



THE CATALYST GROUP
planning and environment

REGIONAL COUNCIL USES OF OVERSEER™

A REVIEW OF THE USE OF THE OVERSEER NUTRIENT
BUDGET MODEL FOR NUTRIENT MANAGEMENT IN
REGIONAL PLANNING

JULY 2018

USE OF THIS REPORT

This report has been prepared by The Catalyst Group at the request of our client for the purposes for which they intended. Where we have relied on information from external sources we have referenced these sources as appropriate and assumed them to be accurate. If you are unsure about interpretation of the content of this report, or its use beyond that for which the client intended, please get in touch with us at enquires@thecatalystgroup.co.nz.

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EXECUTIVE SUMMARY

The management of diffuse discharges is an important component of nutrient management in the context of maintaining and improving receiving environments. As it is difficult to monitor diffuse discharges directly, models are useful for estimating farm emissions. The OVERSEER™ Nutrient Budget Model (OVERSEER) is a farm-level web-based tool that generates nutrient budgets by modelling nutrient flows based on climate and farm-specific information describing the natural resources on-farm (including topography and soils); the farm system; and key inputs, interventions, and management decisions. OVERSEER is used in a number of domains, including to support regional council policy development and implementation across the country, although the manner in which OVERSEER is used varies considerably between councils.

The Parliamentary Commissioner for the Environment (PCE) commissioned The Catalyst Group to undertake a review of all regional council and unitary authority uses of OVERSEER within the context of nutrient management in regional planning. This investigation involved both a desktop review of the resource management plans and phone interviews with staff from each of the councils.

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KEY MESSAGES:

- 1. Council approaches to the management of diffuse discharges as reflected in their resource management plans can be summarised into three broad categories: limited focus; evolving focus; and increasingly sophisticated focus.** Within these categories, council responses varied considerably. The regional context is a key driver of the approach taken. To date, regulatory approaches typically follow the intensification land use and worsening of effects on the receiving environments.
- 2. The use of OVERSEER in managing diffuse discharges appears to be correlated with particular characteristics of councils and the level of sophistication of the policy response.** The application of OVERSEER was dependent on having relevant expertise in council, a recognised and well-defined water quality issue, a relatively well-resourced council, good levels of environmental information, and a predominance of dairy land use. Further, the more sophisticated the approach to the management of diffuse discharges and the greater need for farm-specific and catchment-level knowledge, the greater the prevalence of explicit reference to use of OVERSEER within resource management plans and consent requirements. Councils tend to rely on OVERSEER more to estimate nitrogen losses than to phosphorus losses.
- 3. This review provides a reliable indication of the views and experiences of local government staff involved in the use of OVERSEER model for nutrient management.** A total of 31 council staff working in either land/nutrient management, planning, compliance, consent, or science, and representing each of New Zealand's regional and unitary councils (with the exception of Chatham Islands) were surveyed. Most of those interviewed interacted with OVERSEER at least once a month in the course of their daily work, and generally had a self-identified 'reasonable' to 'strong' understanding of the model and a 'fair' to 'good'

understanding of the model's limitations. This represents a generally confident self-rating in view of the relatively low level of training undertaken by participants. Half of the participants had attended at least one course or workshop relating to OVERSEER and its use for nutrient management, but only seven participants had completed the Advanced Certificate in Nutrient Management from Massey University.

4. **Interview participants** identified 77 aspects relating to the use of OVERSEER. Twenty-three of these were seen as advantages and 54 which were seen as disadvantages. Advantages associated with the use of OVERSEER could be grouped into six themes: ability to identify areas for improvement in management practice; OVERSEER is the best available farm-scale tool; OVERSEER is a property-scale tool; OVERSEER is continually improved; OVERSEER is designed for purpose; and OVERSEER is freely available. Disadvantages associated with the use of OVERSEER could be grouped into seven themes: the model undergoes constant changes; compliance challenge associated with OVERSEER outputs; uncertainty associated with OVERSEER; user introduction limitations; OVERSEER is difficult to understand; the data used in OVERSEER is incomplete; and OVERSEER is data hungry. Many of the issues raised are universal to the use of models (e.g, lack of transparency, inconsistent outputs due to the ability to game the model, and uncertainty about assumptions and outputs). These issues are not unique to OVERSEER but need to be resolved to increase confidence in its use.
5. **Some interview participants identified a perspective that absolute outputs from OVERSEER cannot be relied on to enforce compliance or take prosecution actions.** This view appears to stem from the Resource Management Act 1991 requiring a burden of proof on the basis of strict liability offences. This can be challenging given the uncertainty associated with the model, inability to validate the outputs, and the ability for users to manipulate the numbers. These perspectives exist alongside Environment Court decisions¹ validating the adequacy of OVERSEER for estimating nutrient losses, and recommendations for situations where OVERSEER is used in regulation (Freeman et al. 2016).²
6. **Interview participants raised concerns over the potential commercialisation of OVERSEER.** These concerns centred around added costs to users, especially farmers; the unfairness of such expense if use of OVERSEER was mandatory; and the risk of losing free and easy access to input and output files and nutrient budgets which would hinder the ability to audit and further complicate compliance issues. The general feedback was that central, or central and local government, should be funding both the availability of OVERSEER and any ongoing improvements; and that governance and ownership of OVERSEER was a key matter requiring resolution.
7. **OVERSEER is the best available tool.** This investigation has highlighted that council staff generally consider OVERSEER to be an imperfect model. However, the view that it is the best available tool for the job – particularly for dairy land use –and the model had enabled shifting policy forward, was also expressed.

¹ Day v Manawatu-Whanganui Regional Council (Proposed One Plan Appeals) [2012] NZEnvC 182 (30 August 2012) paragraph 5-65.

² Freeman M, Robson M, Liburne L, McCallum-Clark M, Cooke A, McNae D 2016. Using OVERSEER in regulation. Technical resources and guidance for the appropriate and consistent use of OVERSEER by regional councils. Report prepared by Freeman Environmental Ltd for the OVERSEER Guidance Project Board.

8. **Existing guidance does not yet appear to have been taken up.** A detailed report providing technical resources and guidance for the appropriate and consistent use of OVERSEER in regulation by regional councils was developed by an OVERSEER Guidance Project Board in 2016 (Freeman et al 2016). Many of the detailed recommendations provided in Freeman et al. (2016) are highly relevant and responsive to the issues highlighted by interview participants during the course of this review, suggesting that those recommendations have yet to influence council use of OVERSEER.

RECOMMENDATIONS:

Firstly, articulation of resistance to regulation of diffuse discharges should be untangled from critique of OVERSEER as a tool to support policy responses to a critical natural resource management issue of national relevance.

There is a considerable amount of uncertainty associated with OVERSEER and this has been widely perceived as a key limitation of the model. The Freeman et al. (2016) report provides a pathway to manage uncertainties and limitations associated with OVERSEER, and details how best to apply caution to decision-making in light of these issues. It is interesting to note that while concerns were expressed that OVERSEER outputs were too uncertain to rely on, there appears to be an acceptance that OVERSEER is an appropriate and precise enough tool on which to base fertiliser application and property transfers, both of which involve considerable financial implications. We also suggest that during this period of uncertainty the urgent need to sustainably manage our natural resources needs to be paramount. It is crucial that this urgency is not lost in the debate surrounding the use of OVERSEER in regulating diffuse discharges.

Further, universal issues associated with the use of models should be separated from genuine OVERSEER-specific shortfalls. Many of the issues raised in relation to OVERSEER are common to models and decision-support tools generally. These issues should be resolved as a matter of course, and not used as a platform to undermine more sophisticated approaches to nutrient management.

Emphasis should instead be on resolving issues internal to OVERSEER, increasing robustness of outputs, tightening user standards, and improving practice when using OVERSEER. The following are key to achieving this:

1. Implement the recommendations set out in the Freeman et al. (2016) report

Of particular relevance to this review, the Freeman et al. (2016) report:

- Provides succinct guidance for the regulatory use of OVERSEER
- Provides guidance for dealing with version changes of OVERSEER, and recommendations for minimising issues related to version changes
- Recognises that expertise is required for best practice use of OVERSEER, and suggests minimum qualification standards to achieve this
- Highlights the importance of including data requirements in policies and consent conditions, along with the need for monitoring

The implementation of the recommendations set out in Freeman et al. (2016) could be expedited via

workshops with key council staff; implementation of defined workstreams to operationalise recommendations; and development of specific, concise guidance to translate recommendations into necessary actions. This needs to be in a form that can be used by regional authorities (big or small) on a consistent basis. Improving practice around OVERSEER will require committed leadership and an ownership and funding model that keeps OVERSEER in the public domain.

2. Establishing independence and confidence in the model

We note that this issue identified by Freeman et al. (2016) has not yet been addressed. For example, Freeman et al. (2016) recommended performing sensitivity analysis. This would enable the determination of defensible thresholds to describe acceptable variance in OVERSEER outputs and consent conditions when monitoring and enforcing compliance. We also suggest the following to improve confidence in the model:

- Further development of OVERSEER, in particular to improve its ability to model arable and horticultural land use
- Further documentation describing OVERSEER to increase transparency regarding model assumptions and calculations

3. Establish a combined (local government-central government-commercial users) funding model

Such a funding model should:

- Maintain OVERSEER in the public domain.
- Resource needed upgrades and further developments.
- Continue to develop implementation support (e.g. training and quality control systems; guidance on key issues).

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1 INTRODUCTION

The Parliamentary Commissioner for the Environment (PCE) has embarked on an investigation into the nutrient management in regional planning, including the use of the OVERSEER™ Nutrient Budget Model (OVERSEER). The PCE commissioned The Catalyst Group to undertake a review of all regional council and unitary authority uses of OVERSEER within the context of nutrient management in regional planning. This report details findings of this review, identifies themes across councils, and provides recommendations for addressing areas of concern brought to light by this project.

2 METHODOLOGY

This investigation involved two key methodological components:

1. A desktop review of the resource management plans for each of New Zealand's regional and unitary councils, excluding Chatham Islands (16 councils in total)
2. Semi-structured phone interviews with staff from each of the 16 councils

2.1 Assessment of resource management plans

Regional policy statements and resource management plans from each of the councils were systematically reviewed to:

- Describe the regional approach to management of diffuse discharges (of nitrogen and phosphorus) in broad terms, and identify key mechanisms for implementing approaches
- Provide the regional context against which the policy approach to management of diffuse discharges sits
- Identify if, and how OVERSEER is formally (via reference within planning documents) used within regional approaches to management of diffuse discharges

The focus of this analysis was on diffuse discharges of nitrogen and phosphorus specifically (herein referred to as diffuse discharges), not nutrient management generally. Thus, emphasis was placed on relevant policies and rules relating to discharges to land which may enter water. Provisions for other diffuse discharges, discharges to water, or other point-source discharges were not the focus of this review.

In addition to systematically reviewing relevant policies and rules, a search was conducted for the following terms within the documentation: non-point source; diffuse; nitrogen; nutrient management; OVERSEER; nutrient budget; farm plan, to ensure the analysis was comprehensive and did not overlook bespoke provisions elsewhere in the plan.

A list of the plans reviewed is provided in Appendix 1.

2.2 Phone interviews of council staff

The purpose of interviewing council staff was to supplement the desktop plan review, and in particular to ground-truth the way OVERSEER is being used for the management of diffuse discharges by councils. A cross section of council staff working in a range of pertinent roles were interviewed in June 2018. The number of staff within each role interviewed was dependent upon availability and willingness to participate. Interviewees included council staff with nutrient or land management, policy, consents, compliance, or science focused roles. The extent of interviewing was broadly correlated with the degree to which OVERSEER forms part of the policy framework.

Interview participants were selected in three ways:

- From a list of names provided by the PCE of council staff they had already approached relating to the parent investigation.
- From the project team's networks and knowledge of council staff roles.
- From recommendations provided by council staff as to suitable colleagues to approach.

Potential participants were initially approached via email to gauge suitability and interest in participating, and to arrange an interview time. All participants were asked the same fourteen questions, which included both fixed response and open-ended questions (a list of the interview questions is provided in Appendix 2). Interviews took on average 20 minutes but ranged from 5 minutes to 1 hour.

2.3 Description of interview participants

A total of 31 council staff representing all of the regional or unitary councils (with the exception of Chatham Islands) were interviewed. Table 1 shows how the interviewees were distributed across the 16 councils; their primary work area is shown in Table 2.

TABLE 1:*Number of participants from each council*

Council	Number of participants
Auckland Council	1
Bay of Plenty Regional Council	2
Environment Canterbury	4
Environment Southland	4
Gisborne District Council	1
Greater Wellington Regional Council	1
Hawke's Bay Regional Council	3
Horizons Regional Council	2
Marlborough	1
Nelson City Council	1
Northland Regional Council	1
Otago Regional Council	3
Taranaki Regional Council	1
Tasman District Council	1
Waikato Regional Council	3
West Coast Regional Council	2
Total number of participants	31

TABLE 2:*Percentage of participants by work area*

Job area	Percentage of participants (numbers in brackets; n = 31)
Land/Nutrient management	23 (7)
Science	23 (7)
Policy	16 (5)
Compliance	16 (5)
Planning	10 (3)
Cross-discipline	10 (3)
Consents	3 (1)

Of the three participants working cross-discipline, two stated they worked across both planning and compliance work areas and one described their job area as including both policy and land/nutrient management. Only one respondent identified consents as their primary job area, although this output is likely to be included under planning.



Nearly a third (32%) of the interview participants didn't interact with OVERSEER itself in the course of their work, but 65% (20) of participants interacted with the model at least once a month or more. Of these, 16.1% (5) interacted with the model at least once a month; 12.9% (4) at least once every two weeks; a further 12.9% (4) at least once a week; and 22.6% (7) at least twice a week. One participant did not respond to this question.

3 INTERVIEW OUTCOMES

3.1 Interview participants' understanding of the OVERSEER model

Interview participants were asked to describe their own understanding of OVERSEER using one of the following categories:

- No understanding (no particular knowledge)
- A little understanding (sort of know what it does, but not confident to describe it)
- Reasonable understanding (can describe what its function is)
- Strong understanding (feel confident to describe its core function, inputs, and outputs)

Nine (29%) interview participants self-identified as having 'little understanding' in general of OVERSEER; 45% (14) as having a 'reasonable understanding'; and 23% (7) declared a 'strong understanding' of the model. None of the participants suggested that they had 'no understanding' of OVERSEER, although one participant did not respond to this question.

In terms of understanding the limitations of OVERSEER, 42% (13) of participants stated they had a 'good understanding'; 35% (11) had a 'fair understanding'; and 19% (6) had a 'poor understanding'. One participant did not respond to this question.

The majority of those who stated a lesser degree of understanding of OVERSEER, or its limitations were those participants who did not interact with OVERSEER at all (Table 3).

TABLE 3:

Understanding of (A) OVERSEER, and (B) its limitations by participants' frequency of interaction with the model. Figures given are percentage of total participants within each frequency category, actual numbers are given in brackets. Total n = 30 (one participant did not answer these questions).

			Frequency of interaction				
			Not at all (n = 10)	At least once a month (n = 5)	At least once every two weeks (n = 4)	At least once a week (n = 4)	At least twice a week (n = 7)
A	Understanding of OVERSEER	No understanding (n = 0)					
		Little understanding (n = 9)	78 (7)	22 (2)			
		Reasonable understanding (n = 14)	21 (3)	21 (3)	28 (4)	7 (1)	21 (3)
		Strong understanding (n = 7)				43 (3)	57 (4)
B	Understanding of limitations of OVERSEER	No knowledge (n = 0)					
		Poor (n = 6)	83 (5)			17 (1)	
		Fair (n = 11)	36 (4)	36 (4)	18 (2)		9 (1)
		Good (n = 13)	8 (1)	8 (1)	15 (2)	23 (3)	46 (6)

3.2 Training on use and understanding of OVERSEER

Only 15 of the 31 interview participants had attended at least one course or workshop relating to OVERSEER, and over half of those (53%) had attended more than one course or workshop. Seven (47%) of these 15 participants had completed the Advanced Certificate in Nutrient Management from Massey University, and an additional three (18%) participants had completed the Intermediate Certificate in Nutrient Management. Attendance at workshops was indicated nine times by eight participants, and this included internal workshops, workshops held by other councils, and unspecified workshops. Two participants reported having attended the unofficial introductory training course run by DairyNZ and a further two participants were members of the OVERSEER working group.³

The percentage of participants who had undertaken some form of OVERSEER training increased with the frequency of interaction with the model in the course of their work (Figure 1).

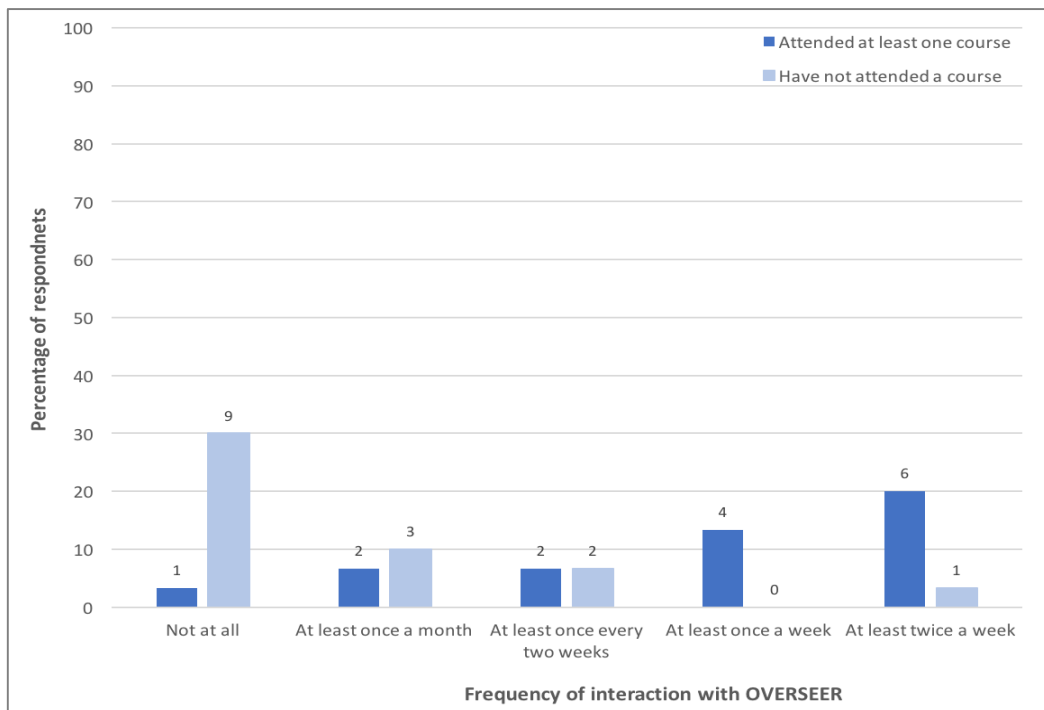


FIGURE 1:

Percentage of interview participants within each category of interaction with OVERSEER who had attended training courses. Actual numbers of participants are provided above the bars.

³ The OVERSEER working group meets regularly to resolve issues and comprises representatives from the OVERSEER owners, industry, and regional councils.

The level of certified training undertaken by participants seems low compared to the self-identified level of understanding of OVERSEER and its limitations. The level of expertise required to increase confidence in the use of OVERSEER was an issue raised by Freeman et al. (2016),⁴ and also by interview participants in this review (see section 5.1). These findings suggest there should be greater emphasis placed on ensuring council staff who use OVERSEER, or make key decisions based on OVERSEER outputs, are adequately trained themselves (or advised by others who are).

3.3 Assistance on the use of OVERSEER available within councils

The findings of the interviews we conducted suggest that most council staff working with OVERSEER have access to in-house advice to assist them with their decision-making relevant to the use of OVERSEER.

The majority (71% [22]) of interview participants indicated that there was at least one person within their organisation who was able to provide advice, while 16% (5) indicated that such support was not available in-house. The remaining four participants did not provide an answer to this question. Of the 22 participants who did have access to advice in-house, 86% (19) indicated that this source was readily available, with the remaining 14% (3) indicating they were the key provider of advice on OVERSEER within their organisation. The vast majority (89% [17]) of participants with access to in-house expertise indicated they used it, with only two participants indicating they did not.

Overall, the interview findings (detailed below) can be considered to be well-founded and a reasonable reflection of perceptions held by the interview participants regarding the issues, challenges, and advantages in using OVERSEER for nutrient management within regional planning. However, these perceptions should be taken in light of the relatively low proportion of interview participants who had undertaken specific training in the use and interpretation of OVERSEER, and in the context of their respective job areas.

⁴ Freeman M, Robson M, Liburne L, McCallum-Clark M, Cooke A, McNae D 2016. Using OVERSEER in regulation. Technical resources and guidance for the appropriate and consistent use of OVERSEER by regional councils. Report prepared by Freeman Environmental Ltd for the OVERSEER Guidance Project Board.

4 REGIONAL APPROACHES FOR ADDRESSING DIFFUSE DISCHARGES

Councils had varied approaches to managing diffuse discharges and their effects, but can be summarised by three broad categories:

- 1. Limited focus:** Councils with a generally non-numerical approach to managing diffuse discharges, coupled with limited resources and expertise within council to interpret outputs or administer the use of OVERSEER.
Gisborne District Council; Nelson City Council; Tasman District Council; West Coast Regional Council
- 2. Evolving focus:** Councils that are currently reviewing their approach to managing diffuse discharges in response to increasing resource pressure and community and stakeholder demand for more sophisticated approaches.
Auckland Council; Environment Southland; Greater Wellington Regional Council; Marlborough District Council; Northland Regional Council; Otago Regional Council; Taranaki Regional Council
- 3. Increasingly sophisticated focus:** Councils that have a relatively comprehensive approach to managing diffuse discharges, including those that are output-based and rely on the use of models such as OVERSEER within their policy framework.
Bay of Plenty Regional Council; Environment Canterbury; Hawke's Bay Regional Council; Horizons Regional Council; Waikato Regional Council

The regional context in terms of the magnitude of resource pressure and vulnerability of the receiving environments appears to be a key driver of the approach taken. It appears that regional regulatory responses to managing diffuse discharges have followed intensification of land use where the cumulative effects on water quality have been such that communities have demanded improvement.

The above categorisation is a simplification that hides important nuances. For example, the increased sophistication of management of diffuse discharges within Hawke's Bay only currently applies to one catchment, but is in the process of being considered for further catchments within the region; Taranaki Regional Council is shifting from a non-regulatory to a regulatory approach, but rules only compel stock exclusion and riparian planting on the Taranaki ring plain and do not address nitrogen leaching; and Northland Regional Council, Greater Wellington Regional Council, and Marlborough District Council are signalling a shift in regime, but the nature and extent of that shift is unknown at this stage.

Council approaches, regional context, and use of OVERSEER within these approaches are summarised in Table 4.

TABLE 4:

Summary of regional context and general approach to managing diffuse discharges. Unless stated, the reference to use of OVERSEER does not specify a version; it can be assumed that in these cases the reference would apply to the current version of the model.

Council	Regional context	General approach	Reference to OVERSEER
Auckland Council	Auckland is New Zealand's most populous region, surrounded by an extensive and sensitive coastline and dissected by many rivers and streams. High levels of urban and peri-urban intensification and sprawl in recent decades have gradually consumed substantial areas of land formerly under agricultural or horticultural land use.	<p>Regional approach; input based; permitted activity</p> <p>Management of diffuse pollution is based on limits to inputs; providing the limits of application are not exceeded, the activity is permitted.</p> <p>Farm plans used to be required but this is no longer part of the approach.</p>	The use of OVERSEER is recognised as a best practice option where a nutrient budget must be prepared (Auckland Unitary Plan E35.6.1.3. Application and discharge of fertiliser onto or into land).
Bay of Plenty Regional Council	The Bay of Plenty Region is rich in agricultural land and has high sunshine hours. The region is dotted with closed waterbodies and has an extensive coastline, vulnerable to the impacts of diffuse pollution. Nearly a quarter of the region is in exotic pasture, demanding a diligent approach to runoff if resources are to be protected. The planning framework is detailed in recognition of the increasing pressure.	<p>Catchment specific; output-based; regulatory approach</p> <p>Diffuse discharges over a specified intensity are regulated. Innovative approaches are being promulgated such as in the Rotorua Lakes catchment, which has a cap and trade framework based on benchmarked nitrogen limits commencing from 2022.</p>	<p>OVERSEER 5.4 used to establish limits and determine annual catchment loads and reductions.</p> <p>Calculation of nitrogen discharge allocations based on benchmark information expressed as OVERSEER 6.2.0 values.</p> <p>Nutrient Management Plans using the most current version of OVERSEER are a condition of controlled activity within the Rotorua Lakes catchment to achieve</p>



Council	Regional context	General approach	Reference to OVERSEER
			<p>managed nitrogen reduction targets (Lake Rotorua Nutrient Management Proposed Plan Change 10, Rules LR R1–LR R13).</p> <p>OVERSEER is explicitly referenced in the plan and in consent conditions.</p>
Environment Canterbury	<p>The Canterbury Region is characterised by a vulnerable receiving environment and a high degree of primary industry activity. Significant pressures of freshwater resources (both ground and surface) through both abstraction and discharge makes Canterbury a flashpoint for New Zealand’s water governance.</p>	<p>Zone based; output-based; regulatory approach</p> <p>The management of freshwater impacts is via Nutrient Allocation Zones with multi-party management committees for each zone. Nitrogen baselines are set at the 2009–2013 period.</p> <p>The approach is generally regulatory with a hierarchical approach depending upon the area and the degree of likely discharge including limits to inputs and some cap and trade of nitrogen.</p> <p>A restricted cap and trade approach within Nutrient User Groups and irrigation schemes is in place.</p>	<p>Nitrogen load limits were modelled using OVERSEER 6.2.1.</p> <p>Farm Environment Plans are to include a nutrient budget produced by OVERSEER (or equivalent approved model).</p> <p>Proposed Plan Change 5 contains a raft of improvements to diffuse discharge management region-wide. It includes the development of a web-based tool which can be used to estimate nutrient losses from farmland and which is based on OVERSEER. The plan change is currently in progress.</p>
Environment Southland	<p>Dairy is a significant land use within the Southland Region. The region also has an environment that includes some</p>	<p>Regional; permitted activity</p> <p>Diffuse discharges to land are</p>	<p>A Farm Environment Management Plan is to include a nutrient budget calculated using the latest version of OVERSEER</p>



Council	Regional context	General approach	Reference to OVERSEER
	important natural features that are declining due to diffuse pollution (e.g. Waituna Lagoon). In contrast, the western portion of the region is public conservation land (Fiordland National Park) under the control of the Department of Conservation.	<p>managed via permitted activity status with the requirement of a Farm Environment Management Plan for all farms greater than 20 ha.</p> <p>A Farm Environment Management Plan may sometimes specify a numerical limit, elevating the level of regulatory oversight to the management of diffuse discharges in the region.</p>	(as set out in Part B of Appendix N to the Proposed Water and Land Plan).
Gisborne District Council	Horticulture and forestry predominate the regional primary industries within Gisborne District, with only three dairy farms in the district.	<p>District-wide; input-based; permitted activity</p> <p>The approach to diffuse discharges is evolving and focusing on managing the impacts of new activities (while giving leeway to existing uses).</p> <p>The overall approach is based on limits to inputs and encouragement of good management practices via use of a Farm Environment Plan as a permitted activity requirement.</p>	OVERSEER is referenced within the requirements of a Farm Environment Plan in Part A of Schedule 11 of the Gisborne Proposed Freshwater Plan (decisions version 2017).
Greater Wellington Regional Council	The Wellington Region spans highly concentrated urban settlement patterns across four different metropolitan areas, several satellite towns and settlements and a significant extent of predominantly	<p>Non-regulatory approach</p> <p>The current reliance on non-regulatory approaches to the management of diffuse discharges</p>	No reference to OVERSEER within planning documents.



Council	Regional context	General approach	Reference to OVERSEER
	<p>rural land in the north of the region. Water quality issues from runoff stem from dairy land use in the Wairarapa through to polluted urban runoff and sewage discharges close to where much of the population live, presenting a significant resource management challenge.</p>	<p>may alter depending on the outcomes of the Whaitua process.</p> <p>The Whaitua process sees a catchment-based collaborative committee produced to discuss, analyse, and broker a way forward to manage freshwater issues; it may include setting limits if appropriate.</p>	
<p>Hawke's Bay Regional Council</p>	<p>Hawkes Bay's extensive region has been highly modified, with farming, horticulture, viticulture, and tourism dominating industry. Increasing focus over the coming years is likely to strengthen the outcomes of policy and planning as rules tighten in focal catchments.</p>	<p>Catchment-specific; output-based; primarily non-regulatory; permitted activity in Tukituki catchment</p> <p>The council primarily relies upon non-regulatory methods to manage diffuse discharges except for the Tukituki catchment.</p> <p>Within the Tukituki catchment the council has a regulatory regime that is output focused and requires each farm to obtain a resource consent. Nitrogen-leaching allowance is based on natural capital.</p>	<p>Within the Tukituki catchment, a nutrient budget using OVERSEER (or approved alternative) and a Farm Environment Management Plan are a condition of permitted activity rule (Rule TT1, Chapter 6.9: Tukituki River Catchment Rules of the Hawke's Bay Regional Resource Management Plan).</p> <p>Reference to OVERSEER also embedded in policies.</p>
<p>Horizons Regional Council</p>	<p>The Manawatu-Whanganui Region is highly modified and under significant environmental pressure from rapid intensification of land uses in the last decade or more. Surface water quality is</p>	<p>Catchment-specific; output-based; mixed regulatory and non-regulatory approach</p> <p>Predominantly regulatory approach</p>	<p>The use of OVERSEER is necessary where a nutrient management plan is required as a condition of consent; and for the preparation of a nutrient budget as required for permitted activities, e.g.</p>



Council	Regional context	General approach	Reference to OVERSEER
	one of the 'big four' environmental challenges recognised by the One Plan (the region's fully consolidated regional policy and planning framework).	to the management of diffuse discharges, with activity status being specific to water management sub-zones (based on catchments). Nitrogen-leaching allowance is based on natural capital.	fertiliser or animal effluent application (Chapter 14: Discharges to Land and Water of the One Plan).
Marlborough District Council	The Marlborough District has a significant amount of primary industry and increasing concern about the state of water quality, particularly as a significant part of the economy is aquaculture in the receiving waters.	District-wide; input-based; currently non-regulatory approach Currently a relatively non-regulatory focus, shifting towards an output-based, regulatory approach by 2024, based on cumulative contaminant limits. Nutrient load restrictions on older farms are in place, and new farms require an activity-based consent (discretionary).	No reference to OVERSEER within planning documents.
Nelson City Council	Nelson is a small unitary jurisdiction with a very limited amount of dairy farming (three farms) or other related industry. The land area is predominantly urban or peri-urban with residential issues comprising a significant proportion of the council's time.	District-wide; non-regulatory approach Planting within riparian margins is encouraged.	No reference to OVERSEER within planning documents.
Northland Regional Council	Northland region is home to a wide variety of land uses and is significantly dependent upon industries that rely on	Regional; non-regulatory approach	No reference to OVERSEER within planning documents.



Council	Regional context	General approach	Reference to OVERSEER
	<p>environmental quality (e.g. farming, tourism). Northland has significant freshwater resources that are facing increasing pressure from agricultural runoff amongst other resources.</p>	<p>Currently a predominantly non-regulatory approach, but having now recognised that diffuse discharges constitute a significant threat to freshwater and coastal ecosystems, the management approach is evolving and shifting towards identification of catchment-specific objectives within a few priority catchments.</p> <p>Catchment objectives will be set via collaborative processes and may include setting of limits and methods for discharge permits.</p>	
<p>Otago Regional Council</p>	<p>The Otago region is vast, stretching from the Southern Alps to the South Pacific Ocean. Low population density and a dominance of sheep and beef farming land use means water quality is relatively good in many catchments. More populated areas and areas where the intensity of agriculture has increased have resulted in declining water quality in adjacent water bodies, increasing pressure to make planning approaches more stringent.</p>	<p>Zone-based; primarily non-regulatory approach</p> <p>Evolving, but currently primarily a non-regulatory approach to the management of diffuse discharges unless certain outcomes are likely (e.g., damage to a significant wetland) or the area is within a Nitrogen Sensitive Zone. Nitrogen Sensitive Zones are part of the upcoming regime to manage diffuse pollution via limits based on outputs.</p>	<p>From 2020, discharges to land where they may enter groundwater will be a permitted activity provided they are within set limits. Within this new regime, nitrogen losses are to be calculated using OVERSEER version 6 (Chapter 12: Rules: Water Take, Use and Management of the Otago Regional Plan Water [based on Plan Change 6a]).</p>



Council	Regional context	General approach	Reference to OVERSEER model
Taranaki Regional Council	Taranaki Region has 286 main catchments and more than 500 rivers, but they are relatively short catchments with fast flows to the sea. Dairy farming has historically been the predominant land use in the region, and the region has not seen the same level of land conversion or intensification in recent years as experienced by other regions. However, pressure on freshwater resources is still evident and the council is reviewing its approach to diffuse discharges as a result.	<p>Land type-specific; currently non-regulatory approach</p> <p>The non-regulatory approach to manage diffuse discharges via riparian fencing and planting is shifting towards a mandatory focus to complete these works for dairy farms on the Taranaki ring plain.</p> <p>The upcoming regulatory regime remains focused solely on riparian management (stock exclusion and planting) to manage diffuse nutrient loss to water and has no other approaches proposed for the management of nitrogen losses.</p>	No reference to OVERSEER within planning documents.
Tasman District Council	Tasman District has only a limited number of dairy farms but although the extent is relatively stable, intensity has increased on a per hectare basis.	<p>District-wide; non-regulatory approach</p> <p>Currently a non-regulatory approach to the management of diffuse discharges which focuses on stock exclusion and support for riparian fencing, although this is signalled to alter following plan changes relating to water quality.</p>	No reference to OVERSEER within planning documents, although a pending consent related to Te Waikoropupū Springs employed the use of OVERSEER.



Council	Regional context	General approach	Reference to OVERSEER
Waikato Regional Council	<p>The Waikato Region is one of the largest in the country and contains more than a third of all dairy herds in the country.⁵</p> <p>There is cause for concern with the increasing role of diffuse pollution in degrading freshwater quality. The regions 100 lakes are predominantly nutrient-enriched from surrounding land uses.</p>	<p>Catchment-based; either input-or output-based; either non-regulatory or regulatory approach</p> <p>The management of diffuse discharges varies across catchments, with a particularly innovative and unique approach to nutrient management via a cap and trade system in the Lake Taupō catchment.</p> <p>Within Lake Taupō catchment Nutrient Management Plans are required to ensure no increases in leaching unless they are offset via the Nitrogen Trading policy. Within the Waikato and Waipā River catchments, Farm Management Plans serve as a permitted activity standard.</p> <p>Outside of these catchments, the management of diffuse discharges is managed via a permitted activity status for fertiliser application subject to input limits and a requirement of a Nutrient Management Plan taking into account all sources of nutrients.</p>	<p>Nitrogen leaching farming activities within the Lake Taupō Catchment are require a Nitrogen Discharge Allowances to be established calculated using OVERSEER 5.4.3. (Rule 3.10.5.3 of the Waikato Regional Plan).</p> <p>Current version of OVERSEER (or another approved model), must be used to calculate the five-year rolling average used to determine the Nitrogen Reference Point specified within a Farm Management Plan.</p> <p>The Farm Management Plan is to include a nutrient budget calculated using OVERSEER. (Introduced to the plan via Variation 5).</p> <p>Nutrient Management Plans must be based on outputs of OVERSEER (or another approved model).</p> <p>(General provision in Table 3-10, Section 3 [Water Module] of the regional plan).</p>

⁵ <http://www.dairyatwork.co.nz/media/16646/QuickStats-about-dairying-Waikato.pdf>



Council	Regional context	General approach	Reference to OVERSEER
West Coast Regional Council	The West Coast Region is remote, and primarily comprised of land administered by the Department of Conservation. However, the mostly privately owned lowlands are increasingly being converted to dairy, involving substantial landscape change including large-scale drainage and soil-flipping.	<p>Regional; non-regulatory approach</p> <p>A primarily non-regulatory approach to the management of diffuse discharges with a focus on promoting riparian margin management and good management practice for the application of fertiliser.</p> <p>Activities are restricted when they exceed maximum inputs, but otherwise diffuse discharges are generally permitted, with a more restrictive approach within the Lake Brunner catchment.</p>	No reference to OVERSEER within planning documents.



4.1 Use of OVERSEER for managing diffuse discharges

Nine councils currently use OVERSEER to support regulatory frameworks, of which four (25% of the total number of councils) use nutrient budget requirements as a permitted activity standard, while the remaining five (31% of the total) use OVERSEER in various ways within their consenting processes for managing diffuse discharges. Seven of the 16 councils (44%) have a non-regulatory approach to managing diffuse discharges and do not explicitly reference OVERSEER in their plans (Table 5).

Otago Regional Council's plan includes an operational permitted activity rule, but this does not take effect until 2020. Taranaki Regional Council's Draft Freshwater and Land Management Plan, which currently has no legal effect,⁶ includes a permitted activity rule (to take effect in 2020) for managing diffuse discharges focused on riparian margin management and exclusion of stock from waterways, but it does not require nutrient budgets or use OVERSEER in support of these policies and rules.

⁶ The Draft Plan has not yet been publicly notified, but Taranaki Council has commenced targeted, informal consultation on the Draft Plan. See <https://www.trc.govt.nz/council/plans-and-reports/strategy-policy-and-plans/regional-fresh-water-plan/water-and-soil-plan-review>

TABLE 5:

Summary of current or proposed (publicly notified) approaches to the management of diffuse discharges of nitrogen or phosphorus within regional planning documents. Circles (●) indicate that OVERSEER is used to support the policy approach; squares (■) indicate that OVERSEER is not referenced within the planning documents. The triangle symbol (Δ) indicates publicly stated future intentions, which do not yet have legal standing.

Council	Framework		
	Non-regulatory (no use of OVERSEER)	Regulatory – permitted activity standard	Regulatory – consent requirement
Auckland Council		●	
Bay of Plenty Regional Council			●
Environment Canterbury			●
Environment Southland		●	
Gisborne District Council		●	
Greater Wellington Regional Council	■		
Hawke's Bay Regional Council			●
Horizons Regional Council			●
Marlborough District Council	■		
Nelson City Council	■		
Northland Regional Council	■		
Otago Regional Council		●	
Taranaki Regional Council	■	Δ	
Tasman District Council	■		
Waikato Regional Council			●
West Coast Regional Council	■		

The use of OVERSEER by councils varies from simple application (e.g., requirement of a nutrient budget for permitted activity status) to more comprehensive and multi-levelled application (e.g., setting catchment-level limits and plan requirements as well as requiring nutrient budgets for estimating on-farm losses).



Examples of the various ways in which OVERSEER is used by councils include:

- Requiring a nutrient budget for permitted activity status and to inform farm plans and pathways to comply with farm plans
Gisborne District Council; Environment Southland, Auckland Council, Otago Regional Council
- Setting leaching limits derived in OVERSEER based on capacity of the catchment to assimilate pollution using Land Use Capability as foundation
Horizons Regional Council; Hawke's Bay Regional Council
- Using outputs from OVERSEER to estimate the farm's nutrient losses and using this as a trigger for activity status
Waikato Regional Council; Horizons Regional Council; Hawke's Bay Regional Council
- Stating an OVERSEER-derived nitrogen limit within the Farm Environment Plan, which is referenced in the consent
Environment Canterbury
- Using OVERSEER estimated nutrient losses at the property scale to inform catchment modelling
Northland Regional Council; Waikato Regional Council
- Using farm-level OVERSEER outputs to benchmark catchment-level losses and determine farm-based nitrogen discharge allowance
Waikato Regional Council
- Using an OVERSEER nutrient budget to compare the farm against the allowable nitrogen loss allocation and inform necessary action for inclusion in the farm plan
Bay of Plenty Regional Council
- Using OVERSEER estimated nitrogen losses to define the Farm Dairy Effluent area necessary to comply with a plan's stated allowable fertiliser input rate and to check the effluent system is designed to achieve compliance
Hawke's Bay Regional Council

The extent of explicit use of OVERSEER appears to be correlated with having relevant expertise in council, a recognised and well-defined water quality issue, a relatively well-resourced council, good levels of environmental information, and a predominance of dairy land use. We also note that socio-political influences are important considerations that can influence plan development processes,⁷ although this was not explored as part of this project.

The more sophisticated the approach to the management of diffuse discharges and the greater need for farm-specific and catchment-level knowledge, the greater the number of explicit references to the use of OVERSEER within resource management plans and consent requirements. Several councils (e.g., Environment Canterbury and Waikato Regional Council) stipulate that outputs from alternative models will meet requirements, providing the model has been formally approved by the Chief Executive. This reflects that the reliance is not on OVERSEER

⁷ One such influence is regulatory capture, as evidenced in Bay of Plenty Regional Council's Plan Change 10, which involved largely devolving the allocation regime to the dairy industry to develop (Statement of Evidence of Christine Bridget Robson for CNI Iwi Holdings Limited in the matter of Lake Rotorua Nutrient Management Proposed Plan Change 10 to the Bay of Plenty Regional Water and Land Plan, 6 March 2017).

per se, but that there is a recognition for the need of quantified and robust data. Currently OVERSEER is the principal tool available, particularly for pastoral farming.

4.2 Other mechanisms for managing diffuse discharges

A variety of other mechanisms used to manage diffuse discharges alongside or instead of OVERSEER were identified by interview participants from all councils, except Northland and Otago Regional Councils. Where OVERSEER was used by councils the focus tended to be estimating nitrogen losses, while other mechanisms tended to capture other diffuse discharges (instead of, or as well as, nitrogen), for example stock exclusion from riparian margins to reduce phosphorus losses and *E. coli* levels in-stream. Responses are summarised in Table 6 and detailed below. It can be assumed that this is an indicative, not exhaustive, list of other mechanisms used by councils to manage diffuse discharges and is likely to be a reflection of a) how key interview participants considered these methods to be for their region, or b) how familiar participants were with other aspects of council work outside of their own.

- **Farm plans:** Participants from eight councils⁸ indicated that farm plans were a key mechanism to manage diffuse discharges. The ways in which farm plans are used varied between the councils and included:
 - An emphasis on good management practice (rather than limit setting) to deal with other contaminants that OVERSEER does not address
Environment Canterbury; Bay of Plenty Regional Council
 - The requirement for a nutrient budget (based on OVERSEER) within a Farm Environment Plan
Gisborne District Council
 - Use of farm plans both as a regulatory tool and to support non-regulatory methods
Horizons Regional Council; Hawke's Bay Regional Council
 - Use of a farm plan as the main tool for addressing diffuse discharges
Southland Regional Council
- **Targeted programmes:** Riparian programmes were identified as a key management tool by participants from eight councils.⁹ Although not specifically stated by interview participants, it is assumed that the focus of riparian programmes was on reducing phosphorus losses to water, and reducing other contaminants from reaching waterways (e.g. *E. coli*); rather than on reducing diffuse discharges of nitrogen. Horizons Regional Council's Sustainable Land Use Initiative (SLUI) is another example of a targeted programme, in this case also targeted towards reducing erosion, which results in reducing phosphorus loadings in waterways. These programmes can also utilise a version of a farm plan as an implementation mechanism, such as riparian plans (e.g., Taranaki Regional Council). These programmes are voluntary and a key non-regulatory method employed by councils, although Taranaki Regional Council

⁸ Bay of Plenty Regional Council; Environment Canterbury; Environment Southland; Gisborne District Council; Hawke's Bay Regional Council; Horizons Regional Council; Nelson City Council; West Coast Regional Council.

⁹ Auckland Council; Bay of Plenty Regional Council; Environment Southland; Hawke's Bay Regional Council; Horizons Regional Council; Nelson City Council; Taranaki Regional Council; Tasman District Council

is proposing to shift its riparian programme on the Taranaki ring plain from non-regulatory to regulatory.

- **Planning framework.:** Participants from eight councils¹⁰ identified additional controls within their plans as contributing to the management of diffuse discharges. These provisions included:
 - Regulatory controls (typically driven by thresholds describing standards for permitted activity, above which a requirement for resource consent is triggered) for stock exclusion from waterways, fertiliser inputs, irrigation, and effluent disposal
Environment Canterbury; Horizons Regional Council; Environment Southland (although such provisions are common across resource management plans)
 - Management of intensive winter grazing and cultivation of sloping ground
Environment Southland
 - Regulatory control on dairy farming
Marlborough District Council (proposed)
 - Identification of sensitive zones
Environment Southland

- **Other models:** Participants from four councils¹¹ identified the use of other models alongside OVERSEER as a key method to inform decision-making regarding management of diffuse discharges. Such models included:
 - Catchment Land Use for Environmental Sustainability model (CLUES), a GIS-based modelling system which assesses the effects of land use change on water quality and socio-economic indicators
Waikato Regional Council
 - SedNet NZ, a spatially distributed, time-averaged model that routes sediment through the river network using a sediment budgeting approach
Waikato Regional Council
 - NZ Empirical Erosion Model (NZEEM), which predicts mean annual soil loss from annual rainfall, type of terrain and level of woody vegetative cover
Waikato Regional Council
 - The Agricultural Production Systems sIMulator (APSIM), a simulation model that simulates biophysical processes in agricultural systems, particularly as they relates to the economic and ecological outcomes of management practices in the face of climate risk
Environment Canterbury; Hawke's Bay Regional Council
 - Soil Plant Atmosphere System Model (SPASMO), a model used for allocation of irrigation water and which considers water, solute (e.g., nitrogen and phosphorus), and microbial (e.g., viruses and bacteria) transport through a one-dimensional soil profile
Hawke's Bay Regional Council

¹⁰ Auckland Council; Bay of Plenty Regional Council; Environment Canterbury; Environment Southland; Horizons Regional Council; Marlborough District Council; Taranaki Regional Council; Tasman District Council

¹¹ Bay of Plenty Regional Council; Environment Canterbury; Hawke's Bay Regional Council; Waikato Regional Council

- Water accounting models (unspecified, but including groundwater models)
Environment Canterbury; Hawke's Bay Regional Council
 - Economic models (unspecified)
Waikato Regional Council
 - Catchment models (unspecified)
Waikato Regional Council; Bay of Plenty Regional Council
- **Engagement.** Participants from four councils¹² identified some form of engagement as a tool that contributes to management of diffuse discharges. This category included engaging with catchment groups, conducting annual visits to dairy farms, and employing staff (e.g., land management advisors and land sustainability offices) who provide advice and education to landowners. Although not mentioned by participants from other councils, the provision of such support to landowners in some form was common across all councils.

5 ADVANTAGES AND DISADVANTAGES OF REGIONAL APPROACHES TO THE MANAGEMENT OF DIFFUSE DISCHARGES

Interview participants were asked to specifically identify what they considered to be the three main advantages and disadvantages of the way their organisation uses OVERSEER. More generally, they were also requested to provide any thoughts or concerns they had regarding the use of OVERSEER. Overall, these questions yielded a range of views and important insights into the use of OVERSEER in practice.

In considering the evaluation of individual council approaches, the limitations of our analysis should be kept in mind. Not all staff involved in all work areas relevant to the use of OVERSEER were interviewed, and the following evaluation is by nature, a reflection of the views of those interviewed and not necessarily the view of their colleagues or an official council position. The listed advantages and disadvantages is unlikely to be an exhaustive list, particularly for those councils where a smaller number of staff were interviewed. Identified advantages and disadvantages of each council's approach for managing diffuse discharges are presented alongside a summary of regional approach and use of OVERSEER for context (Table 6). The results are presented as candid individual positions in the context of their particular role in the council and understanding of their council's plans, have not been filtered or evaluated for accuracy.

¹² Environment Canterbury; Environment Southland; Hawke's Bay Regional Council, West Coast Regional Council



TABLE 6:

Summary of advantages and disadvantages of regional approaches for managing diffuse discharges as identified by interview participants. Councils are grouped within policy response categories (Limited focus; Evolving focus; Increasingly sophisticated focus). Responses are presented as stated by interview participants and it is recognised that the perspectives of the participants will have been given in the context of the roles they held within regional authorities.

Council	Regional approach	Advantages	Disadvantages
Limited focus			
Gisborne District Council	District-wide; input-based; permitted activity OVERSEER budget required within a Farm Environment Plan.	Target our use of OVERSEER only at dairy land use (as designed for this).	Not in a strong position to validate the use of OVERSEER.
Nelson City Council	District-wide; non-regulatory approach Does not reference OVERSEER.	As only have three farms there is no need for a bespoke approach.	Could be perceived as having no science basis for management of diffuse discharges.
Tasman District Council	District-wide; non-regulatory approach Future requirements for nutrient management plans as consent requirement, which could be calculated using OVERSEER.	<i>No response on own approach.</i>	<i>No response on own approach.</i>
Evolving focus			
Auckland Council	Regional approach; input-based; permitted activity An OVERSEER budget must be used to	Approach is not directive and gives flexibility. Requires best practice.	Flexibility may result in inconsistency.

Council	Regional approach	Advantages	Disadvantages
	plan effluent application within permitted activity requirements.		
Environment Southland	Regional; permitted activity An OVERSEER budget must be included in a Farm Environment Management Plan as a permitted activity requirement.	Uses the model as an education tool (comparative analysis of scenarios and identifying where practice can improve). Requires all farmers to prepare a budget. Approach does not set limits. Using OVERSEER allows us to specify numbers (in consents).	Approach does not set limits, and lacks a mechanism to compel resource users to reduce losses to reach an environmental outcome.
Greater Wellington Regional Council	Non-regulatory approach Does not reference OVERSEER	The use of OVERSEER as a prediction tool allows the prediction of on-farm losses and also to extrapolate farm-scale losses up to the catchment scale.	OVERSEER is used for all land use types, although the accuracy of the model varies across land use types.
Marlborough District Council	District-wide; input-based; currently non-regulatory approach Does not reference OVERSEER.	Non-regulatory approach avoids issues of enforceability of OVERSEER outputs.	<i>No response on own approach.</i>
Northland Regional Council	Regional; non-regulatory approach Does not reference OVERSEER.	Use OVERSEER in a 'case-study approach' which is useful.	<i>No response on own approach</i>
Otago Regional Council	Zone based; primarily non-regulatory approach From 2020: OVERSEER nutrient budget required for permitted activity status.	Output-focused rather than input-focused. 'Hands-off' approach (no requirement to provide OVERSEER files to council) means council will not get swamped with data. Allows farmers to demonstrate they are capable of managing themselves without regulatory control. Use of OVERSEER in educational context informs management change on-farm.	The hands-off approach does make it easier for farmers to 'game' the outputs of OVERSEER.



Council	Regional approach	Advantages	Disadvantages
Taranaki Regional Council	<p>Land type-specific; currently non-regulatory approach</p> <p>Does not reference OVERSEER.</p>	<p>Non-regulatory approach promotes farmer awareness of the environmental effects of farm activities and avoids issues with using OVERSEER in a regulatory sense.</p> <p>Approach focuses on independently tested and proven riparian programme.</p>	<p>None.</p>
Increasingly sophisticated focus			
Bay of Plenty Regional Council	<p>Catchment-specific; output-based; regulatory approach</p> <p>Uses OVERSEER to establish limits; calculate nitrogen discharge allocations; inform nutrient management plans; and requires OVERSEER budgets as condition of consent.</p>	<p>Approach includes a reasonable method, which allows for adaption to new science, farmer protection and stability, and more accurate or reasonable assessment of compliance.</p>	<p>No provision for version change</p> <p>Very resource hungry (e.g., tracking allocations, data management).</p> <p>Requires high monitoring costs for the approach to be effective.</p>
Environment Canterbury	<p>Zone based; output-based; regulatory approach</p> <p>Nitrogen load limits modelled using OVERSEER; OVERSEER budgets to be included in Farm Environment Plans</p>	<p>Approach is output based and has got farmers thinking about diffuse discharges and comparative risk.</p> <p>Offers incentive to improve practice and promotes innovation.</p> <p>Provides consistency across all land uses and land types. Do not need to employ multiple models on one property.</p> <p>Sets a baseline limit.</p> <p>Provides certainty.</p>	<p>Uses a fixed threshold (absolute number rather than a comparative number), which puts undue emphasis on a number.</p> <p>No provision to incorporate version change in plan.</p> <p>One approach for all land uses, despite challenges and high cost for arable systems.</p>
Hawke's Bay Regional Council	<p>Catchment-specific; output-based; primarily non-regulatory; permitted activity in Tukituki catchment</p>	<p>Approach is output based.</p> <p>Relies on only one model, which is the best model available.</p>	<p>Uses absolute numbers, which poses challenges for compliance.</p> <p>Applies a single blanket approach across all</p>

Council	Regional approach	Advantages	Disadvantages
	An OVERSEER budget is a requirement of permitted activity status.	Uses the model as an education tool to enable farmers to identify opportunities to reduce discharges.	properties.
Horizons Regional Council	<p>Catchment-specific; output-based; mixed regulatory and non-regulatory approach</p> <p>OVERSEER is required where a nutrient management plan is a condition of consent; and for preparation of a nutrient budget required for permitted activity status.</p>	Uses numerical leaching targets, which need less council involvement in management and which is more efficient and provides greater flexibility for farmers.	Numerical outcomes when measured in absolute numbers can be problematic from an enforcement perspective. How well OVERSEER and Land Use Capability align is a concern.
Waikato Regional Council	<p>Catchment-based; either input- or output-based; either non-regulatory or regulatory approach</p> <p>Uses OVERSEER to calculate Nitrogen Discharge Allowances; five-year rolling averages to determine Nitrogen Reference Points; nutrient budgets within Farm Management Plans; and Nutrient Management Plans to be based on outputs from OVERSEER.</p>	<p>Approach is output based and does not control inputs.</p> <p>Has generated robust nutrient data at farm scale across all catchments in the region.</p> <p>Targets biggest polluters and provides mechanism for improvement.</p>	<p>Dealing with version changes of OVERSEER can be problematic.</p> <p>Farms are capped at current level, which for low emitting farms constrains their ability to change (Grandparenting).</p> <p>Targets for 5000 farms to have a nitrogen reference point by 2020 is a ambitious work plan.</p>



This analysis shows that one council (Greater Wellington Regional Council) uses OVERSEER in practice while not being required to by their policies and plans. In this case, the model is being used as an educative tool and for informing catchment modelling. One participant (from Environment Southland) considered it was too early in the life of their Plan to identify any advantages or disadvantages of their approach.

Responses from interview participants were generally varied, and several aspects of council approaches that were raised by more than one council. Most of the commonalities sat across councils that fall into the 'Evolving focus' category, although there was also agreement between councils within the 'Evolving focus' and 'Increasingly more sophisticated' categories. There was less agreement between councils as to the main disadvantages of their respective approaches.

Interestingly, the use of one approach across all land types and land uses, and the absence of limits from Plans were aspects of council approaches that were considered both an advantage and a disadvantage, and in two instances by staff within the same council.

5.1 Advantages and disadvantages of using OVERSEER to support the management of diffuse discharges

In general, the interview participants appeared to have a good understanding of how OVERSEER was being used by their own, and other councils (including where other councils were using the model differently to themselves), and by the wider sector (e.g., fertiliser consultants to make farm-specific recommendations and banks for the transfer of properties).

Across the 31 interview participants, a total of 77 comments explicitly regarding OVERSEER itself were recorded. These comments were summarised as describing either advantages (30% of the comments) or disadvantages (70% of the comments) and grouped into themes which reflected the broad topic of specific comments (Tables 7 and 8).

Once again, some aspects were considered to be both an advantage and a disadvantage by different participants. For example, the constant updating of OVERSEER was mentioned as an advantage as it allows for continuous improvement and the most current science to be incorporated into decision-making; but this constant updating (and subsequent version changes) was also seen as a disadvantage as this poses challenges for aligning consent conditions to policies.

TABLE 7:

Advantages associated with the use of OVERSEER as identified by interview participants. The percentage of the total number of positive comments (n = 23) that fell within each theme is provided in brackets.

Theme	Topics describing advantages associated with the use of OVERSEER
Ability to identify areas for improvement in management practice (35%)	The use of OVERSEER allows for (scenario-based) comparative analysis. OVERSEER can be used as an educational tool to generate conversations about improving practice. The use of OVERSEER provides a point of focus for thinking about consequences of decisions and for improving practice. The use of OVERSEER identifies areas that are the greatest polluters.
OVERSEER is the best available farm-scale tool (30%)	OVERSEER is imperfect, but it is a better tool than any alternatives. There is no better tool for pastoral land use. OVERSEER is useful for both resource users and regulators
OVERSEER is a property-scale model (13%)	OVERSEER provides the ability to manage nutrients at the property scale. The property-scale information generated by OVERSEER can be used to inform catchment-scale modelling.
OVERSEER is continually improved (9%)	Continual updates improve the model and outputs. Updates to the model ensures the most up-to-date information is being used.
OVERSEER is designed for purpose (9%)	OVERSEER has provided the ability to manage nutrients. OVERSEER is specifically designed for dairy land use.
OVERSEER is freely available (4%)	OVERSEER is freely available.



TABLE 8:

Disadvantages associated with the use of OVERSEER as identified by interview participants. The percentage of the total number of negative comments (n = 54) that fell within each theme is provided in brackets.

Theme	Topics describing disadvantages associated with the use of OVERSEER
The model undergoes constant version changes (22%)	Version changes result in a lot of confusion and uncertainty. Version updates change all the numbers. Impacts of version changes are often not in the control of the regulator. Version changes make it hard to maintain the relevance of policy relative to changing science. Version changes create planning and policy challenges.
Compliance challenges associated with OVERSEER outputs (19%)	Fundamentally difficult to form an adequate base for enforcement of consent conditions. Frequent updates to OVERSEER make enforcement of consent conditions that rely on an output from OVERSEER difficult. OVERSEER should not be used on its own for compliance issues. There is little ability to defend an absolute number, and therefore to enforce it. The ability to 'game' the model undermines its usefulness from a compliance perspective.
Uncertainty associated with OVERSEER (17%)	Lack of confidence in numbers due to the uncertainty associated with the model. Inability to validate the outputs contributes to uncertainty about those outputs. Outputs from OVERSEER are variable.
User introduced limitations (9%)	There is a general lack of competent and accredited operators. The ability to 'game' inputs undermines the outputs of OVERSEER. OVERSEER can be exploited by consultants to be get best results for clients. There is inconsistency in the application of OVERSEER between operators.
OVERSEER is difficult to understand (6%)	Hard for some consent holders to grasp Farmers do not necessarily understand the purpose of the model
The data used in OVERSEER is incomplete (4%)	OVERSEER relies on incomplete or inconsistent data The industry currently lacks required data to input into the model
OVERSEER is data hungry (2%)	OVERSEER is data hungry

6 KEY CONCERNS RELEVANT TO THE CURRENT USE OF OVERSEER

6.1 Implementation issues

A common thread to the comments made by interview participants was that while OVERSEER was imperfect, it was nonetheless useful. One participant noted it had *'shifted the conversation to how best to resolve diffuse discharges'*. Several others noted *'it allows conversations'* and *'comparative analysis'* between different farm management practices, and thus was useful in indicating the magnitude of nutrient loss issues, risk, and the scope and direction of travel required from mitigation or behaviour change required to address these issues.

Further, it was noted that OVERSEER was becoming *'generally accepted'*; *'a national standard'* and *'nationally recognised, endorsed, and accepted'*, *'including by the courts'*.

Many of the issues raised by the participants can be common to models and decision-support tools more generally (e.g., ability to 'game', lack of transparency, difficult to understand, lack of competent operators), and these issues should be resolved as a matter of course and not used as a platform to undermine more sophisticated approaches to nutrient management. Criticisms of an imperfect model, and recognition for the need to improve practice, should not be conflated with resistance to policy responses to issues associated with diffuse discharges. The increasingly sophisticated policy approaches are following intensification of land use and corresponding water quality issues, indicating that by allowing food production to occur beyond environmental limits, more limited approaches have failed to sustainably manage scarce and finite resources.

Further, several of these more generic issues ultimately feed into a larger, more fundamental concerns regarding the ability to enforce compliance with consent conditions. The ability to game the model, a lack of transparency, the variability of numbers generated by different operators are interdependent and also serve to generate uncertainty (another identified issue). Addressing these universal problems and implementing robust data quality and operating standards will increase confidence in OVERSEE. Many natural resource challenges require making decisions despite a lack of perfect knowledge. The increasingly sophisticated approaches to management of diffuse discharges avoid the need for more blunt, generic, and restrictive policies. However, output-based approaches are harder to measure and monitor than input-based approaches. What we cannot see or measure we have to predict, or derive from informed assumptions. Models will increasingly be a key component of resource management into the future, especially in light of climate change and the need to manage emissions. The increasingly sophisticated approaches to management of diffuse discharges avoid the need for more blunt, generic, and restrictive policies. However, output based approaches are harder to measure and monitor than input based approaches. What we cannot see or measure we have to predict, or derive from informed assumptions. Models will increasingly be a key component of resource management into the future, especially in light of climate change and the need to manage emissions.

The authors recognise the legitimate concerns raised by interview participants regards the uncertainty associated with OVERSEER and concur with Freeman et al. 2016 on this issue:

Uncertainty in OVERSEER nutrient loss estimates is inevitable and regional plan and resource consent decisions need to acknowledge and endeavour to reduce uncertainty. Uncertainty is not a reason to take no action. Rather, the higher the uncertainty, the greater the need for robust monitoring and review processes

for plan provisions and resource consents. (p. vii)

The issue does, however, highlight the requirement for regional councils to ensure the capacity and capability exists to discharge their responsibilities in respect of nutrient losses and the consequential impacts on water quality, and this includes ensuring ability (in-house or externally) to use and interpret OVERSEER appropriately.

6.2 Governance issues

A strong theme emerging from the interviews with council staff was the potential that OVERSEER could be commercialised, removing the current free availability of the model. One participant noted that if this was to occur it would be a *'backward step'* for nutrient management. Several others considered OVERSEER to be *'too valuable to the country'* and *'too important'* to allow commercialisation of the model. Concerns centred around added costs to users, especially farmers, and the fairness of this if this use was mandatory; and the risk of losing free and easy access to input and output files and nutrient budgets, which would hinder the ability to audit and further complicate compliance issues. The general feeling was that central government, or central and local government, should be funding both the availability of OVERSEER and any ongoing improvements.

The issue of potential commercialisation and access to OVERSEER and outputs generated using the model needs resolution. A framework to address the governance (and consequently ownership) issues for OVERSEER needs to embrace (1) recognition of the public-good outcomes generated by OVERSEER; (2) that the agency and individual's participation in the administration of OVERSEER occurs in a fully transparent manner; (3) that the model owners advocate good practice approaches to the use of OVERSEER in policy development processes; and (4) that the use of OVERSEER in respect of managing diffuse losses of nutrients in a regulatory context is a key (but not the only) output from the model.

Leadership is required to ensure:

- Technical challenges facing OVERSEER are addressed as a priority.
- Continuous improvements and advances in research are incorporated into the use of OVERSEER.
- The development of further guidance to assist councils in their application of OVERSEER that is easily accessible by all councils, including smaller and less well-resourced councils. This guidance needs to also include use and interpretation of OVERSEER outputs in enforcement proceedings



APPENDIX 1

List of regional policy statements and resource management plans reviewed to determine regional approaches to the management of diffuse discharges, and council use of OVERSEER.

Council	Plan	Plan date	Status
Auckland Council	Unitary Plan Decision Version 19	29 March 2018	Operative in part
	Regional Plan: Air, Land and Water	21 October 2010	Operative in part
Bay of Plenty Regional Council	Proposed Plan Change 10 (Lake Rotorua Nutrient Management)	September 2017	Proposed
	Natural Resources Plan	1 December 2008 (amended for NPS FM, 2011 & 2014)	Operative
Environment Canterbury	Land and Water Regional Plan Change 5	24 August 2017	Operative
Gisborne District Council	Regional Freshwater Plan Tairāwhiti Resource Management Plan	August 2017	Decision version
Greater Wellington Regional Council	Regional Proposed Natural Resources Plan – red line version	downloaded 16 May 2018	Proposed
	Regional Plan for Discharges to Land	December 1999 updated July 2014	Operative
	Regional Freshwater Plan	December 1999 updated July 2014	Operative
Hawke's Bay Regional Council	Regional Resource Management Plan	28 August 2006	Operative
Horizons Regional Council	The One Plan	2014	Operative
Marlborough District Council	Marlborough Sounds Resource Management Plan	December 2008	Operative
	Wairau Awatere Resource Management Plan	9 March 2009	Operative in part
	Environment Plan	June 2016	Proposed
Nelson City Council	Resource Management Plan	Updated 2012	Operative
Northland Regional Council	Regional Policy Statement	May 2016	Operative
	Water and Soil Plan	As at 2014, updated 2016	Operative
	Proposed Regional Plan for Northland	September 2017	Proposed

Council	Plan	Plan date	Status
Otago Regional Council	Regional Plan: Water for Otago	Updated March 2016	Operative
Southland Regional Council	Water and Land Plan (Decisions Version)	4 April 2018	Proposed
Taranaki Regional Council	Taranaki Freshwater Plan	2001	Operative
	Draft Freshwater and Land Management Plan for Taranaki	April 2015	Draft
Tasman District Council	Resource Management Plan	26 February 2011	Operative in part
Waikato Regional Council	Proposed Regional Plan Change 1 – Waikato and Waipā River Catchments	October 2016	Proposed
	Regional Plan Online Version	Downloaded 14 May 2018	Operative
West Coast Regional Council	Land and Water Plan	May 2014	Operative



APPENDIX 2

Questions asked during interviews with council staff regarding the use of OVERSEER for management of diffuse discharges management by councils

1. What are your main role within the organisation?
POLICY LAND/NUTRIENT MANAGEMENT PLANNING COMPLIANCE
2. Thinking about your council's management of diffuse discharges, Is OVERSEER relevant to your decision-making?
If yes, in your role, is OVERSEER used in a regulatory or non-regulatory context?
REGULATORY NON-REGULATORY
3. How would you describe your understanding of the OVERSEER model?
1 = No understanding (no particular knowledge)
2 = A little understanding (sort of know what it does, but not confident to describe it)
3 = Reasonable understanding (can describe what it's function is)
4 = Strong understanding (feel confident to describe its core function, inputs, and outputs)
4. How often do you use or interact with OVERSEER?
1 = Not at all
2 = At least once a month
3 = At least once every two weeks
4 = At least once a week
5 = At least twice a week
5. What is your understanding of OVERSEER's assumptions and limitations?
1 = No knowledge
2 = Poor
3 = Fair
4 = Good
6. Is there someone within your organisation that is able to help you with your decision-making relevant to the use of OVERSEER?
 - If yes, is this person readily accessible?
 - Do you use this person?
7. Have you attended any courses, workshops, or similar that focussed on OVERSEER and/or it's application for managing diffuse discharges?
 - If yes, what were those courses?

8. Thinking about your council's management of diffuse discharges, does your organisation use other approaches and/or tools either instead of, or alongside, OVERSEER that you are aware of?
 - If yes, what are they?
9. As far as you are aware, is OVERSEER directly referenced in consent conditions?
 - If yes, is it to establish a numerical limit to be met?
 - If no, how is it used?
10. How do you monitor compliance with OVERSEER related consent conditions?
11. What do you see as the three main advantages of the way your organisation uses OVERSEER?
Expand.
12. What do you see as some of the three main disadvantages or challenges in the way your organisation uses OVERSEER?
Expand.
13. Are you aware of how the OVERSEER model is being used by the wider sector?
 - If so, do you have any observations or thoughts relating to its use by others?
14. Do you have any other comments or thoughts to add?
15. Are you happy for us to contact you again should we need to clarify any of aspects of this conversation?



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