Linkages between land management activities and water quality in the Bog Burn catchment, Southland.

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AgResearch, Invermay
Outline

1. Study process & links to farm planning initiatives

2. Mitigation research
   - technical fixes...
   - the BMP Toolbox
     environmental reductions & $$$

3. Lessons learnt
Project participants

Chris Smith, Richard Muirhead, Richard McDowell, Denise Bewsell

Bob Wilcock, John Quinn, Maurice Duncan

Environment Southland

Bruce Thorrold

Lew Metcalfe, John Russell, Jim Barnett, Charlotte Rutherford
National Dairy Catchments study
(all predominantly dairy)
Bog Burn catchment location
Bog Burn landuse
The catchment management planning process

BMP Toolbox:
• Easy things first
• Effectiveness (re-established values)
• Cost-effectiveness
• Suite of options preferred

Monitoring, status → Identify key land-water linkages → Establish catchment values/targets → Farm planning

Review the plan’s success
Identify key land-water linkages
Establish catchment values/targets
Farm planning

Monitoring, status

Stream water quality status (median values)

Turbidity
Phosphorus
Nitrogen
E. coli
Clarity

% of water quality guideline
Identification of key land-water linkages.

Establishment of catchment values/targets.

Farm planning.

Bar charts illustrating the percentage of water quality guidelines for different parameters:
- Turbidity
- Phosphorus
- Nitrogen
- E. coli
- Clarity

Legend:
- Bog Burn
- Inchbonnie
- Waikakahi
- Waiokura
- Toenepi
Bog Burn

Direct drainage of farm dairy effluent through mole-tile drains

(Monaghan et al. 2007 Ag. Eco. Env. 118: 211-222)
Other key land-water linkages: mole-tile drains, overland flow

Contribution to farm discharges:

Phosphorus

Faecal bacteria
Other key land-water linkages: wintering

- leaching loss of 32 kg N/t milksolids:
Why is this catchment important?
Stakeholder workshop

Farmers
• Local values and information

Regional Councils
• Values from their planning processes
• Targets to protect/restore values

Scientists
• Current state of water
• Land-water linkage knowledge

Conceptual linkage model developed
Identified catchment values:

- Trout spawning & rearing in BB
- Contact recreation in Oreti R.
- Farm returns
Bog Burn Dairy Farm Plans

- riparian works more important for small stream habitat in tile drained areas
  - Stock exclusion, planting, erosion control, etc

- effluent mgmt very important for major river WQ
  - Storage, low rate application etc.
Bog Burn Dairy Farm Plans

1. Exclusion of cattle from streams & wetlands
   - including no stream crossings

2. Nutrient management systems are in place
   - OVERSEER runs completed

3. Effluent management complies with local agency requirements….
2. Mitigation research

Improved effluent management systems
- wet, fragile or artificially drained soils
Option 1: Deferred irrigation

1. Large storage ponds (2 – 3 months)
2. Capital cost: $35 – 100 per cow
3. Annualised cost: $4 – 11 per cow
Option 2: Advanced Pond System

1. 4-pond treatment & discharge
2. Capital cost: $90 – 110 per cow
3. Annualised cost: $10 – 20 per cow
Option 3: Low rate (K-Line) technology

- Low application rate (4 mm/hr) & improved uniformity
- High degree of control of application depth
- Intermittent pumping option
- Annualised cost: $3 – 5 per cow
Option 4?: DairyYard

- recent development
- greatly reduces wash-down water volumes
  ➢ smaller pond required
Option 5+?:

- in progress
- again designed to reduce pond storage reqts
**Effluent systems: horses for courses**

**Recommended minimum effluent storage reqts: Southland**

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<th>Landscape risk</th>
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Tackling the nitrogen problem...
Nitrification inhibitor technology

Fertiliser urea → Gaseous

Urine urea → NH₄

Soil organic matter → NH₄

Nitrite

DCD → NO₃

Gaseous

Leaching
N leaching losses from DCD-treated pasture: Southland (DCn product)

- Control
- N inhibitor

46% reduction

N leaching, kg/ha/year

- 0
- 5
- 10
- 15
- 20
- 25

Nitrate leaching losses under restricted autumn grazing management

- Control
- 3 hour autumn grazing

2001-2003: 41% reduction
The BMP Toolbox

- selecting the right tool for the job
Toolbox of BMPs

- net cost
- effectiveness
- cost-effectiveness

$25-100/cow/year
$4-11/cow/year
$10-20/cow/year
$40-60/cow/year
$20-60/cow/year
$-20-20/cow/year
$-37/cow/year
$-20-60/cow/year
$4/cow/year
Web-based tool: As defined by catchment/farm values

BMP Toolbox

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### Improved N management systems: Bog Burn dairy farms

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<th>Method</th>
<th>Cost $/cow/year</th>
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<td>Optimal effluent mgmt</td>
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<td>Nitrification inhibitors</td>
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<td>Restricted aut grazing</td>
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<td>Nil N fertiliser</td>
<td>73</td>
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<tr>
<td>Dry stock farming</td>
<td>160 – 700</td>
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![Cost vs. $ cost per kg N conserved](chart)

- **Net benefit**
- **Net cost**
Lessons learnt

Targeted application of BMPs is important
- but will struggle to off-set dairy conversion rates...

Many environmental impacts of dairy farming are hard to see

Environmental considerations generally not a driver
- logistics & economics are

Range of options preferred
Acknowledgements

DairyNZ
Sustainable Farming Fund
New Zealand Fertiliser Manufacturers’ Research Association
FRST
Ballance AgriNutrients
Environment Southland