MGI

MORVEN GLENAVY IKAWAI IRRIGATION COMPANY LIMITED

Irrigation Field Day

Irrigation

Soil Moisture

Nutrient Limits

Spring 2012

Venue: Strathburn Farms

mulgor ltd.

The AgriBusiness Group™

Irrigation Field Days
For Morven Glenavy Ikawai Irrigation Company Limited

Keeping up with irrigation, soil moisture and nutrient limits
What you need to know

Date	Location	
Wed 17 October **10.00am – 12.00pm** followed by sausage sizzle	Strathburn Farm Jeremy Dyson & Jim Stevenson 4088 Morven Glenavy Highway	Dairy farm - flat Dairy support - rolling Hydro Services neutron probes
Wed 17 October **2.00 – 4.00pm** followed by sausage sizzle	Fairbank Paul Mulligan & Murphy Farms 531 Waihao Back Road	Dairy farm - rolling Decagon buried probes

Workshop Topics

Soil moisture measurement and monitoring.

Why checking soil moisture with an electric fence standard or hand held probe won't be good enough in the future

What you need to know about investing in good soil moisture monitoring equipment

Speaker: Tony Davoren, HydroServices

Nutrient budgets and nutrient limits

What they are and what they mean for you

How to make the most of them

BYO Farm Nutrient Budget to compare with our case study budgets

Speaker: Sue Cumberworth & Dave Lucock, The AgriBusiness Group

Save Water! Save Energy! Save Money!

For further information contact: Dave Lucock (027 2580 771) or Sue Cumberworth (027 4415 605)

Making Good Use of Soil Moisture Sensors

There is increasing adoption of measurement and monitoring to make objective irrigation decisions. Are we getting the best from sensors and salespeople?

Many companies make soil moisture sensors to measure volumetric water content (V%).

Most measure the soil's dielectric constant with capacitance or frequency domain technology.

They claim to be easy to install, robust, accurate and are "plug and play"

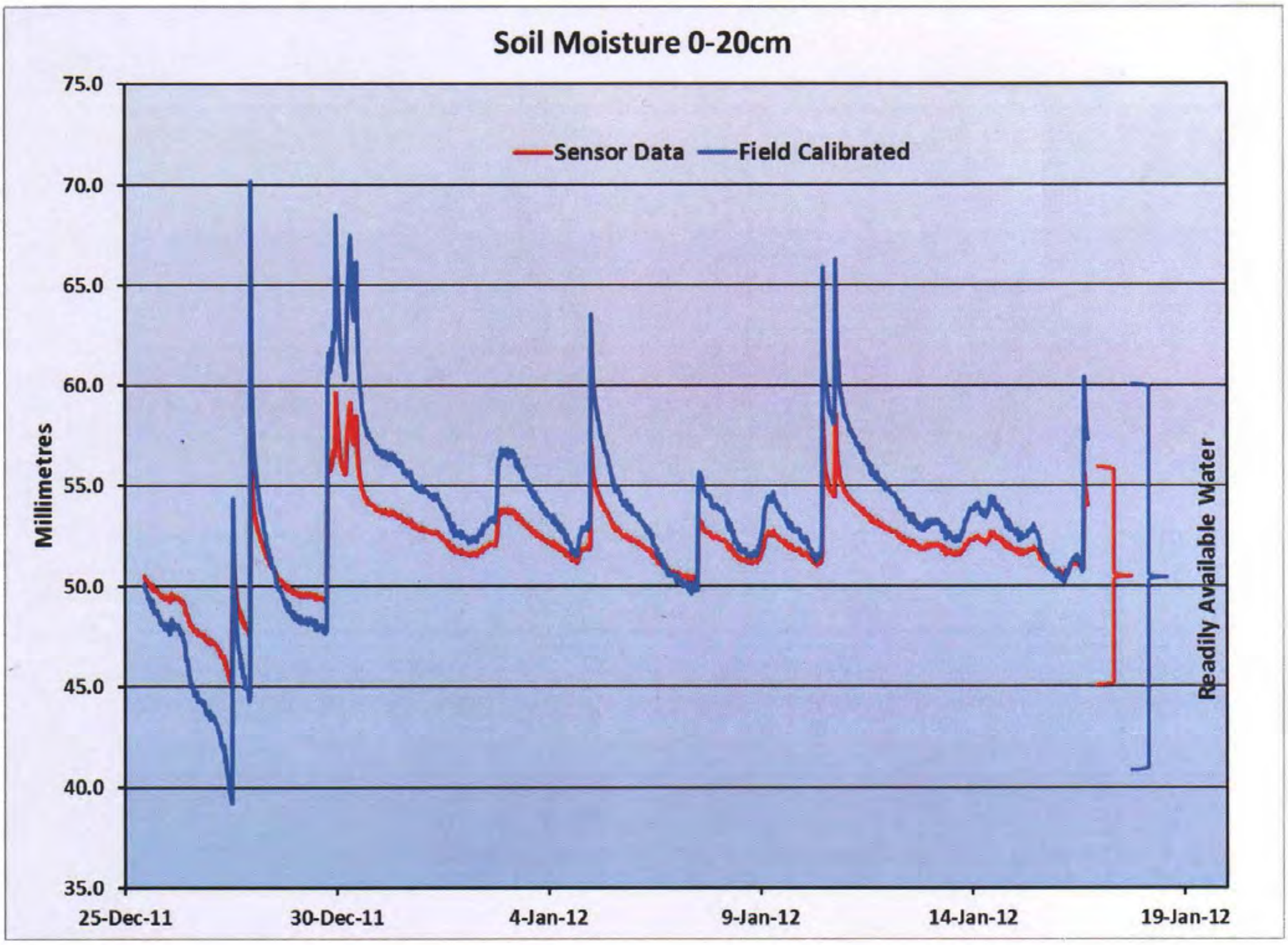
All of these sensors are sensitive to soil temperature and salinity (conductivity).

The best filter and/or correct the signal to minimise the effect of salinity, temperature and texture on the measure of V%.

Temperature and conductivity are simple to measure (easier than soil moisture), but the relationship with V% is complex.

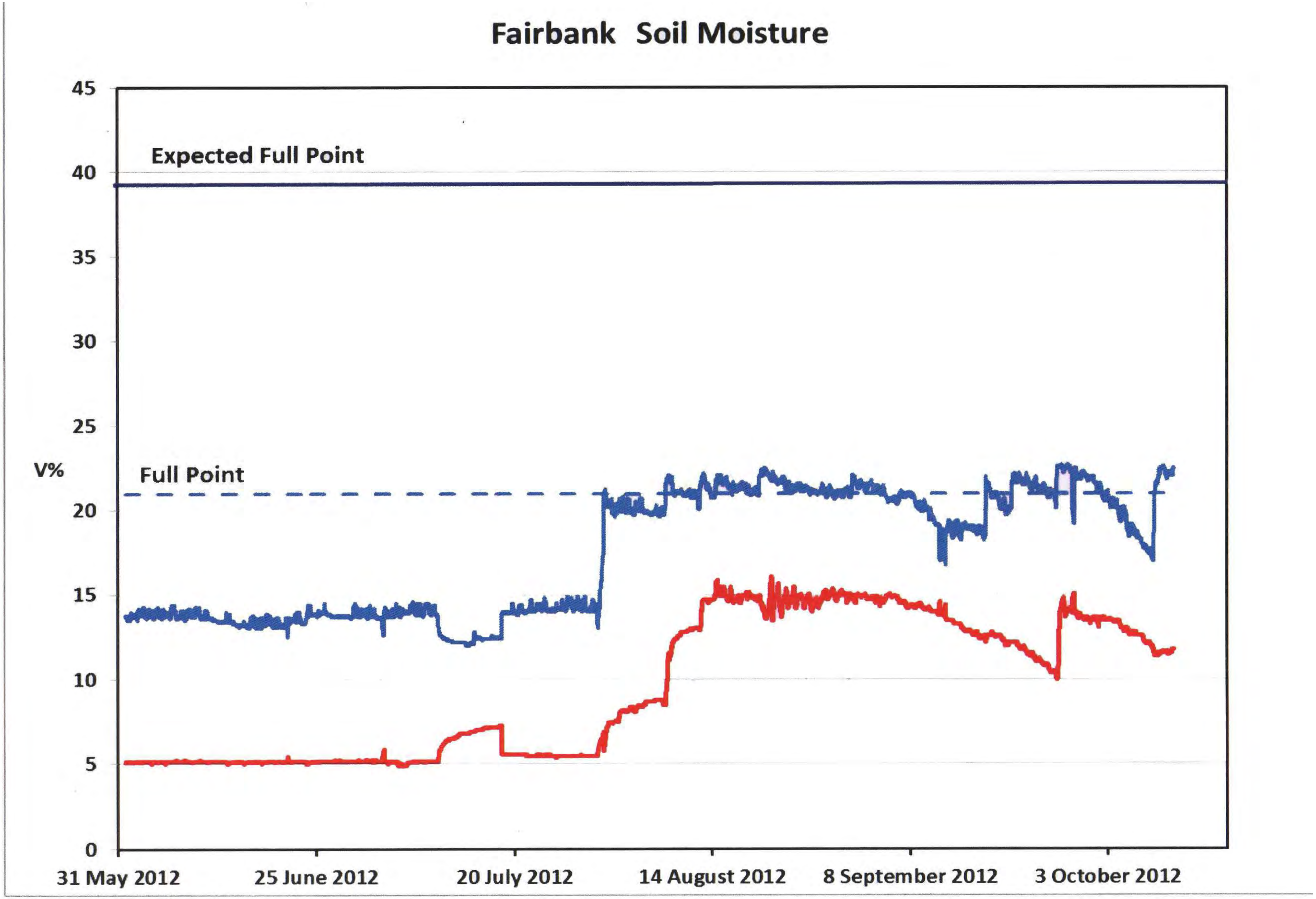
Sensors are delivered with a "factory calibration" and some recommend field calibration.

All sensors should be field calibrated to produce the true soil moisture V%.



Both traces show similar trend(s), sensor measures less available water is "right" once field calibrated.

Like accepting the fuel gauge in your ute measures 10-30% less or more than what it holds.



Fairbank Soil Moisture
45
40
35
30
25
20
15
10
5
0
V%
Expected Full Point
Full Point
31 May 2012
25 June 2012
20 July 2012
14 August 2012
8 September 2012
3 October 2012

MGI Irrigation Field Day, October 2012

Investing in the right soil moisture sensor(s)

On-site, accurate irrigation management to meet your specific crop requirements — HydroServices irrigation management & water resource consultants

WHAT YOU NEED TO CONSIDER

Before buying anything consider:

1. What are you growing – pasture or crops or trees/vines
2. How deep are the roots
3. How deep is your soil (A and B horizons)
4. Do you have stony soils
5. What do you need the sensor to measure

On-site, accurate irrigation management to meet your specific crop requirements — HydroServices

WHAT CROP

What you are growing influences your choice

Pasture:

- Shallow root depth and permanent

Crops:

- Deeper/deep root depth and temporary

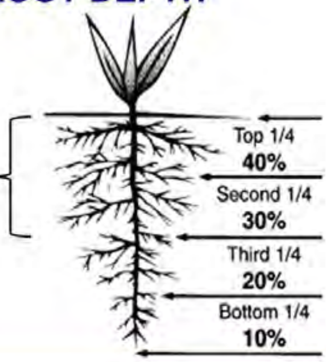
Trees & Vines:

- Deep root depth and permanent

On-site, accurate irrigation management to meet your specific crop requirements — HydroServices

CROP ROOT DEPTH

Pasture	~ 30cm
Ryegrass	~ 30cm
Winter Wheat	~ 60-80cm
Spring Barley	~ 30-40cm
Lucerne	~ 80-100cm

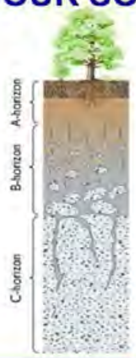


On-site, accurate irrigation management to meet your specific crop requirements — HydroServices

HOW DEEP IS YOUR SOIL

Key factors:

- Depth to gravel
- Depth to any pan
- Depth of both A and B horizons



On-site, accurate irrigation management to meet your specific crop requirements — HydroServices

WHAT THE SENSOR NEEDS TO MEASURE

What do you need the sensor to measure

- More than one depth
- At more than one site or location
- Sequential depths rather than discrete depths
- Record the measurements
- MOST OF ALL need to measure volumetric content (% or mm)

On-site, accurate irrigation management to meet your specific crop requirements

HydroServices irrigation management & water resource consultants

MEASURING SOIL MOISTURE

Most Important Factor:

- No matter how you decide to irrigate you are making a measure of soil moisture
- Direct measurement "Black Boxes" everything that affects soil moisture
- There is no substitute for measuring soil moisture

On-site, accurate irrigation management to meet your specific crop requirements

HydroServices irrigation management & water resource consultants

SENSOR OPTIONS

Just two that will suit your needs

1. Dielectric sensors; e.g.
   - Decagon 5TM, 10HC
   - Aquaflex
   - Best suited to pasture, permanent crops, silt loam soils
2. Neutron moderation
   - Any crop and any soil

On-site, accurate irrigation management to meet your specific crop requirements

HydroServices irrigation management & water resource consultants

Dielectric Sensors

- Low – high cost
- Proven
- Accurate when field calibrated

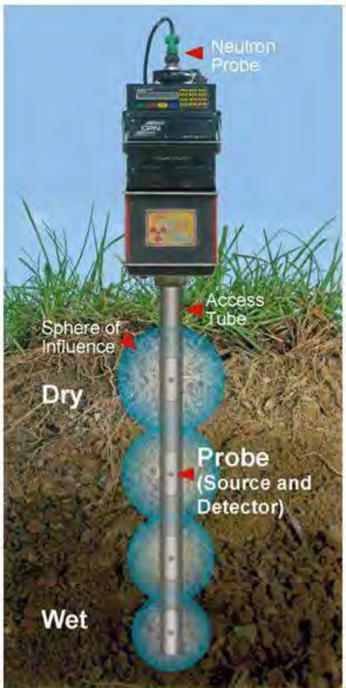
- Best in silty soils
- Continuous measurement
- Soil not disturbed when installed for some sensors

On-site, accurate irrigation management to meet your specific crop requirements

HydroServices irrigation management & water resource consultants

Neutron Moderation

- Still the benchmark
- Expensive
- Proven & accurate
- Best sensor in stony soils
- Large volume sampled
- Soil not disturbed when installed



On-site, accurate irrigation management to meet your specific crop requirements

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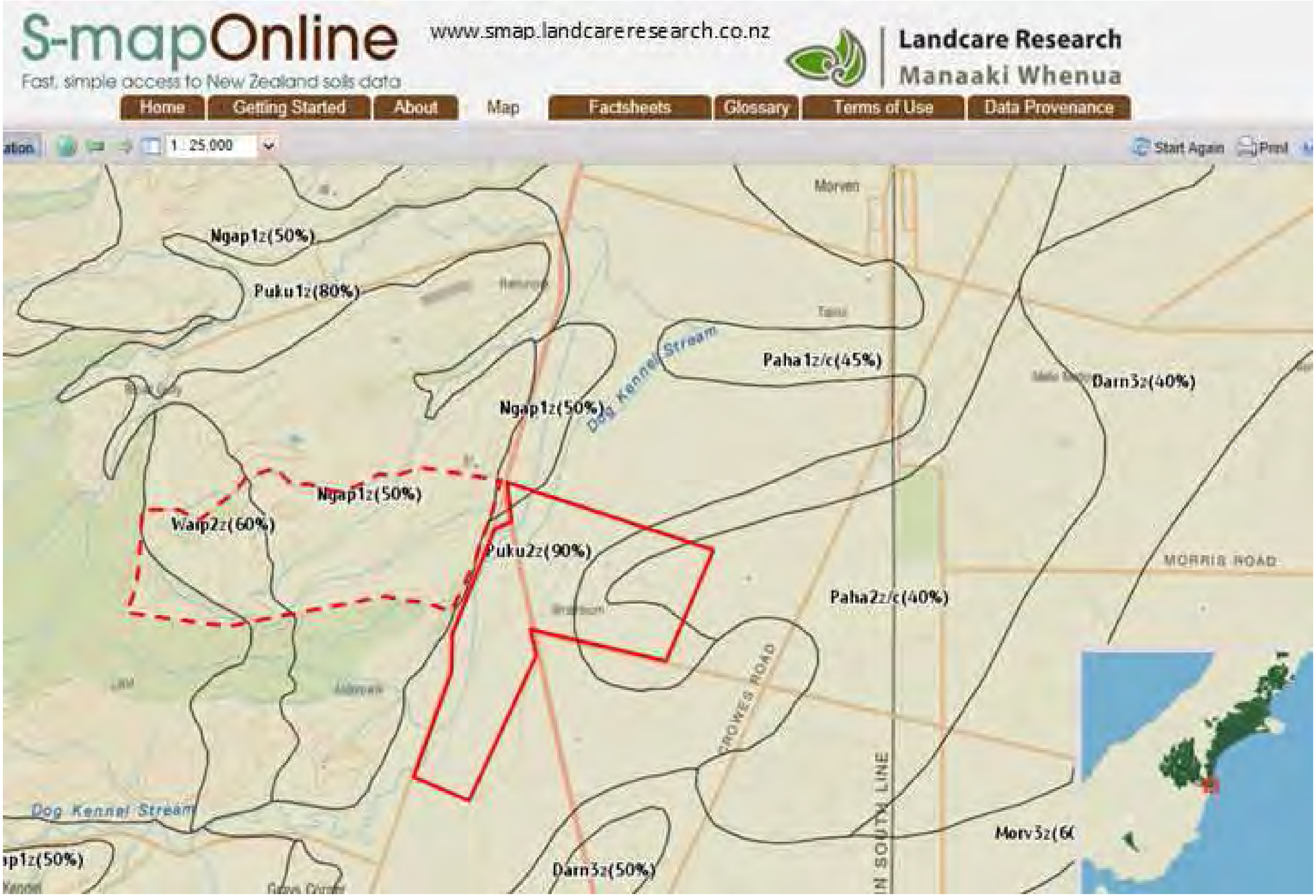
Strathburn Farms Ltd

Jim Stevenson (Owner), Jeremy & Louise Dyson (S/M)

Farm Description

Size	180ha total 165ha effective
Irrigation	Centre-pivot (80ha) K-Line (85ha)
Water	Seasonal allocation of 85l/s with single variable speed pump pumping to both irrigation systems
Soils	Pukeuri and some Pahau
Pasture	Perennial Ryegrass, White Clover
Peak cows milked	600



S-mapOnline
Fast, simple access to New Zealand soils data
www.smap.landcareresearch.co.nz
Landcare Research
Manaaki Whenua
Home
Getting Started
About
Map
Factsheets
Glossary
Terms of Use
Data Provenance
1 : 25,000
Start Again
Print
Ngap1z(50%)
Puku1z(80%)
Paha1z/c(45%)
Darn3z(40%)
Ngap1z(50%)
Dog Kennel Stream
Ngap1z(50%)
Waip2z(60%)
Puku2z(90%)
MORRIS ROAD
Paha2z/c(40%)
CROWES ROAD
Dog Kennel Stream
Morv3z(6(
Darn3z(50%)

Landcare Research
Manaaki Whenua

S-map Soil Report

Report generated: 12-Oct-2012 from http://smap.landcareresearch.co.nz

This information sheet describes the typical average properties of the specified soil to a depth of 1 metre, and should not be the primary source of data when making land use decisions on individual farms and paddocks.

Pukeurif Puku2z (90% of the mapunit at location (5032365, 1447956), Confidence: Medium)

S-map ref: Puku_5.1

Key physical properties

Depth class (diggability)		Moderately Deep (45 - 90 cm)
Texture profile		Silty Loam
Potential rooting depth		Unlimited
Rooting barrier		No significant barrier within 1 m
Topsoil stoniness		Stoneless
Topsoil clay range		15 - 25 %
Drainage class		Imperfectly drained
Aeration in root zone		Moderately limited
Permeability profile		Moderate Over Slow
Depth to slowly permeable horizon		50 - 80 (cm)
Permeability of slowest horizon		Slow (< 4 mm/h)
Profile total available water	(0 - 100cm)	Moderate to high (139 mm)
Top 60 cm available water	(0 - 60cm)	High (106 mm)
Top 30 cm available water	(0 - 30cm)	High (62 mm)
Dry bulk density, topsoil		1.22 (g/cm3)
Dry bulk density, subsoil		1.53 (g/cm3)
Depth to hard rock		No hard rock within 1 m
Depth to soft rock		No soft rock within 1 m

Key chemical properties

Topsoil P retention	Low (13%)

Overseer values

Soil Order	Pallic
Sand parent material	
Topsoil soil texture	
Depth	

About this publication

- This information sheet describes the *typical average properties* of the specified soil to a depth of 1 metre.
- For further information on individual soils, contact Landcare Research New Zealand Ltd: www.landcareresearch.co.nz
- Advice should be sought from soil and land use experts before making decisions on individual farms and paddocks.
- The information has been derived from numerous sources. It may not be complete, correct or up to date.
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Additional factors to consider in choice of management practices

Vulnerability classes relate to soil properties only and do not take into account climate or management

Soil structure integrity

Erodibility of soil material	Severe
Vulnerability to rill and slip erosion	not available yet
Structural vulnerability	Very high (0.73)
Pugging vulnerability	not available yet

Water management

Water logging vulnerability	Low
Drought vulnerability - if not irrigated	Low
Bypass flow	Medium
Hydrological soil group	C
Irrigability	Flat to very gently undulating land with slight drainage/permeability restrictions and soils with high PAW

Contaminant management

N leaching vulnerability	Medium
P leaching vulnerability	not available yet
Runoff potential	Very Low
Bypass flow	Medium
Dairy effluent (FDE) risk category:	B

Additional information

Soil classification	Mottled Laminar Pallic Soils
Family	Pukeurif
Sibling number	5
Dominant texture 0 - 60 cm	Silty
Soil profile material	Moderately deep soil
Rock class of stones/rocks	From Hard Sandstone Rock
Rock origin of fine earth	From Hard Sandstone Rock
Parent material origin	Loess on Alluvium

Characteristics of functional horizons in order from top to base of profile:

Functional Horizon	Thickness	Stones	Clay	Sand
Loamy Weak	18 - 30 cm	0 %	15 - 25 %	5 - 20 %
Loamy Fine Slightly Firm	10 - 30 cm	0 %	8 - 22 %	5 - 20 %
Loamy Coarse Slightly Firm	10 - 60 cm	0 %	8 - 20 %	5 - 50 %
Very Stony Sandy Compact	0 - 50 cm	50 - 70 %	1 - 8 %	80 - 95 %

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S-map Soil Report

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Pahauf Paha1z/c (45% of the mapunit at location (5032827, 1448562), Confidence: Low)

S-map ref: Paha_3.1

Key physical properties

Depth class (diggability)		Deep (> 1 m)
Texture profile		Silty Loam Over Clay
Potential rooting depth		Unlimited
Rooting barrier		No significant barrier within 1 m
Topsoil stoniness		Stoneless
Topsoil clay range		20 - 35 %
Drainage class		Imperfectly drained
Aeration in root zone		Limited
Permeability profile		Moderate Over Slow
Depth to slowly permeable horizon		30 - 70 (cm)
Permeability of slowest horizon		Slow (< 4 mm/h)
Profile total available water	(0 - 100cm)	High (154 mm)
Top 60 cm available water	(0 - 60cm)	High (102 mm)
Top 30 cm available water	(0 - 30cm)	High (63 mm)
Dry bulk density, topsoil		1.22 (g/cm3)
Dry bulk density, subsoil		1.53 (g/cm3)
Depth to hard rock		No hard rock within 1 m
Depth to soft rock		No soft rock within 1 m

Key chemical properties

Topsoil P retention	Low (19%)

Overseer values

Soil Order	Pallic
Sand parent material	
Topsoil soil texture	
Depth	

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Additional factors to consider in choice of management practices

Vulnerability classes relate to soil properties only and do not take into account climate or management

Soil structure integrity

Erodibility of soil material	Moderate
Vulnerability to rill and slip erosion	not available yet
Structural vulnerability	High (0.66)
Pugging vulnerability	not available yet

Water management

Water logging vulnerability	Medium
Drought vulnerability - if not irrigated	Low
Bypass flow	High
Hydrological soil group	C
Irrigability	Flat to very gently undulating land with moderate drainage/permeability restrictions and soils with high PAW

Contaminant management

N leaching vulnerability	Low
P leaching vulnerability	not available yet
Runoff potential	Very Low
Bypass flow	High
Dairy effluent (FDE) risk category:	B

Additional information

Soil classification	Mottled Argillic Pallic Soils
Family	Pahauf
Sibling number	3
Dominant texture 0 - 60 cm	Silty
Soil profile material	Stoneless soil
Rock class of stones/rocks	Not Applicable
Rock origin of fine earth	From Hard Sandstone Rock
Parent material origin	Alluvium

Characteristics of functional horizons in order from top to base of profile:

Functional Horizon	Thickness	Stones	Clay	Sand
Loamy Weak	18 - 27 cm	0 %	20 - 35 %	5 - 15 %
Loamy Fine Slightly Firm	15 - 35 cm	0 %	25 - 38 %	5 - 20 %
Clayey Fine Sl Firm	0 - 40 cm	0 %	30 - 50 %	5 - 30 %
Clayey Coarse	15 - 45 cm	0 %	40 - 60 %	10 - 40 %
Loamy Coarse Slightly Firm	0 - 40 cm	0 %	15 - 30 %	5 - 40 %

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Nutrient Budget

OVERSEER

Milking Platform	N	P	K	S	Ca	Mg	Na	H+*
				(kg/ha/yr)				
Nutrients added in								
Fertiliser, lime & other	218	13	13	28	30	0	0	0
Rain/clover N fixation	98	0	3	5	2	6	34	0
Irrigation	10	0	6	10	37	9	38	0
Supplements fed on block	31	3	28	2	5	2	3	1
Nutrients removed								
As animal products	104	18	23	6	25	2	7	0
As supplements	0	0	0	0	0	0	0	0
Net transfer by animals	54	5	45	3	9	3	2	-1.2
To atmosphere	66	0	0	0	0	0	0	0
To water	13	0.5	12	30	55	1	1	-0.8
Change in internal pools								
Organic pool	119	13	0	7	0	0	0	-0.2
Inorganic mineral	0	4	-33	0	-1	-1	-1	0
Inorganic soil pool	0	-24	3	0	-14	11	68	3.2

Effluent Area	N	P	K	S	Ca	Mg	Na	H+*
				(kg/ha/yr)				
Nutrients added in								
Fertiliser, lime & other	12	23	0	57	50	0	0	1.8
Rain/clover N fixation	165	0	3	5	2	6	34	0.1
Irrigation	10	0	6	10	37	9	38	0
Effluent added	130	12	118	7	24	9	4	-3.1
Supplements fed on block	31	3	28	2	5	2	3	1
Nutrients removed								
As animal products	104	18	23	6	25	2	7	0
As supplements	0	0	0	0	0	0	0	0
Net transfer by animals	54	5	45	3	9	3	2	-1.2
To atmosphere	54	0	0	0	0	0	0	0
To water	13	0.6	19	69	58	3	12	-0.7
Change in internal pools								
Organic pool	122	12	0	5	0	0	0	-0.3
Inorganic mineral	0	4	-8	0	-1	-1	-1	0
Inorganic soil pool	0	-1	75	0	28	18	60	2.1

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Block Nitrogen

OVERSEER

Block name	Total N lost (kg N/yr)	N lost to water (kg N/ha/yr)	N in drainage * (ppm)	N surplus (kg N/ha/yr)	Added N ** (kg N/ha/yr)
Milking Platform	1629	13	9.2	252	206
Effluent Area	599	13	8.8	244	130
Other farm sources	21				
Whole farm	2250	13			

* Estimated N concentration in drainage water at the bottom of the root zone. Maximum recommeded level for drinking water is 11.3 ppm (note that this is not an environmental water quality standard).

** Sum of fertiliser and external factory effluent inputs.

Report from OVERSEER® Nutrient budgets 2011, Copyright© 2011 MAF, AgResearch and Fert Research. All rights Reserved.
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Block Phosphorus

OVERSEER

Block name	Total P (kg P/yr)	P lost (kg P/ha/yr)	P loss categories		
			Soil	Fertiliser	Effluent
Milking Platform	58	0.5	Low	Low	N/A
Effluent Area	27	0.6	Low	Low	Medium
Other Sources	75				
Whole farm	161	0.9			

Water Quality

The DairyNZ and Sustainable Farming Fund Best Practice Dairying Catchments project (2000-2010) included baseline monitoring of water quality and quantity, soil quality, farm performance and practices.
Over the 10 years of monitoring, water quality has improved in most catchments in one or more aspects. Nitrogen concentrations are the one aspect of water which has shown a widespread increasing pattern (except for Inchbonnie).

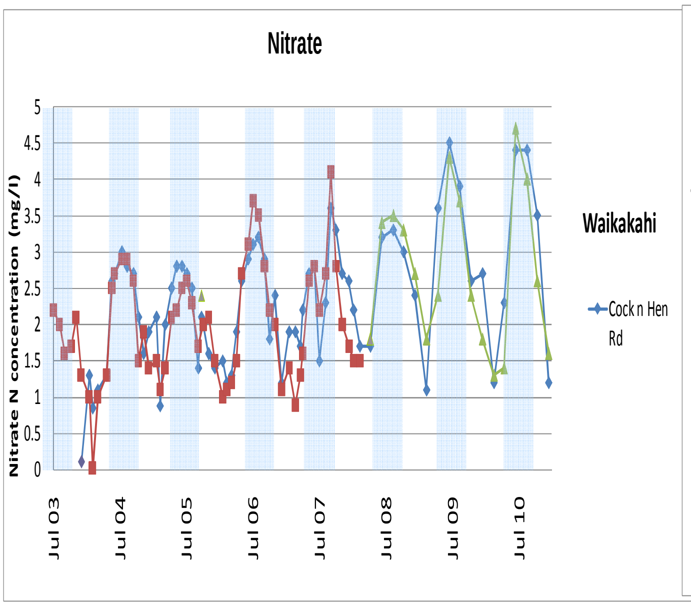
Over the same period, productivity in the catchments has increased. E.g. 39% productivity increases in the Waikakahi catchment. The voluntary measures of farmers in the catchment has improved some of the key water quality concerns (e.g. appearance, water clarity, e coli) while increasing their production.

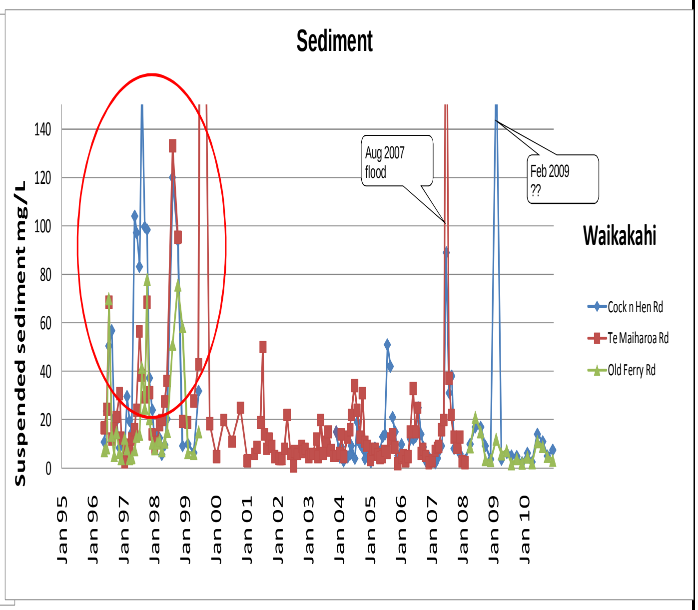
Trends in water quality (2000-2010) *Inchbonnie began in 2004.

Catchment	Total nitrogen	Total phosphorus	Turbidity/ suspended solids	E. coli bacteria	% Dissolved oxygen
Toenepi	⬆	⇑	⬇	No change	⬇
Waiokura	⬆	⬇	⬇	⬇	No change
Waikakahi	⬆	No change	No change	⬇	⬇
Inchbonnie*	No change	No change	No change	No change	⬇
Bog Burn	⇑	No change	No change	No change	No change

Key

(green)	Strong improving trend
(red)	Strong deteriorating trend
(orange)	Weak deteriorating trend
(white)	No change in water quality





What is a Nutrient Budget?

- A statement of the total nutrient balance for a specific area or farm system
- It takes into account all the nutrient inputs and all the nutrient outputs
- It is based on soil type, topography, rainfall, irrigation type & quantity and farming system inputs and outputs
- Inputs include fertiliser, atmospheric, supplements brought on to the farm, effluent spread on the land and use of nitrification inhibitors (e.g. eco-n)
- Nutrient transfer around the farm is also considered e.g. silage grown in one area and fed in another area, from paddock to raceway, and within paddocks in dung and urine patches
- Outputs include nutrients removed from the farm in stock sold on, products (meat, milk, wool), crops sold or fed out off farm, and through processes such as nitrate leaching, volatilisation and phosphate run-off It can help identify potential production or environmental issues arising from nutrient excesses or deficits
- Farmer information needs to be detailed and accurate
- A nutrient budget can be used to evaluate different nutrient management scenarios and inform the manager of the most efficient options before the nutrient (fertiliser) recommendation is implemented.
- A nutrient budget is created based on and an estimation of other nutrients that are added into the farming system, such as animal dung/urine, supplementary feed brought on, atmospheric conditions, etc.
- Nutrient budgets are required by ECan's Land & Water Regional Plan.

What is a Nutrient Management Plan (NMP)?

- A written plan that describes how the major plant nutrients (nitrogen, phosphorus, sulphur and potassium, and any others of importance to specialist crops) will be managed annually on a particular area or property
- This plan aims to optimise productivity, to reduce nutrient losses and to avoid, remedy or mitigate adverse effects on the environment.
- NMPs are usually provided by a fertiliser representative and include a nutrient budget which compares nutrient inputs from all sources, with all nutrient outputs. A good nutrient management plan minimises the cost of supplying nutrients and avoids wasted spending on unnecessary or unused nutrients.
- A NMP also considers the land manager's personal and business objectives.

OVERSEER® Nutrient Budgets Model

- OVERSEER® is an agricultural management tool which assists farmers and their advisers to examine nutrient use and movements within a farm to optimise production and environmental outcomes.
- The computer model calculates and estimates the nutrient flows in a productive farming system and identifies risk for environmental impacts through nutrient loss, including run off and leaching, and greenhouse gas emissions.
- OVERSEER® produces a nutrient budget which is a summary of all nutrient inputs and outputs from a farm or block within a farm. The model provides the means to investigate alternative farm management options to improve the efficiency of nutrient use so as to optimise production and reduce the risk of adverse environmental impacts.
- Overseer Nutrient Budgets provides for pastoral and cropping (fruit, vegetable and arable) farms.
- OVERSEER® is owned by MAF, The Fertiliser Association and AgResearch.

References: http://www.fertiliser.org.nz , http://www.overseer.org.nz http://www.ballance.co.nz http://www.ravensdown.co.nz

Mitigation Strategies/Options
to reduce losses of nutrients, sediment, pathogens

- Improved irrigation management & water use efficiency (variable rate)
- Irrigation type (spray vs border dyke)

- Improved Cow Efficiency
- Lower stocking rate/less cows
- Improved farm performance

- Nitrification Inhibitor/DCD e.g. eco-N
- Reduced N fertiliser
- Reduced Autumn N fertiliser
- Low N feeds and supplements

- Optimum Olsen P levels
- Low solubility P fertiliser
- Split fertiliser applications

- Effluent management (low application rate, storage and deferred application, reduced water use)

- Crop rotation
- Improved soil physical condition to reduce erosion
- Variable rate and precision application of fertiliser
- Timing of cultivation

- Managed grazing of fodder crops/reduced or no winter grazed fodder crops
- On / Off grazing
- Feed pads with collected effluent
- Winter housing for stock

- Reduce runoff eg management of tracks/lanes/runoff
- Natural wetlands
- Artificial, constructed or flood plain wetlands
- Riparian margins and grass buffers to filter nutrients and sediment
- Sediment traps and ponds

- Ensure accurate information goes into the Overseer model

For further information contact:

Hydroservices

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The AgriBusiness Group

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