Why has Overseer become so important?

The Overseer model was originally developed as a tool to help farmers use fertiliser and other inputs more efficiently. As the model also estimates the nutrient loss from farms, over time it came to be used by regional councils to help inform regulations around water quality. Based on data farmers input to the software, such as fertiliser use and stock numbers, the model gives an indication of the nutrient flow between fertiliser, plants, animals and soils on-farm.

The biggest problem facing New Zealand's waterbodies is nutrient pollution from a number of contaminants, including nitrogen, phosphorus, sediment and *E. coli*.

Overseer has been the main tool available to estimate the amount of nutrients that leave the farm.

What did the Commissioner's 2018 report Overseer and regulatory oversight report recommend?

The Commissioner's 2018 review found that it is hard to tell whether the nutrient loss estimates the model produces are accurate.

To have confidence in Overseer's outputs in the regulatory setting, the report recommended the Government:

- commission a comprehensive evaluation of the Overseer model by independent experts (including a peer-review and sensitivity and uncertainty analysis)
- provide greater transparency around how the model works
- provide official guidance on how Overseer should be used by regional councils
- align Overseer's ownership, governance and funding arrangements with the transparency required for it to be used as a regulatory tool.

What has the Government done since?

In March 2020, the Ministry for Primary Industries commissioned an independent Science Advisory Panel to undertake a whole-model review.

In the meantime, the Government released the Essential Freshwater reforms. While neither the National Policy Statement for Freshwater Management 2020 nor the Resource Management (National Environmental Standards for Freshwater) Regulations 2020 require the use of Overseer, the regulatory system at the local government level has become reliant on Overseer, as an increasing number of regional councils have used Overseer as a tool to implement and enforce national direction.

What did the Science Advisory Panel find?

In their assessment of the model, the panel said it does "not have confidence that Overseer's modelled outputs tell us whether changes in farm management reduce or increase the losses of nutrients, or what the magnitude or error of these losses might be."

The panel considered that "Overseer's structure is not adequate to provide more than a coarse understanding of a farm's nutrient losses … It cannot reliably estimate how changes in farm management would affect those losses."

A common belief has emerged that the accuracy of the output does not matter because relative uses are just as useful. However, the panel has stated it is "unlikely to be a reliable tool for predicting either relative or absolute nutrient loss estimates."

The review panel found Overseer as it stands cannot provide a robust numerical account of farm-scale nitrogen loss because:

- Overseer focuses on nitrate-nitrogen – one of the chemical forms of nitrogen. This means that Overseer does not provide a robust estimate of total nitrogen loss.
- Overseer focuses on nitrate-nitrogen leaching with the subsurface flow and does not adequately capture overland flow – which can be a significant pathway of nutrient losses as a result of high rainfall, flood events or the physical characteristics of the land.
- Overseer uses a form of average climate, but there is no such thing as an 'average year', as each year is different. As Overseer does not use actual climate data, it is not able to capture discrete events, and resulting nutrient losses.
- Overseer relies on a simplistic hydrology sub-model, which uses a single soil layer and assumes uniform water movement.
- Overseer does not balance the inputs and outputs of nitrogen. This means that the model is not constrained by the fundamental laws of mass conservation.

What has the Government proposed?

In the next 12 months, the Government will investigate, and put in place, one or more of the following options:

a. creating a *new risk index tool* (potentially using elements of Overseer such as the user interface)
b. developing a next generation *Overseer* to address the issues raised by the Science Advisory Panel and ensure that it is fit for purpose as a tool to use in appropriate regulatory settings
c. greater use of *controls on practices and inputs* to manage nitrogen loss
d. a completely new approach, such as:
    (i) near *real-time monitoring* of water quality at the local scale
    (ii) a tool that provides detailed understanding of nutrient loss risk based on the *characteristics of land*
    (iii) a new nutrient loss model.

What does the PCE make of the Government's announcements?

Improving freshwater quality in waterways around the country is vital. No single tool on its own will be enough to achieve that – a combination of tools and approaches is needed. So it is encouraging to see the Government acknowledging the serious concerns raised by the Science Advisory Panel and exploring multiple options going forward.

The Commissioner accepts that the Government is in a very difficult situation. It appears that the Government has decided to continue to support Overseer on the basis that it has become legally hardwired into many regional plans that are either operative or being developed.

The Commissioner considers this is risky because it is asking farmers and the wider community concerned about water quality alike, to accept the outcome of a process built, in part, on model outputs that are unreliable. This is unlikely to underwrite trust in what is already a complex process.

The priority in the short term should be to disentangle Overseer from the regulatory system to make sure regional councils and farmers are no longer solely reliant on it.

Some of the Government's proposals look promising.

A nutrient risk assessment approach as proposed by the Government could be a pragmatic way forward for addressing the risks associated with the loss of a wide range of diffuse contaminants, not just nitrogen. Such a tool could become a component of farm plans.

While a specific contaminant risk assessment framework has not been developed yet and several options are discussed, the Commissioner encourages officials to develop an approach that captures both the risks associated with management practices **and** inherent vulnerability of the land (mainly driven by variability in climate and other biophysical data).

Some sort of **controls and limits on practices and inputs** as sketched out by the Government may also be fairer and more transparent than continued reliance on a model that has been shown to be seriously flawed. If management practices cannot yield sufficient improvements, the only way to significantly reduce excess nutrients from livestock farming is to limit some of the inputs. The problem for regulators is, of course, that the extent of reduced inputs will depend on the infinitely variable mix of topography, climate, soils and the uses to which the land is being put.

In the long term, a **fine-grained landscape-based management approach** that takes the physical properties of the land into account may be a better platform for engaging with land users. Such an approach could be based on actual measurements and use the powerful data analysis techniques available today to adjust management approaches based on climate and landscape variability. The Commissioner encourages the Government to focus on and invest in near real-time monitoring of freshwater quality at high resolution scale, and deploy tools that provide detailed understanding of nutrient loss risk based on the characteristics of the land.

What about the proposal to redevelop Overseer?

Development of a 'next generation Overseer' is one of the options also explored by the Government.

The Commissioner is concerned that talking about developing a 'next generation Overseer' could raise the expectation that Overseer remains central to a comprehensive solution on water quality. A careful reading of the Government's proposal suggests something much more modest. It has picked up two specific shortcomings identified by the Science Advisory Panel – use of averaged climate data and a simplistic hydrology sub-model.

Tackling these two shortcomings is only likely to make Overseer's use more credible in a small number of locations – specifically, flat, free-draining soils where nitrate leaching is the dominant source of nitrogen loss.

Even with these improvements, the model will still be unable to do the following:

- capture the overland flow
- estimate total nitrogen loss
- be reliably used in catchment modelling
- be reliably used to explore future scenarios, especially management changes
- be reliably used for modelling other contaminants, like sediment and *E. coli*, for example

- shine any light on the fate of nitrogen between the 60 centimetre cut-off and distant receiving waterbodies, thus being unable to be used to estimate environmental impacts of lost nutrients on distant waterbodies.

This effectively reduces Overseer to being little more than a nitrogen leaching calculator in limited settings. This may be a useful part of the toolbox, but no one should overestimate what 'next generation' Overseer means.

Has the Government made recommendations on the future ownership of Overseer?

Importantly, one element missing from the Government's announcement is anything concerning the ownership and the governance of Overseer. Overseer's intellectual property is currently split three ways between the Ministry for Primary Industries, AgResearch, and the New Zealand Phosphate Company Ltd (which is owned in equal shares by the country's two major manufacturers of superphosphate and nitrogen fertilisers – Ballance Agri-Nutrients Ltd and Ravensdown).

The Commissioner believes the Government should consider compensating the fertiliser companies for their investment in Overseer and becoming its sole owner so that there can be total transparency about the model and any future uses to which it might be put.

Should Overseer be used in catchment scale modelling?

The Government supports the continued use of Overseer to inform catchment modelling in the interim.

The Commissioner considers that it would be better to invest in improved catchment modelling and enhanced monitoring instead of continuing to rely on the limited and uncertain outputs of Overseer.