MAXMIMISING THE EFFECTIVENESS OF FARM PLANS

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Abstract
The traditional route of water quality management often puts considerable resources into understanding the problem from all angles and exploring a large range of causes. However, this detailed understanding of the problem frequently doesn't readily translate to solutions being implemented on the ground. We are developing a process to more effectively link existing tools (databases, plans, toolkits, models, e.g. CLUES, OVERSEER®, Beef+Lamb LEPs, DairyNZ tools, NZeem®, LRI/LUC, Restoration Indicator Toolkit, etc.) to address water quality concerns identified at catchment scale through more targeted on-farm advice. For this process we focus on solutions and move the timing of the solutions phase up front which focuses subsequent analysis. The new process is being designed with and tested by land management officers (LMO). It contains four modules (catchment prioritisation, LMO training, farmer led planning and implementation, and catchment outcomes), can be used for up to four pollutants: sediment, nitrogen, phosphorus and faecal microbes.

Introduction
Whole farm planning as a tool to achieve sustainable land use practices has a long history in the Greater Wellington region, with the first plan being prepared in the 1950s. The target of these plans was soil erosion on hill country properties in the eastern Wairarapa. Gross sediment erosion is visible on the land and downstream in rivers as turbid water, so engaging farmers is reasonably straightforward. Farm planning has slowly grown to include a greater diversity of land uses and extended to address a wider range of water quality issues (e.g., nutrients and faecal contamination). This project builds on the long history of farm planning by developing protocols land managers can use to prioritise where mitigation practices (implemented via farm planning) should be targeted to address specific water quality concerns in a catchment. This project is also developing a method for quantifying the cumulative effect of farm plans on catchment-scale outcomes. The goal is to develop a simple process for Land Management Officers (LMOs) to follow that assists in identifying key leverage farms within a catchment and engaging with farmers to explore how current and future practices impact on water quality generation on-farm. The underlying principles adopted for this process are to:

1. Do more good,
2. Identify opportunities for change, *not problems*
3. Identify how to take the *best* actions first
4. Separate judgement calls from technical data.

Our new process is flexible and simple and makes use of existing tools, models, data, plans, and databases by showing the links between knowledge, actions and outcomes.

Most approaches to affecting change seek to discover what to do next by examining the problem and seeking to address it. This works well for complicated systems like faulty cars and washing machines, but less well for complex systems involving people and natural systems. Instead, we use three solution focused approaches: (1) Structured Decision Making (Gregory *et al.*, 2012); (2) Solutions Focus Risk Assessment (Finkel, 2011) and (3) Solutions Focus (Jackson and McKergow, 2006; Jackson and Waldman, 2010). These approaches focus on decisions (either large or small/experimental), are iterative, explore what matters, value creativity, do not presuppose a single "right answer". By travelling a different route to the problem-centred approach, we deliver: (1) a "short-cut" or focused analysis route for LMOs and (2) a means for engaging farmers.

The process is designed for a primary user – Land Management Officers to address four key pollutants – sediment, nitrogen, phosphorus and faecal microbes found in waterways. In some catchments all four pollutants must be addressed, while in others only one or two may be of concern. Identification of catchment water quality values is outside the bounds of this tool (see Table 1). The process provides a positive and pragmatic approach to change and our hope is that it is a living process that continues to evolve as new tools are developed.

Table 1. Tool boundaries.

Tool is	**Tool is NOT**
• designed for a primary user = land management officer • address 4 key pollutants: sediment, nitrogen, phosphorus and faecal microbes • focus is on solutions • a process to optimise the use of existing tools • captures and values farmer knowledge • uses available science but also recognises that science is not the only credible or relevant source of knowledge • a process for identifying farms that require closer scrutiny • farm information feeds back into outcomes modelling • farm planning is face-to-face using tools as required	• an ICM • a model • a target setting process • a value identification process

The process starts with a 'signal of harm'- i.e., clear evidence that water quality does not meet the purposes required by the community (Figure 1). If these is no 'signal of harm' then there is no need to go any further, unless there is an interest by land owners of their current impact. The signal of harm provides the boundaries for what is to follow - the pollutant(s) and the harmed water body. A good understanding of what is an acceptable and unacceptable water quality outcome is therefore critical.

The process has four modules - Catchment prioritisation, LMO training, Farmer led solutions and Catchment outcomes. The LMO works on three of the tasks individually for a particular catchment, and works with the farm decision maker(s) on the farmer led solutions module (Figure 1).

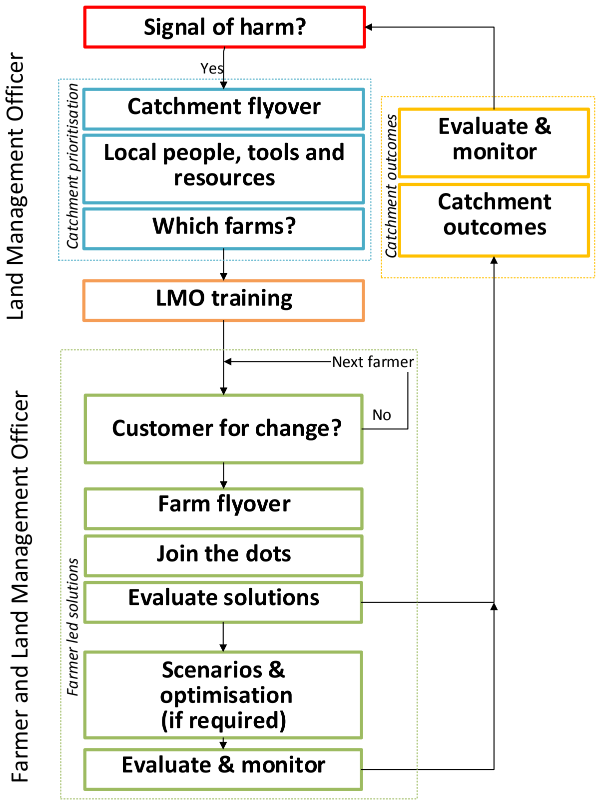

Figure 1. Tool framework.

Catchment prioritisation

Catchment prioritisation contains three tasks – a flyover, local resources and 'which farms?

Catchment flyover

The catchment flyover is a familiarisation task – basically the launch pad for the remainder of the process. Whether you interpret 'flyover' figuratively or literally, this task is designed as a day-long (ish) exercise, focused on gathering together the information and resources that are required for launch. It's a mini catchment inventory – a rapid appraisal. The questionnaire builds a picture of what's wanted? what's working? and what's next?

Local people, tools and resources

This questionnaire prompts a LMO to reflect on resources and people that are available to support them - other regional council staff, local community group members, farmers, DairyNZ consultants, DairyNZ discussion groups, consultant, etc.

Which farms?

This task explores how each farm might be contributing to the water quality outcome in a catchment - to assist a LMO to decide whether any farm is worthy of further investigation. Our aim is to provide enough information to complete the task and avoid overcomplicating it by having including too many models or variables. We use models to complement working face to face with individual farmers rather than using them to replace that interaction. *Which farms?* has several levels to provide a range of options that suit the LMO's GIS skills, farm systems in the catchment, data availability and level of past investigation. We use existing models and data and also make use of existing inventories about this information (i.e., Interoperable Freshwater Models Wiki). At this stage, we are considering each pollutant separately, rather than trading-off between pollutants.

Communicating model outputs can be a challenge and we are looking at simple ways to explain and explore catchment patterns with farmers to help them 'join the dots' between their farm and catchment water quality. For example, working in relative terms (e.g., normalising (0-1) the model outputs cf. kg/ha/yr) removes any accusation from the communication and deflects debate away from the accuracy of predictions. In addition, catchment models might tell you where to look first, but the local details are very important. Using the term 'potential' (e.g., potential sediment hotspots) clearly denotes where a hotspot *could be,* not where it *is*. Merot et al. (2006) developed a potential-existing-efficient hierarchy for valley bottom wetlands (Figure 2), and it has wider applicability here. We can model a potential option, check if it exists and work out if its management is efficient to meet a given objective. For example we can model potential hillslope erosion (e.g., NZeem®), check if it exists on the ground, and check if it is being efficiently managed.

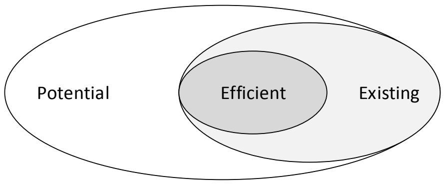

Figure 2. Theoretical representation of hierarchy from potential to existing to efficient (Merot et al., 2006).

Pollutant loss is controlled by physical location, pollutant form, fate and environmental availability, coupled with hydrologic processes that create active connections between the source and water body. The challenge is to develop predictions (relative or actual) at the catchment scale while retaining the ability to 'see' the detailed hydrologic structure at the farm and paddock scale. The first level is a land use map showing farm types (Agribase, combined with a land use or Land Use Capability layer), combined with a lookup table of potential losses from a typical farm under each land use. Numerous models of pollutant sources are also available (e.g., NZeem®, CLUES P and N generation, ENSYS, etc.) and they are in the second level of *Which farms?* (Table 2). The third level of *Which farms?* combines pollutant sources and local transport. We are exploring using high resolution DEMs and topographic indices (e.g., Topographic Wetness Index and Network Index) to map potential hydrology and connectivity. The fourth level includes updating CLUES from the 2004 default to the present. By combining the output with farm boundaries (e.g., Agribase) we have a map of the catchment which identifies those farms that are thought to be the ones that are mostly likely causing downstream pollution.

Table 2. *Which farms?* proposed levels of investigation.

	Level 1	**Level 2**	**Level 3**	**Level 4**
		Generation only	**Generation + connectivity**	
Sediment	LUC map identifying land at risk from erosion	NZeem® and/or CLUES (default)	NZeem® and/or CLUES (default) topographic indices	NZeem® and/or CLUES (present) with topographic indices
Nitrogen	OVERSEER® for a typical farm types	CLUES (default regional N generation)		CLUES (present)
Phosphorus	Overseer for a typical farm types	CLUES (default regional P generation)	CLUES (default P generation) + topographic indices	CLUES (present) + topographic indices
Faecal microbes	Typical farm type look up tables	CLUES default	CLUES (default regional) + topographic indices	CLUES (present) + topographic indices

LMO Training

There are three main components in the training package, a workshop on the process (Figure 1) and two questionnaires designed to take stock, develop a vision for the future, find past and present resources and skills, and identify some actions to take. These can be done individually or with partners in small groups. The Tool training workshop will cover all aspects of the tool – what it is, how to use it, when to use the different tasks and an introduction to solutions focused approaches (i.e., Structured Decision Making, Solutions Focus Risk Assessment and Solutions Focus).

Because farmers seek and are offered advice by many experts or consultants the LMOs plays a unique role in linking farm to catchment water quality. *Being an asset to farmers* helps a LMO consider how they can best assist farmers in a particular catchment. For example, a LMO might need to deal with faecal pollution for the first time and want to explore their understanding of the issue. The questionnaire takes them through a progress focused conversation and along the way they will gather small steps to take them closer to what they want. LMOs also need assistance in assessing whether farm decision makers are receptive and willing to explore the impact their farm system has on water quality versus land owners who may have little interest in understanding more about the impact their business has on water quality. The interest from the farmer will determine the approach the LMO takes. For example, the conversations and resources used with farmers who approach GWRC for farm plans, will be very different from the approach with land owners that see little merit in formal land evaluation and planning. In this case in the first instance the LMO would need to focus on relationship building.

Farmer led solutions

Ownership of the process by the farmer puts the farmer in the driver's seat, with the LMO as the co-driver or navigator. There are four basic steps in the process, *–Farm Flyover*, *Join the dots*, consequences analysis and *how will you notice change?* The underlying philosophy of this module is to help farmers rearrange what they – and the LMO – know about the situation and arrive at a mutually useful understanding. Farmers are a highly diverse group with different resource endowments and exposures to risk; production needs, tenure arrangements and ownership goals; environmental motives; personalities; tendencies for engaging with programmes; and social networks (Reimer *et al.,* 2014). At this conference we repeatedly heard the question 'how are we/you going to get farmers to do that?' Recognition of a community agreed water quality problem, a commitment to do something about it and a progress-focused, constructive conversation are the keys to unlock motivation for useful change.

Farm Flyover

The Farm Flyover is the focus for the first meeting(s) between the LMO and farmer. It has three key elements: (1) base farm information gathering, (2) placing the farm within the catchment context and (3) a progress focused conversation. The base farm information gathering starts with an overview of the farm system and includes previous planning or data. Establishing the soils, farm type, stock policy, farm performance and the farmer's personal and business goals, the current and potential future opportunities and associated constraints and risks to the business is a key first step in advancing any conversation by LMOs. This ensures a holistic approach to advancing sustainable land management. During this conversation the LMO might introduce any tools (or parts of tools) that are a good fit, such as visual soil assessment, farm hydrology tool, DairyNZ Farm Enviro Walk, Beef+Lamb LEP

Tool Kit. The LMOs will also have a local OVERSEER® "library" of mitigation scenarios to share with farmers.

Placing the farm within the wider catchment content includes using catchment maps and asking open questions to define the launch pad for future action is the next important step. The conversation will help both the land owner and LMO quickly establish the influence that farm could be having on catchment outcomes. Importantly, if a farmer sees faecal contamination as the main issue facing farming in the catchment, the LMO can use this interest to start of conversation on the links between on farm practice and catchment outcomes. While not necessarily relevant to nitrogen, phosphorus and sediment pollution, it does create the opportunity to talk more broadly about the relationship between on-farm decision making and wider catchment outcomes.

Once an issue has been identified, a progress-focused conversation is used to complete the *Farm Flyover*. The building blocks for change are much more likely to come from what's already going well. This does not have to be restricted to that farm. Use of examples from neighbours or local leaders can also be very useful in affecting change. During this conversation, the LMO is looking for examples which have happened in the past and present, and to connect up these parts. The progress-focused conversation explores *what's wanted? what's working?* and *what's next?* using simple questions (see Table 3). *What's working?* is used to build a foundation (there is no need to start from scratch), identify resources and skills and identify what's currently preserving good water quality and not go backwards (preservation of the status quo is easier than repair!)

Table 3. Some basic questions for each step in the progress focused conversation.

Step	**Questions**
What's wanted?	What do you want instead? What are the benefits? What do we need to get right?
What's working?	What's going well? How does it happen?
What's next?	How can we do it differently? What will happen? What would tell you you're making progress?

For example, if dairy farm effluent (DFE) application options are inadequate 60% of the time for various (but identifiable) reasons, the LMO can focus on the times when the system performs well, as a process for lifting performance. This approach is motivating as we already have the makings of a good solution and with small changes (such as staff training or adopting low rate application technology) we could reduce the period when land application is not appropriate to say 10% with minimal effort. Another important element of this conversation is also detecting or noticing when change occurs and finding the next steps forward.

Join the dots

It's an overview process designed to link the pollutants in space and time, to the processes and possible solutions. Conceptually, a catchment can be seen as a conveyor belt for transporting pollutants which has a series of leaks that can be on or off at different times (e.g., event, seasonal). For sediment we do not have a sediment problem *per se*, but a series of sediment leakages, each related but separate. The priority is then to assess the leakages, in order to decide which one(s) to change.

A leakage is used to define pollutants in time and space –what? where? when? how long? This is followed by explicitly stating the process that links the leak and the closest waterway (drain, stream, wetland, etc.) and a downstream water body (Figure 3). It should be a quick explanation, in simple everyday language. Once the process (*how does that happen?*) has been stated, alternative processes (or solutions) can be explored. Solutions at this stage are general - what's in, what's out – no details required and this step should allow for creative solutions. The status quo must be included – the do nothing option. At this point, there might be a clear cut best solution which can be implemented or experimented with immediately, or for larger issues further analysis of the solutions might be required (Task 3 Consequences analysis). The final step is asking *how will you know when there is no leak?* Farmers already do daily monitoring, so we can build on this to include detecting change for new actions (see Task 4 for the types of questions). A mock-up *Join the dots* table for faecal microbes is outlined in Table 4.

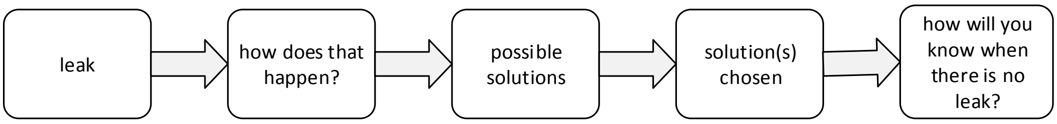

Figure 3. Framework of *Join the dots.*

Table 4. Join the dots for faecal microbes on a dairy farm (mock-up).

leak	**dung+ surface ponding+ effluent spraying**	**dung + stream + grazing**	**dung + boggy bits + grazing**	**dung + grazed pasture+ storms**	**dung + races+ storms**
how does it happen?	spray rate>ability of soil to absorb, effluent into stream and into Y Lake	dung into stream and into Y Lake	dung on boggy bit to stream and into Y Lake	storm washing dung on recently grazed paddocks to stream into Y Lake	storm washing dung into drain to stream and into Y Lake
possible solutions	- do nothing - staff training - storage - lower rate - monitor soil water	- do nothing - permanent fencing -temporary fencing -…	- do nothing - trough - temporary fencing …	- do nothing - graze cattle in paddocks not connected to stream when heavy rain is forecast - …	- do nothing - divert water coming off races …
solution(s) chosen	- send staff on training course - explore lower rate and storage as longer term solutions	- temporary fencing on paddocks 63 and 65 - cost permanent fencing	- permanent fencing	- explore grazing plan	- do nothing
how will you know when there is no leak?	no visible ponding	no dung visible in stream	no pugging of wetland and no dung visible		storm runoff seen to enter pond beside race

Consequences analysis

In this task a consequence table (i.e., solutions vs criteria with score or value) is developed. This moves beyond the simple pros and cons style of analysis that is often presented to farmers – which can be inconsistent, contain gaps, have vague descriptions, include value judgements, confuse means (how) and ends (why) and include double counting (Gregory et al., 2012). For example, Table 5 is a mock-up consequences table for DFE. Solution 4 is out-performed by solution 2 completely, so it is dropped from the table. Next, solution 1 is a short-term solution that reduces the small cost outweighs the possible fines, so it is removed after implementing it immediately. The longer term solutions to be explored further are Do nothing and Solutions 2 and 3. At this point, the cost can condensed to one value (Do nothing 0, Solution 2 25,000, Solution 3 80,000), simplifying the analysis. A choice can be made between Solutions 2 and 3 given the 2 year time frame for a new system to meet new consent requirements.

Table 5. Mock up consequences table for DFE.

Objective	**Measure**	Do nothing	Solution 1	Solution 2	Solution 3	Solution 4
Minimise cost	implementation cost ($)	0	500	40,000	100,000	60,000
	additional maintenance cost	0	0	-5,000	-10,000	3,000
	possible fines	10,000	10,000	0	0	0
Maximise effectiveness	effectiveness % reduction	0	20%	60%	99%	40%
	Lead in time	0	2 weeks	6 mo	1 year	6 mo
	number days cannot use	50	50	0	0	0
Maximise strategic	will be required for new consent in 2 years	No	Yes	Yes	Well beyond future requirements	No

A structured consequences table provides the basis for open dialogue about trade-offs. When required, scenarios and optimisation can be used to inform consequence analysis. This might be outside of the LMO's role, but the LMO will be able to suggest a suitable consultant to a farmer. Scenarios are journeys into the possible future and may be limited to certain pollutants e.g., Overseer® currently can explore N and P scenarios. The LMO will have available some Overseer® scenario runs for a handful of typical farming systems within the catchment. Economic modelling may also be required.

Evaluate and monitor

We need to inform the gap between 'what's there now' and 'what's wanted' and quantify and understand the reasons why any change has taken place. This has several layers – LMOs keeping track of a farmer's "journey" and LMOs helping farmers evaluate the outcomes of their actions. A quick (5 minutes) and simple questionnaire could be used to guide farmers through an evaluation of their actions and design a simple monitoring programme (Table 6). The responsibility lies with the farm decision maker to implement this monitoring.

Table 6. Questionnaire for evaluate and monitor

How will you know when X has improved because of the actions you're taking? What would you notice?
How often might you count/measure X?
Where will you measure X?
When might you measure X?
How many measurements?
How will you record the results?
What changes will you be looking for?
What sort of delay might you expect?

Catchment outcomes

The loop is closed by evaluating both the process and catchment outcomes. We need to inform the gap between 'what's there now' and 'what's wanted' and clarify the likely causes of any change that has taken place and any change that occurs in the future. This evaluation includes tracking changes in land management, farmer engagement and water quality outcomes. A key task is to revise the default CLUES model by feeding in local farm system information. An additional task is to gain insights into likely water quality outcomes as a result of mitigation actions. This might be achieved using a simple spreadsheet model (currently under development at NIWA) which uses the farm as the base unit, and/or CLUES scenario modelling. Evaluating catchment scale good management practice is fraught with problems and many such 'science projects' often fail (see Meals *et al.*, 2010). Part of this task is familiarisation with these issues.

What's next?

We are currently testing our modules and tasks in the Mangatarere catchment near Carterton. This catchment has been the focus of a 'Wheel of Water' project recently, and community values have been explored in depth, providing the ideal 'warm-up' for the tool. Some tasks will be remodelled during testing, while others are likely to be stable. This tool will be a living document and new tools (e.g., MitAGator) may be linked in as they emerge.

Acknowledgements

This is an Envirolink Tools project funded by MBIE (C01X1214).

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