Research for sustainable intensive dairy farming: focus on phosphorus

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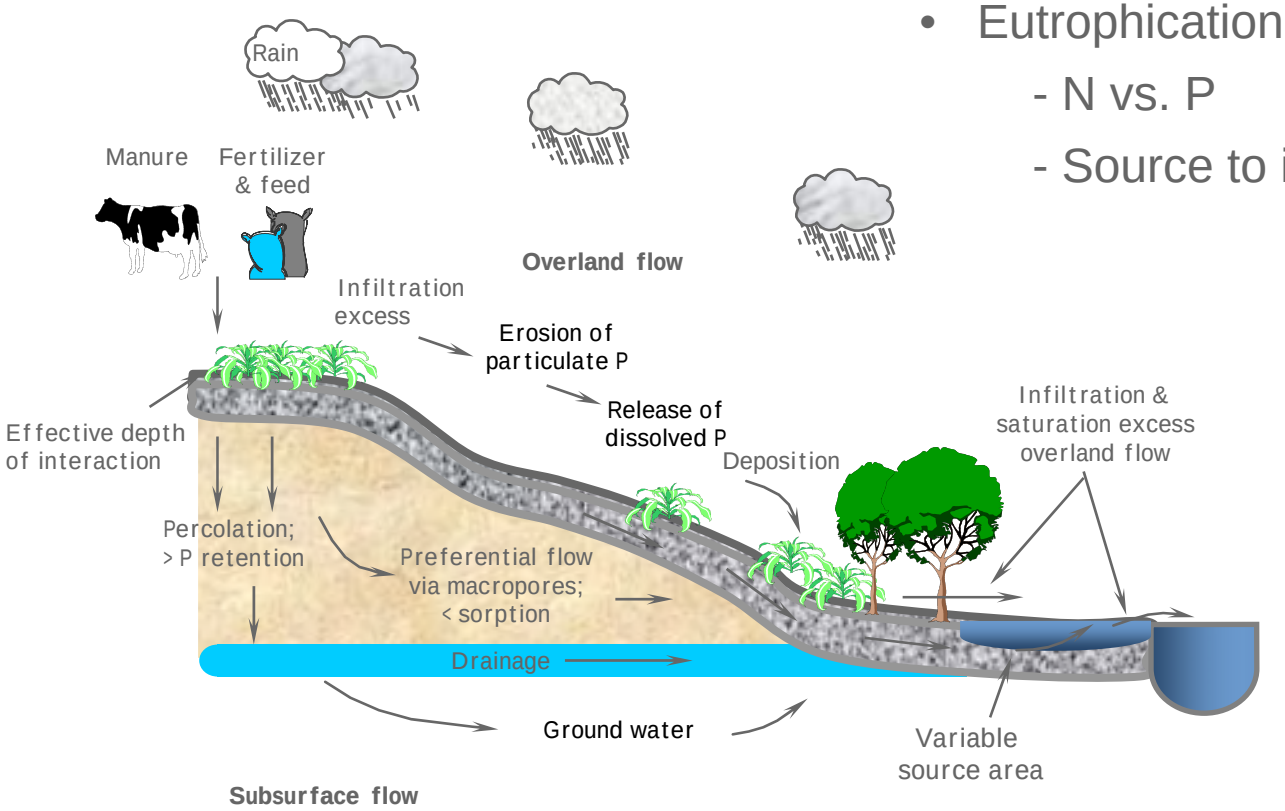
Te Ahuwhenua, Te Kai me te Whai Ora. Tuatahi

CONTEXT

The challenge

- Eutrophication
  - N vs. P
  - Source to impact site



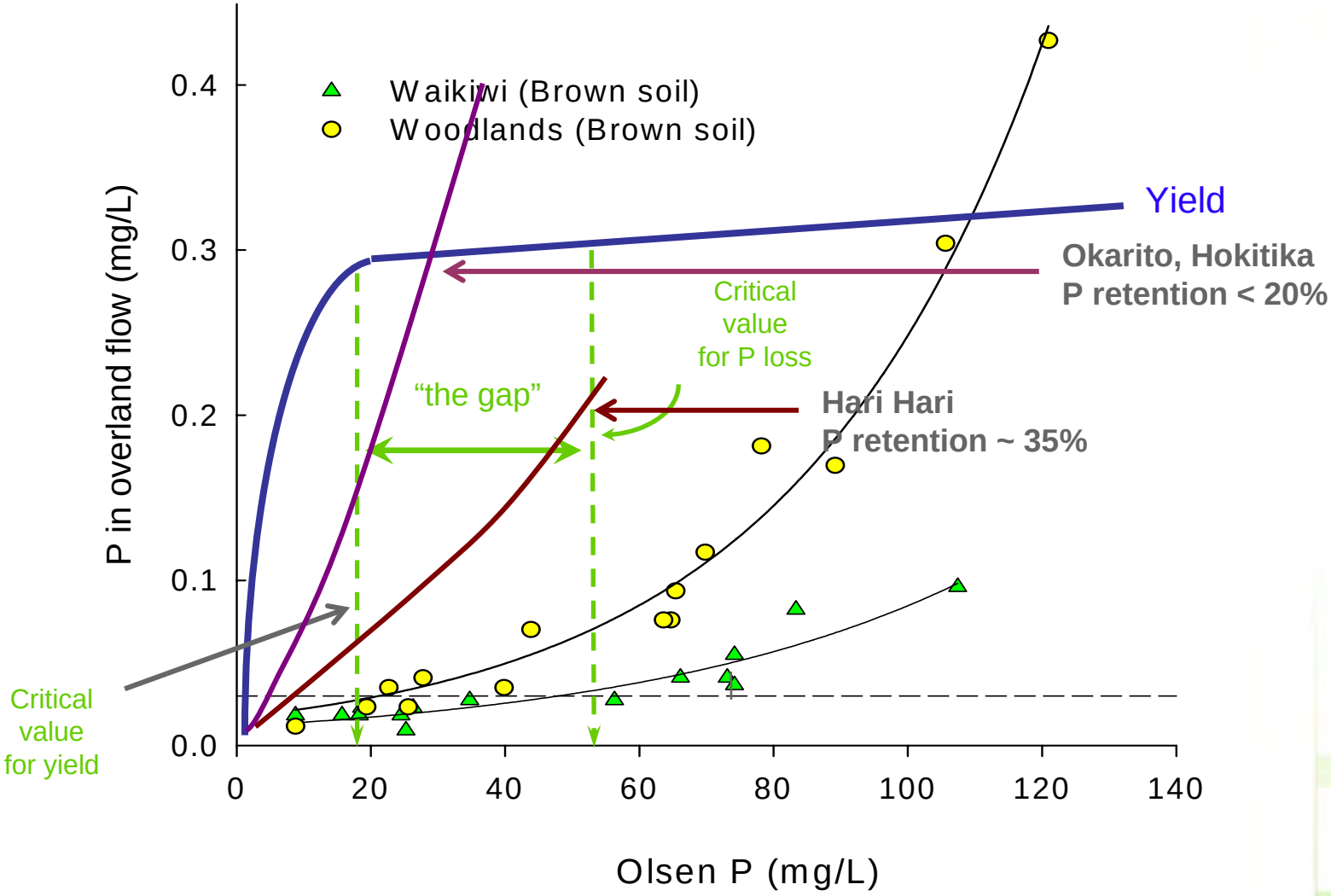
Typical phosphorus losses

Site	Loss (kg P ha^{-1} y^{-1})
Southland milking platform	1.0 - 1.5
- effluent block	1.3 - 4.5
Waikato dairy farm	1.0 - 2.5
Canterbury dairy farm	0.3-0.5
Dairy catchment losses	0.3 – 8.5
Deer catchment losses	0.3 – 4.0
Sheep catchment losses	0.1 – 0.8
New Zealand mean	1.2

Phosphorus issues facing a typical dairy farm

- Dung and effluent
- Soil
- Fertiliser
- Wintering
- Drainage / irrigation
- Timing and spatial management

P loss from soil



P loss from soil

Let soil Olsen P decline by having a negative soil P balance

- How long does each soil in a catchment take for Olsen P to decline to safe concentrations and what is the safe strategy?

Farm systems

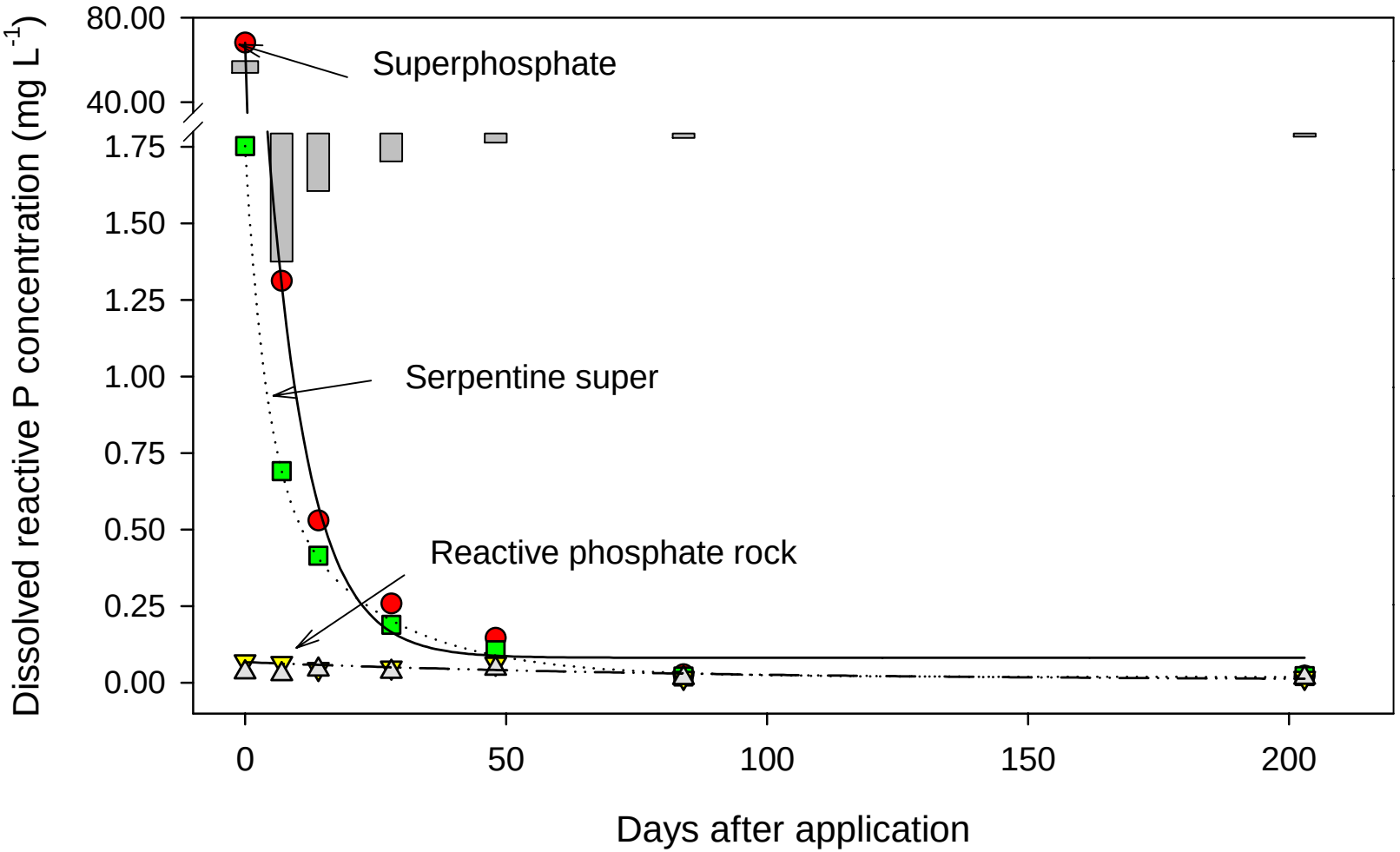
- Is clover high-P and ryegrass low-P better than clover/ryegrass high P?

Addition of P sorption agents: e.g., by-products

- Paddock application or in-stream

Relocate areas of high potential P losses to non-CSAs

P loss from fertiliser



P loss from fertiliser

Timing

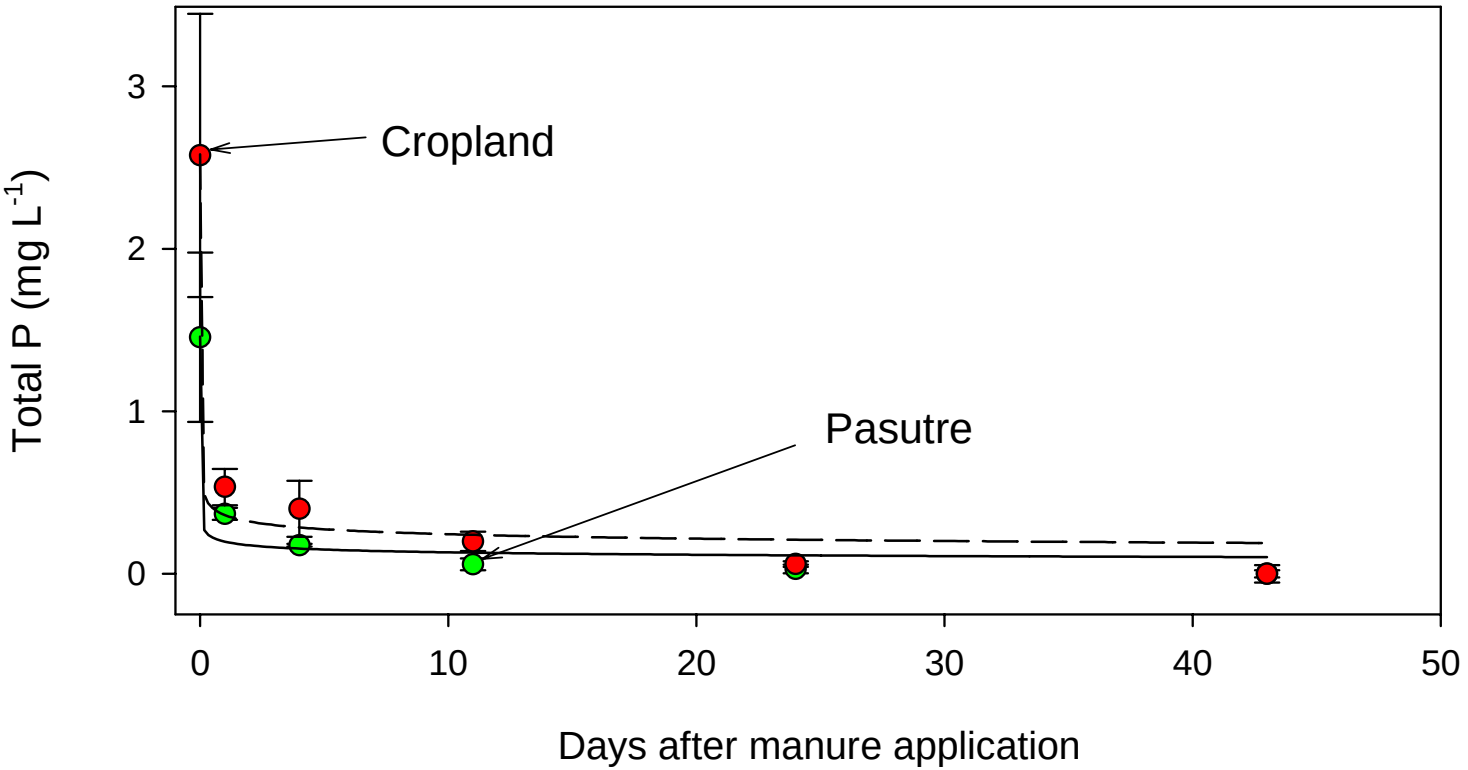
Placement

Solubility

P loss from application of 30 kg P/ha/yr (± 0.02)

Application date	Superphosphate	RPR
2002		
June	0.24	0.01
December	0.04	0.01
2003		
June	0.23	0.01
December	0.09	0.01

P loss from dung / effluent



P loss from effluent

Timing

Placement

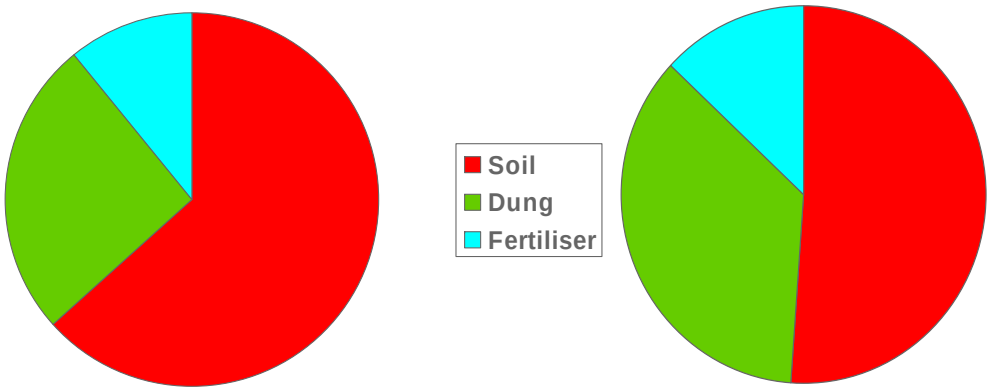
Storage

Monthly P loss from irrigation of 130 mm effluent

Application date	5% effluent block	10% effluent block
2002		
June	1.8	1.3
December	0.8	0.9
2003		
June	1.6	1.2
December	0.8	0.8

Sources of phosphorus loss from Tussock Creek

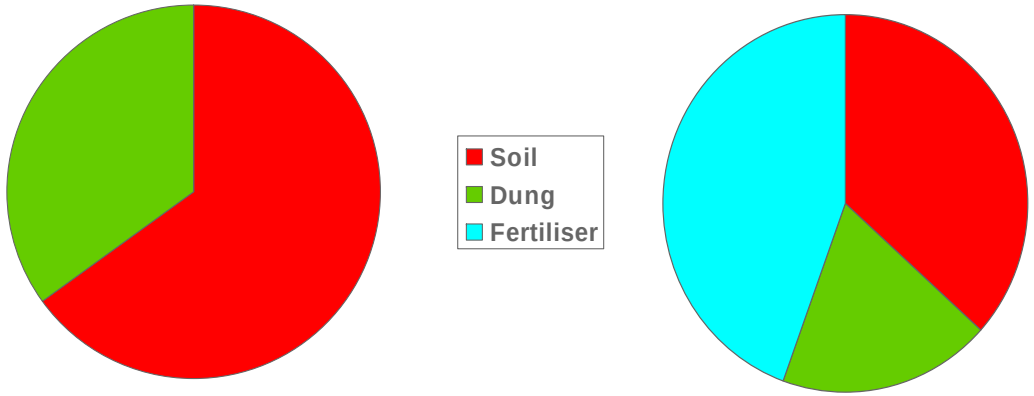
Contribution to farm discharges:



2002 2003

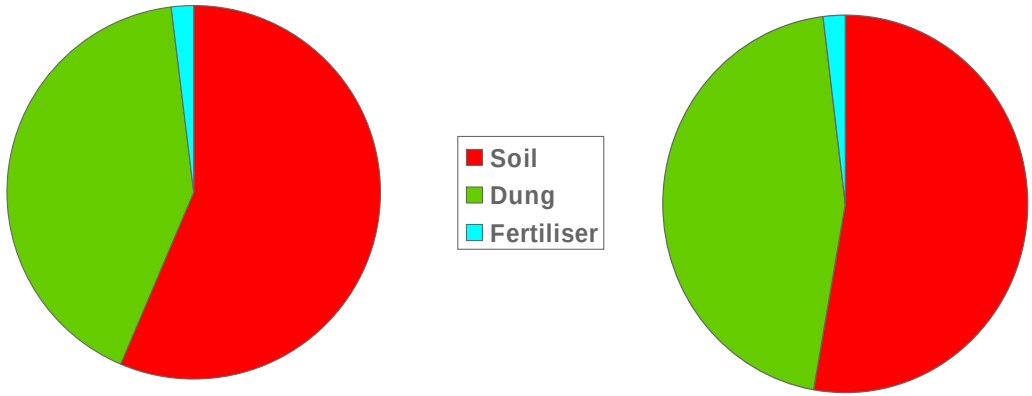
Sources of phosphorus loss from Rotomanu H&H

Site M0



2004 2005

Site M7



Options for mitigating phosphorus losses

Soil amelioration

- Decrease soil Olsen P to 30 mg kg^{-1} unless in top 20% of producers for the region
- Cultivation and soil mixing as part of farm re-grassing program or addition of P sorption agents

Fertiliser P loss mitigation

- Use RPR or serpentine super.
- Avoid applying superphosphate if rain forecast within the next 7 days.

Effluent/dung P loss mitigation

- Only apply effluent when soil dry, increase storage and use K-line.
- Use feed-pad / wintering pad.

Options for mitigating phosphorus losses

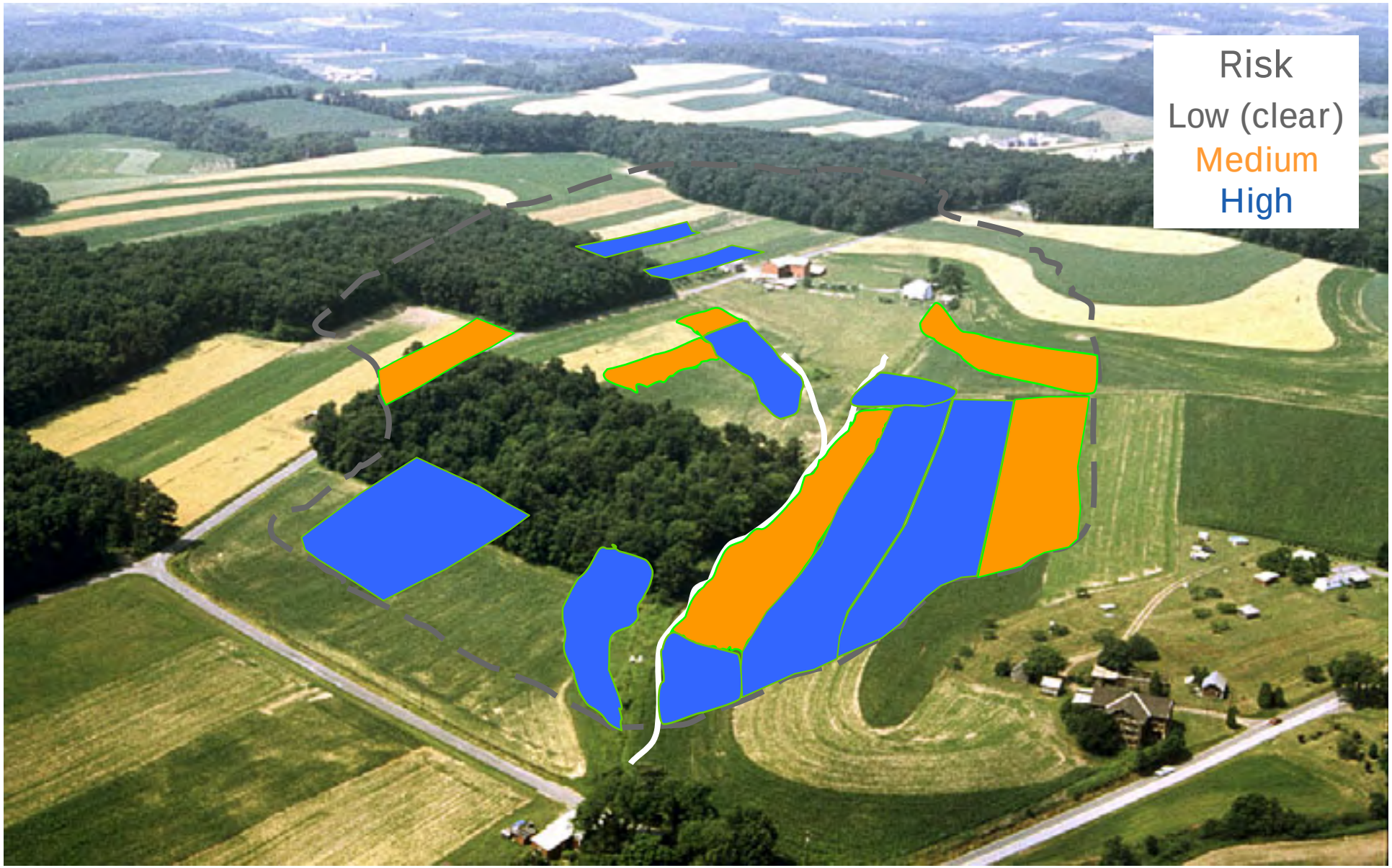
Net costs of BMPs

	$ per cow per year
Deferred irrigation & K-line	<4
Wintering pads	-5 to 44
Optimum Olsen P	-15 to -22

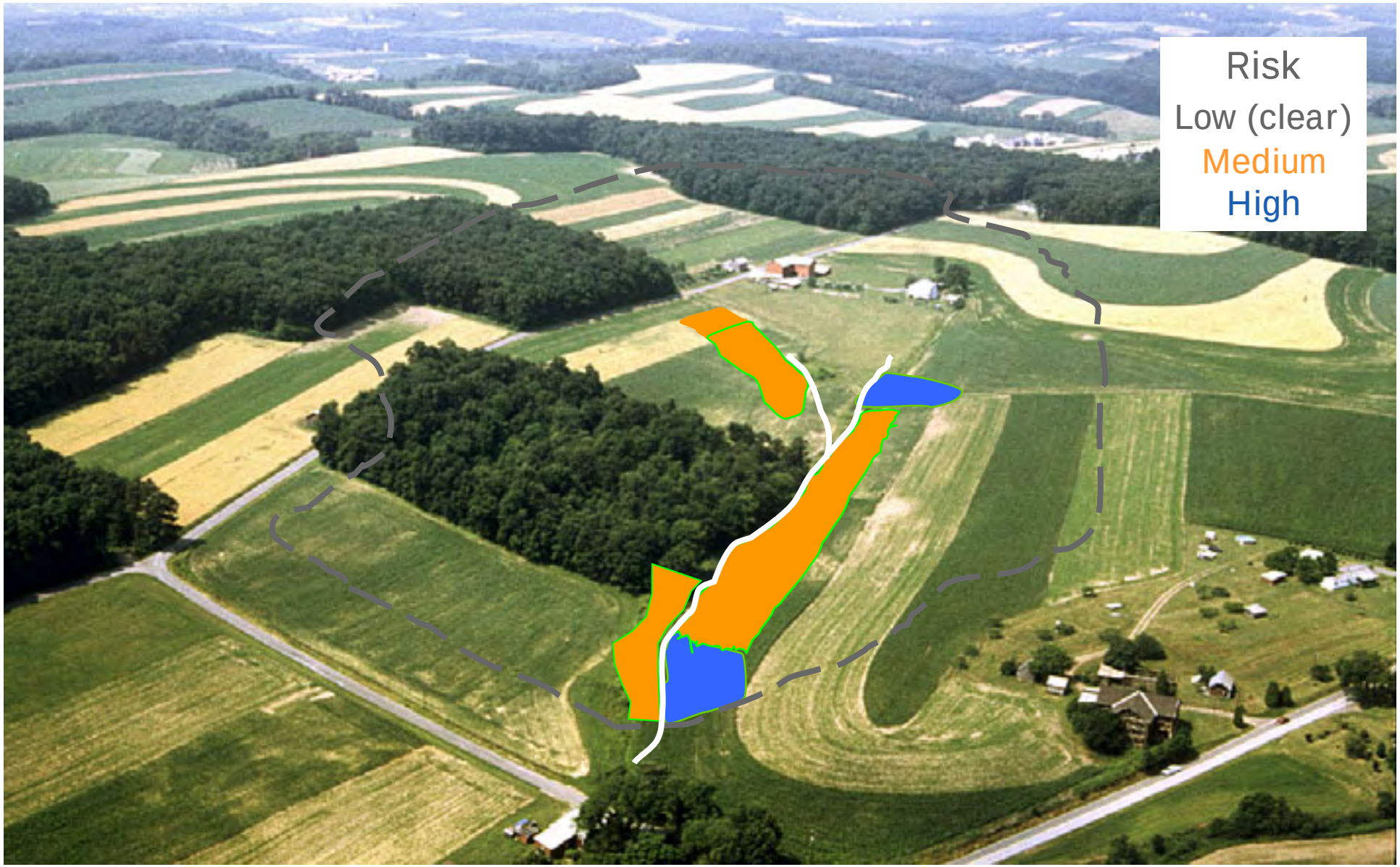
Effective managements?

Strategy/treatment	Dissolved P loss (kg P ha^{-1} or %)	Total P loss (kg P ha^{-1} or %)
Constructed wetland	-92 to 85%	-426 to 77%
Effluent irrigation with aeration	-	70
K-line irrigation	-	75
Sedimentation pond	10	33
RPR	60	25
Restricted grazing of cropland	10	75
Amendment in drainage	80	75
Amendment in streamflow	31	15

Source areas



Potential transport areas



Critical source areas of P loss