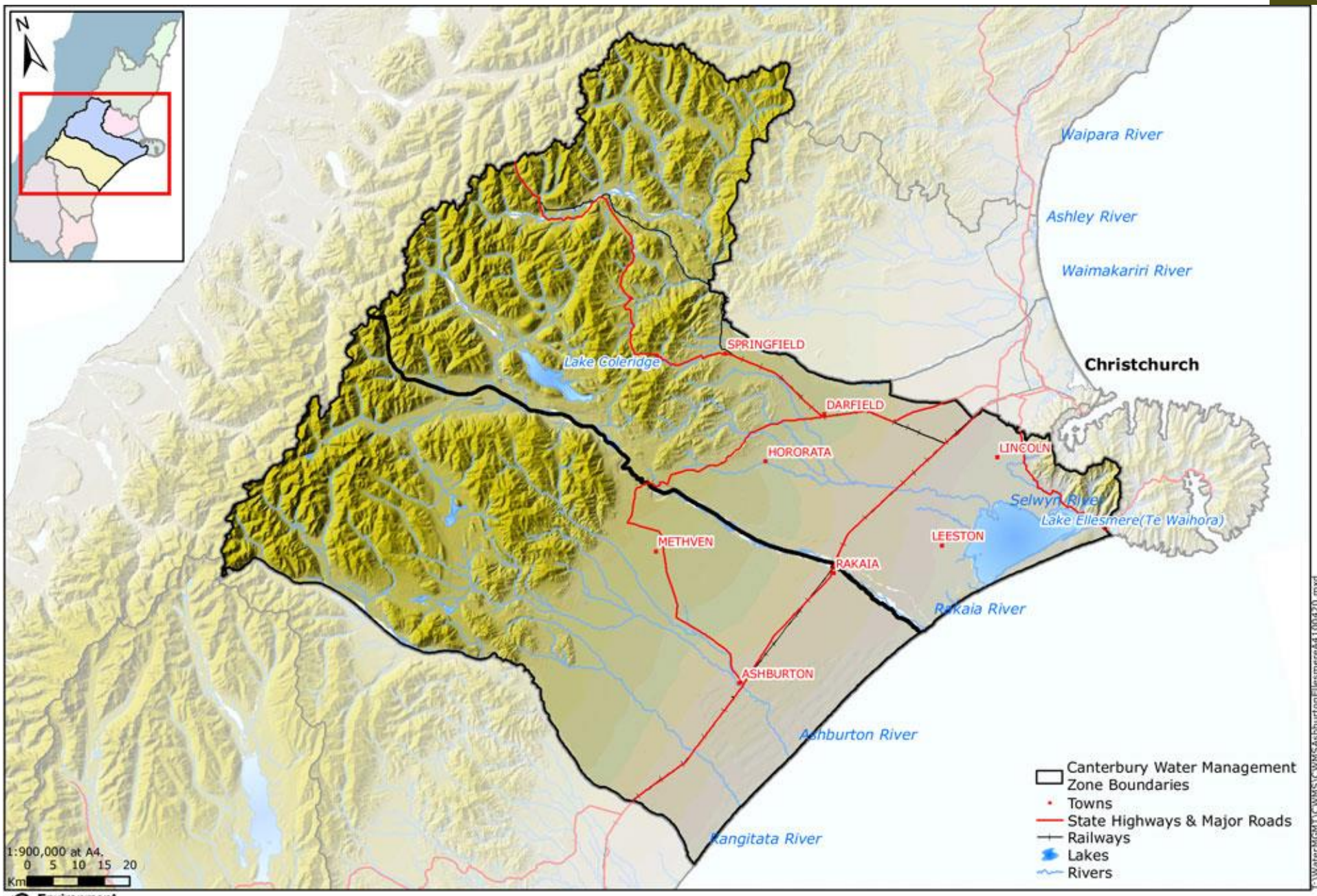
- Varies by:
  - Soil type
  - Land use/enterprise
  - Current management practices
  - Mitigation technologies
  - Allocation approach
  - Policy target
- Costs likely to be non-linear with stringency of target


N Leaching v. Net Farm Revenue
Dairy 1
Dairy 2
Dairy support 1
Dairy support 2
Sheep and beef 1
Sheep and beef 2
Arable 1
Arable 2
AM1
AM2
AM3
Good management
Base
N Leaching Mitigation Costs
Net Farm Revenue - $ per ha
$5,000
$4,500
$4,000
$3,500
$3,000
$2,500
$2,000
$1,500
$1,000
$500
$0
0
10
20
30
40
50
60
70
80
Nitrate leaching - kg per ha

Illustrative Case Study

- Two Canterbury catchments
  - Hinds & Selwyn-Waihora
- 3 Catchment-wide policy targets
  - 10%, 25% and 50% reduction in N leaching
- Methodology
  - New Zealand Forest and Agriculture Regional Model (NZFARM)
  - Assess allocation impacts to net farm revenue, N leaching, and land use

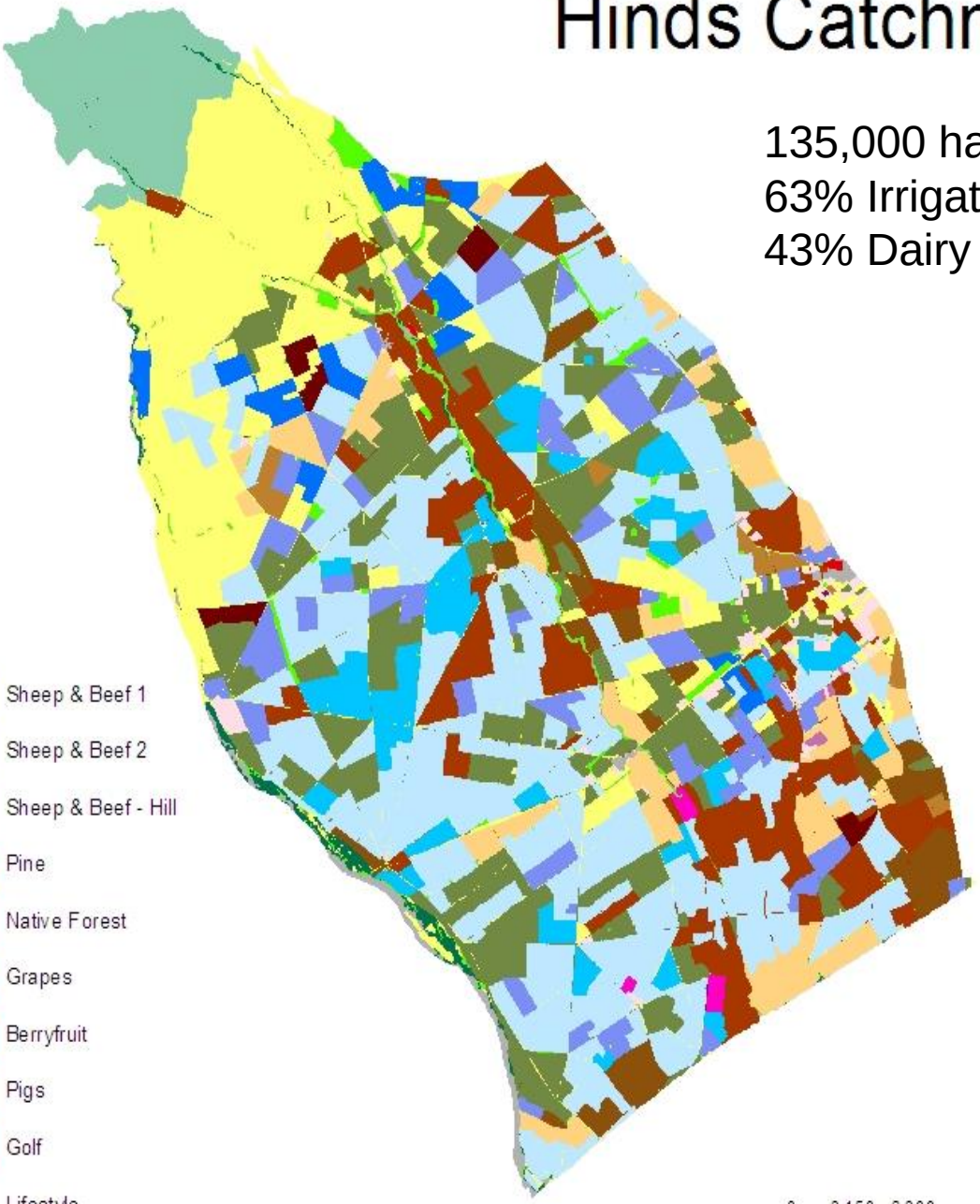
Note: Both catchments currently under development for specific policy and reduction targets. Figures here for Illustrative purpose only.



Environment Canterbury Regional Council

Canterbury Water Management Zones: Ashburton & Selwyn - Waihora Zones

Hinds Catchment



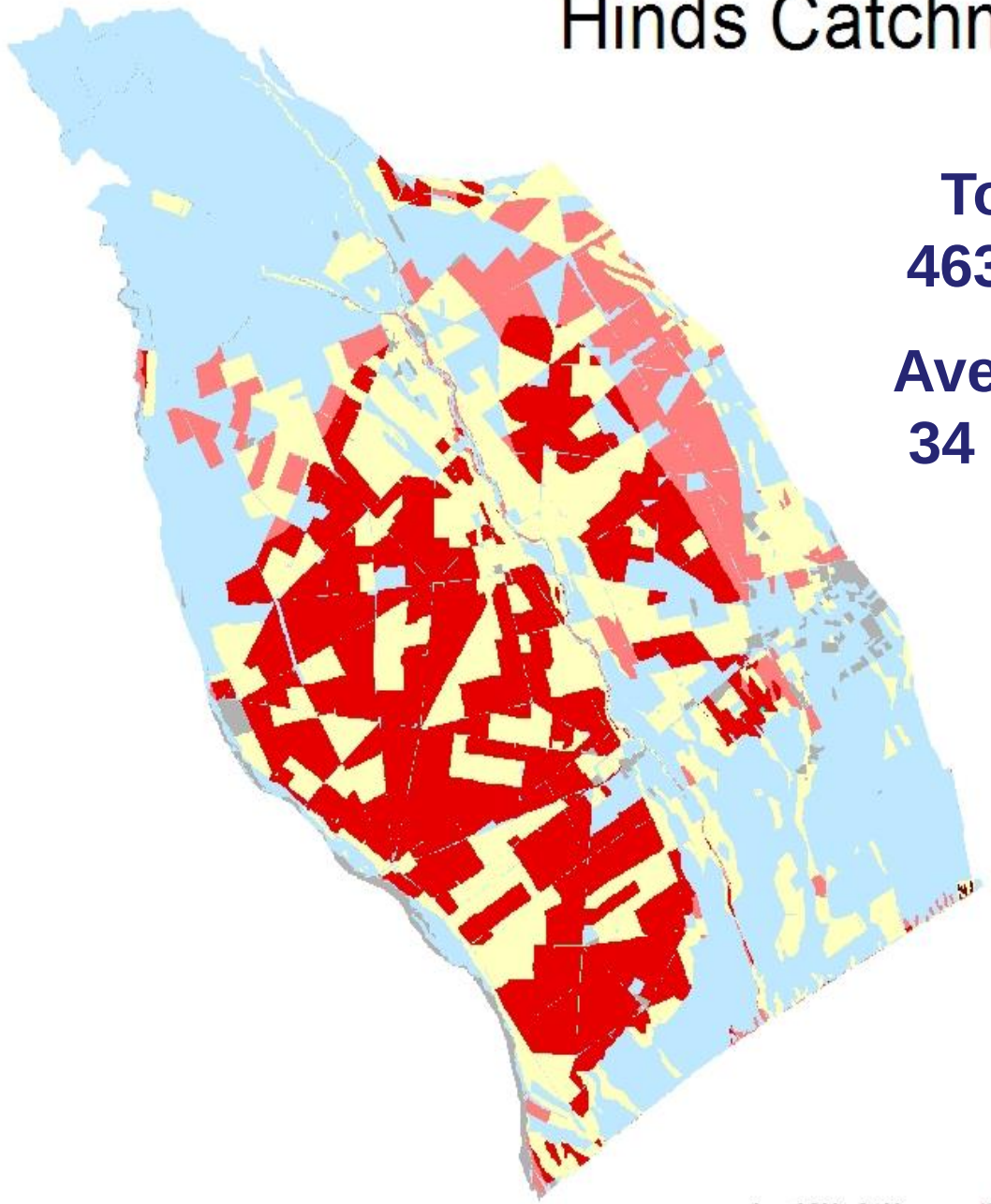
135,000 ha
63% Irrigated
43% Dairy

Legend

- Undefined
- Dairy 1
- Dairy 2
- Dairy Support 1
- Dairy Support 2
- Arable 1
- Arable 2
- Arable 2-3
- Arable 3
- Arable 4
- Sheep & Beef 1
- Sheep & Beef 2
- Sheep & Beef - Hill
- Pine
- Native Forest
- Grapes
- Berryfruit
- Pigs
- Golf
- Lifestyle

0 3,150 6,300 12,600 18,900 25,200
Meters

Hinds Catchment



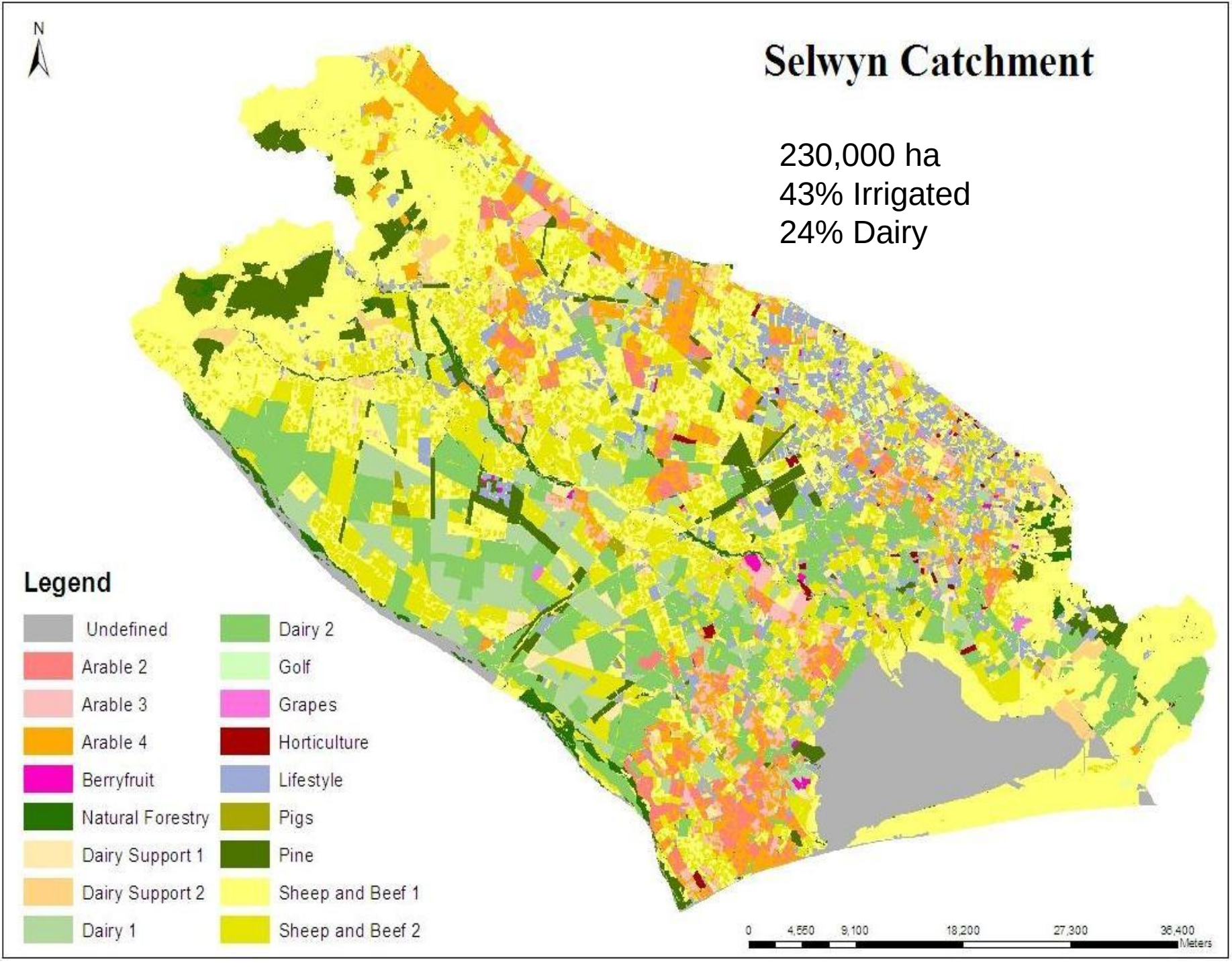
Total N:
4630 tN/yr

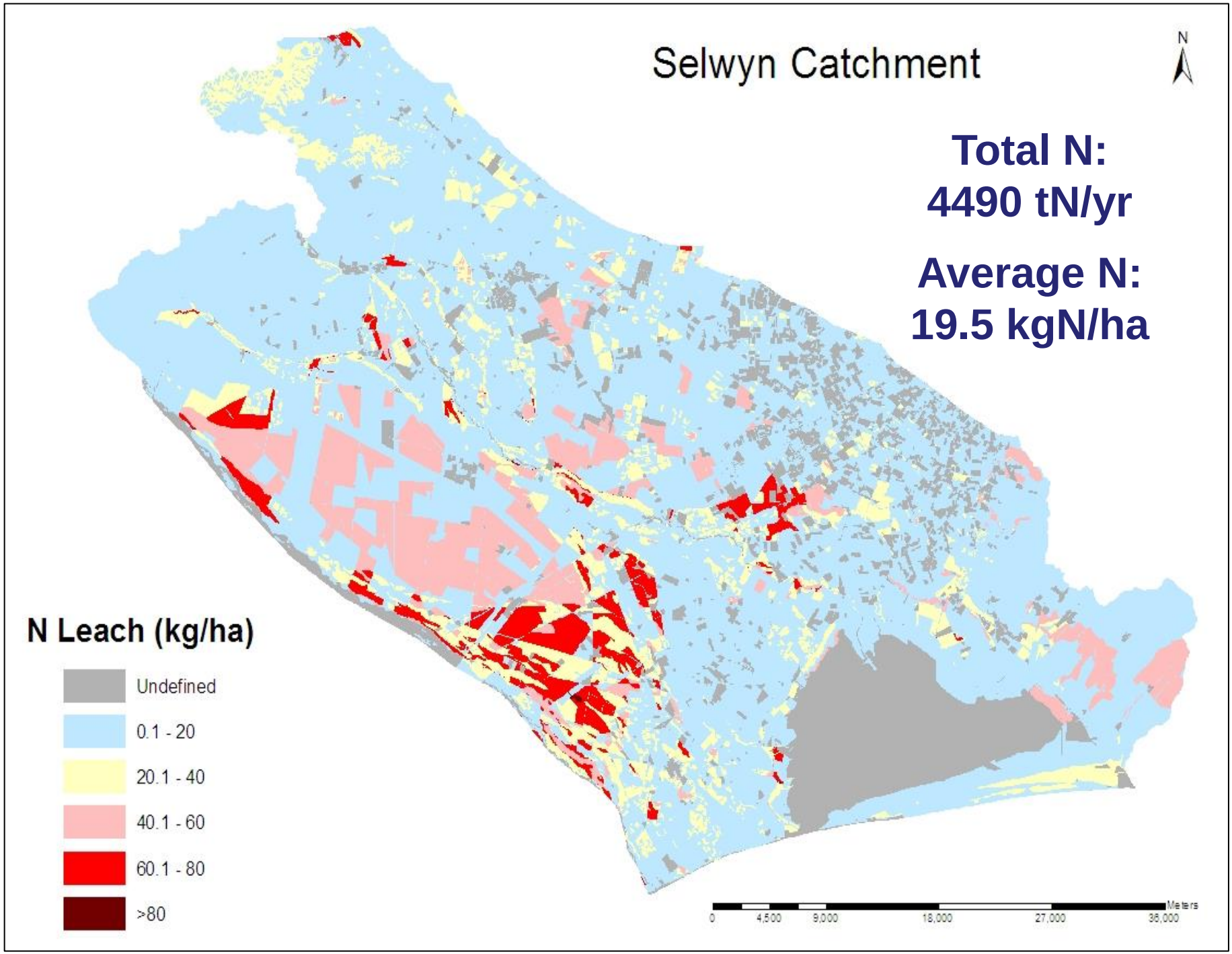
Average N:
34 kgN/ha

N Leach (kg/ha)

- Undefined
- 0.1 - 20
- 20.1 - 40
- 40.1 - 60
- 60.1 - 80
- >80

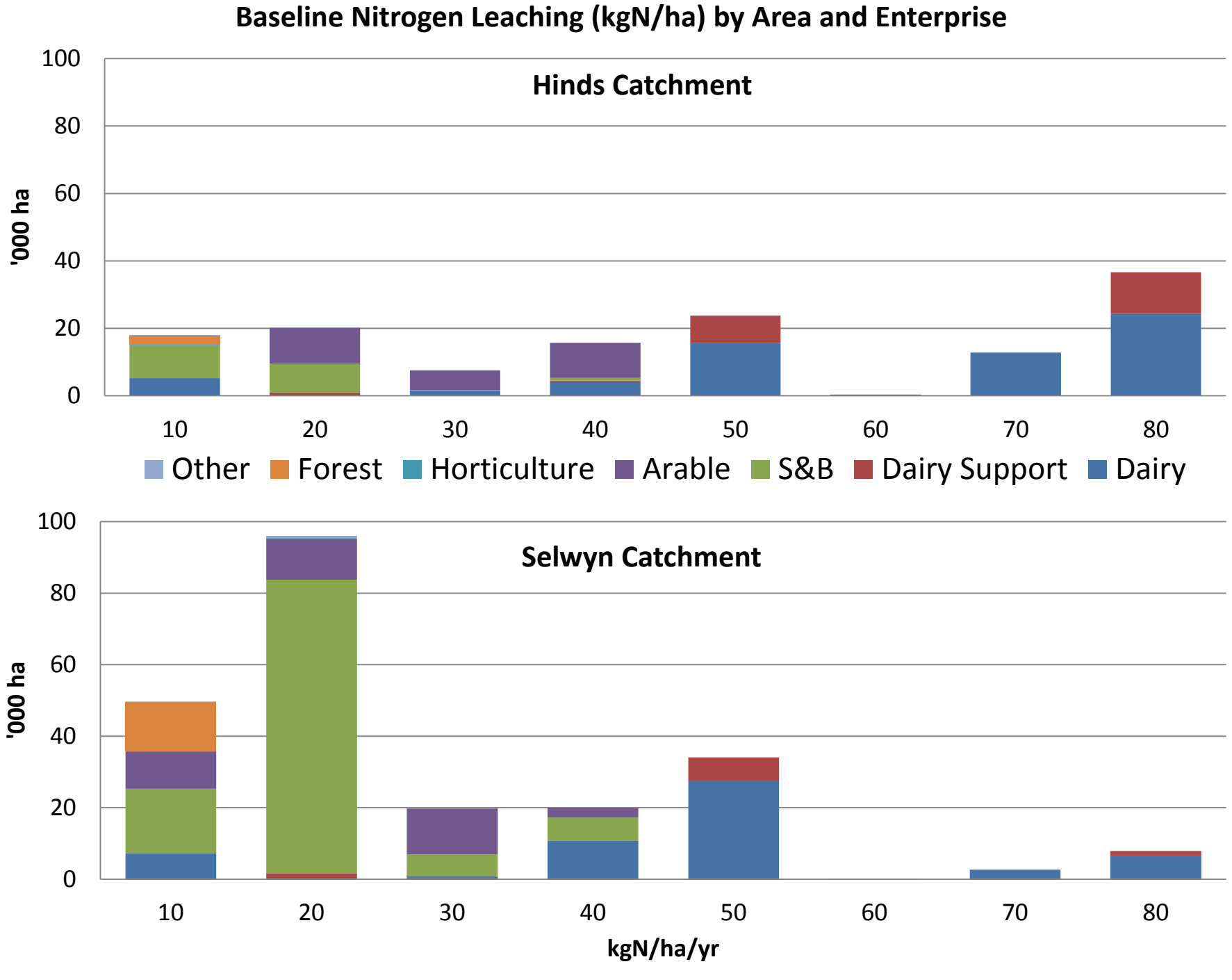
0 3,200 6,400 12,800 19,200 25,600
Meters


N
Selwyn Catchment
230,000 ha
43% Irrigated
24% Dairy
Legend
Undefined
Arable 2
Arable 3
Arable 4
Berryfruit
Natural Forestry
Dairy Support 1
Dairy Support 2
Dairy 1
Dairy 2
Golf
Grapes
Horticulture
Lifestyle
Pigs
Pine
Sheep and Beef 1
Sheep and Beef 2
0
4,550
9,100
18,200
27,300
36,400
Meters


Selwyn Catchment
N
Total N:
4490 tN/yr
Average N:
19.5 kgN/ha
N Leach (kg/ha)
Undefined
0.1 - 20
20.1 - 40
40.1 - 60
60.1 - 80
>80
0
4,500
9,000
18,000
27,000
36,000
Meters

Enterprise Area and N Leaching

Enterprise	Hinds		Selwyn	
	% Total Area	% Total N	% Total Area	% Total N
Dairy	47%	54%	24%	43%
Dairy Support	16%	13%	4%	7%
S&B	14%	19%	49%	39%
Arable	20%	14%	16%	10%
Horticulture	0%	0%	0%	0%
Forestry	2%	0%	6%	0%
Other	0%	0%	0%	0%

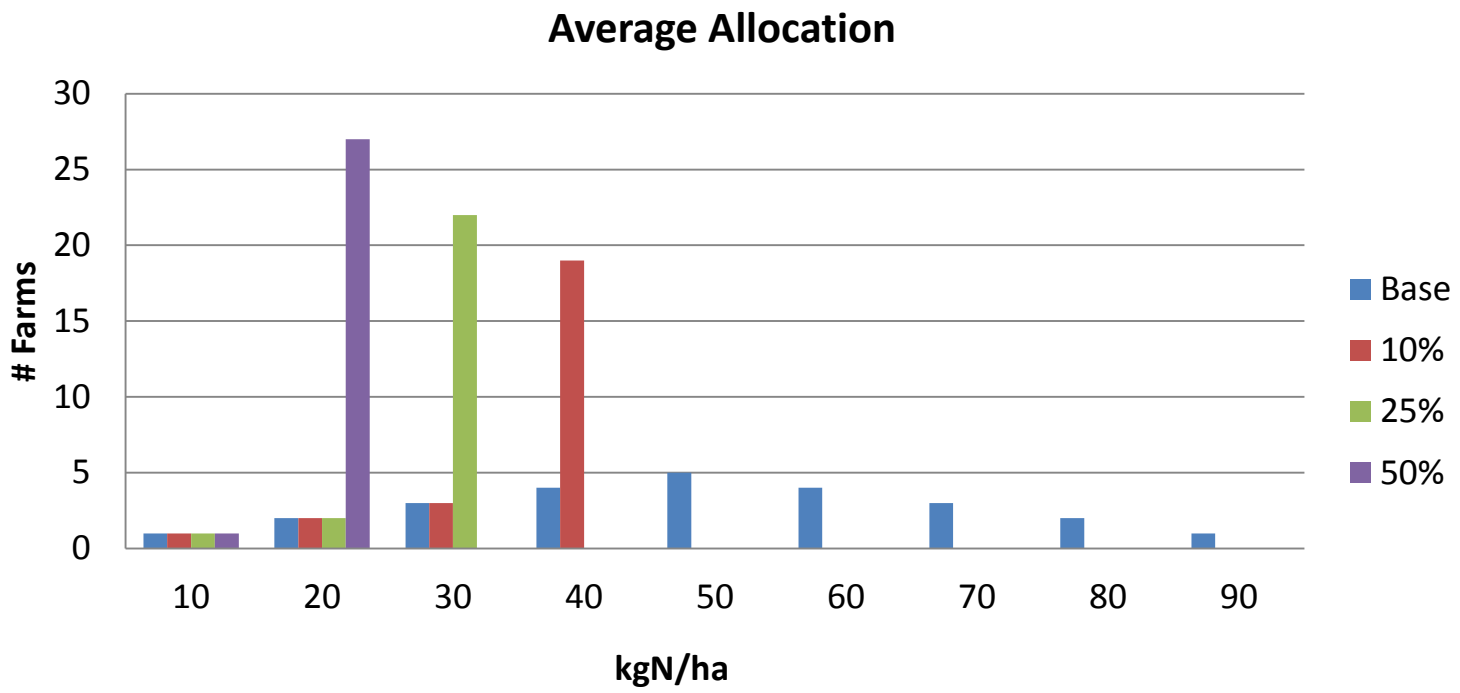

Baseline Nitrogen Leaching (kgN/ha) by Area and Enterprise
Hinds Catchment
'000 ha
100
80
60
40
20
0
10
20
30
40
50
60
70
80
Other
Forest
Horticulture
Arable
S&B
Dairy Support
Dairy
Selwyn Catchment
'000 ha
100
80
60
40
20
0
10
20
30
40
50
60
70
80
kgN/ha/yr

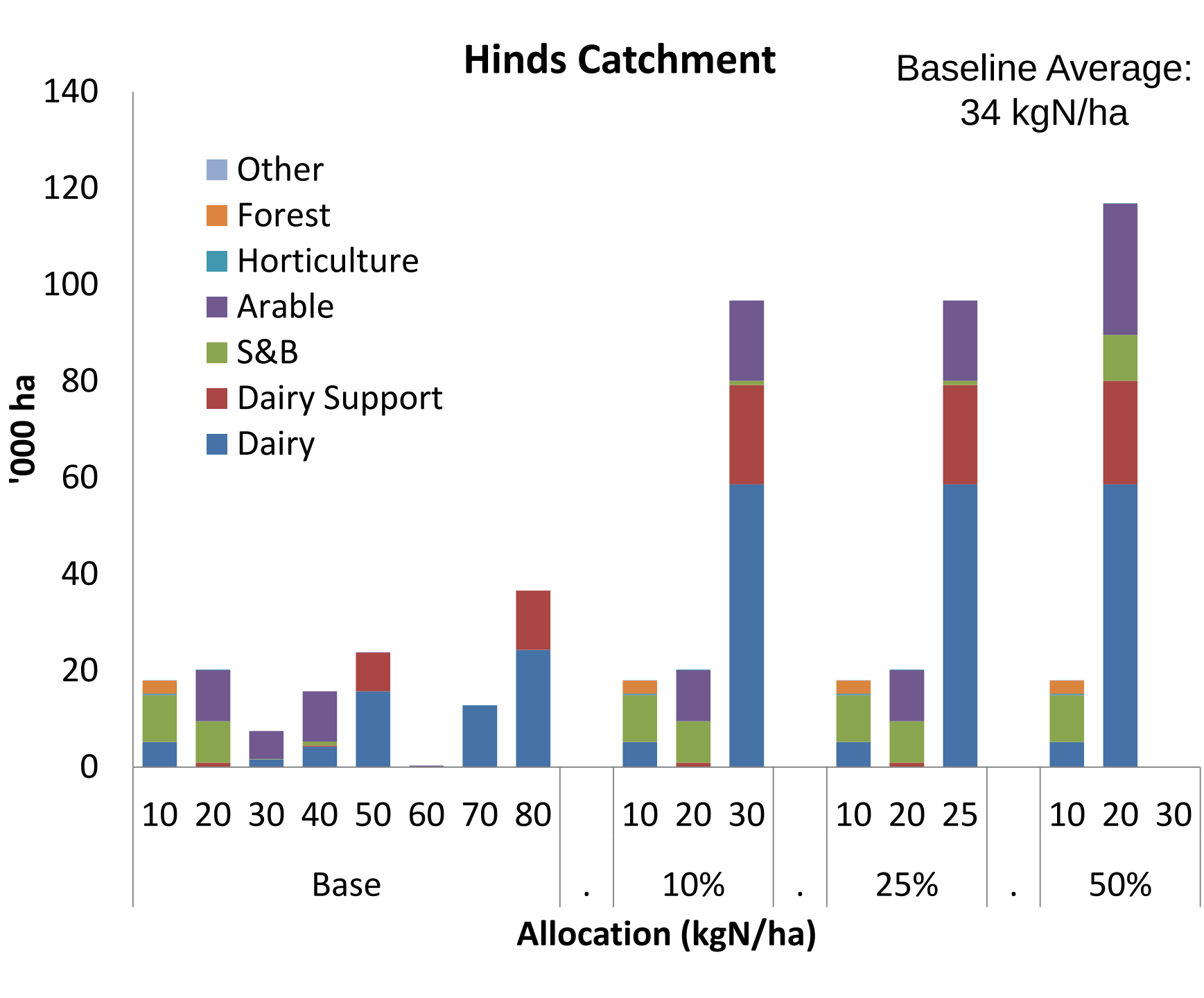
Baseline (no policy) Estimates

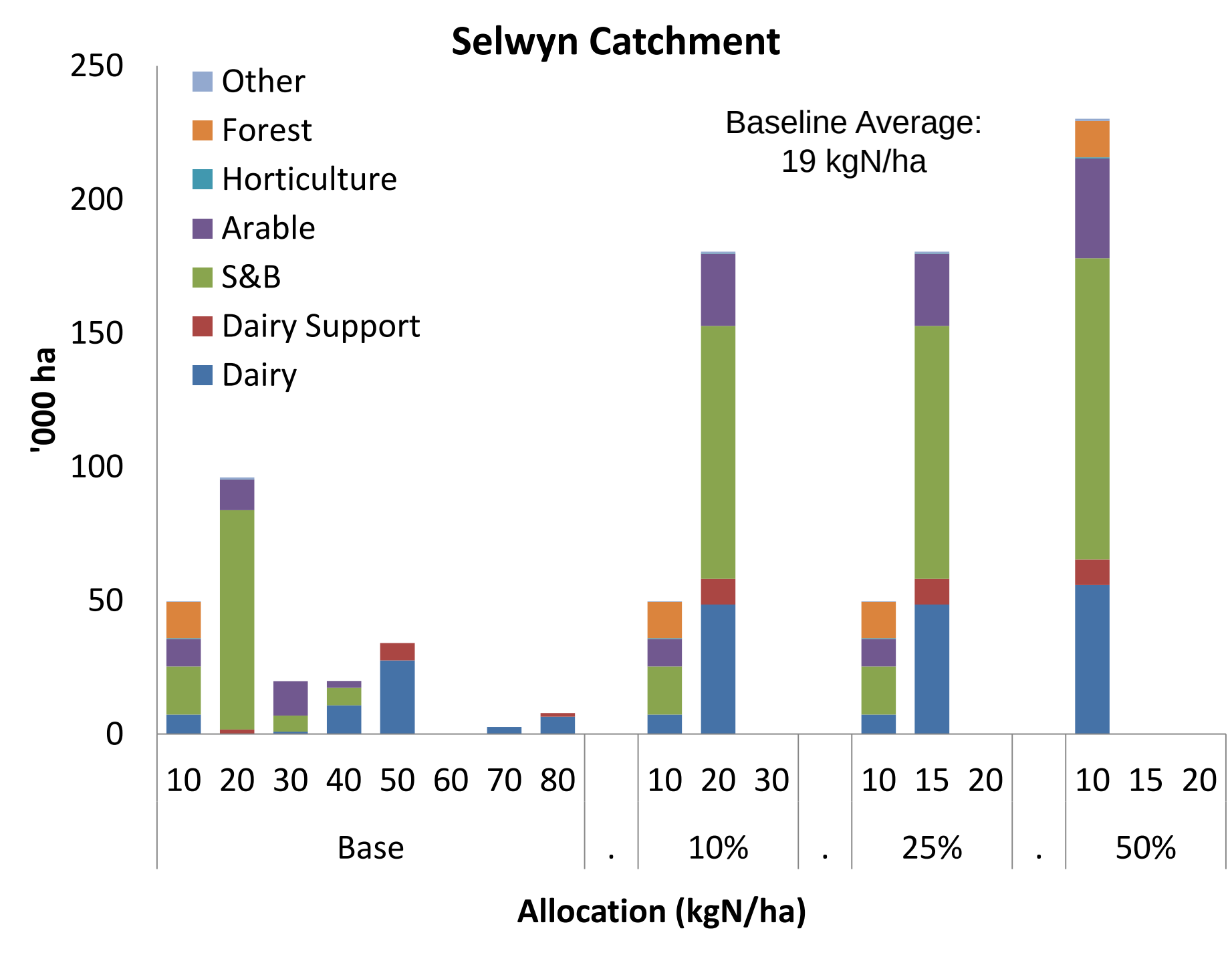
Enterprise	Net Farm Revenue (million $)	N Leaching (tonnes)	Enterprise Area ('000 ha)
Hinds Catchment			
Dairy	$167.3	2,515	43.6
Dairy Support	$12.8	620	11.0
Arable	$40.0	629	27.7
Sheep & Beef	$21.6	860	49.8
Horticulture	$3.6	3	0.3
Forestry	$1.3	2	2.0
Other	$0.1	1	0.9
Total	**$246.7**	**4,628**	**135.4**
Selwyn Catchment			
Dairy	$178.6	1,940	46.0
Dairy Support	$8.3	293	7.2
Arable	$32.4	470	33.1
Sheep & Beef	$56.8	1,756	128.4
Horticulture	$6.0	5	0.7
Forestry	$8.5	10	13.1
Other	$1.3	15	1.6
Total	**$292.0**	**4,490**	**230.0**

Catchment Averaging

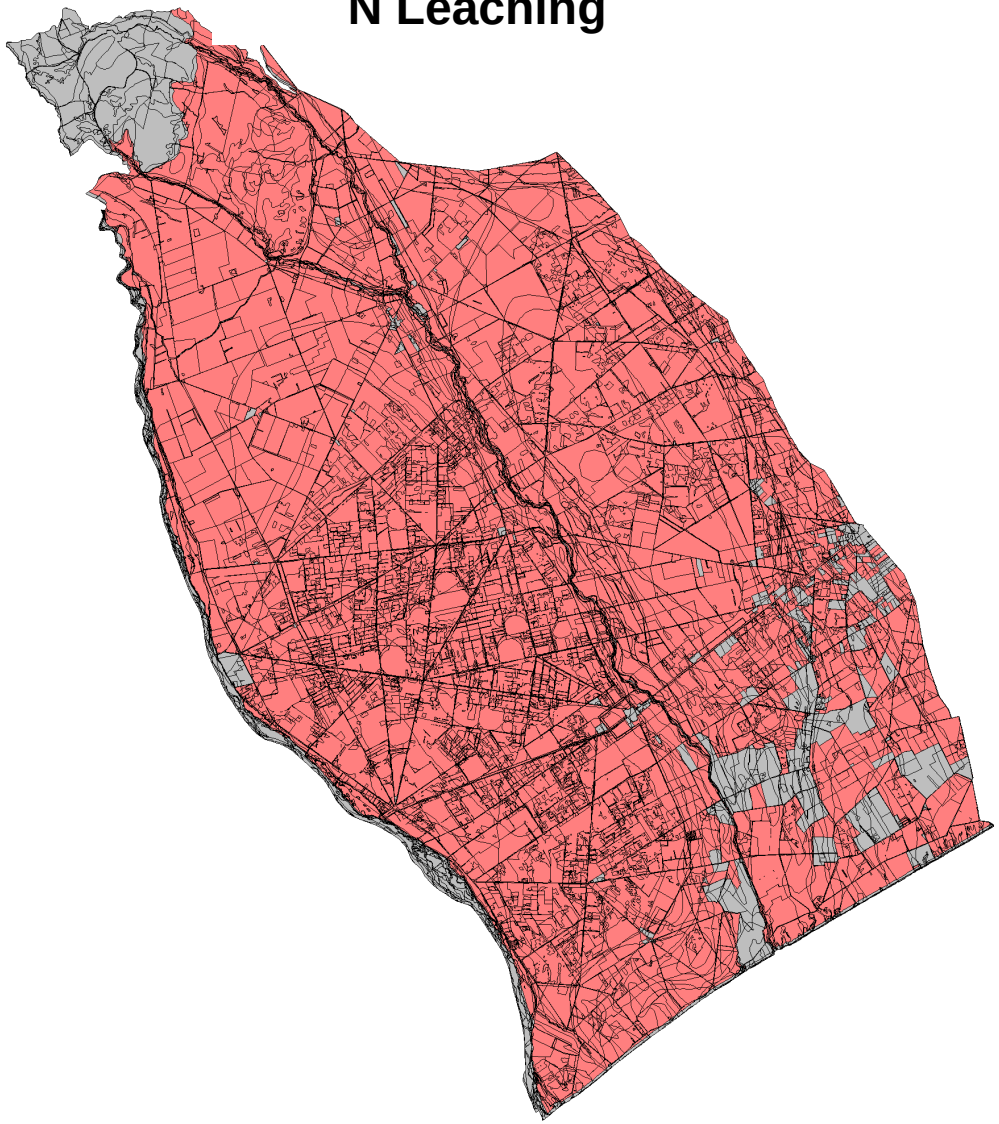
- All landowners in the catchment receive the same allocation X kgN/ha/yr)
- Favours farms with low leaching soils and practices
- May allow flexibility to expand




Hinds Catchment
Baseline Average:
34 kgN/ha
Other
Forest
Horticulture
Arable
S&B
Dairy Support
Dairy
'000 ha
140
120
100
80
60
40
20
0
10 20 30 40 50 60 70 80 . 10 20 30 . 10 20 25 . 10 20 30
Base
10%
25%
50%
Allocation (kgN/ha)

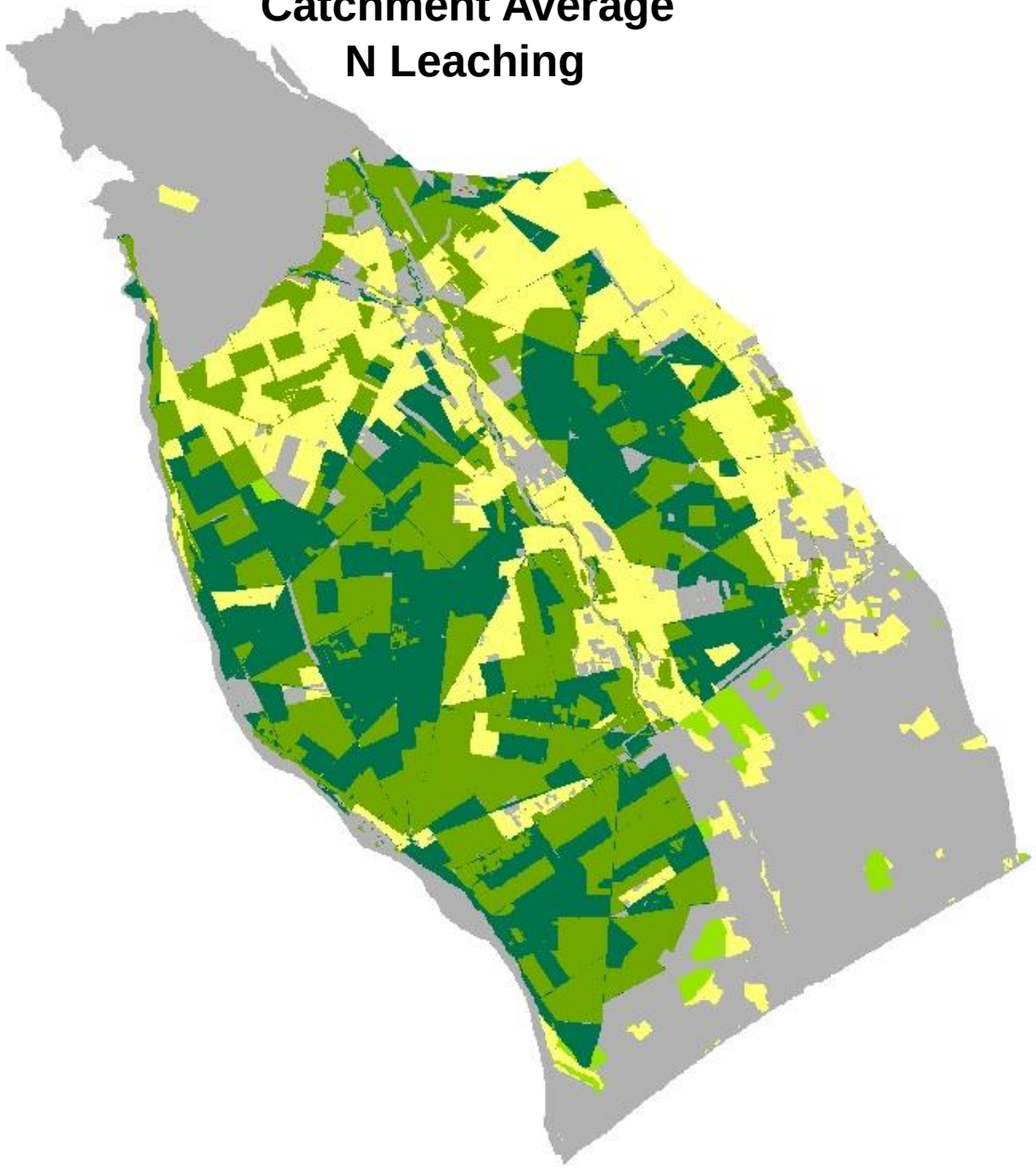

Selwyn Catchment
Other
Forest
Horticulture
Arable
S&B
Dairy Support
Dairy
Baseline Average:
19 kgN/ha
'000 ha
250
200
150
100
50
0
10 20 30 40 50 60 70 80 . 10 20 30 . 10 15 20 . 10 15 20
Base
.
10%
.
25%
.
50%
Allocation (kgN/ha)

Catchment Average N Leaching



0
0.1 - 20
20 - 40
40 - 60
60 - 80
> 80
Undefined

Catchment Average N Leaching



% Change from Baseline

- < -60%
- -60% to -40.1%
- -40% to -20.1%
- -20% to -0.1%
- 0%
- > 0%

0 3,200 6,400 12,800 19,200 25,600 Meters

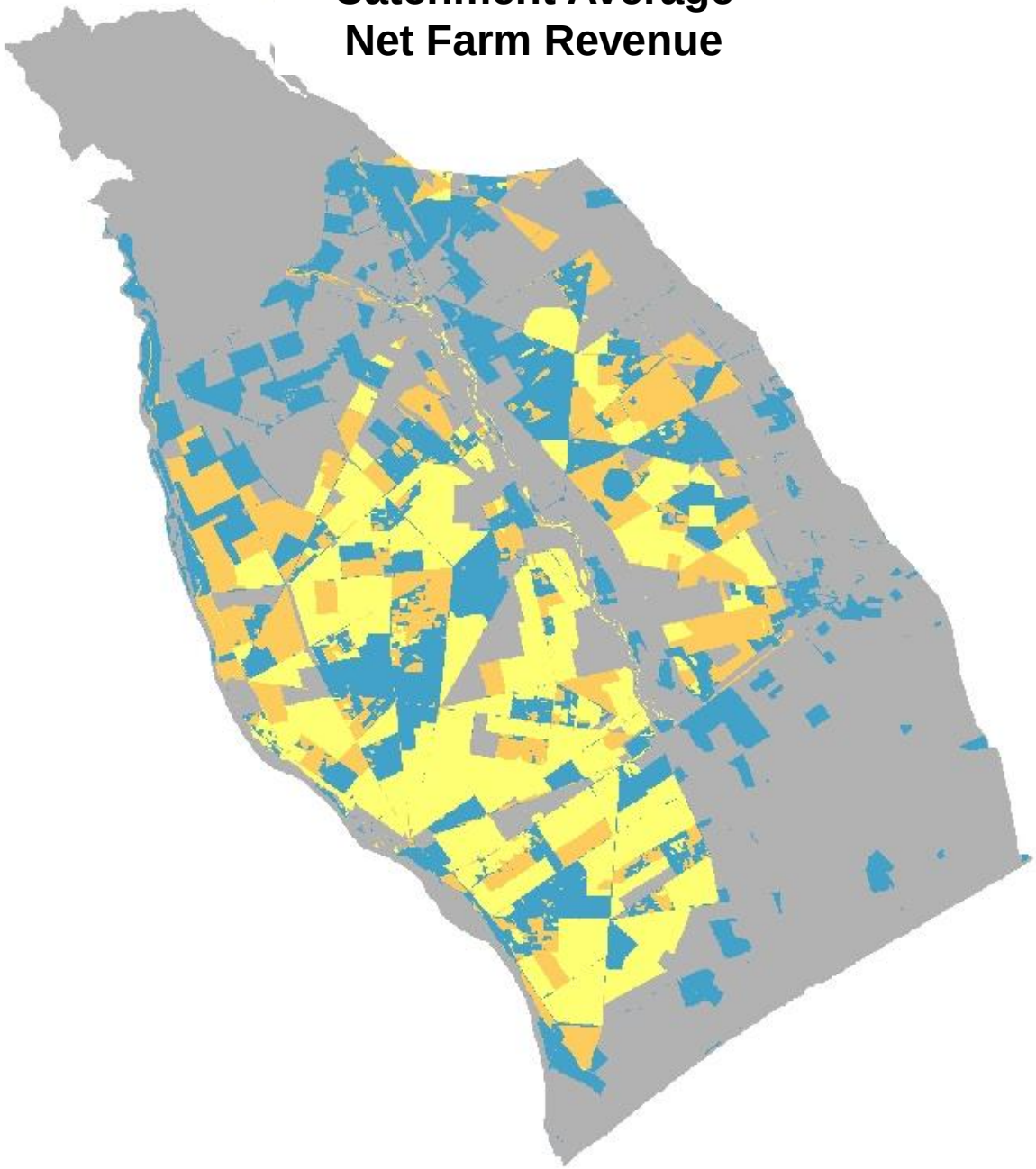
Catchment Averaging Estimates

Reduction Target	Hinds		Selwyn	
	Net Revenue	N Leaching	Net Revenue	N Leaching
10%	-9%	-35%	-10%	-36%
25%	-12%	-41%	-13%	-42%
50%	-21%	-56%	-20%	-54%

Costs relatively equal across catchments
Policy target exceeded in all cases as excess allocation provided to some landowners


Change in Net Revenue From Baseline ('000 $)
Hinds
50%
25%
10%
Selwyn
50%
25%
10%
Dairy
Dairy Support
Sheep & Beef
Arable
Horticulture
Forestry
Other
-$100,000
-$80,000
-$60,000
-$40,000
-$20,000
$-
$20,000
$40,000

Catchment Average Net Farm Revenue



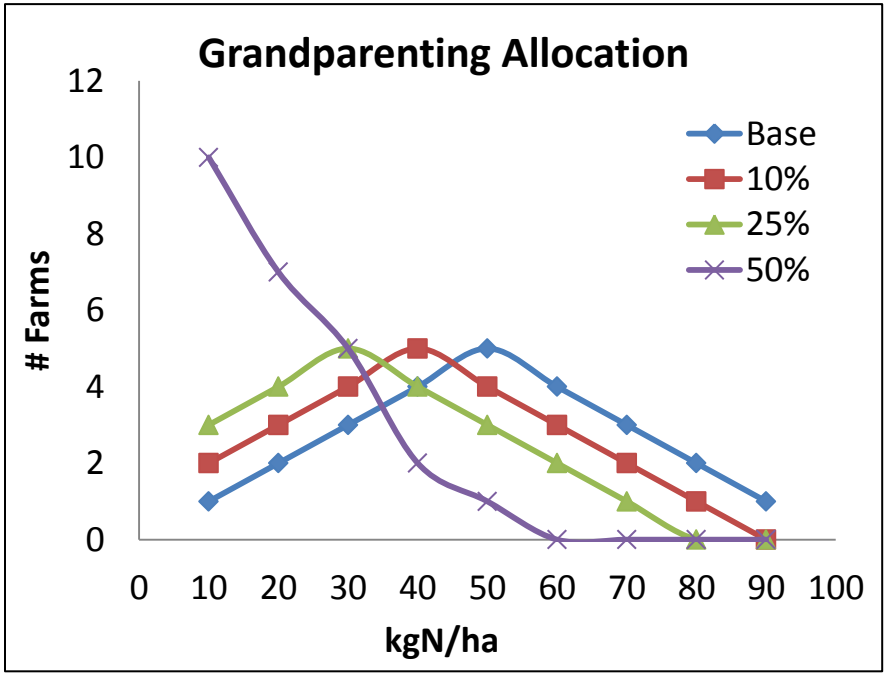
% Change from Baseline

- -40% to -20.1%
- -20% to -0.1%
- 0%
- > 0%

0 3,200 6,400 12,800 19,200

Grandparenting

- Based on existing land use and N leaching
- All landowners receive allocation that is X% of current N leaching, where X% is policy target
- Favours farms currently with high leaching rates
- Disadvantages landowners seeking to intensify/change land use in future

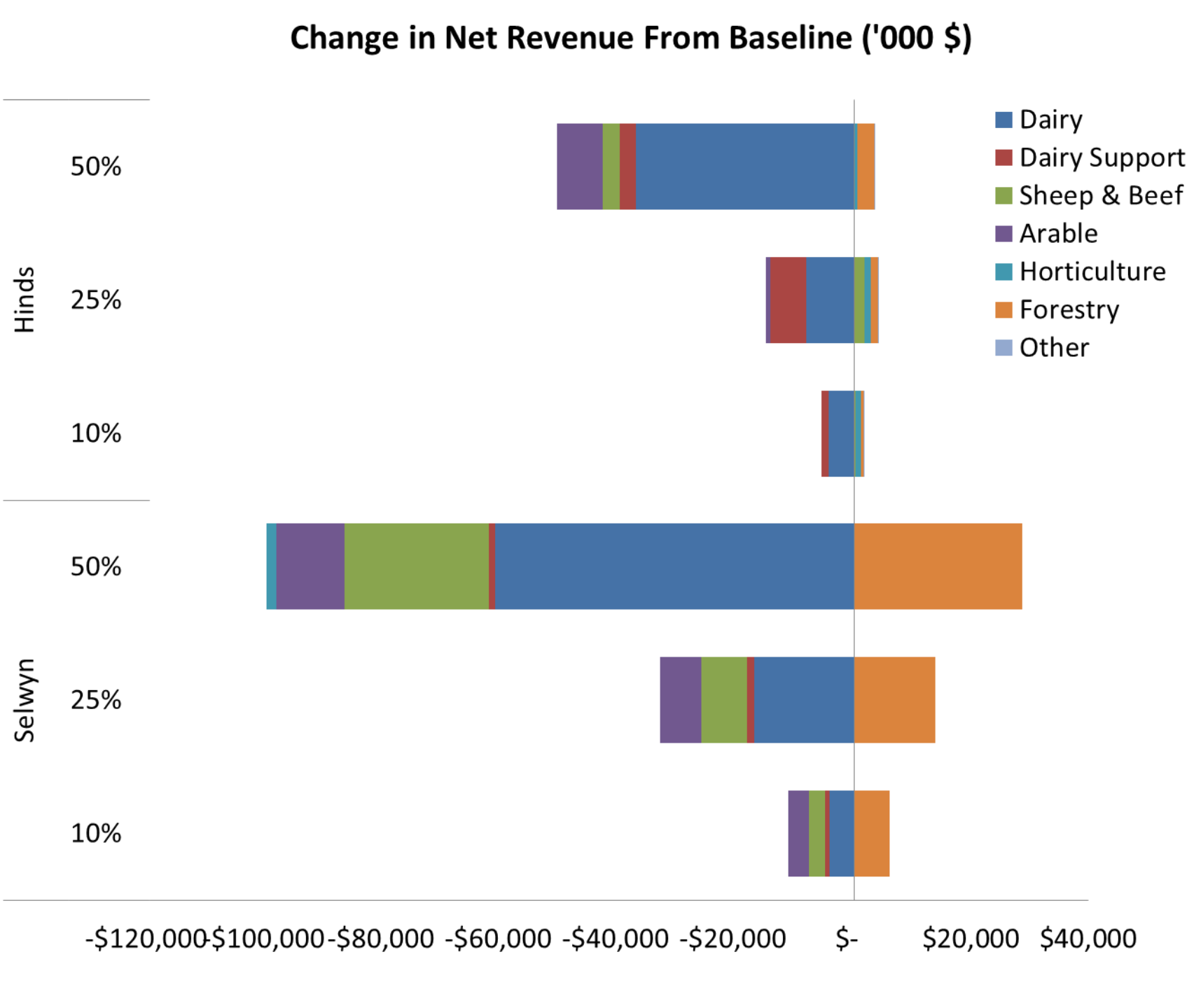


Grandparenting Estimates

Reduction Target	Hinds		Selwyn	
	Net Revenue	N Leaching	Net Revenue	N Leaching
10%	-2%	-10%	-2%	-10%
25%	-4%	-25%	-7%	-25%
50%	-19%	-50%	-24%	-50%

Selwyn faces higher costs (i.e. reduction in net farm revenue)

Policy target exactly met in all cases


Change in Net Revenue From Baseline ('000 $)
Hinds
50%
25%
10%
Selwyn
50%
25%
10%
Dairy
Dairy Support
Sheep & Beef
Arable
Horticulture
Forestry
Other
-$120,000
-$100,000
-$80,000
-$60,000
-$40,000
-$20,000
$-
$20,000
$40,000

Land Cover Averaging

- All landowners in specific land cover (e.g., pasture, crops, forest) receive the same allocation of X kgN/ha/yr)
- Favours farms with low leaching soils and practices
- May allow flexibility to intensify within land cover

Sector	Hinds Base (kgN/ha)	Selwyn Base (kgN/ha)
Pasture	38.3	22.0
Cropland	22.7	14.2
Horticulture	10.0	7.1
Forest	1.0	0.8
Other	1.1	9.4
Average	34.2	22.0

Land Cover Averaging Estimates

Reduction Target	Hinds		Selwyn	
	Net Revenue	N Leaching	Net Revenue	N Leaching
10%	-9%	-24%	-9%	-35%
25%	-12%	-40%	-11%	-39%
50%	-21%	-56%	-19%	-52%

Costs relatively similar across catchment

Policy target exceeded in all cases as excess allocation provided to some landowners


Change in Net Revenue From Baseline ('000 $)
Hinds
50%
25%
10%
Selwyn
50%
25%
10%
Dairy
Dairy Support
Sheep & Beef
Arable
Horticulture
Forestry
Other
-$100,000
-$80,000
-$60,000
-$40,000
-$20,000
$-
$20,000
$40,000

Sector Averaging

- All landowners in specific sector (e.g., dairy, arable,) receive the same allocation of X kgN/ha/yr)
- Favours farms with low leaching soils and practices
- May allow flexibility to intensify within sector
- Could be difficult to intensify across sectors

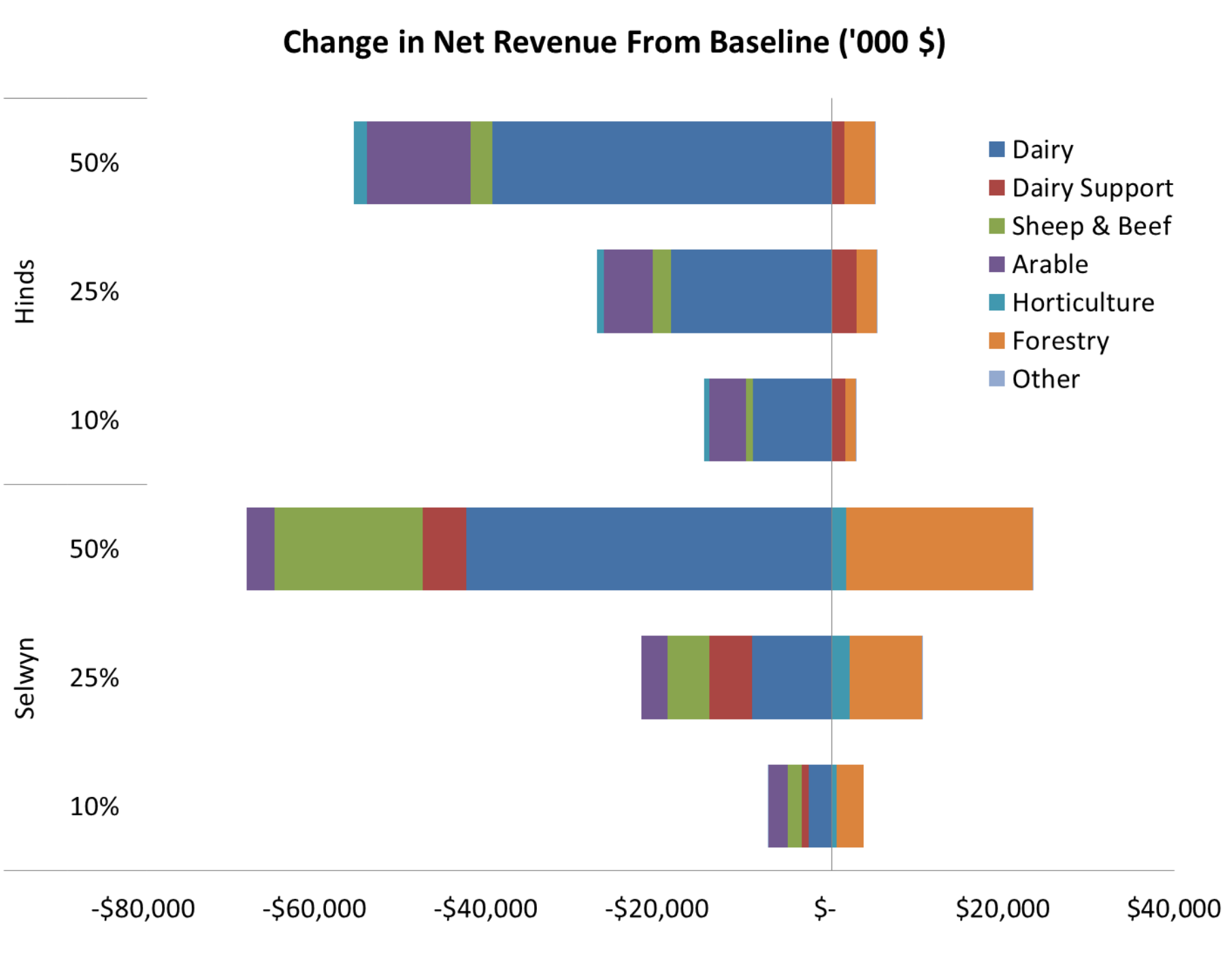
Sector	Hinds Base (kgN/ha)	Selwyn Base (kgN/ha)
Dairy	57.7	42.2
Dairy Support	56.4	40.7
Sheep & Beef	22.7	14.2
Arable	17.3	13.7
Horticulture	10.0	7.1
Forestry	1.0	0.8
Other	1.1	9.4
Average	34.2	19.5

Sector Averaging Estimates

Reduction Target	Hinds		Selwyn	
	Net Revenue	N Leaching	Net Revenue	N Leaching
10%	-5%	-21%	-1%	-10%
25%	-9%	-31%	-4%	-25%
50%	-21%	-50%	-15%	-50%

Costs relatively higher in Hinds

Policy target exceeded in some cases as excess allocation provided to some landowners


Change in Net Revenue From Baseline ('000 $)
Hinds
50%
25%
10%
Selwyn
50%
25%
10%
Dairy
Dairy Support
Sheep & Beef
Arable
Horticulture
Forestry
Other
-$80,000
-$60,000
-$40,000
-$20,000
$-
$20,000
$40,000

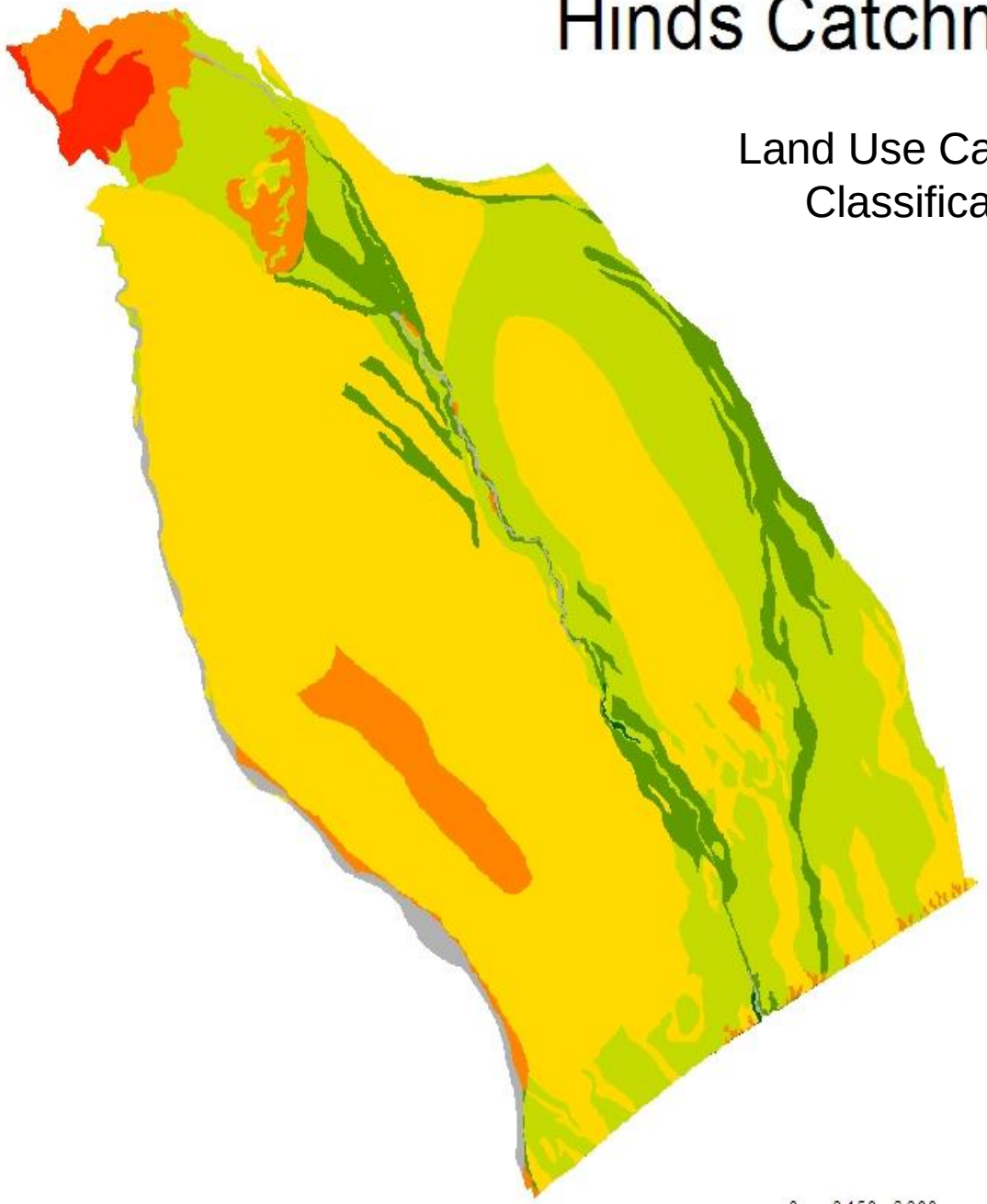
Land Use Capability

- Based on land use capability (LUC) class
- More productive LUCs (i.e., I and II) receive greater allocation
- Favours farms with high productive land
- May allow flexibility to expand, depending on LUC

LUC	Baseline (kgN/ha)	Policy (kgN/ha)
LUC I	16.1	24.7
LUC II	20.4	24.0
LUC III	21.6	21.6
LUC IV	31.7	16.2
LUC V	31.7	16.2
LUC VI	18.0	9.4
LUC VII	9.2	4.5
Average	19.5	17.0

Hinds Catchment

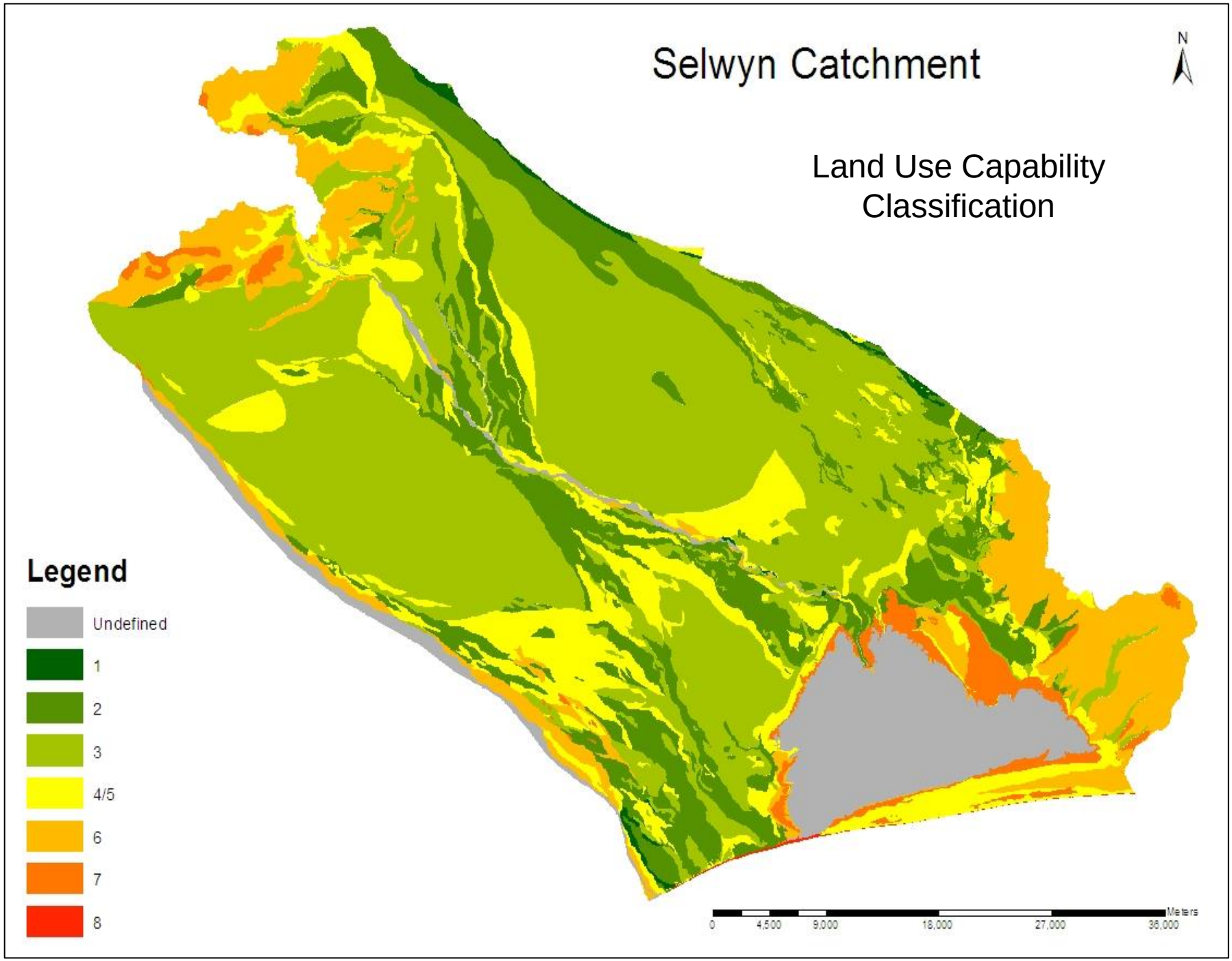
Land Use Capability Classification



Legend

- Undefined
- 1
- 2
- 3
- 4/5
- 6
- 7

0 3,150 6,300 12,600 18,900 25,200
Meters

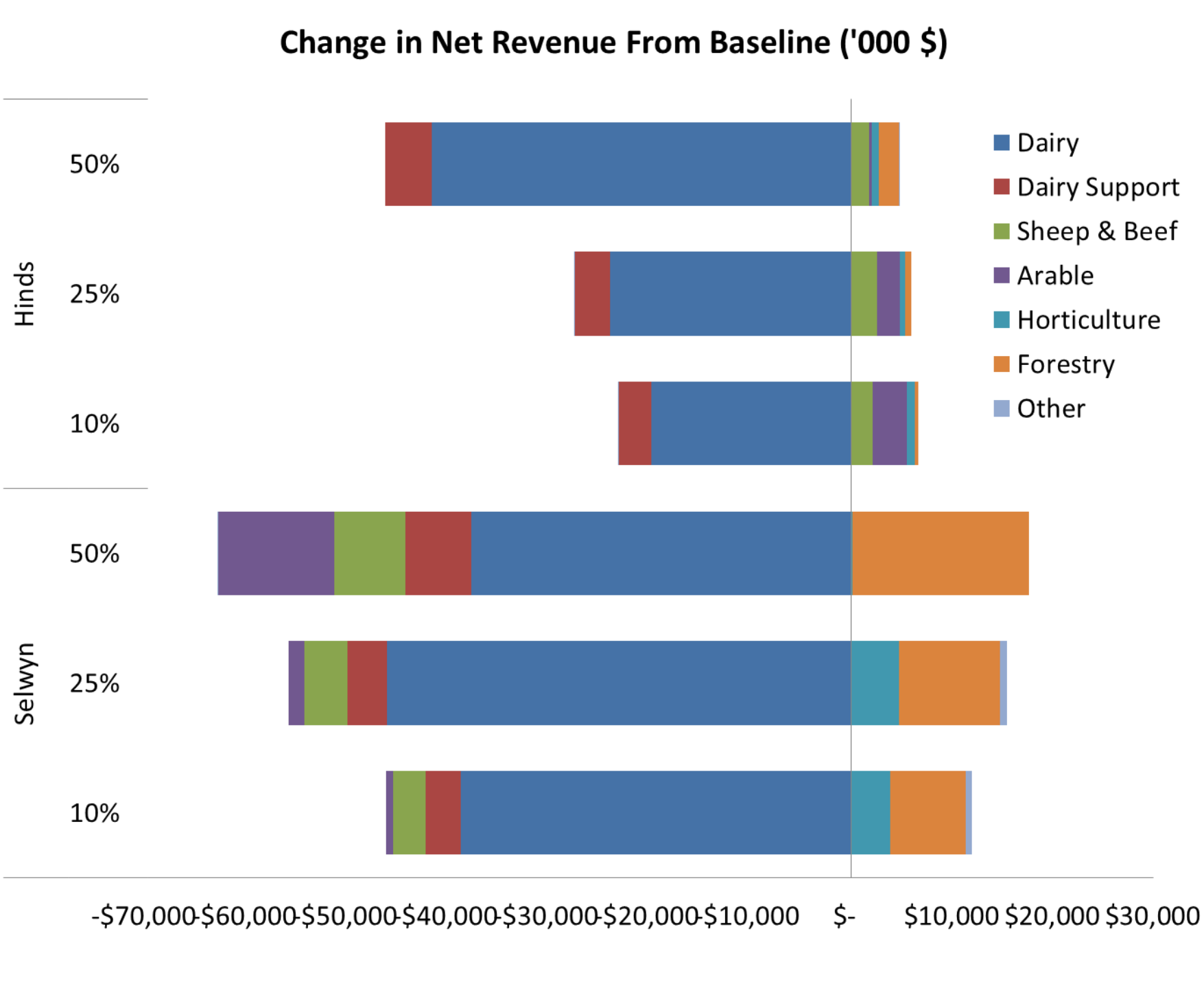

Selwyn Catchment
N
Land Use Capability Classification
Legend
Undefined
1
2
3
4/5
6
7
8
0
4,500
9,000
18,000
27,000
36,000
Meters

Land Use Capability Estimates

Reduction Target	Hinds		Selwyn	
	Net Revenue	N Leaching	Net Revenue	N Leaching
10%	-7%	-27%	-12%	-13%
25%	-9%	-32%	-14%	-43%
50%	-17%	-50%	-22%	-55%

Selwyn faces higher costs (i.e. reduction in net farm revenue)

Policy target exceeded in most cases as excess allocation provided to some landowners


Change in Net Revenue From Baseline ('000 $)
Hinds
50%
25%
10%
Selwyn
50%
25%
10%
Dairy
Dairy Support
Sheep & Beef
Arable
Horticulture
Forestry
Other
-$70,000
-$60,000
-$50,000
-$40,000
-$30,000
-$20,000
-$10,000
$-
$10,000
$20,000
$30,000

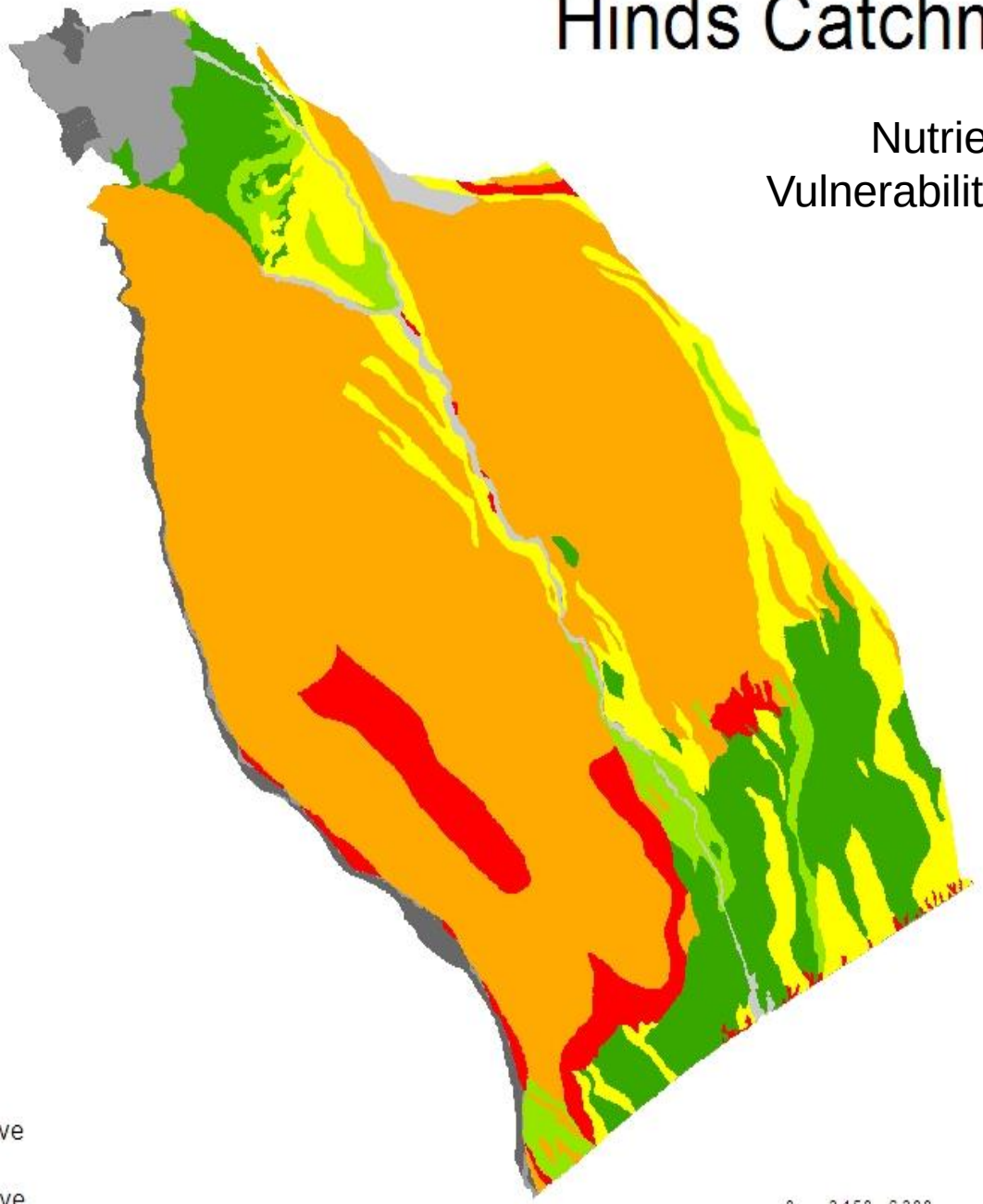
Nutrient Vulnerability

- Based on nutrient vulnerability (vul) class
- Less leaky soils (e.g., low) receive greater propostion of allocation relative to their current leaching
- Favours farms on the least leaky soils
- May allow flexibility to expand, depending on Vul class

Vul Class	Baseline (kgN/ha)	Policy (kgN/ha)
Very High	59.9	29.7
High	55.9	26.3
Medium	26.9	24.9
Low	24.5	24.9
Very Low	12.4	27.8
Other	10.4	11.1
Average	34.2	25.7

Hinds Catchment

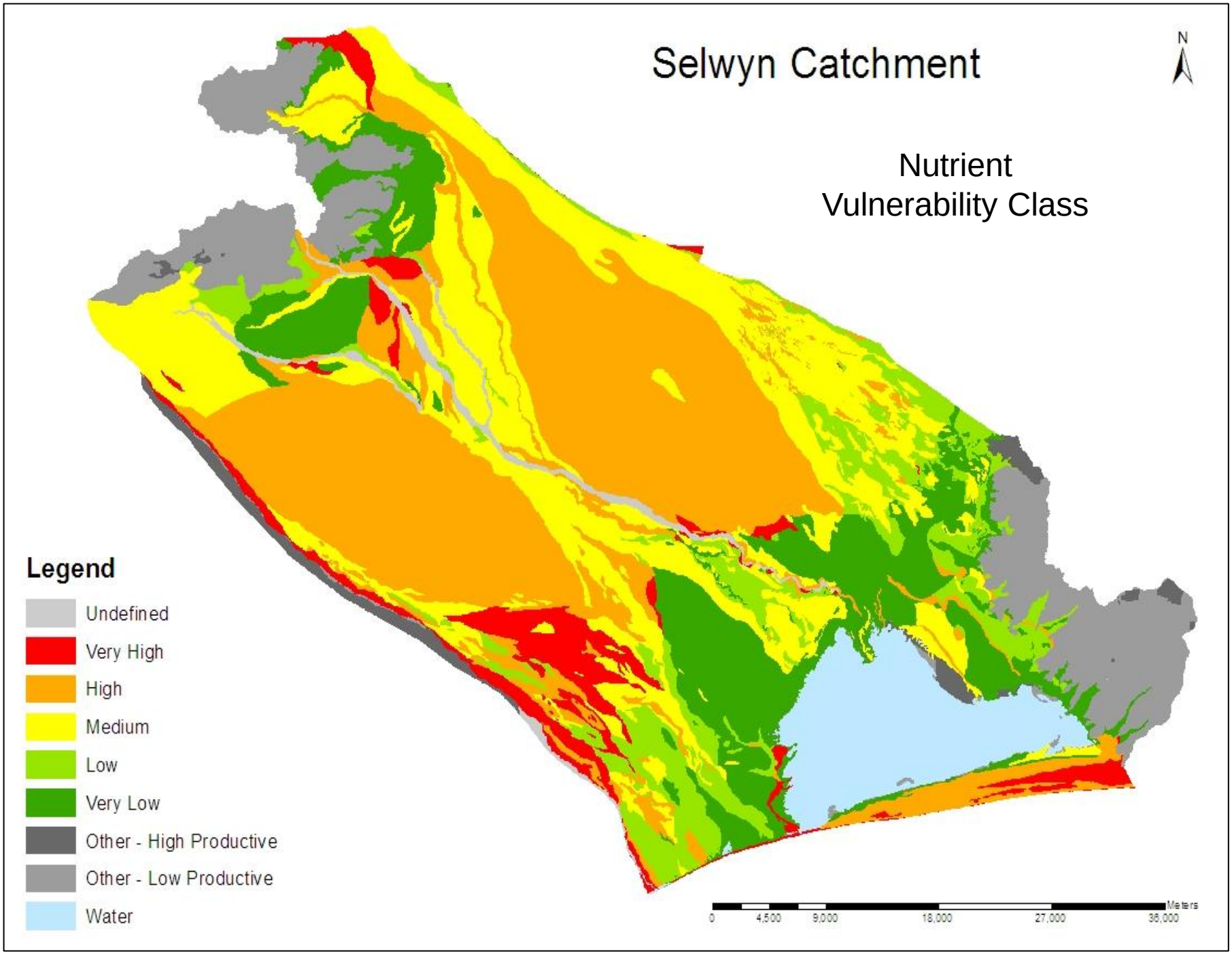
Nutrient
Vulnerability Class



Legend

- Undefined
- Very High
- High
- Medium
- Low
- Very Low
- Other-High productive
- Other- Low productive

0 3,150 6,300 12,600 18,900 25,200
Meters

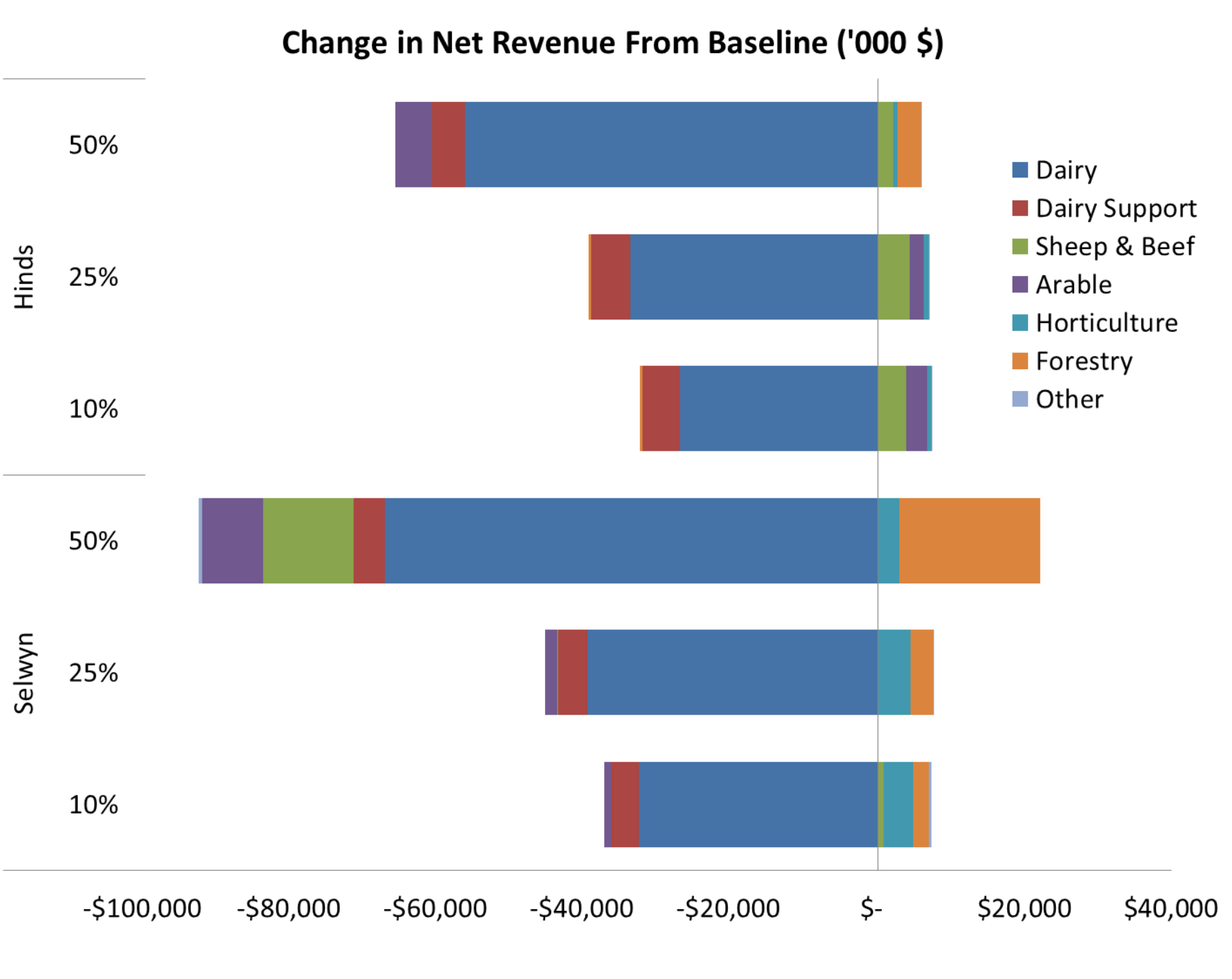

Selwyn Catchment
N
Nutrient
Vulnerability Class
Legend
Undefined
Very High
High
Medium
Low
Very Low
Other - High Productive
Other - Low Productive
Water
0
4,500
9,000
18,000
27,000
36,000
Meters

Nutrient Vulnerability Estimates

Reduction Target	Hinds		Selwyn	
	Net Revenue	N Leaching	Net Revenue	N Leaching
10%	-10%	-37%	-10%	-36%
25%	-13%	-43%	-13%	-41%
50%	-24%	-60%	-24%	-58%

Costs relatively equal across catchments

Policy target exceeded in most cases as excess allocation provided to some landowners


Change in Net Revenue From Baseline ('000 $)
Hinds
50%
25%
10%
Selwyn
50%
25%
10%
Dairy
Dairy Support
Sheep & Beef
Arable
Horticulture
Forestry
Other
-$100,000
-$80,000
-$60,000
-$40,000
-$20,000
$-
$20,000
$40,000

Allocation + Trading

- Can occur under any allocation scheme
- All landowners will buy (sell) if marginal cost of abatement greater (less) than allocation value ($/kgN)
- Assuming perfect market with willing buyers and sellers, will always converge to same outcome
- Potential windfall gain to landowners who can sell excess permits
- Allows opportunity for all landowners to intensify, if they are willing to pay for it

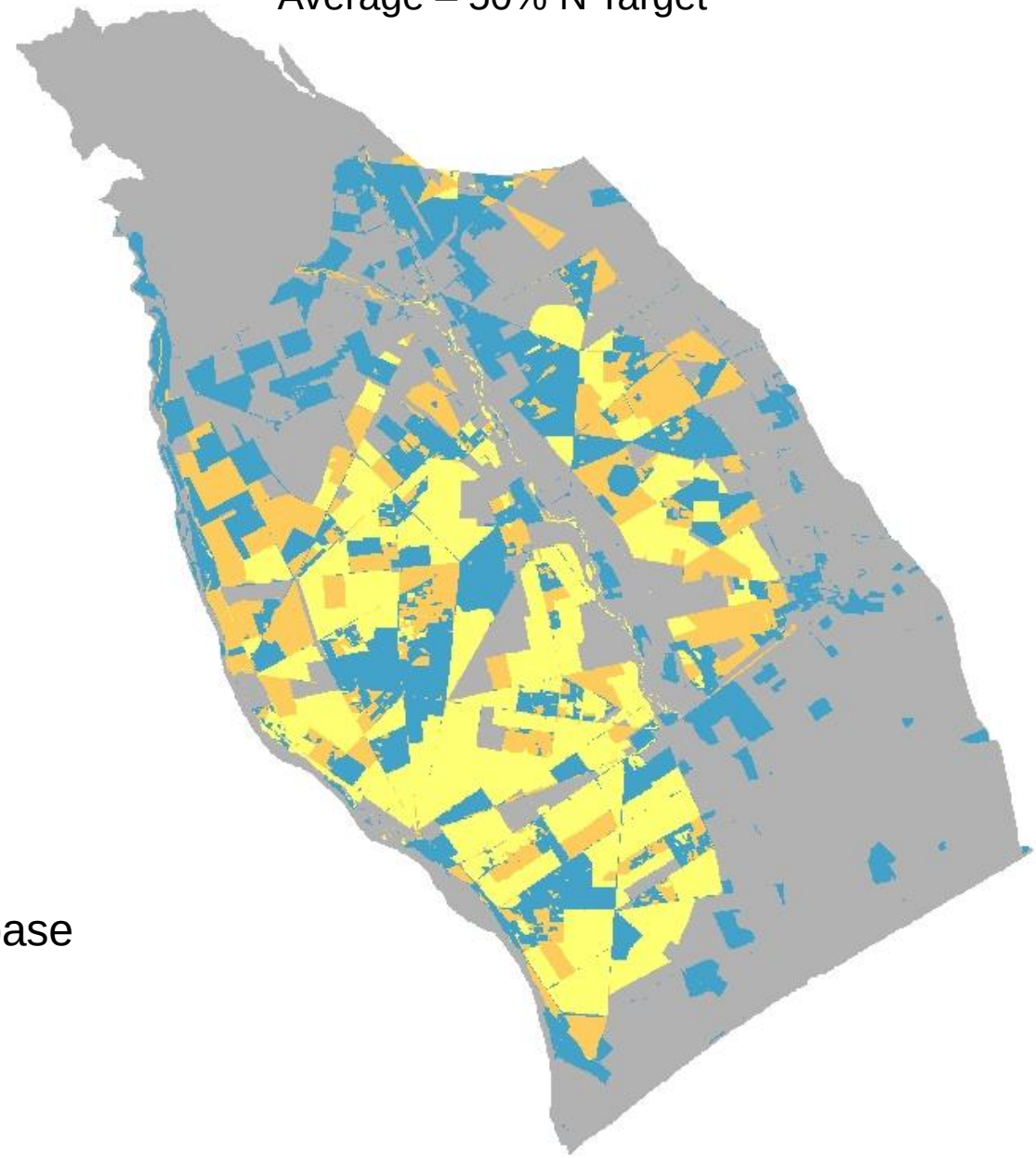
Allocation + Trading Estimates

Reduction Target	Hinds		Selwyn	
	Net Revenue	N Leaching	Net Revenue	N Leaching
10%	-1%	-10%	0%	-10%
25%	-4%	-25%	-3%	-25%
50%	-14%	-50%	-14%	-50%

Costs relatively similar across both catchments

Policy target met in all cases due to option for landowners to sell excess allocation

Net Revenue Change
Average – 50% N Target



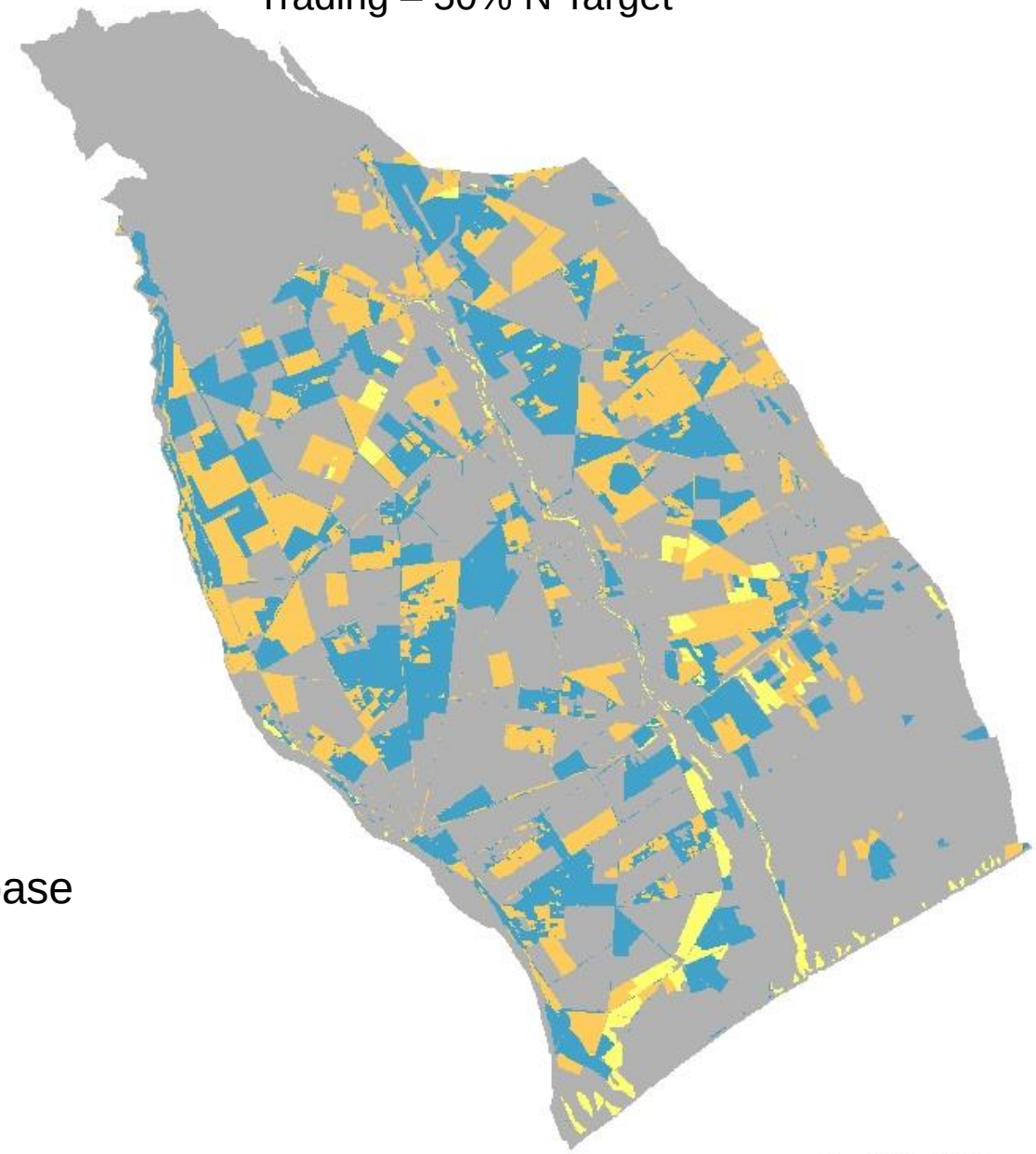
% Change from base

- -40% to -20.1%
- -20% to -0.1%
- 0%
- > 0%

0 3,200 6,400 12,800 19,200 25,600
Meters

Net Revenue Change

Trading – 50% N Target



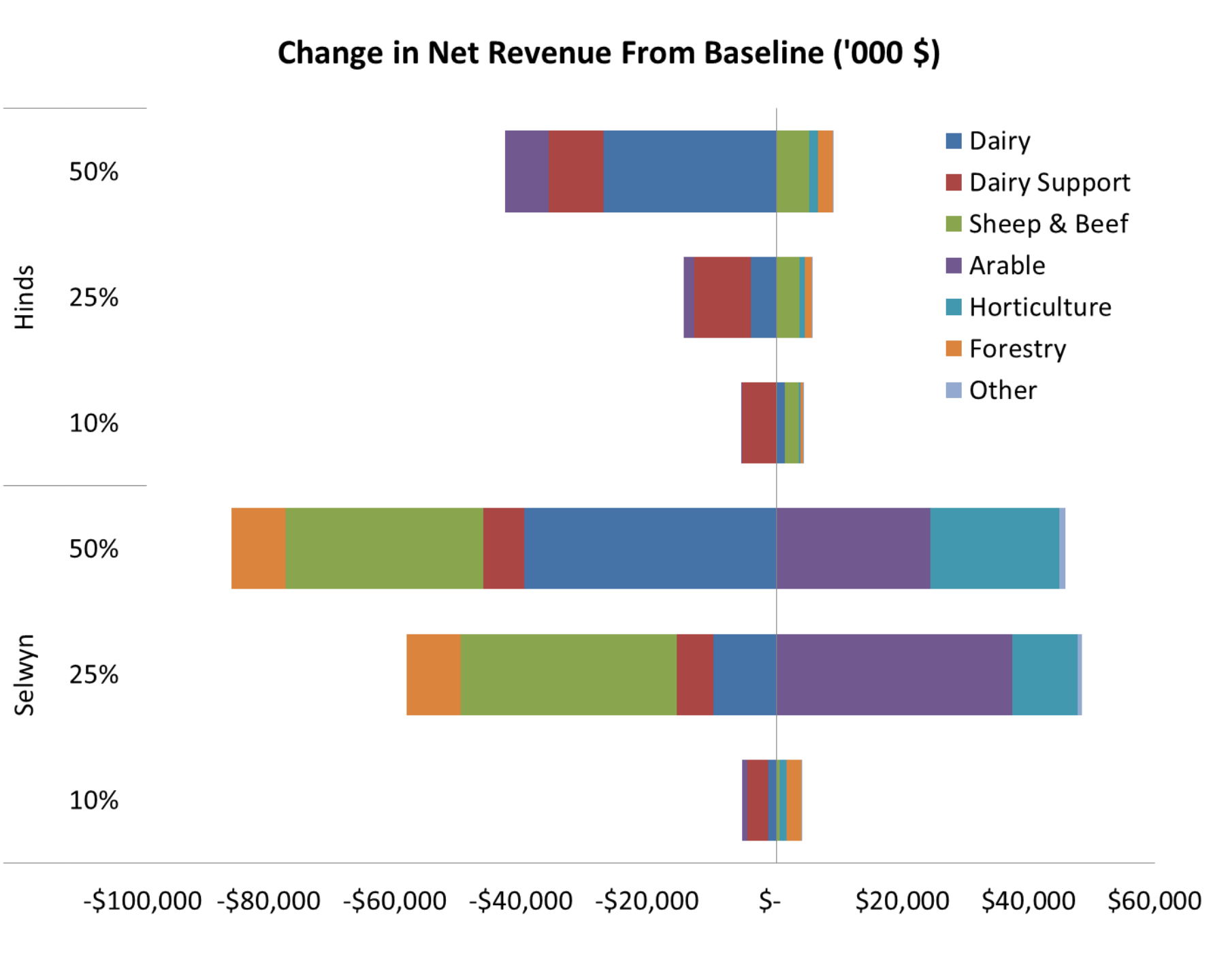
N

% Change from base

- -40% to -20.1%
- -20% to -0.1%
- 0%
- > 0%

0 3,200 6,400 12,800 19,200 25,600

Meters


Change in Net Revenue From Baseline ('000 $)
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10%
Selwyn
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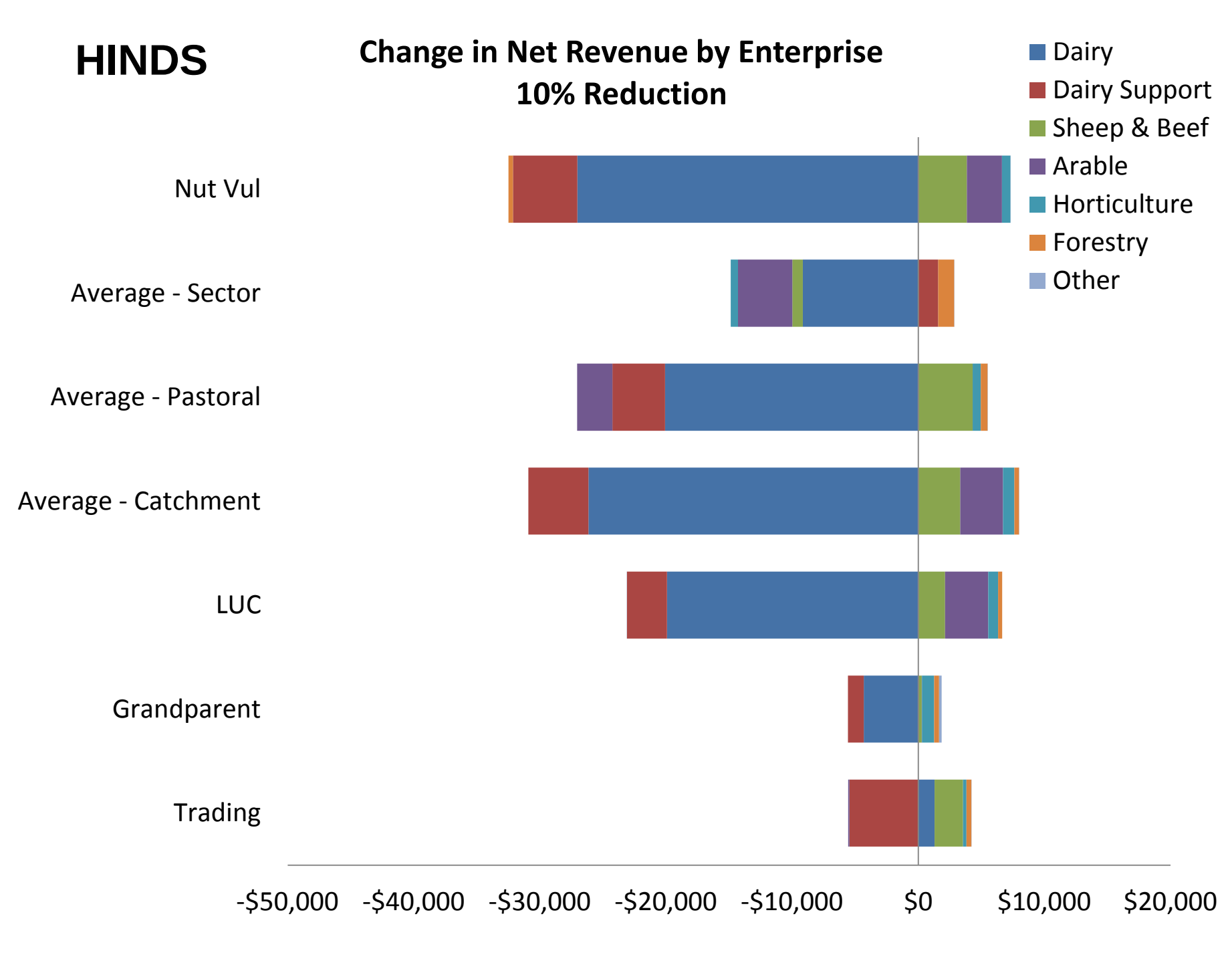
Dairy
Dairy Support
Sheep & Beef
Arable
Horticulture
Forestry
Other
-$100,000
-$80,000
-$60,000
-$40,000
-$20,000
$-
$20,000
$40,000
$60,000

Marginal Cost of Abatement

- Landowners willing to buy (sell) if marginal cost of abatement greater (less) than allocation value
- Those with excess allocation stand to gain from trading (i.e. selling right to leach) at these values
- Relatively lower cost in Hinds suggests more abatement potential (i.e. Dairy with advanced mitigation)

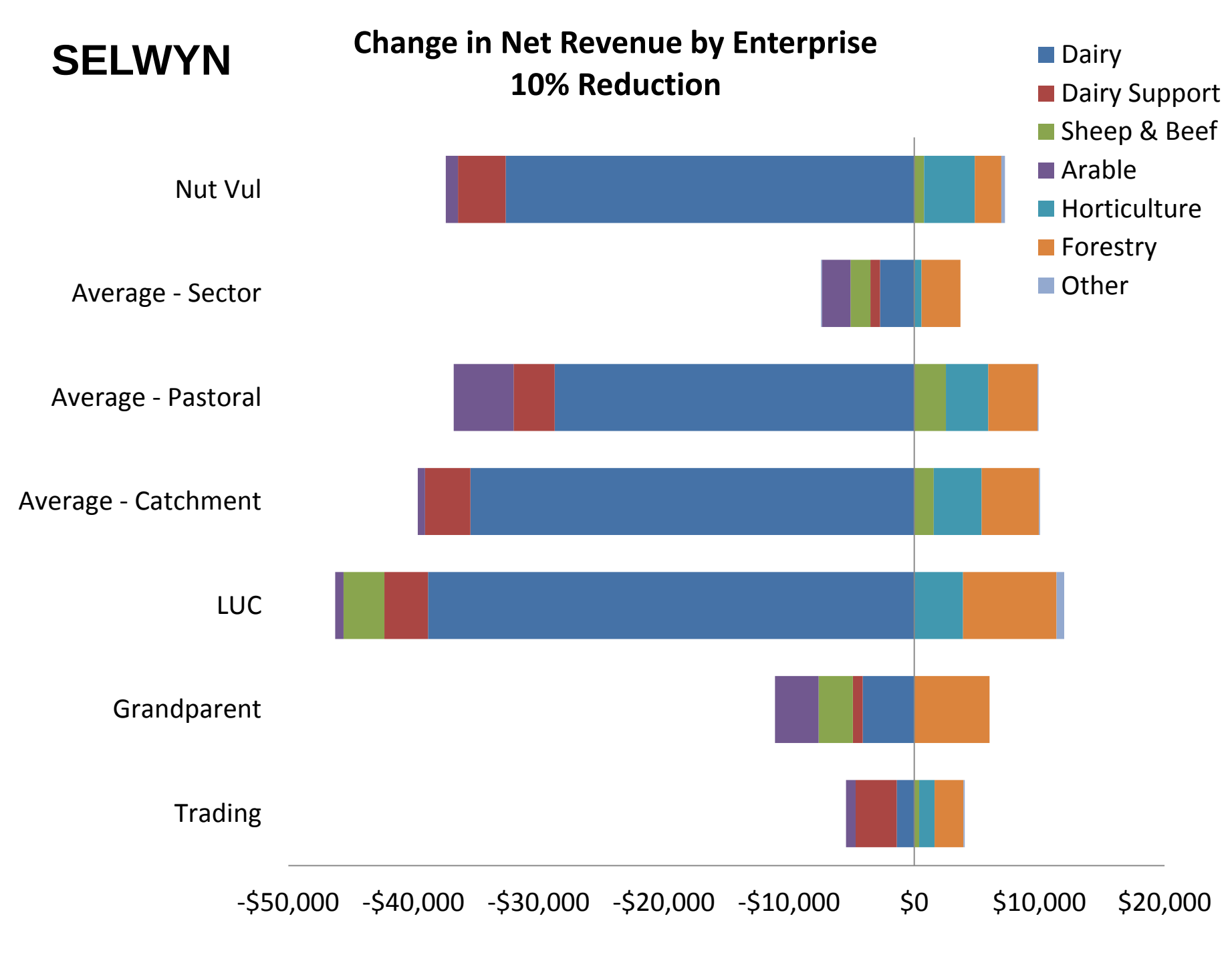
Reduction Target	Hinds	Selwyn
10%	$6.53	$7.45
25%	$16.59	$19.36
50%	$30.95	$39.70

HINDS

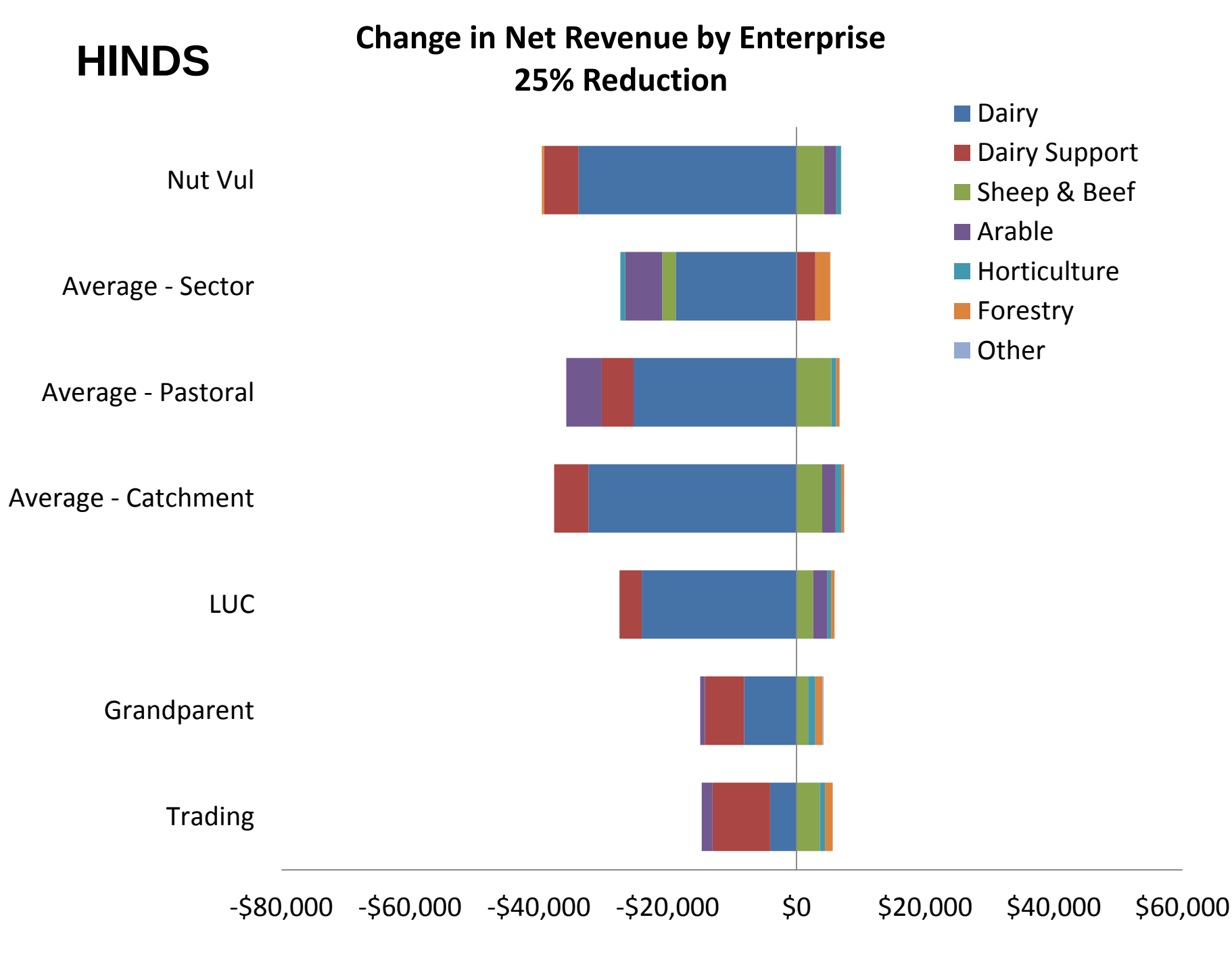

Change in Net Revenue by Enterprise
10% Reduction
Dairy
Dairy Support
Sheep & Beef
Arable
Horticulture
Forestry
Other
Nut Vul
Average - Sector
Average - Pastoral
Average - Catchment
LUC
Grandparent
Trading
-$50,000
-$40,000
-$30,000
-$20,000
-$10,000
$0
$10,000
$20,000

SELWYN

Change in Net Revenue by Enterprise
10% Reduction

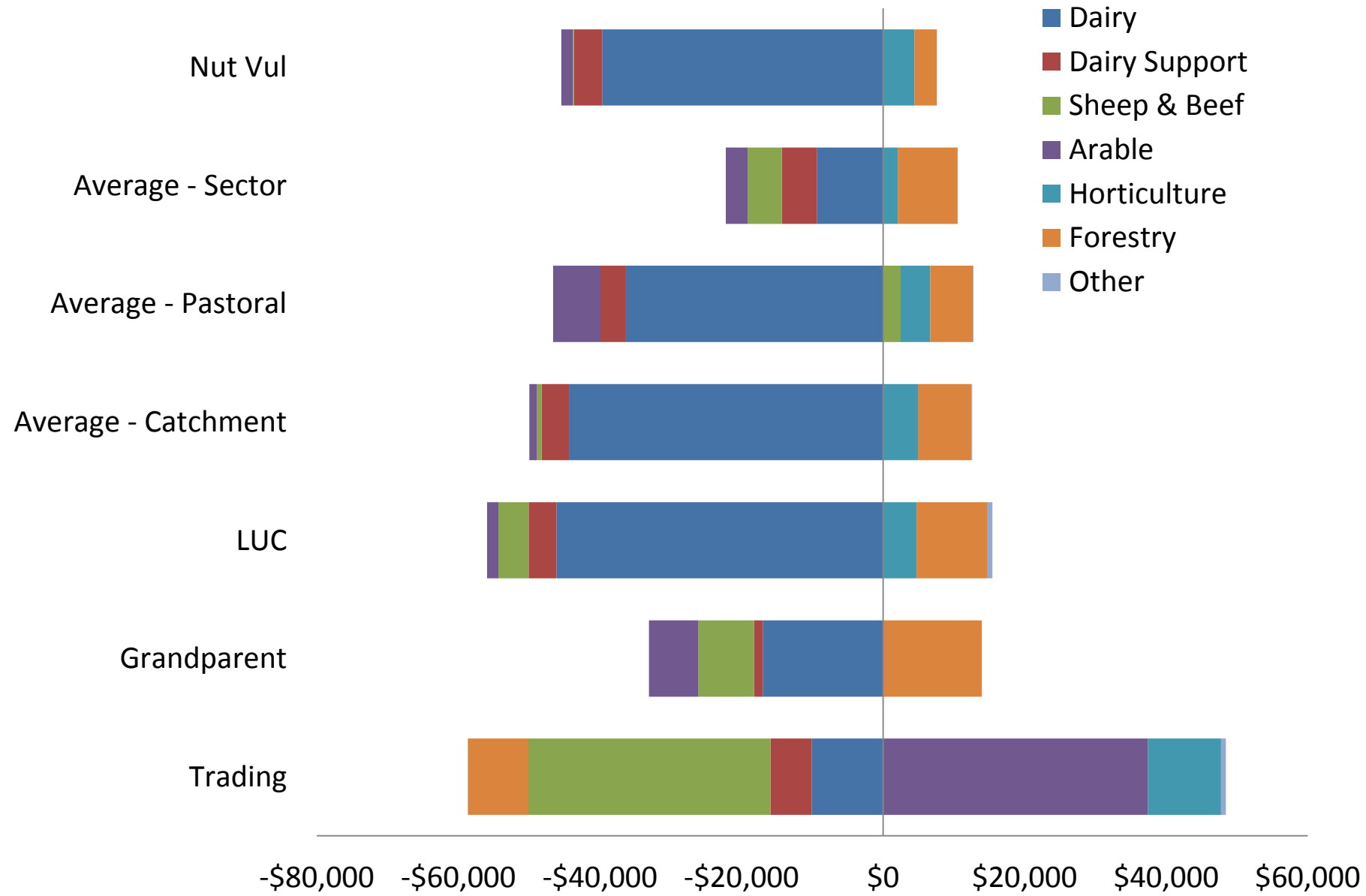


HINDS

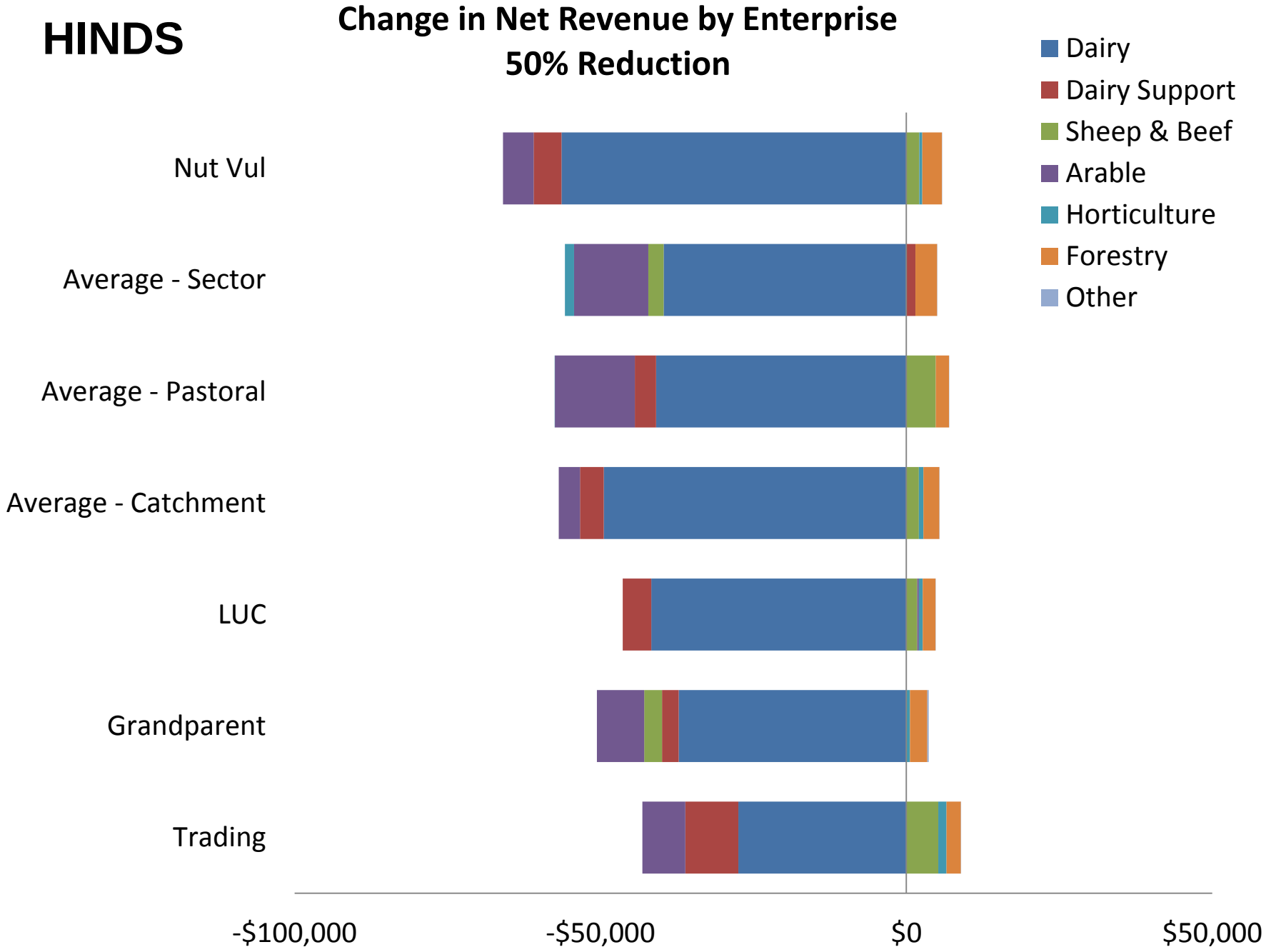

Change in Net Revenue by Enterprise
25% Reduction
Dairy
Dairy Support
Sheep & Beef
Arable
Horticulture
Forestry
Other
Nut Vul
Average - Sector
Average - Pastoral
Average - Catchment
LUC
Grandparent
Trading
-$80,000
-$60,000
-$40,000
-$20,000
$0
$20,000
$40,000
$60,000

SELWYN

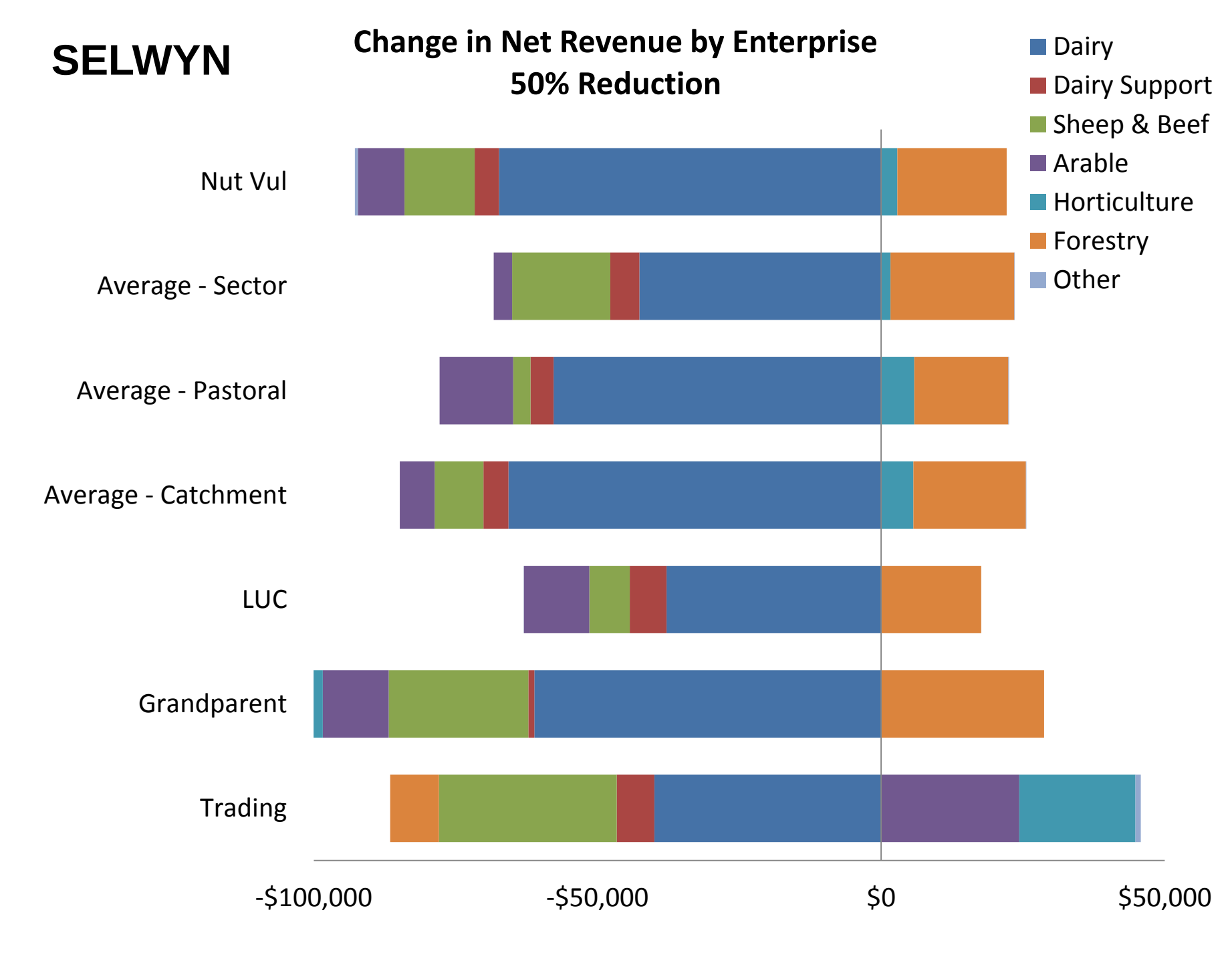
Change in Net Revenue by Enterprise
25% Reduction



HINDS


Change in Net Revenue by Enterprise
50% Reduction
Dairy
Dairy Support
Sheep & Beef
Arable
Horticulture
Forestry
Other
Nut Vul
Average - Sector
Average - Pastoral
Average - Catchment
LUC
Grandparent
Trading
-$100,000
-$50,000
$0
$50,000

SELWYN


Change in Net Revenue by Enterprise
50% Reduction
Dairy
Dairy Support
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Horticulture
Forestry
Other
Nut Vul
Average - Sector
Average - Pastoral
Average - Catchment
LUC
Grandparent
Trading
-$100,000
-$50,000
$0
$50,000

Results Summary

Rank order of allocation options by catchment and policy target

(1 = lowest cost/reduction in catchment-wide net farm revenue)

Allocation	Hinds			Selwyn		
	10%	25%	50%	10%	25%	50%
Base	1	1	1	1	1	1
Trading	2	2	2	2	2	2
Grandparent	3	3	4	4	4	7
LUC	5	4	3	7	7	6
Average - All	7	7	7	6	6	5
Average - Pastoral	6	6	5	5	5	4
Average - Sector	4	5	6	3	3	3
Nutrient Vul	8	8	8	7	7	7

Outcome

- Appropriate allocation approach likely to vary based on
  - Catchment characteristics
  - Current land use configuration
  - Size of reduction target
- It is a ‘political’ decision where different principles need to be weighed up
- Outcome likely to be variable
- Even if catchment-wide impact is minimal, specific landowners will still gain/lose

SELWYN

Change in Net Revenue by Enterprise
25% Reduction