

The Application of an Audited Self-Management  
Approach to Manage  
Nutrient Losses in the Hurunui River Catchment

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Master of Water Resource Management

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## Abstract

Water quality impairment is becoming an increasing problem in Canterbury, and throughout New Zealand. In North Canterbury, the Hurunui River has been associated with elevated nutrient levels. Not only are elevated nutrient levels a threat to the environmental and cultural values of the area, they also threaten the economic and social aspirations of the community. The community has aspirations to intensify land use in the catchment by increasing the area of irrigated land. To manage nutrient levels in the catchment and to ensure the goals of the community are realised the Hurunui and Waiau Regional Plan sets forth a requirement that an audited self-management (ASM) approach be applied in the region, which is identified in the Canterbury Water Management Strategy as a key tool for the management of water quality.

This study investigates the application of an ASM approach in the Hurunui River catchment and by the use of semi-structured interviews seeks to identify the ASM features and institutional arrangements key stakeholders in the catchment are willing to support. The majority of the key features of an ASM approach are supported in the catchment including governance arrangements, farm environment plans, audits, enforcement mechanisms and effective communication measures. There were areas of divergence in the stakeholders' opinions however, with differences relating to who administers the enforcement programme, and the public reporting of audit results.

The institutional arrangements supported by the interview participants in the application of an ASM approach are compared to the design features outlined by Elinor Ostrom (1990). The majority of the institutional arrangements supported by stakeholders align with Ostrom's features including: the freedom of resource users to make their own day-to-day choices; the desire for monitoring; the increasing severity of sanctions on those non-complying resource users; the need for conflict-resolution mechanisms; and that management collectives should retain the freedom to frame their own rules. An area which does not align with these design features was the hesitation of some organisation representatives to allow land users to have direct input into the rules governing the application of an ASM approach.

The research identifies obstacles to the effective application of ASM. Specifically the issues of scientific uncertainty, the promotion of economic over environmental values, and the feeling of lack of involvement felt by some stakeholders, are identified as significant obstacles. To overcome these issues solutions are offered including further water quality monitoring, the promotion of further stakeholder interaction and the continuation of discussions to find an equitable solution to nutrient allocation concerns. Finally, the research presents several recommendations for the consideration of those undertaking the implementation of an ASM approach in the Hurunui River catchment and elsewhere, these include agreement upon the final boundaries for management groups, further investigation into management group governance and data management systems, ensuring audits are undertaken by fully trained and accredited auditors, ensuring that audit results are reported in a manner than generates corrective action, and providing opportunities for land users to frame the rules for an ASM approach.

# Chapter 1

## Introduction

New Zealand's freshwater resources are essential to the country's economic, environmental, cultural and social well-being. Freshwater provides for primary production, tourism and recreational opportunities, and energy generation. It is essential for its role in New Zealand's biodiversity. It also provides deep cultural meaning to many New Zealanders (Ministry for the Environment, 2014).

Farming in New Zealand continues to intensify. One of the prime concerns with land use intensification is the potential for water quality impairment (Jenkins, 2012). New Zealand's surface water and groundwater systems are coming under increasing pressure from pollutants mobilised by intensive farming (Marsh, 2012; McKergow, Tanner, Monaghan, & Anderson, 2007). The dairy industry in particular has expanded in recent years, and the drive to increase production per hectare and per cow continues to escalate. Fertiliser use has also increased at an alarming rate (McKergow et al., 2007). In Canterbury there has been a major increase in irrigated land (Jenkins, 2007). Unless agricultural land use practices are improved, further intensification is likely to be constrained by cumulative effects on water quality (Jenkins, 2012).

In Canterbury, the Canterbury Water Management Strategy (CWMS) was established to manage the Region's water resources, which had been coming under increasing pressure and had reached sustainability limits (Canterbury Water, 2010). It was the intention of the CWMS that a high level of audited self-management (ASM) would be in operation in the Canterbury Region, to address water impairment concerns.

This thesis focusses on the application of an ASM approach for the management of water quality in the Hurunui River catchment. The Hurunui River catchment was chosen as this case study due to the

requirement in the Hurunui and Waiau River Regional Plan that land users are to be subject to an ASM approach for the management of water quality by 2017. The current researcher was interested in how an ASM approach would be developed, after hearing of successful examples of ASM implementation in other areas (e.g. North Otago and South Canterbury). Interest was sparked further when the researcher's supervisors suggested that valuable lessons could be learned from an exploration of stakeholders' opinions relating to changes they would have to make in the application of an ASM approach in the catchment.

This thesis explores the stakeholders' opinions relating to management changes and compares the ASM features stakeholders are willing to accept and support, with ASM features found in academic literature. It further explores the institutional arrangements stakeholders support in the application of an ASM approach, and how these align with the design principles set forward by Elinor Ostrom (1990) in her work *Governing the Commons*.

In this chapter the case study area is introduced along with an outline of the values associated with the Hurunui River, the current state of the water quality in the Hurunui River and its tributaries is discussed, and the structure of the thesis is outlined.

## 1.1 The Hurunui Catchment and water resource use

The Hurunui River catchment is located in the Hurunui Waiau Zone in North Canterbury (see Figure 1). The Hurunui River is a braided river, with a highly valued hapua (coastal lagoon), which is important for cultural values, ecosystem health, river birds and fish. The Hurunui River bed is an important location for the breeding of threatened black-fronted tern, black-billed gull, wrybill plover and banded dotterel. As a nationally renowned trout fishery, the river is noted for its recreational freshwater fishing. The river provides habitat for both indigenous and acclimatised fish species. The native species found in the river include the longfin eel, lamprey and Stokell's smelt. The river also provides habitat for a number of threatened plants which grow in the zone, including aquatic plant species (Hurunui Waiau Water Management Zone Committee, 2011).

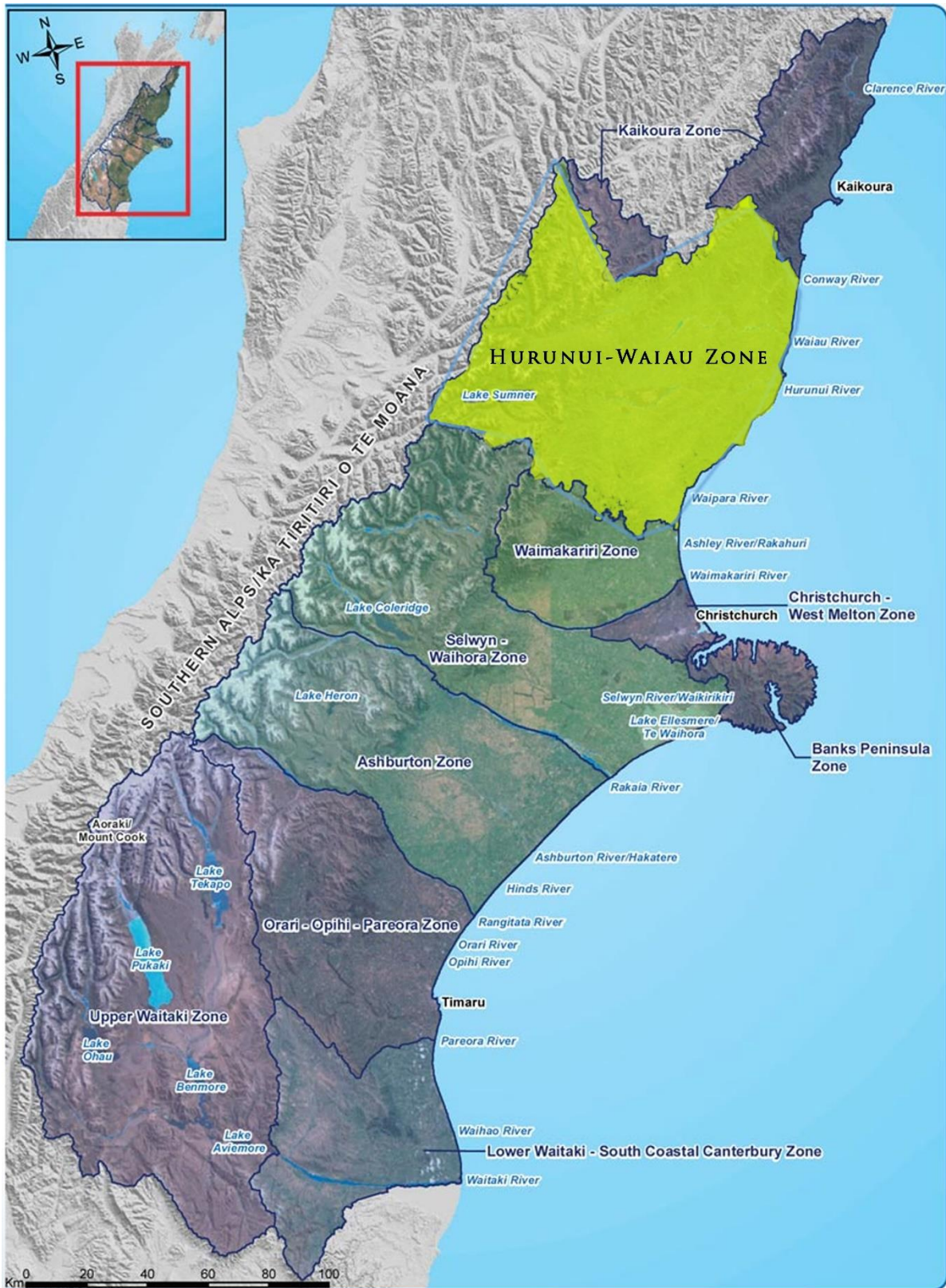


Figure 1: Map showing the location of the Hurunui Waiiau Zone in North Canterbury (Source: Environment Canterbury Regional Council, 2012. Retrieved 29 April 2015, from <http://ecan.govt.nz/get-involved/canterburywater/Pages/canterbury-water-zone-map.aspx>).

Maori are the indigenous people of New Zealand. The takiwā (geographical interests) of two Ngāi Tahu hapū (sub-tribes) straddle the Hurunui and Waiau river catchments. These two hapū have the responsibility, through kaitiakitanga, to protect the natural and physical resources in the area. Kaitiakitanga relates to the Maori philosophy of resource management and guardianship. The two hapū are Te Ngāi Tūāhurriri Rūnanga and Te Rūnanga o Kaikōura (Hurunui Waiau Water Management Zone Committee, 2011).

The Hurunui River is noted for its important recreational and scenic values, for which visitors come from all over the world. Examples include white-water kayaking, jet boating, scenic and landscape values, picnicking, swimming, mountain biking, and tramping (Hurunui Waiau Water Management Zone Committee, 2011).

At present the Hurunui River catchment is dominated by sheep and beef farming types, there is however significant potential for dairy expansion dependent on the supply of irrigation water (Brown et al., 2011). Within the catchment there is a significant amount of land that could be irrigated if reliable water could be sourced and distributed. Increasing the amount of irrigated land is seen as a key economic driver for the Hurunui District (Hurunui Waiau Water Management Zone Committee, 2011). In 2013 consent was granted to provide the additional water that would be required for this irrigation through the Hurunui Water Project. The resource consents granted provide the potential to irrigate close to 60,000 hectares, and has the potential to increase the economic prosperity of the catchment and provide for over an estimated 3000 new jobs (Hurunui Water Project, 2013).

It is expected that with increased irrigation water, there will be a corresponding increase in land use intensification, with major dairy conversion. Ngāi Tahu Properties have also applied for consent to change their land use practices in the Balmoral Forest to a mixture of dryland and irrigated dairy farming (Environment Canterbury Regional Council, 2014a). Modelling shows that dairy farming yields the highest nitrogen and phosphorus losses per hectare of any land use in the Hurunui catchment. However, dairy farming also has the lowest nitrogen loss per dollar of profit. This high return from dairy farming translates into a significant contribution to the economy (Brown et al., 2011).

With this economic driver through the provision of major water storage, and the potential for large scale dairy conversion, there is likely to be a corresponding threat to the water quality in the Hurunui Catchment. The Zone Implementation Programme sees the need to ensure that economic development is able to proceed at a beneficial speed to the economy of the Hurunui District. The Committee, through its Zone Implementation Programme, aims to maintain and improve the water quality in the Hurunui catchment and to deliver environmental, social, cultural as well as economic outcomes (Hurunui Waiau Water Management Zone Committee, 2011).

A two-fold approach is taken to address water quality concerns in the district, so that land use practices resulting in nutrient losses to water align with best practice. Firstly, non-statutory implementation actions such as good management practices are promoted. Secondly, the Hurunui and Waiau River Regional Plan provides the regulatory backstop by setting load limits for nitrogen and phosphorus in the Hurunui River, and toxicity limits on the river and its tributaries (Environment Canterbury Regional Council, 2013b).

## 1.2 Water quality in the Hurunui River catchment

Water quality results at the monitoring site above the confluence with the Mandamus River show that the water quality in the headwaters of the Hurunui River to its confluence with the Mandamus River is generally at levels protective of recreational and aesthetic values for nutrients, *E. coli* and turbidity (Brown et al., 2011).

A further water quality monitoring site is located at the State Highway 1 Bridge. This lower site experiences occasional breaches of *E. coli* guideline values, indicating that at times there is a risk to contact recreation values. In this lower site dissolved nitrogen is up to 20 times higher than in the upper river. The dissolved reactive phosphorus levels are about two to three times higher at this site also (Brown et al., 2011), and the guideline concentration of 0.003 g/m<sup>3</sup> is exceeded (Ausseil, 2010). At this site there has been increasing nitrate concentrations over the past 20 years, and a pattern of increasing phosphorus concentrations until 2001, after which phosphorus concentrations have reduced (Brown et al., 2011). These reductions in phosphorus levels can probably be attributed to the work of the Pahau



Enhancement Group, which was initiated after periphyton blooms in the Hurunui River led to community concerns regarding the levels of nutrients entering the river. In 2000 the Council identified the Pahau River catchment as being the main source of the nutrients and initiated the Pahau Enhancement Group. The actions of this group resulted in the reduction of phosphorus in the Pahau River and the Hurunui River (Environment Canterbury Regional Council, 2014b).

There are four main tributaries that emerge out of the mid-catchment foothills and enter the Hurunui River after flowing across the Culverden Basin (see Figure 2). Water quality monitoring in these tributaries indicates that dissolved inorganic nitrogen concentrations are elevated in all four. Nitrate concentrations breach the 95% level for aquatic species protection occasionally in the Waitohi River and Dry Stream, and frequently in the Pahau River and St Leonards Stream. Concentrations of dissolved reactive phosphorus and *E. coli*, and turbidity values, also breach guideline values in all four tributaries (Brown et al., 2011).

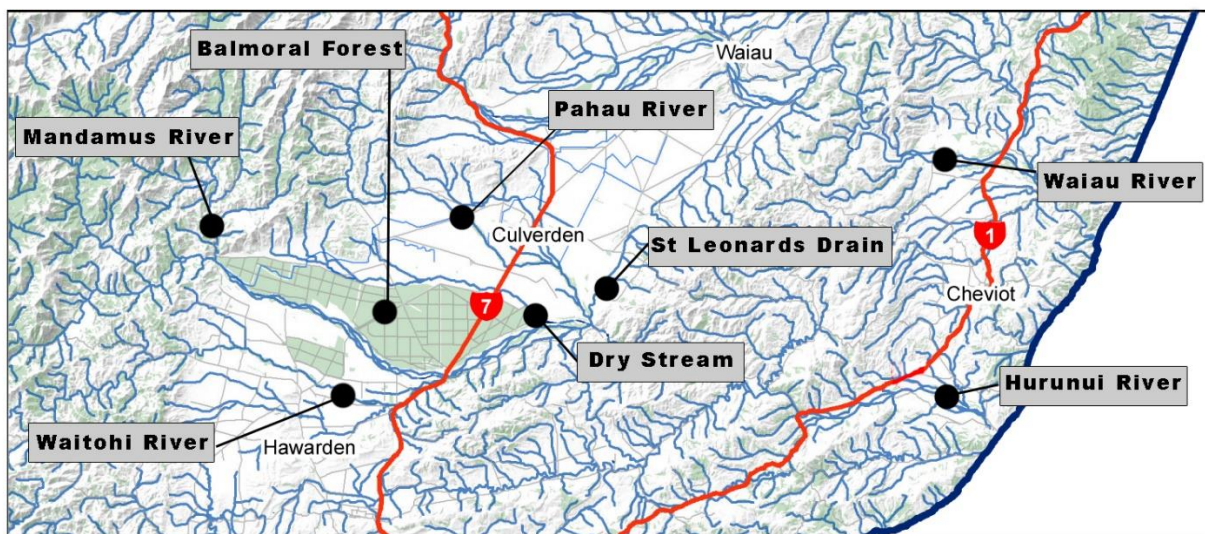


Figure 2: Location map of the Hurunui River catchment, showing the tributaries to the Hurunui River, along with other geographical features (Adapted from: Environment Canterbury Regional Council, 2015. Retrieved 22 April 2015, from <http://ecan.govt.nz/get-involved/canterburywater/committees/hurunui-waiau/PublishingImages/hurunui-map.pdf>)

The water quality in the Hurunui River and its tributaries is currently exceeding the phosphorus load limit set in the Regional Plan (Davie, 2014). With the prospect of further land use intensification there will be a resulting increase in nutrients entering the river (McKergow et al., 2007). There is a need therefore, for existing land users to reduce nutrient losses from their land use practices, and thus create room for further intensification (the room thus created is referred to as 'headroom' throughout this thesis). An audited self-management approach has been identified as a key tool to aid in the reduction of nutrient losses (Canterbury Water, 2010; Jenkins, 2013; Land and Water Forum, 2010). The application of an ASM approach is therefore of particular relevance in the realisation of the economic aspirations of the Hurunui District. It is also of vital importance to aid in the protection and maintenance of the environmental values of the Hurunui River and its tributaries.

### 1.3 Thesis structure

Chapter 2 outlines literature relating to the collaborative management of natural resources. It firstly considers the planning documents providing the regulatory background for water resource management in the Hurunui River catchment. The chapter then moves to discuss the source of nutrient pollutants, their effect on the environment, and the setting on nutrient limits in the Hurunui River and its tributaries. Literature relating to collaborative governance arrangements and audited self-management (ASM) are then reviewed. The chapter continues by presenting the design principles identified by Elinor Ostrom (1990) for the enduring management of common pool resources. Finally the chapter discusses literature dealing with geographical scale in water resource management.

Chapter 3 introduces the conceptual framework which guides this research and which has been developed from a consideration of relevant literature. The conceptual framework is set out, the research aim and objectives used to examine this framework are introduced and the methodology by which the research was conducted is discussed, which relied primarily on semi-structured interviews with relevant stakeholders.

Chapter 4 presents the results of the research including a detailed analysis of the interviews which were conducted with stakeholders in the Hurunui River catchment. Within this chapter the results are

presented categorically based on one of two criteria: the geographical area in which the participants' farm; or the organisation of which they were a representative.

Chapter 5 discusses the results of the stakeholder interviews and compares them to the relevant literature to address the research objectives. The chapter offers suggestions as to how to overcome some of the potential limitations in the application of an ASM approach in the Hurunui River catchment, and offers potential reasons as to why some of the opinions were expressed.

The final chapter reassesses the study's findings to address the research aim and objectives. It outlines limitations that have affected the quality of this research, and presents several recommendations for the consideration of those undertaking the implementation of an ASM approach in the Hurunui River catchment and elsewhere.

## Chapter 2

### Literature review

This chapter outlines literature relating to the collaborative management of natural resources. The chapter is set out in five distinct but related sections. The chapter begins with a discussion of the planning documents which provide the regulatory background for water resource management in Canterbury, and specifically in the Hurunui River catchment. The chapter then moves on to discuss the source of nutrient pollutants, their effect on the environment, and the setting on nutrient limits in the Hurunui River and its tributaries. This section also presents a discussion of measures to reduce nutrient contamination including mitigation strategies. In the third section, literature is reviewed which relates to collaborative governance arrangements and the audited self-management (ASM) approach for the management of water resources. The fourth section presents the design principles identified by Elinor Ostrom (1990) for the enduring management of natural resources; these are outlined and discussed. Finally the chapter discusses literature dealing with the problem of geographical scale in water resource management.

#### 2.1 Planning background

This section outlines the legislative background to water resource management in the Hurunui River catchment, along with wider regional and national policy.

### 2.1.1 The Canterbury Water Management Strategy

The Canterbury Water Management Strategy (CWMS) is a key partnership between Environment Canterbury (ECan), Canterbury's district councils and Ngāi Tahu; it also includes key environmental, recreational and industry stakeholders. The vision of the Strategy (Canterbury Water, 2010) is: "To enable present and future generations to gain the greatest social, economic, recreational and cultural benefits from our water resources within an environmentally sustainable framework" (p. 6).

The CWMS was set up as a collaborative approach to manage a resource that had reached sustainability limits, and in so doing draws on the work of Elinor Ostrom (1990). When the strategy was developed it was regarded as essential, as Canterbury's water resources had been coming under increasing pressure. Aquatic health of lowland streams, high country lakes and groundwater were continuing to decline, and there was a resulting loss of cultural and recreational opportunities, along with a less reliable availability for agricultural use (Canterbury Water, 2010).

The CWMS sets forward fundamental principles to underpin the strategy; these are categorised in first order priorities and second order priorities. The first order priorities are environment, customary use, community supplies and stock water. The second order priorities are irrigation, renewable electricity generation, recreation and amenity (Canterbury Water, 2010).

One of the key themes of the CWMS is that while there are detrimental environmental effects associated with land use intensification, there are also highly valued economic benefits. The challenge of the CWMS is to promote economic growth while ensuring the environmental, cultural and social values are protected and that freshwater resources are not compromised. As such the CWMS developed targets which were to be measureable and are in the following areas:

- Drinking water;
- Irrigated land area;
- Energy security and efficiency;
- Ecosystem health/biodiversity;
- Water use efficiency;
- Kaitiakitanga;

- Regional and national economic growth;
- Natural character of braided rivers;
- Recreational and amenity opportunities; and
- Environmental limits.

The Strategy proposed that planning activities be carried out in ‘nested’ levels, where issues could be allocated to the most appropriate level while ensuring coherence between the levels. This approach followed that of Gunderson and Holling (2002), and identified four water management levels: the regional, catchment, sub-catchment and property level (Jenkins, 2007). Following this nested approach the Strategy divided the Canterbury region into ten water management zones, and within each zone a local level governance structure was set up under a Zone Water Management Committee. The Zone Committees were established to act as facilitators and to contribute to plan and policy making. Their primary function was to develop a zone implementation programme (ZIP) for their zone. The CWMS discusses the need for statutory backing for zone and regional implementation programmes, and this backing comes from the Land and Water Plan. This Plan operated at two levels, the region-wide level containing objectives, policies and rules that apply across the region; and the sub-regional level, comprised of ten sub-regional sections (Environment Canterbury Regional Council, 2014b), which align with the water management zones of the CWMS. The Hurunui Waiiau Zone Committee released its Zone Implementation Programme in July 2011. (Environment Canterbury Regional Council, 2013a).

### 2.1.2 Hurunui Waiiau Zone Implementation Programme

The Hurunui-Waiiau Zone Implementation Programme (ZIP) contained recommendations as to how to address the targets of the CWMS. It was developed after collaborative work between the Zone Committee, the Hurunui District Council, and Environment Canterbury. These entities undertook extensive consultation with, and received submissions from, rūnanga (Maori tribal assembly), local communities, interested parties, industry groups, government and non-government organisations, scientists and advisory groups (Hurunui Waiiau Water Management Zone Committee, 2011).

As discussed, while the ZIP presents a suite of water management recommendations, it is not a statutory plan under the Resource Management Act (RMA). The ZIP represented a significant period of work, and the receipt and consideration of over 125 submissions to the Draft ZIP, together with significant feedback and input from members of the public from meetings held throughout the zone. Because of this extensive consultation, the Zone Committee did expect that the Hurunui and Waiau River Regional Plan would give effect to the recommendations of the ZIP (Hurunui Waiau Water Management Zone Committee, 2011).

A significant finding of the ZIP was the recognition that the future social and economic prosperity of the zone is largely based on the utilization of its water resources for agricultural and horticultural development; the expansion of irrigation will contribute significantly to this prosperity. The Zone Committee's vision is that this can be achieved while maintaining, but striving to enhance, environmental outcomes, as well as preserving cultural and recreational values. To achieve these goals the ZIP focussed on the need to set appropriate environmental flow regimes, as well as "the setting of nutrient load limits in catchments and adoption of sustainable best practice audited self-management programmes led by community/user-based land care groups and industry backed up by a regulatory framework" (Hurunui Waiau Water Management Zone Committee, 2011, Executive Summary, para. 4). The key water quality outcomes identified in the ZIP are for the Hurunui River to be safe for contact recreation; achieve periphyton limits; not produce toxic cyanobacteria that render the river unsuitable for recreation or animal drinking water; and for nutrients and microbial contamination to decrease over time so that additional irrigation can occur (Hurunui Waiau Water Management Zone Committee, 2011).

The ZIP took a tributary-based approach to the management of nutrients in the catchment, suggesting that the farmers from Amberley, Hawarden, Culverden, Cheviot and Omihi should form management groups in those areas.

### 2.1.3 Hurunui and Waiau River Regional Plan

Following the recommendations of the ZIP the Proposed Hurunui and Waiau River Regional Plan (PHWRRP) was developed. The Plan was required to comply with the provisions of the Resource Management Act as well as the Environment Canterbury (Temporary Commissioners and Improved Water Management) Act 2010 (ECan Act) (Environment Canterbury Regional Council, 2013a). The PHWRRP attracted a total of 146 submissions and 16 further submissions. The Hearing Report describes how experts were called upon to aid in the development of the Plan (Environment Canterbury Regional Council, 2013a). The Plan became operative in December 2013.

The purpose of the Plan is “to promote the sustainable management of rivers and streams and groundwater in the Hurunui, Waiau and Jed river catchments” (Environment Canterbury Regional Council, 2013b, pg. 1). Further the Plan states that “the policies and rules in this Plan work in combination with, and are intended to complement, the non-statutory actions identified in the Waiau-Hurunui Zone Implementation Programme, 2011,” (p. 1).

Under the Regional Plan (Environment Canterbury Regional Council, 2013b), irrigators need a consent to take and to use water, but if the nutrient concentrations breach the load limits specified in the Plan, then those wishing to change land use (defined as a 10% or greater increase in nitrogen leaching or phosphorus loss) need a resource consent (Rule 10.2, p. 26).

Rule 10.1 deals with land users submitting Overseer nutrient budgets (b), that nitrate-nitrogen leached will not exceed specified limits (c), and (d) that any contaminants leached are not to cause or contribute to breaches of Resource Management Regulations or New Zealand Drinking Water Standards guideline or maximum acceptable values (Environment Canterbury Regional Council, 2013b, p. 25). Overseer is a model which was required to be used in the Land and Water Plan, and has been approved by the Chief Executive of Environment Canterbury for the calculation of nutrient losses (Environment Canterbury Regional Council, 2014b).



Currently the Regional Council's view is that the phosphorus load limit contained in the Regional Plan is breached (Davie, 2014; Eder, 2014). Therefore any change in land use is now a non-complying activity under Rule 11.1A (Environment Canterbury Regional Council, 2013b, p. 26).

#### 2.1.4 Land and Water Forum

The Land and Water Forum (LWF) was a nation-wide initiative bringing together a range of industry groups, environmental and recreational NGOs, iwi, scientists, and other organisations with a stake in freshwater and land management. The Forum's work began in 2009, and resulted in the production of three reports. The Forum's objective "is to develop a shared vision and a common way forward among all those with an interest in water, through a stakeholder-led collaborative process" (Land and Water Forum, 2011, para. 4).

In its first report the LWF realised the need for a National Policy Statement for freshwater management and recommended the setting of catchment-based water quality limits. To ensure outcomes were being met, the report, recommended the use of adaptive management, good management practices (GMP) and audited self-management (ASM) (Land and Water Forum, 2010). While the LWF Report details that ASM is to be supported strongly by the application of GMPs, the auditing component of an ASM approach would verify that land users were in fact adhering to GMP requirements. The LWF Report suggests that the best solutions to water issues may involve a combination of voluntary measures supported by regulatory measures. Gunningham (1995), in his examination of an industrial self-regulation scheme which he found to be ineffective, concludes similarly. He identified three shortcomings of self-regulation: the "assurance problem" relating to questions surrounding whether other industries were being environmentally responsible; the "collective action problem" requiring other industries to police non-performing industries; and the "credibility obstacle" which he concluded is inherent in self-regulation. Gunningham (1995) commented that no single policy instrument in isolation is likely to deliver good results, rather the "optimal regulatory strategy is likely to be multifaceted" (p. 94). He goes on to discuss how such an optimal strategy could include a combination of self-regulation combined with third-party oversight mechanisms, such as independent environmental audits and verification procedures.

The adaptive management approach promoted in the LWF Report is an iterative process involving discussions and cooperation between users and stakeholders to create a basis for decision-making. It involves a panel of experts and resource users working together to continually evolve and improve the management plan for the resource or the scheme. It has at its core a component of knowledge building through 'learning by doing,' where the results of actions taken can be reversed or changed if they are found to be ineffective (Land and Water Forum, 2010).

## 2.2 Nutrient management

This section reviews literature dealing with nutrient losses and their effect on the environment. It details difficulties with the setting of regulatory nutrient limits and then discusses management options along with mitigation measures and nutrient trading, to reduce the impact of nutrient losses on the environment.

### 2.2.1 Nutrient losses

The expansion of agricultural land is widely recognised as one of the most significant human alterations to the environment. Intensification is accomplished through high-yielding crop varieties, chemical fertilizers and irrigation (Matson, Parton, Power, & Swift, 1997). The increasing intensification of agriculture, and in particular increasing conversion to dairy farming, has been associated with increasing nutrient concentrations in streams and rivers throughout the world and in New Zealand (Goulding, 2000; Marsh, 2012; Quinn, Wilcock, Monaghan, McDowell, & Journeaux, 2009). Elevated nutrient levels in streams are due to a combination of factors caused by agricultural practices – increased runoff, eroded sediment, and subsurface leaching carrying excess nutrients from fertilisers, nitrogen fixed by legumes and stock excreta on pastures. Elevated levels may also be due to direct inputs from fertiliser drift and from stock excreta where animals have free access to waterways (Parkyn & Wilcock, 2004). Phosphorus (P) may be transported in soluble and particulate forms, where particulate P can include P adsorbed by soil particles and organic matter (McKergow et al., 2007), thus erosion, fertilisers and animal wastes are important diffuse sources of phosphorus (Parkyn & Wilcock, 2004). Nitrogen (N) can also be transported

in several different forms, including dissolved organic N, inorganic N and particulate-associated N (McKergow et al., 2007). The main routes for N transfer from land to streams are generally through animal wastes, particularly urine which provides concentrated inputs of nitrogen exceeding the nitrogen requirements of the pasture (Parkyn & Wilcock, 2004), direct inputs of animal excreta, surface runoff, and soil erosion (McKergow et al., 2007). Brown et al. (2011) modelled nutrient losses from different farming systems in the Hurunui River catchment, their results showed that dairying farming yields the highest N and P losses per hectare of any farming type.

While in the paddock, nutrients and sediment are perceived as a resource promoting plant productivity, the cumulative effects downstream in receiving waters can mean they become pollutants (McKergow et al., 2007). The cumulative effects of poor water quality in streams are most often expressed in downstream lakes and estuaries (Parkyn & Wilcock, 2004). Tidal reaches of rivers, such as river mouths and lagoons (hapua) can become sediment deposition zones, the hydrology changes dramatically and consequentially water quality and ecological conditions can change. While tidal reaches are not free flowing, they should be protected by the main flowing reaches if objectives for the mainstem of rivers have been set appropriately (Hayward, Meredith, & Stevenson, 2009).

### 2.2.2 Periphyton growth

Periphyton are the slime and algae found on the bed of streams and rivers. They are essential for ecosystem functioning, due to their ability to capture energy from sunlight, they absorb carbon dioxide and other nutrients such as phosphorus and nitrogen from the surrounding water, and then synthesise organic carbon; a portion of this is secreted and is used by other organisms such as bacteria, fungi and protozoa, to live. These communities in turn are grazed upon by invertebrates such as mayflies, snails, and midges etc. that live on the stream bed. Periphyton communities also play an important role in improving water quality in streams due to their high capacity for removing nitrogen and phosphorus (Biggs, 2000).

Under certain conditions periphyton can proliferate and cause water management problems including degrading aesthetics, contact recreational and biodiversity values (Biggs, 2000; McDowell, Wilcock, &

Hamilton, 2013). Excessive periphyton biomass is dependent on extended periods of stable or low flow, on the absence of shade and low turbidity. Once these conditions are met, the rate of development and peak biomass are controlled by concentrations of nitrogen (N) and phosphorus (P) in the water, which are bioavailable. For freshwaters it is common to regard bioavailable N as dissolved inorganic nitrogen (DIN) and bioavailable P is taken as being dissolved reactive phosphorus (DRP) (McDowell et al., 2013).

### 2.2.3 Setting nutrient limits

There is growing realisation that the social, environmental, cultural and economic values our water resources provide must be maintained. For example the National Policy Statement for Freshwater Management requires regional councils to set enforceable water quality and quantity objectives and limits. To set enforceable limits is seen as fundamental in achieving environmental outcomes and creating incentives to use water resources efficiently and in providing the confidence for investment. The setting of the limits is seen as a key purpose for the national policy statement (Ministry for the Environment, 2014). Total Maximum Daily Loads (TMDL) are used in the United States to designate the amount of pollutants a water body can sustain and still safely meet water quality standards (Feldman, 2007; Jarvie et al., 2013). TMDLs are similar to the load limits (Duncan, 2014; Norton & Kelly, 2010) set for the Hurunui River. Feldman (2007) discusses three main areas in which TMDLs have been criticised:

1. environmental groups charge that they are inadequately enforced, and incorporate public input poorly and are developed too hesitantly to be effective;
2. economic interests regulated by TMDLs assert they impose high mitigation costs; and
3. independent assessments by scientists conclude that many water bodies placed on impairment lists have been improperly analysed.

The setting of nutrient load limits in the Hurunui Catchment was guided by the Land Use and Water Quality Governance Group (LUWQ). This group oversees the Land Use and Water Quality project, which is a collaborative project between Environment Canterbury, Dairy NZ and other primary sector and non-governmental organisations. The LUWQ project works alongside the Canterbury Water Management Strategy, and aims to scientifically assess the effects of land use changes on Canterbury's water resources (Environment Canterbury Regional Council, 2012a). Several reports were produced by LUWQ, two of which are directly related to the nutrient setting process. The first dealt with water quality in

Canterbury region – “The preferred approach for managing the cumulative effects of land use on water quality in the Canterbury region” (Environment Canterbury Regional Council, 2012b); the second report dealt specifically with the Hurunui catchment –“Nutrient Management in Hurunui: A case study in identifying options and opportunities” (Brown et al., 2011).

The LUWQ project suggested that catchment load limits should be set for nitrogen and phosphorus, with farmers operating under an audited self-management regime in order to comply with the load limits. The setting of nutrient load limits is often uncertain, and while limits are set based upon the ‘best’ science available, there can be difficulty in gaining agreement from those setting the regulatory policy and those who work on the land from day-to-day (Memon, Duncan, & Spicer, 2012) An example of this is found in the LUWQ group’s report on nutrient management in the Hurunui Catchment (Brown et al., 2011), where they discussed a lack of “clear and universal agreement on the load limits that should apply in the catchment” (p. 31). Norton and Kelly (2010) identified significant levels of scientific uncertainty in their estimates of the current nutrient load limits in the Hurunui River catchment. Such examples of lack of agreement and scientific uncertainty can lead to hesitation in obtaining community buy-in and consequent difficulties in managing nutrient losses (Lees, Robertson, Garvan, Barnett, & Edger, 2012). Questions have also been raised about the use of the model Overseer to aid in the setting of nutrient limits, for example its lack of precision and variations between versions have been questioned (Duncan, 2014; Federated Farmers, 2014). Duncan (2014) examined the catchment nutrient limit setting process in Canterbury and concluded that although there was an assumption that governing by numbers (limit setting) would remove ambiguity and provide clarity and certainty for local government and resource users, this was not the case and limits that have been set were in fact proving to be unrealistic and unworkable.

An example of lack of clarity surrounding the limit setting process in the Hurunui can be found in the change between the ZIP and the Regional Plan in the setting of nutrient load limits on the mainstem of the Hurunui River. The ZIP had recommended in Section 11.2.2: *The goal for water quality in the Hurunui River at the SH1 Bridge will be at or about the same or better standard as present, in terms of nitrate and phosphorus loads* (p. 39). However, the PHWRRP while maintaining the current load for phosphorus, due to phosphorus being the limiting nutrient for nuisance algal growth in the Hurunui River, allowed for an increase in the DIN load by 20%. The reason surrounding this increase was “to allow for additional headroom to be created while large scale irrigation water storage was being consented and developed” (Environment Canterbury Regional Council, 2013a, para. 134), as there was an envisaged 100,000ha of

total irrigation to occur. However the Hearing Commissioners revised this further to allow a 25% increase in nitrogen load limits (Environment Canterbury Regional Council, 2013a, para. 155).

#### 2.2.4 Managing for limiting nutrients

Norton and Kelly (2010) discussed that phosphorus may be the limiting nutrient for algal growth in the Culverden Basin based on DIN:DRP ratios. The nutrient limits set in the Regional Plan were also based on this understanding allowing for an increase in dissolved inorganic nitrogen, but requiring that the dissolved reactive phosphorus levels be maintained. The Regional Plan comments on its nutrient load limits: “This recognises that the lower Hurunui River is phosphorus limited, and therefore it is possible to manage periphyton growth (in terms of nutrients) by retaining phosphorus concentrations at their current levels, while allowing for a modest increase in nitrogen” (Environment Canterbury Regional Council, 2013b, p. 9).

The load limits set in the Regional Plan take a different approach compared to the LUWQ’s preferred approach to managing the cumulative effects of land use on water quality. The LUWQ group (Environment Canterbury Regional Council, 2012b) comment: : “Restricting just one nutrient is risky, as nutrient limitation may vary within different reaches of a river and over time” (p. 6). This point is also made by Norton and Kelly (2010) where they comment that it is likely that the limiting nutrient status will vary in space and time, therefore management should focus on controlling both nutrients.

Adding to the concern of managing for single nutrients a recent New Zealand study found that the sites with the greatest cyanobacteria (*Phormidium*) coverage had the highest total N:total P ratios (greater than 20:1). These sites all had low levels of dissolved P and it appeared that increased dissolved inorganic N concentrations were required in the water before *Phormidium* will bloom. It appears *Phormidium* communities could obtain P from other sources, perhaps layers of fine sediment found under the *Phormidium* mats (Quiblier et al., 2013). These findings were similar to a further study of the Hutt River, where it was found that as nitrogen increased, so too did benthic *Phormidium* coverage (Heath, Wood, Brasell, Young, & Ryan, 2015). Jarvie et al. (2013) discussed similar findings where in some recorded instances focussing on a single nutrient management strategy to limit nuisance algal growth has resulted

in improvements, but in other cases there have been no demonstrated improvements, and in some of the examples discussed, nuisance algal growth has actually increased.

While the Plan does allow for increases in nitrogen, the Hearing Commissioners, after hearing evidence from some witnesses who expressed concern that cyanobacteria (*Phormidium*) blooms in the rivers can be stimulated by high nitrogen concentrations (Environment Canterbury Regional Council, 2013, para. 163), acknowledged that this may be a problem and thought it required further attention. They consequently inserted an additional policy (Policy 5.4A) into the Plan, to investigate the reasons for cyanobacteria blooms, and if necessary to allow the Plan's nutrient load limits be amended.

#### 2.2.5 Good Management Practices

The Land and Water Forum (2012b) defines good management practices (GMPs): "GMP refers to the evolving suite of tools or practical measures that could be put in place at a land user, sector and industry level to assist in achieving community agreed outcomes (in this case for water quality)" (p. 106). GMPs are practices that are agreed to be acceptable to reduce or minimise an adverse environmental effect in a given situation. It is difficult to detail GMPs at a regional or even catchment level as they need to be specific to each particular situation (Mulcock & Brown, 2013b). Management plans, such as environmental management plans, farm plans and development plans are useful tools to assist the adoption of GMPs (Land and Water Forum, 2012b).

Despite the need to take local situations into account there are generic GMPs, which can be readily adapted to local circumstances. For example an important management step to minimise nutrient loss is to ensure fertiliser nutrients are applied according to need, and at rates and times and in the most suitable form to ensure the maximum uptake from the plants (Brown et al., 2011). Consideration of grazing practices can also be an effective way to minimise nutrient losses, for example an effective way to mitigate P loss is to restrict grazing of winter forage crops (McDowell et al., 2013).

The CWMS investigated the effects of intensification of land use and the management of nutrients on land. It concluded that if further intensification occurred in the region, it would be necessary for both existing and new land users to improve land management practices to better than best management practices (Canterbury Water, 2010).

#### 2.2.6 Nutrient mitigation

The Land Use and Water Quality Governance Group discuss contaminant mitigation options which are categorised into Tier 1, Tier 2 and Tier 3 mitigation practices. Tier 1 mitigation options represent those options that have been well proven and are relatively cost-effective – examples include stream fencing to protect stock access, protecting existing wetlands, nutrient management planning and the implementation of improved effluent management practices. Tier 2 practices can be considered as ones where some uncertainty remains as to their effectiveness; options include nitrification inhibitors, herd shelters and constructed wetlands. Mitigation practices which fall into the Tier 3 category would be larger scale options including catchment or sub-catchment scale projects such as sediment traps or strategically placed wetlands (Brown et al., 2011; Environment Canterbury Regional Council, 2012b).

Brown et al. (2011) outlined the options available to and the cost-effectiveness of mitigation practices for both cattle grazed, and dry stock farming systems. For cattle grazed farms, Brown et al. (2011) recommend implementation of Tier 1 options in nutrient-sensitive catchments like the Hurunui as they are considered highly cost-effective. Tier 1 mitigation options for cattle grazed farms are listed as:

- improved management of effluent;
- increased irrigation efficiency;
- stock exclusion from streams; and
- nutrient management plans.

Tier 2 options for cattle grazed farms are less clear cut, and Brown et al. (2011) discuss some matters to be considered before implementing these. Considerations include conducting a farm-specific assessment; the fact that some mitigations fit some farms better than others; that some measures incur large capital costs and can reduce farm profitability; and that there is uncertainty surrounding the



effectiveness of some of these measures. A good example can be found in McDowell et al. (2013) who outline mitigation strategies for the loss of contaminants from land to water and within water itself. Included in these strategies are constructed wetlands which according to the report can have a very high effectiveness on N but only a medium effectiveness on P, so depending on where the farm lies and what the major nutrient of concern is, constructed wetlands may or may not be a sensible mitigation measure. Similarly sediment traps were also included in the report by McDowell et al. (2013); according to this report sediment traps are effective at mitigating suspended solid loss particularly coarse sized sediment, but have a low effect on P loss due to the sorptive capacity of P being greater to fine particles than to coarse particles.

Brown et al. (2011) comment that for dry stock farming systems the distinction between Tier 1 and Tier 2 options is of less importance. They do list the available options in order of cost-effectiveness, with stock exclusion from streams and nutrient management plans being targeted as key areas. A sensible mitigation option for both dry stock and cattle grazed farming systems would be in facilitating the protection and enhancement of natural wetlands. For irrigators, a sensible mitigation option would be to change from border dyke to spray irrigation which would help to reduce N and P losses (Brown et al., 2011; Jenkins, 2012).

Tier 3 options may also be feasible for the catchment, for example, earlier Tanner (2012) had investigated the construction of wetlands on the St Leonard's Drain, and indicated that strategically placed wetlands could remove approximately 70 tonnes/yr of nitrate.

#### 2.2.7 Nutrient trading

In cases where contaminant allowances have been allocated, the Land and Water Forum (2012a) suggest that market-based instruments, such as trading systems, may form part of the overall variety of techniques and tools used to manage water quality. The use of markets to efficiently achieve environmental quality goals is one area of innovation for environmental policy derived from economic research. Advocates of markets point to several benefits including efficiency gains and innovation incentives, as well as their ability to deliver environmental improvements in a more timely and less costly

manner than other policy instruments are capable of (Shortle, 2013). Shortle (2013) discusses several instances of water quality trading programmes, several of these involve non-point sources of contaminants, however, only one of these trading programmes - that of Lake Taupo, involves non-point-non-point trading. The others involving detailed agricultural non-point reductions, are designed to reduce the cost of point-source compliance by offsetting these using agricultural reductions.

The Lake Taupo trading programme is designed to reduce nutrient loads from agriculture entering the lake. Nutrient losses from agricultural land uses have been identified as the primary threat to water quality in the lake (Duhon, Young, & Kerr, 2011). Due to this threat and the long lag times for nutrients to travel from land surface to groundwater to lake water, the Regional Council developed an innovative water management policy. This policy establishes a nitrogen cap on all discharges across the catchment, a permanent 20% reduction in nitrogen discharges across the catchment, and has established a nitrogen trading scheme. The scheme allows farmers the flexibility to trade units of nitrogen allowances with other land users or with a publicly funded trust (the Lake Taupo Protection Trust). This policy is designed to provide land users with the flexibility to change management practices while preserving the overall catchment cap on nitrogen and thus ensuring nutrient levels are met to preserve water quality (Duhon et al., 2011; Waikato Regional Council, 2011). While the overall policy for the Lake Taupo catchment has successfully limited increases in nitrogen leaching, Duhon et al. (2011) report that trading activity itself has been limited other than with the Lake Taupo Protection Trust itself. This is thought to reflect the immature market, or that the nitrogen cap is not yet binding on farmers. This being said the selling of nitrogen was still considered an attractive opportunity from a business standpoint.

### 2.3 Collaborative governance

In 1968 Garrett Hardin argued that a finite world can only support a finite population. He discussed a fictitious example of herdsmen each questioning whether to increase their herd numbers on a pasture which has a finite carrying capacity; each herdsman contemplates the utility gained by adding another animal. Hardin wrote:

The rational herdsman concludes that the only sensible course for him to pursue is to add another animal to his herd. And another, and another...But this is the conclusion reached by each and every rational herdsman sharing a commons. Therein is the tragedy. Each man is locked

into a system that compels him to increase his herd without limit – in a world that is limited. Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons. Freedom in a commons brings ruin to all (p. 1244).

Hardin asserted that a conscience was self-eliminating and that those who restrain their use of a common-pool resource lose out economically in comparison to those who continue with unrestrained use. Hardin (1968) suggested that the answer to this tragedy, as he put it, was coercion, commenting: “the only kind of coercion I recommend is mutual coercion, mutually agreed upon by the majority of the people affected” (p. 1247). Hardin recommended the imposition of laws for those common-pool resources that were not readily divided for private property, commenting that to avoid the tragedy of the commons coercive laws or taxing devices could be imposed upon polluters of water which made “it cheaper for the polluter to treat his pollutants than to discharge them untreated” (p. 1245).

Challenges arose to Hardin’s reasoning in the 1970s and early 1980s, with researchers arguing that Hardin had confused the concept of common property with open access conditions where there were no rules to limit entry and use. Further challenges came from scholars who argued on the basis of game theory, with several concluding that Hardin’s predictions hold under conditions where there is only one chance with no communication, but not necessarily in a world where there are chances to change behaviour, where there is no predefined endpoint and where communication is possible (Dietz, Dolšák, Ostrom, & Stern, 2002).

Until the 1980s, many scholars had presumed that users of common-pool resources (CPRs) could not organize to manage such resources. It was assumed that when someone did not own a resource, they would have no long-term interest in sustaining the resource over time (Ostrom & Cox, 2010). Scholars often recommended the imposition of government or private ownership (Cox, Arnold, & Tormás, 2010; Ostrom & Cox, 2010; Singleton & Taylor, 1992). However in the 1980s researchers began examining the diverse property systems operating in different resource sectors. In one such study Elinor Ostrom (1990), in *Governing the Commons*, drew on work used to create a database to record information from a number of case studies found in academic literature related to how CPRs could be managed by self-organized communities (Cox et al., 2010). In this work, Ostrom described a series of case studies in which CPRs were managed by the cooperation and collective action of those living in the location to which they

related. Scholars continue to examine how CPRs can be effectively managed, with options ranging from the resource being left as open access without rules, being managed by government, as private property, or by a common property regime. Some argue that the best tool for sustainable management of a CPR depends on its characteristics and those of the users (Dietz et al., 2002).

In Canterbury the CWMS has promoted collaborative governance (Canterbury Water, 2010), as did the Land and Water Forum from a wider New Zealand water management perspective (Land and Water Forum, 2010). Collaboration displays several characteristics, it involves a wide range of stakeholders who work together to find creative solutions to problems, goals, and proposed actions, and who display a sustained commitment to problem solving (Margerum, 2008). Many researchers claim significant benefits of stakeholder participation. For example, Reed (2008) discusses how stakeholder participation can reduce marginalisation, can increase public trust, can empower through the co-generation of knowledge, can increase the likelihood that environmental decisions are perceived as holistic and fair, and can promote social learning. While experts agree there is no panacea for managing non-point pollutants, Feldman (2007) comments that there is growing consensus that “only a comprehensive, decentralized approach focused on watersheds will achieve lasting solutions” (p. 186). He discusses how in the United States actions to improve water quality under the TMDL process are supposed to encourage local stakeholders to form ‘watershed partnerships’ or ‘initiatives’ in order to find consensus-based solutions to water quality problems. A similar approach can be seen in the suggestion by the Zone Committee that land and water user groups should be a key part of improving nutrient management in the Hurunui Basin, and that these land and water user groups should work collaboratively to achieve the desired environmental outcomes (Hurunui Waiau Water Management Zone Committee, 2011).

Community-based resource management groups are not uncommon in New Zealand. The NZ Landcare Trust has worked alongside rural communities since its establishment in 1996, and since that time there are a growing number of successful examples of catchment programmes in New Zealand. As farmers are the ones who live in the local area, and ultimately it will be their actions that will determine the success of any catchment-based programme, then it is obvious that they need to be actively engaged, and it is their trust that is to be gained first and foremost. As soon as farmers’ confidence has been gained, the wider community should become engaged (Lees et al., 2012). Reed (2008) discusses how stakeholder participation should be considered at the outset of a project and continue throughout its life. He comments “engagement with stakeholders as early as possible in decision-making has been frequently cited as essential if participatory processes are to lead to high quality and durable decisions” (p. 2422).

When local users are not involved in the planning of a project, they have no vested interest in its success, and in some cases can directly or indirectly act to undermine the project. However when users are involved they can add the local knowledge to make the project more adaptive (Ostrom & Cox, 2010). In this way community ownership will be promoted with the far more likely resulting social-ecological benefits (Lees et al., 2012).

According to the Hurunui and Waiau River Regional Plan, by 2017 any land use resulting in the discharge of nitrogen or phosphorus which may enter water is to be subject to a Plan, System or Agreement, which has as a minimum an environmental management strategy, management objectives and a description of an audit and reporting process (Environment Canterbury Regional Council, 2013b). An audited self-management (ASM) system would fulfil these requirements and also align with the Zone Committee's suggestion that land and water user groups should be a key part of improving nutrient management. ASM has been suggested as an appropriate system to achieve the objectives of the Hurunui-Waiau ZIP and the CWMS. Audited self-management has also been strongly endorsed by the Land and Water Forum, where the Forum comments that irrigator user groups should partner with regulators and local communities to implement ASM programmes (Land and Water Forum, 2010, 2012b).

### 2.3.1 Audited self-management

Under the Resource Management Act (1991), natural resource use and the effects of resource use are managed through rules in consents or plans and the encouragement of the adoption of best management practices. Neither of those approaches, however, encourage confidence that resource use and the mitigation of adverse effects are being achieved (Earl-Goulet, 2011). In recent times there has been a desire to move towards a more collaborative approach. Audited self-management is one such approach, which transfers the day-to-day management responsibility to users under agreed terms, and is subject to a transparent audit. ASM schemes can create a shift in behaviour from that of strict compliance, to performance where greater ownership of environmental issues results in moving beyond the required minimum (Land and Water Forum, 2012b). ASM schemes recognise that land owners and resource users must be able to act innovatively and in ways that are economically profitable and efficient (Mulcock & Brown, 2013b).

Audited self-management was developed in an industrial setting in the 1990s, in Western Australia, through the work of Bryan Jenkins (Jenkins, 1996). It developed to overcome three problems identified by Gunningham (1995) in relation to self-regulation: the “assurance problem”, the “collective action problem”, and the “credibility obstacle”. As discussed earlier, the “assurance problem” related to questions surrounding whether other industries were being environmentally responsible. It was overcome through an ASM approach which had requirements to be met to qualify for a best practice licence, and having direct regulation of industrial premises not meeting best practice licence requirements. The “collective action problem” required other industries to police non-performing industries. ASM overcame this in its requirement for independent certification of performance and government intervention involving sanctions for non-performance. Finally the “credibility obstacle” is inherent in self-regulation, while ASM involves third party certification of environmental management systems, and third party involvement in performance audits, along with public reporting of performance (Jenkins, 1996).

Audited self-management is defined by (Mulcock & Brown, 2013b) as: “A management programme (individual, industry, or land user collective) which allows for the credible and transparent demonstration (audit) that agreed actions have been implemented (in this instance for water quality and quantity)” (p. 3).

An ASM approach involves the scheme management developing their own policies, procedures and plans to achieve agreed environmental outcomes and allows flexibility to suit the specific local conditions (Jenkins, 1996). It may involve the need for a higher level authority, such as the Regional Council, to set the environmental outcome in cases where there are cumulative adverse environmental effects. ASM goes beyond the *status quo* by establishing clear expectations surrounding the collective pursuit of targets and the responsibility that falls on landowners to implement agreed actions (Environment Canterbury Regional Council, 2012b), and it involves close inspection to ensure compliance.

### 2.3.2 Benefits of audited self-management

There are many potential benefits in implementing an ASM approach. Some opportunities presented in the literature are:

- community management will lead to flexibility and innovation to move beyond compliance;
- decision making reflecting local knowledge and concerns – a decentralised approach, yet still maintains a collaborative approach between resource users and regional council;
- more extensive and open communication within community will enhance trust;
- improve efficiency and discipline in meeting economic and environmental objectives;
- holding technical and institutional memory locally;
- the independent audits make it more than just self-regulation;
- provides a record of performance which may be useful for future resource management issues; and
- ASM enables the resource use to be managed at a more appropriate scale than individual properties (Earl-Goulet, 2011; Irrigation New Zealand Inc., 2008).

### 2.3.3 Key features of an audited self-management

An ASM scheme relies on public confidence and buy-in, ranging from stakeholder engagement in the development of the ASM scheme to its credibility in the eyes of the community. This confidence will be achieved if the ASM process is robust, transparent and accountable and achieves community aspirations for water (Land and Water Forum, 2012b; Mulcock & Brown, 2013b). As such any ASM approach must have several key principles to ensure its credibility. The literature is rife with examples of features and principles of ASM and these are examined in this section.

The key principles of ASM as outlined by Jenkins and Hine (2003:115) are:

- establishment of objectives for environmental performance which are benchmarked to best practice;
- an environmental management system, with third party or government accreditation, which ensures continual improvement;

- auditing of performance with third party involvement and verification; and
- public reporting of environmental performance and pollution incidents.

The ASM approach described by Jenkins and Hine (2003) had regard to industrial discharges in Western Australia. In New Zealand, ASM has been adapted for water management. For example Earl-Goulet (2011) describes three key phases of an ASM approach for the management of water quality and quantity:

1. identification of specific environmental outcomes;
2. the day-to-day decisions and activities that are made to achieve specified outcomes; and
3. the audit of progress towards meeting those outcomes and subsequent reporting.

The North Otago Irrigation Company manages an ASM scheme which was developed along with the Otago Regional Council to meet consent requirements. The key components of this system are:

- a shareholder water supply agreement which incorporates environmental outcomes;
- an over-arching Environmental Policy;
- Environmental Farm Plans which follow an agreed template and detail GMPs that are to be implemented;
- annual on-farm audits utilising an independent auditor;
- a process to address non-compliance;
- an enforcement process to compel compliance;
- an incentive programme to recognise excellence in environmental management;
- company-level environmental performance objectives and annual performance review;
- reporting to the Regional Council;
- an education programme consisting of field days and workshops; and
- events to ensure shareholders have the necessary skills and knowledge to implement the GMPs required (Land and Water Forum, 2012b; North Otago Irrigation Company, 2014).

While Irrigation New Zealand (2008) describe five key attributes of a successful and acceptable ASM system:

- data used for system management and decision making needs to be sound and robust if confidence of the community is to be gained and maintained – this applies specifically to



measurements of river flows, water use and water quality parameters; and to methods of data acquisition, transfer (telemetry) and quality assurance;

- data and derived information must be accessible to all stakeholders, in detail appropriate to the issue of interest;
- an open and regular communication process must be maintained between those responsible for system management and those affected by decisions taken by system managers;
- the governance arrangement must reflect democratic values and be protected from capture by more powerful interest groups; and
- the roles and responsibilities of all entities with the ASM system must be clearly defined and agreed at the outset – particularly the responsibilities of entities with delegated or core statutory responsibilities for consent compliance (p. 2).

The ASM approach put forward by Mulcock and Brown (2013a, 2013b) incorporates a feedback loop that provides for continuous improvement, recognising that there are uncertainties “in our understanding of catchment processes, water user priorities, and the effects of the scheme operation” (Mulcock & Brown, 2013a, p. 10). Therefore scheme management systems should retain the flexibility to change and evolve. There is also the possibility of new technologies and methods which may need to be incorporated as they develop (Carruthers, 2011), along with the updated requirements of GMPs (Land and Water Forum, 2012a), therefore this on-going review process, or feedback loop, is an important component of an ASM approach.

While the literature details a number of key features of an ASM approach, the current research focusses on five elements in more detail. The key features focussed on are consistently commented on in approaches to the implementation of an ASM approach and appear to be the primary key features. These features provide the basis for the feedback loop as described by Mulcock and Brown (2013b), where they set forward two ASM processes, one for schemes and collectives and another for individual users. For this research the order of their feedback loops have been modified, and a single set of key features for both schemes and individuals are drawn, to reflect the prevailing opinions as outlined in the literature. These are:

1. Governance arrangements;
2. Farm Environmental Plans;
3. Audits;

4. Enforcement; and
5. Communication.

### 2.3.3.1 Governance arrangements

Ostrom (1990), who dealt with resource allocation, recognised the need for different levels of rules in the collaborative governance of CPRs. She discussed that rules are nested in other sets of rules that define how the first set can be adjusted. She distinguishes three levels of rules “...that cumulatively affect the actions taken and outcomes obtained in using CPRs” (p. 52). These she identifies as *operational rules* which affect the day-to-day decisions made by appropriators – in an ASM approach this would align with the farm level; *collective-choice rules* which detail the policy by which the operational rules are defined – the management group level; and *constitutional-choice rules* which determine the specific rules to be used in crafting a set of collective-choice rules – the Zone Committee or Regional Council level. Such a framework can aid our understanding of how to apply an ASM approach for the effective management of water resources, by realising that while many of the governance arrangements sit with the managing body, there are other rules which affect the scheme operation. For example, at times and in situations where there are cumulative adverse environmental effects on a resource, the actions of one management collective can have far reaching effects on other collectives accessing the same resource, where the effects of upstream land users are felt downstream. In these situations there is a need for external governance to ensure environmental outcomes are set appropriately (Jenkins 2007).

The management group level of an ASM approach will differ according to the situation. For example, in some areas the irrigation company would take on this role of collective management, whereas in other areas the managing body could be formed through farmers working together around a reach of river, or tributary to collectively manage water quality. The managing body needs to provide strong leadership with well-organised and regularly reviewed systems (Mulcock & Brown, 2013a). The managing body operates under an Environmental Management Strategy (EMS) which sets out its objectives and targets; the process for preparation and review of individual management plans; processes for audit, enforcement and reporting; processes for consultation and communication with stakeholders; and its education and adaptive management programme (Mulcock & Brown, 2013b). Jenkins (1996) discussed the need for a managing body’s EMS to be certified by a third party, which would likely reside at the Regional Council level.

A key detail of an ASM approach will be the upkeep and maintenance of the documents required which are likely to be retained by the scheme's managing body. All documents should be regularly reviewed and updated, with information on contact personnel including owners, managers, sharemilkers etc. (Mulcock & Brown, 2013a). Mulcock and Brown (2013a) comment that there is most likely a need "that a specific data management solution will be required" (p. 6). Similar comments were made by Carruthers (2011) where she discusses collation methods for data to allow aggregation up to a catchment and regional scale which would need to be agreed upon.

### 2.3.3.2 *Farm Environment Plans*

Each enterprise operating under a managing body would need a management plan or Farm Environment Plan (FEP). Each FEP should be regularly audited and should contain its own objectives and targets for water quality and quantity; an assessment of water quality and quantity risks from their farming operation; a record of their actions and practices to achieve objectives and targets; and timelines for improvements (Mulcock & Brown, 2013b).

Farm environment plans are increasingly being viewed as a key tool to achieve widespread on-farm improvements in water quality and quantity (Mulcock & Brown, 2013b). While farm plans have been used throughout New Zealand for many years, there is a difference in the objective for the preparation of a FEP, which is to improve knowledge about water management and how to implement actions on the ground. This is done by setting objectives and required outcomes for water quality and quantity to meet regulatory requirements, thus allowing land users the flexibility to adopt methods they deem necessary to achieve these outcomes. FEPs are to be readily auditable and include provision for corrective actions where required. A FEP would cover a subset of the general Farm Plan and focus specifically on the land and water resources. Other types or parts of the Farm Plan may include personal and financial information about the farm business, and it may be more appropriate that these are retained by the business, but the FEP may be available to other parties including the ASM scheme governing body, and the Regional Council (Mulcock & Brown, 2013a, 2013b).

### 2.3.3.3 Audits

The LAWF's first report discusses how there is a need for both regulators and the public to have confidence that GMP programmes are effective (Land and Water Forum, 2010). To achieve this credible, robust and reliable monitoring of outcomes are required (Carruthers, 2011). Audits provide the check that the self-management is achieving the management objectives and targets, a check of the overall robustness of the management programme, and the level of confidence in the nutrient budget results (Mulcock & Brown, 2013b). Carruthers (2011) comments that although auditing is not seen by farmers as enjoyable, the value of auditing was recognised by farmers in studies she discusses, and was seen as necessary for the credibility of environmental management systems. In a review of the performance of environmental management systems, Briggs (2006) discusses how performance monitoring, environmental reporting, compliance, and conformance control were seen as being the most effective means in reducing pollutant discharges.

Gunningham (2007) comments that "where an enterprise self-monitors there will be a temptation to misrepresent the results, providing an overly favourable account of its environmental performance, particularly if there are regulatory or public relations benefits to be gained from so doing" (p. 305). This critique was also found by Deans and Hackwell (2008) in their examination of the Dairying and Clean Streams Accord, where questions were raised surrounding the self-reporting by farmers leading to exaggerated improvements in performance. To overcome this temptation the LWF's first report (2010, p. 26) suggests that auditing responsibility could be undertaken by schemes as self-auditors, while the regulator retains compliance and enforcement powers to audit ASM data upon request. The Land and Water Forum (2012b), in their third report, describe three levels of audit:

1. first party audit – carried out by an individual land user within the scheme;
2. second party audit – carried out by the ASM collective, sector or scheme or an agent thereof;  
and
3. third part audit – carried out by a party independent of the ASM collective, sector or scheme.

Both Carruthers (2011) and Gunningham (1995) also suggest a credible auditing course would be to engage independent auditors. Carruthers (2011) discusses the need for development to build robust auditing programmes, in particular auditors should be aware of not only the standards to be audited against, but also of relevant industry and catchment issues. The development of standards to audit against are seen by Carruthers (2011) as implicit. She details examples of EMSs where audits were guided

by standards and those without such guidance, concluding that: “Standards also allow consistency between different industry sectors, regional councils, the reporting requirements and audit and review procedures to be used” (p. 12). A further aspect that Carruthers (2011) discusses is the need for auditors to be recognised by an accredited certification body, this would add a further level of transparency and confidence that audit processes are robust.

The frequency of the audit will be determined by the scheme’s governing body or the Regional Council’s requirements. Mulcock and Brown (2013a) discuss a suitable audit frequency of two years of full compliance, and then dropping to at least one year in three. This time period would ensure water users are provided with the support and information needed, while ensuring regulatory authorities and the wider community can have assurance that the farm plan process is being implemented and the required environmental outcomes are achieved.

#### *2.3.3.4 Enforcement*

To ensure that an ASM approach continues to maintain community and regulator confidence there is a requirement for a fair and equitable compliance process that identifies sets of actions necessary to achieve compliance by all users and to correct dangers to the environment. ASM compliance should include training and education dissemination to promote compliance; inspection and monitoring through internal systems and independent third party audits; and enforcement in cases of breaches of agreed objectives and targets (Mulcock & Brown, 2013a). In their Workshop Report on ASM the Ministry of Agriculture and Forestry and the Primary Sector Water Partnership (2011) reported that the consensus from participants attending the workshop was for there to be an enforcement programme of graduated sanctions, which would increase in severity for those resource users not achieving FEP targets.

The question of who should administer enforcements is not clear. For example Jenkins (1996) suggests that to overcome the “collective action problem” outlined by Gunningham (1995), it was necessary that enforcement measures are administered by a high level authority, operating at Ostrom’s (1990) constitutional-choice level, e.g. the Regional Council. However, Ostrom (1990) herself identifies the operational level as the more appropriate level for enforcement, which would involve the resource users themselves administering enforcement measures.

An ASM approach will require more effort on the part of the land owners, therefore some form of incentive to get involved would be welcome. The literature is unclear what form such an incentive would take. In the Hurunui area, a type of incentive comes in the form of rules contained in the Regional Plan, wherein it is a requirement to be part of an ASM approach, otherwise the land use would need a resource consent (Environment Canterbury Regional Council, 2013b).

#### 2.3.3.5 *Communication*

An integral component of an ASM approach is found in communication channels including the reporting of audit results. This is especially true where there is a community stakeholder dimension as there is in an agricultural setting (Lees et al., 2012). Communication should be frequent and on-going, and communication channels must be adequately resourced (Carruthers, 2011). With open communication there can be continuous learning from the experience of operation both from farmers and scheme operators and consultants (Ministry of Agriculture and Forestry & The Primary Sector Water Partnership, 2011). To share information between collaborative groups was seen by Holley, Gunningham, and Shearing (2012) as an opportunity to diffuse innovations and enhance capacities between these groups. By sharing information between collaborative groups and higher level authorities, the accountability roles of governments are improved, through government bodies being able to utilize locally reported data to reformulate and refine minimum performance standards (Holley et al., 2012). Mulcock and Brown (2013a) comment that public reporting could take the form of an annual report produced by a scheme wherein there is a summary of the achievement results for the different management areas within the scheme, along with the identification of issues of non-compliance with the FEPs and details of remedial action. If such a report were produced it would need to be extremely transparent, and subject to independent verification in order to assure the public of the credibility of the ASM approach (Gunningham, 1995).

A further aspect of communication occurs if and when disputes arise within a scheme and between schemes and regulators; in these cases there needs to be low cost conflict resolution mechanisms available (Ministry of Agriculture and Forestry & The Primary Sector Water Partnership, 2011).

There has been some concern surrounding the duplication of plans and audits, but it is envisaged that ASM will be complementary and provide links with other environmental management systems and industry schemes (Mulcock & Brown, 2013b), again this will rely on communication and collaboration between industry schemes.

## 2.4 Ostrom's design principles

Collaborative self-governance is discussed at length in Elinor Ostrom's *Governing the Commons* (1990). In this work, Ostrom describes 14 case studies where resources users (which she refers to as 'appropriators') attempted, with varying degrees of success, to create, adapt and sustain institutions to manage CPRs. She describes a set of eight design principles which characterise the management of all of the robust CPR examples she analyses, some of which were absent in those cases which were not robust. These eight design principles are listed in Table 1. These design principles are regarded by Ostrom as essential to the successful management of CPRs in the examples investigated (Ostrom, 1990).

Institutions are the rules that are developed by people to specify what can be done and what cannot be done in a particular situation. In CPRs, rules define who has access to a resource; what can be harvested from, dumped into, or engineered within a resource; and who participates in any key decisions about these and other issues and about transferring rights and duties to others (Dietz et al., 2002). Ostrom (1990) found that groups of people can design institutional arrangements that help the sustainable management of resources. The design features Ostrom (1990) puts forward are the conditions, based on empirical studies, that are most likely to promote local self-management of resources (Agrawal, 2002).

Table 1: Design principles illustrated by long-enduring CPR institutions (Source: Ostrom, 1990).

|    |  |
|----|--|
| 1. | <i>Clearly defined boundaries</i><br>Individual or households who have rights to withdraw resource units from the CPR must be clearly defined, as must the boundaries of the CPR itself  |
| 2. | <i>Congruence between appropriation and provision rules and local conditions</i><br>Appropriation rules restricting time, place, technology, and/or quantity of resource units are related to local conditions and to provision rules requiring labour, material, and/or money |
| 3. | <i>Collective-choice arrangements</i><br>Most individuals affected by the operational rules can participate in modifying the operational rules   |
| 4. | <i>Monitoring</i><br>Monitors, who actively audit CPR conditions and appropriator behaviour, are accountable to the appropriators or are the appropriators   |
| 5. | <i>Graduated sanctions</i><br>Appropriators who violate operational rules are likely to be assessed graduated sanctions (depending on the seriousness and context of the offense) by other appropriators, by officials accountable to these appropriators, or by both          |
| 6. | <i>Conflict-resolution mechanisms</i><br>Appropriators and their officials have rapid access to low-cost local arenas to resolve conflicts among appropriators or between appropriators and officials  |
| 7. | <i>Minimal recognition of rights to organize</i><br>The rights of appropriators to devise their own institutions are not challenged by external governmental authorities   |
| 8. | <i>Nested enterprises (for larger systems)</i><br>Appropriation, provision, monitoring, enforcement, conflict resolution, and governance activities are organized in multiple layers of nested enterprises   |

A substantial volume of literature has been written discussing the usefulness and validity of Ostrom’s (1990) design principles. The thoughts about and reactions to the design principles have been quite diverse in the literature, ranging from those who support the principles, to those who have criticised their theoretical grounding, or have argued that they are overly precise (Cox et al., 2010). Ostrom (1990) discussed each principle in turn describing how “they can affect incentives in such a way that appropriators will be willing to commit themselves to conform to operational rules devised in such



systems, to monitor each other's conformance, and to replicate the CPR institutions across generational boundaries" (p. 91). The design principles are discussed in more detail below.

#### 2.4.1 Principle 1: Well-defined boundaries

Defining the CPR boundary and specifying who is authorized to use it can be thought of as a first step in organizing for collective management. While the CPR boundaries are undefined, and before it is closed to 'outsiders,' local appropriators face uncertainty that any benefits of their efforts will be reaped by others who have not contributed (Ostrom, 1990). Agrawal (2002) divides this principle into two parts as it addresses two different aspects - the presence of well-defined boundaries around a community of users, and boundaries around the resource system the community uses. This principle has been the subject of several criticisms. Cox et al. (2010) discuss that the main criticism relating to this principle is it is seen as being too rigid, and that in many systems, less clear social or geographic boundaries are needed to facilitate more flexible, arrangements between participants.

#### 2.4.2 Principle 2: Congruence between appropriation and provision rules and local conditions

Well-tailored appropriation and provision rules that reflect the specific attributes of the particular resource help to account for the perseverance of the CPR. In all successful cases investigated by Ostrom (1990), those who receive the highest proportion or use of the resource, also paid the highest proportion of fees. Cox et al. (2010) discuss how in some of the literature they reviewed all farmers have to contribute to the maintenance of the system, but they do it in proportion to the amount of land each of them irrigates. The fact that appropriation and provision rules are applied to all users, but vary according to each farmer's needs helped to enforce a sense of equity and facilitated the sustainability of the management system.

Again this principle addresses two separate conditions, first that both appropriation and provision rules conform to the local conditions such as spatial and temporal heterogeneity; and secondly, that congruence exists between appropriation and provision rules (Agrawal, 2002).

### 2.4.3 Principle 3: Collective-choice arrangements

CPR institutions where the individuals that are affected by operational rules can participate in modifying those rules are better able to tailor their rules to local conditions, since local users have first-hand and low-cost access to information about their situation and an advantage to be able to come up with effective rules for the locality in which they are based. This is especially true when local conditions change. When appropriators design at least some of their own rules, they can learn from experience to craft enforceable rules.

### 2.4.4 Principle 4: Monitoring

Monitoring is a necessary attribute of successful management of CPRs. Monitoring allows all CPR users to see who complies with the rules. This in turn facilitates the effectiveness of rule enforcement mechanisms. Cox et al. (2010) discuss how scholars have also emphasised the importance of environmental monitoring, to allow information about the conditions of the appropriated CPR to be known, so that community members can adapt appropriation and provision rules to ensure sustainability of the resource. Ostrom (1990) suggested not only the presence of monitors, but also that the monitors are members of the local community, or are accountable to those members. There is a benefit in monitoring to appropriators, as if no-one is discovered breaking the rules, the appropriator-monitor learns that others comply and therefore it is safe for the appropriator-monitor to also comply. However, if there is rule infraction, it is possible to learn about the infraction and participate in deciding the appropriate level of sanctioning, and then to decide whether or not to continue to comply (Ostrom, 1990).

### 2.4.5 Principle 5: Graduated sanctions

Graduated sanctions progress incrementally depending on the severity or the repetition of the violation of rules. Graduated sanctions help to maintain cohesion in the community, they punish severe cases of rule infractions, but allow flexibility in cases which are less severe, or are a one-off infraction due to extreme circumstances (e.g. taking too much water in the case of drought). In successful examples of

CPR management, monitoring and sanctioning are undertaken not by external authorities, but by the participants themselves, who create their own internal enforcement to deter those who are tempted to break rules and thereby assure quasi-voluntary compliers that other resource users also comply (Ostrom, 1990).

Ostrom (1990) discusses how with regard to this particular principle it was presumed that participants would not undertake mutual monitoring and enforcement because this action would result in high personal costs. However, it was found the costs of monitoring are low in many enduring CPRs as a result of the rules in place. The example given by Ostrom (1990) is that of two irrigators monitoring each other, one wanting to extend his rotation, the other waiting for his turn and wishing to begin irrigation early. “The presence of the first irrigator deters the second from an early start, the presence of the second irrigator deters the first from a late ending” (Ostrom, 1990, p. 95). In this example neither irrigator invests additional resources, nor is monitoring a by-product of their own motivation to use their water rotation to the fullest extent.

#### 2.4.6 Principle 6: Conflict-resolution mechanisms

This principle indicates that systems with low-cost conflict resolution mechanisms are more likely to survive than those which do not have such mechanisms. Such mechanisms do not need to be complex, but can be quite informal depending on the setting (Ostrom, 1990). It is true that there is almost an inevitability of conflict over a CPR, therefore there is a need for the presence of established mechanisms for conflict resolution to maintain collective action. Although the presence of conflict-resolution mechanisms does not guarantee enduring institutions, the maintenance of CPRs is difficult in their absence (Ostrom, 1990).

#### 2.4.7 Principle 7: Minimum recognition of rights

In enduring examples of CPR management external governments do not challenge the rights of local users to create their own institutions, but such rules are given at least minimal recognition by external government. If external government officials presume that only they have authority to set the rules, then it will be very difficult for local appropriators to sustain the CPR (Ostrom, 1990).

#### 2.4.8 Principle 8: Nested enterprises

All of the more complex and enduring examples of CPR management described by Ostrom (1990), had rules organised in multiple layers of nested levels. Cox et al. (2010) discuss how many scholars have stressed how important it is that smaller common property systems are nested in larger ones. They explain their reasoning: "...given the high probability that the social systems have cross-scale physical relationships when they manage different parts of a larger resource system and thus may need mechanisms to facilitate cross-scale cooperation" (p. 38). The nesting enterprises may occur either between user groups and larger governmental jurisdictions, or between different user groups themselves. Intercommunity connections can be thought of as horizontal linkages, while connections between different jurisdictional levels can be thought of as vertical linkages (Cox et al., 2010).

#### 2.4.9 Critique of the principles

Cox et al. (2010) identified three primary critiques directed at the design principles. First, some of the literature argues that the principles are incomplete, and that additional criteria are needed for sustainable management (see for example Agrawal, 2002).

Cox et al. (2010) comment that much of the literature also stresses the importance of external factors that are not stressed in the design principles. Examples of such factors include external socio-economic factors, like market integration and the alteration of local incentives resulting in decreasing dependence of local users on the resource. This was also a criticism of Agrawal (2002), who discussed how most of

the principles focus on local institutions, or on relationships within this context, with only two of them relating to legal recognition of institutions by higher level authorities (Design Principle 7) and nested institutions (Design Principle 8), expressing the relationship of a given group with other groups or authorities. While it is a limitation of the design principles that they lack an important degree of specificity, this was trade-off for more general applicability to different situations. The lack of specificity can actually be viewed as a potential strength, in that they may avoid the problem of over specificity (Ostrom & Cox, 2010).

The second main issue discussed by Cox et al. (2010) regarding the design principles is whether they can be applied to a wide range of cases beyond those that were used to develop them. The similarity between Ostrom's (1990) principles and those found in the other research which Agrawal (2002) discusses would tend to negate this suggestion. However, Dietz et al. (2002) comment, that suggesting that there is a single best strategy for CPR management is futile, as the best tool for sustainable management depends upon the characteristics of the resource and users.

The final critique discussed by Cox. et al. (2010), criticizes the design principle approach itself, with several authors arguing for a more constructionist or historically, socially and environmentally embedded perspective. Some scholars have called for a more diagnostic approach to analysis. For example, Agrawal (2002) comments that the limited attention to resource characteristics is unfortunate, and referenced further work referring to the determination of whether a resource is stationary along with the storage capability of a resource. These two characteristics, it is argued, have an impact on the sustainability of management.

Singleton and Taylor (1992) argue that Ostrom (1990) "has so organized her materials as to obscure something important – the role of community" (p. 315); and that groups of actors which are successful in managing CPRs involve "a community of mutually vulnerable actors" (p. 315). These communities have several attributes in common (i) shared beliefs; (ii) with a more-or-less stable set of members; (iii) who expect to continue interacting with one another for some time to come; and (iv) whose relations are direct and multiplex. The "mutual vulnerability is a condition of a group of actors each of whom values something which can be contributed or withheld by others in the group and can therefore be used as a sanction against that actor" (Singleton and Taylor, 1992, p. 315). Agrawal (2002) argues similarly, commenting that most of the design principles are expressed as general features of long-lived,

successful commons management rather than as relationships between characteristics of the separate units, or as factors that depend on the presence or absence of other variables.

## 2.5 Politics of scale

There is a large body of literature which argues that a scalar perspective is crucial for water governance (Budds & Hinojosa-Valencia, 2012; Cohen & Davidson, 2011; Norman, Bakker, & Cook, 2012). Engaging in scalar debates allows us to refine and redefine our understanding of complex socio-ecological relationships (Norman et al., 2012). In the following sections literature analysing water governance at the river basin and watershed scales is discussed, along with literature detailing a waterscape and nested-scale approach.

### 2.5.1 River-basin governance

The concept of a river-basin as a management or planning unit draws its strength from its obvious association with the biophysical world, and its relevance as a hydrologic and management unit. Despite its usefulness and obvious applicability to solve problems of storage, water allocation, flood control or risk management, political or administrative boundaries seldom correspond to river-basin lines. In addition, the socio-economic influences and other forces which affect the management of water resources often do not correspond with biophysical scales (Molle, 2009).

The river-basin level for water management is being challenged by those favouring the watershed approach, the distinction between these being watersheds are considered smaller catchments, and river-basins are regarded as larger (Vogel, 2012). Watershed approaches “emphasise civic responsibility and ecological stewardship with respect to communities of place and are concerned with developing patterns of governance that benefit natural units defined on ecological and community grounds” (Molle, 2009, p. 491).

### 2.5.2 Watershed governance

Rescaling to a watershed basis is not a miracle solution, but there are many situations where watersheds can be extremely useful tools. An open acknowledgement of the challenges of management at a biophysical scale can prompt interesting questions, such as what decisions are best made at the watershed-scale and what decisions are best made elsewhere? What relationships exist between watersheds and the tools and frameworks with which they have become conflated (Cohen & Davidson, 2011)? Furthermore, Cohen and Davidson (2011) comment how scales of governance are both socially and politically constructed and continue: “This constructivist perspective on scale actively decouples geographic space from power, seeing scales not as predetermined administrative units, but as products of boundaries drawn through processes rooted in social power structures” (p. 8). The uptake of watershed (or river-basin) boundaries can thus be seen as a policy choice, rather than as an unquestionable scale at which good water governance must take place (Cohen & Davidson, 2011).

When the purpose, utility, advantages and disadvantages of governance based on watershed boundaries are openly analysed they may be seen as an appropriate scale by which to manage water resources. Two examples of situations where this would be the case are: (1) in cases where there is a hydrologically bounded issue guiding the boundary choice; and (2) in cases where the foundations of good water governance are in place in advance of a re-scaling of such governance. However, watersheds may not be appropriate where re-scaling is being undertaken to address governance challenges which persist, such as lack of enforcement or monitoring (Cohen & Davidson, 2011).

Scalar reforms to watershed management where river-basin authorities gradually change into coordinating agencies and are reconfigured in order to accommodate local scales and processes, and the diversity of stakeholders and interests, have been occurring more and more in recent decades (Molle, 2009). Community management is being advocated as a means of improving efficiency, access and sustainability. There has been a shift from ‘government’ to ‘governance’ in which local community actors play a much more significant role in the management of environmental resources than in the past, along with new decision-making processes and new types of community organisations (Norman et al., 2012). Advocates of watershed approaches and proponents of local governance arrangements promote this approach as necessary and positive, a means to supplant higher order levels, and to reinforce the emergence of ‘social trust’ where public and private needs are met and local democratic institutions are enabled (Norman & Bakker, 2009). However Norman and Bakker (2009) conclude that

in their examination of Canadian-US transboundary water governance decentralisation did not result in the delegation of decision-making power, nor in local community groups becoming empowered.

### 2.5.3 Problems with river basin-and watershed approaches

Unfortunately by embracing what might seem like obvious biophysical boundaries, there has been limited thinking about what results these geographies of river governance are likely to achieve and whether they actually make a difference (Vogel, 2012). There are many challenges when people try to institutionalise some kind of governance or management within watershed units, for example Cohen and Davidson (2011) discuss five challenges to the watershed approach to water resource management:

1. *Boundary choice*

While it is common to define a watershed as “an area of land draining into a common body of water”, it does not offer any guidance with respect to which watershed boundary is most useful for the purposes of governance or management. Furthermore, hydrologic boundaries are constantly shifting as our understanding of surface and groundwater flow increases, therefore decisions surrounding which boundary to use for the purpose of governance are often political ones;

2. *Accountability*

Ensuring accountability of watershed-scale decisions and decision-making bodies is a second challenge, in which can be seen the function of the process through, and the degree to which stakeholders have been involved in the decision-making process;

3. *Public participation and empowerment*

Arguments about the benefits of the inclusion and empowerment of local actors in environmental decision-making abound, where it is assumed that policies and strategies at the local scale are more likely to have desired social and ecological effects than activities organized at other scales. However there have been questions raised about the actual participation and empowerment surrounding local governance;

4. *Asymmetry between watersheds and ‘problem-sheds’*

Watershed boundaries frequently impact and are impacted by physical, social or economic factors outside of their boundaries;

5. *Asymmetry between watersheds and ‘policy-sheds’*



Unless policy is made at a watershed scale, no single set of policies will wholly encompass the watershed. This presents two challenges: (1) it can lead to gaps and overlaps in legislation to be implemented by the watersheds' governance body and regional government; (2) it is hydrologically problematic, for if policy cannot be made at the watershed-scale, the hydrological arguments for watersheds seem moot.

Cohen and Davidson (2011) comment about the challenges they present:

Efforts to tackle these challenges would involve altering boundaries for each problem in an attempt to obtain an accountable, participatory system that integrates the factors within and outside of a given watershed's boundaries and coordinating these with existing governmental and non-governmental institutional boundaries (p. 5).

#### 2.5.4 The waterscape approach

While there is a growing body of work examining scalar dimensions, the recognitions that scale is socially constructed and politically mobilised is only beginning to be developed, with scholars tending to take the adoption of 'natural' scales for granted (Budds & Hinojosa-Valencia, 2012). Budds and Hinojosa-Valencia (2012) suggest that the concept of 'waterscape' represents a useful framework to approach the multiple processes and dynamics that mediate water over space and time, in a way that avoids the limitations of thinking about water according to traditional spatial scales and accepting hierarchical forms of institutional administration as given. The concept of a waterscape explores "the ways in which flows of water, power and capital converge to produce uneven socioecological arrangements over space and time, the particular characteristics of which reflect the power relations that shaped their production" (Budds & Hinojosa-Valencia, 2012, p. 124). Budds and Hinojosa-Valencia (2012) further comment that a waterscape is "a sociospatial configuration that is constituted by social and ecological processes, which become manifest through the particular nature of flows, artefacts, institutions and imaginaries that characterise a particular context" (p. 125).

Budds and Hinojosa-Valencia (2012) argue that focussing on the concept of waterscape avoids three particular limitations in relation to analysing water governance. (1) It enables a shift from thinking about

the governance of water as a material resource towards an examination of the relationship between water and society; (2) it endeavours to transcend conventional and hierarchical administrative structures that characterise formal water governance; and (3) it avoids confining analyses to conventional scalar containers, and taking scale choices for granted. The concept of waterscape therefore could overcome some of the difficulties presented by relying on a river-basin or watershed approach to water governance.

#### 2.5.5 Nested scales

The focus on scale can be problematic as we can become focussed on the specific scale we are interested in, but as Walker and Salt (2006) discuss, the scale which we are interested in, is connected to and affected by what happens at scales above and below, not only in time, but also in space. They describe how linkages across scales play a major role in determining how the system at another scale is behaving. In fact, as Holling, Gunderson, and Peterson (2002) argue, the organisation and functions we see embracing biological, ecological and human systems are in fact interactions across and between multiple levels of nested systems. Limiting management to specific scales while not recognising the nested components seems itself to be potentially problematic, in fact Olsson, Folke, and Hahn (2004) describe ecosystem management as requiring a multi-scale approach, therefore a recognition of the nested nature of water management can help in a comprehensive governance approach. Folke et al. (2010) describe how transformational changes at lower scales can lead to effects at the catchment scale, which can in turn facilitate eventual catchment-scale transformational change resulting in enduring and robust social-ecological systems. A nested multi-scale approach to water management is therefore necessary for effective water resource management.

#### 2.5.6 Canterbury context

At a national level in New Zealand the Land and Water Forum (2012b) promotes a tributary-based approach to freshwater management, while the National Policy Statement for Freshwater (Ministry for the Environment, 2014) advocated setting catchment-based water quality limits. Within the Hurunui River catchment itself the Zone Committee in its ZIP (Hurunui Waiau Water Management Zone Committee, 2011) also suggests a tributary-based approach for the management of load limits in the

Hurunui River. However the LUWQ group had discussed that management objectives should be established at both the overall catchment level and at a sub-catchment level (Brown et al., 2011), and Mulcock and Brown (2013b) describe how GMPs should be outlined at a farm level, and are not readily detailed at the regional or catchment level. Further to this Rule 10.1 and 10.2 of the Regional Plan require land users to be subject to an industry certification system, a catchment agreement, an irrigation management plan, or a lifestyle block management plan by 2017 (Environment Canterbury Regional Council, 2013b). While being subject to a catchment agreement may realise a tributary-based management approach, the other systems and plans do not necessarily follow this approach. For example the Amuri Irrigation Company takes water from the Waiau River as part of its water supply to land users, and therefore operates between two different catchments.

Therefore it can be seen that within the Hurunui River catchment, and within the wider New Zealand management literature there is the recognition that different scales can play an important role in ecosystem management. This is recognised in the CWMS (Canterbury Water, 2010), which sets out a nested approach to water resource management. This Strategy details the regional, catchment, sub-catchment and farm property levels of management.

As discussed earlier, a nesting approach was recognised by Ostrom (1990). The levels she discussed are similar to the approach presented in the CWMS. In the CWMS the constitutional-choice rules formulate the governing arrangements which legislates that an ASM approach is required in the Regional Plan, this is the regional level of management. Rules and decisions made at this level relate to the catchment geographical scale. At this level environmental outcomes may be required for the effective management of cumulative effects. The collective-choice rules are formulated at the level at which the ASM managing body operates. This body manages the ASM data, providing advice and suggestions for effective management, organising the auditing and communication avenues, and detailing their own environmental outcomes. The geographical scale of this level is likely to align with a tributary-level. Finally the operational rules affect the land users who are concerned with when and how to use their land, the results of which have an effect on the resource itself. At this level in the application of an ASM approach resides in the FEP development, monitoring and possibly enforcement. The geographical scale at which this level relates is to the farm-level.

## Chapter 3

### Conceptual Framework and Methodology

In the previous chapters the background to this research was established, and relevant literature was examined. On the basis of an examination of the literature a conceptual framework has been developed which has guided the current research. In this chapter the conceptual framework is set out, the research aim and objectives used to examine this framework are introduced and the methodology by which the research was conducted is discussed.

#### 3.1 Conceptual framework

Ravitch and Riggan (2012) analyse how conceptual frameworks guide research, what they are and how to develop them. They argue that conceptual frameworks are comprised of three primary elements: personal interests, topical research and theoretical frameworks. Each of these elements has influenced the conceptual framework upon which this research is based. Ravitch and Riggan (2012) suggest that a conceptual framework is a series of logical propositions, which have the purpose of convincing the reader of the study's importance and rigor. Furthermore, it should argue that the research questions are an outgrowth of the argument for relevance, that data collected will provide the researcher the raw material needed to explore the research questions or aims, and that the analytic approach will allow the researcher to respond to those questions or aims (p. 7).

The first two sections of this thesis presented a discussion about concerns surrounding the current levels of nutrients in the Hurunui River and its tributaries, due to the presence of high periphyton coverage. With the prospect of more irrigation expansion and the corresponding intensification of land use practices, there is concern that the cultural, social and environmental values of the river may be further compromised if nutrient losses are not addressed. As part of addressing the loss of nutrients, the

Regional Plan has set nutrient limits on the Hurunui River and its tributaries and is promoting the collaborative governance of water resources. While there are means to address nutrient losses including good management practices and mitigation measures discussed in the literature, without the buy-in of the stakeholders in the Hurunui River catchment any such measures are likely to be ineffective (Lees et al., 2012; Ostrom & Cox, 2010; Reed, 2008).

In past years, scholars argued that users of CPRs were unable to organise the management of these resources (Hardin, 1968). However in the 1980s many scholars began to realise that collaborative governance had been effective in many examples of CPR management (Ostrom, 1990). The literature has many empirical examples illustrating that where there is positive stakeholder involvement, there will be corresponding stakeholder ownership if any particular problems exist regarding the management of CPRs (Lees et al., 2012; Ostrom, 1990; Ostrom & Cox, 2010; Reed, 2008)). It was the intention of the CWMS that a high level of audited self-management would be in operation in the Canterbury Region (Canterbury Water, 2010). Following this recommendation the Hurunui and Waiau Regional Plan requires land users to belong to a self-governing body, referred to throughout this thesis as a management body or collective, operating under an ASM approach for the management of water quality (Environment Canterbury Regional Council, 2013b).

Audited self-management (ASM) is a relatively new style of self-governance, and has been viewed as an alternative to regulation (Jenkins, 1996). There are a number of key elements, outlined in the literature, in the application of an ASM approach, which need to be adjusted somewhat to the locality in which an ASM scheme operates. These include governance arrangements, farm environmental plans, audits, enforcement, and communication mechanisms (Mulcock & Brown, 2013a, 2013b). As these factors will form the basis upon which any ASM approach will operate, it is important to investigate how these elements are viewed in the Hurunui River catchment.

Ostrom (1990) described a series of case studies in which common pool resources (CPRs) were managed by the cooperation and collective action of local users. In her work *Governing the Commons* she describes eight design principles which characterised the management of all of the robust CPR examples she discusses (see Table 1). While there have been critiques of the principles Ostrom puts forward, the literature examined widely supports them. For an ASM approach to endure and to work effectively it

would follow that the institutional arrangements proposed and accepted in the Hurunui River catchment would reflect the design principles set forth by Ostrom (1990).

The examples Ostrom (1990) used in her work, ranged from rather small villages to large states in the United States. She included in her design principles a provisional principle relating to those instances where the management of the common pool resource was large, with the provision of a nesting arrangement in the management. Scale can be seen as a contentious issue. There are many researchers who argue that a catchment-wide approach is the most appropriate, those arguing a tributary-based approach is the most appropriate, to those who argue that a waterscape is a more fitting concept by which to analyse scale. There are also scholars who recommend a nested approach to water management, and this was in fact the approach upon which the CWMS was based (Canterbury Water, 2010). Whether the differing views of scalar governance affects the management of the water resources is an interesting question, therefore how differing views could shape an ASM approach in the Hurunui River catchment is worthy of examination.

The conceptual framework for this thesis is based upon the design principles outlined by Elinor Ostrom (1990). As Ostrom observed the enduring management of natural resources at sustainability limits should reflect these principles. The literature argues that ASM is an effective means of managing water quality, therefore the ASM approach adopted in the Hurunui River catchment, should reflect and be a means of implementing the design principles described by Ostrom (1990). This research will seek to identify whether this is the case, by examining the opinions of stakeholders in the Hurunui River catchment regarding the application of an ASM approach.

## 3.2 Research aim and objectives

This research investigates the collaborative approach in applying an audited self-management approach to the Hurunui catchment, the stakeholders' perceptions of different features of an ASM approach and the institutional arrangements they support to meet the nutrient limits outlined in the Regional Plan.

The principal aim of this research arising from the literature is:

***To identify the features and institutional arrangements that stakeholders are willing to support, and to identify and address potential obstacles in the effective application of audited self-management to manage nutrient losses in the Hurunui catchment.***

To aid this examination the research has five key objectives:

- a) To assess stakeholders' opinions as to whether they believe there is a water quality problem and whether they are prepared to act to manage the water quality;
- b) To determine which features of an audited self-management system the key stakeholders in the Hurunui catchment support, and how these align with ASM literature;
- c) To determine the type of institutional arrangements key stakeholders in the Hurunui catchment support and how these align with Ostrom's eight design principles;
- d) To compare the preferences in ASM features and institutional arrangements supported by land and water users in three different geographical areas;
- e) To examine stakeholders' views on the scale at which they think the water quality should be managed.

### 3.3 Research methodology

The research draws on qualitative research methods to enable the stakeholders' opinions to be explored. In particular case study research was used to enable research into the complex problem of managing water quality in the Hurunui River catchment where socio-economic and biophysical systems interact (Scholz, Lang, Wiek, Walter, & Stauffacher, 2006). Stake (2000) comments that case studies can be used to test hypotheses. ASM, it is hypothesised, is an effective way of managing nutrient discharges and maintaining water quality and is set forth in the CWMS as such. Although the specific details of each particular zone will differ from those in the Hurunui, case study analysis provides rich lessons which can be learnt from an investigation into the stakeholders' perceptions of the application of ASM in the Hurunui River catchment. These lessons may be applied in other zones in the Canterbury region. Yin (2009) argues that the use of case study research does not represent a "sample" as in an experiment, rather the goal of using a case study will be to expand and generalise theories or findings. Furthermore, as Stake (2000) comments, because of the universality and importance of experiential understanding, "case studies can be expected to continue to have an epistemological advantage over other inquiry methods" (p. 24).

Case Study research is defined by Simons (2009) as:

An in-depth exploration from multiple perspectives of the complexity and uniqueness of a particular project, policy, institution, programme or system in a 'real life' context. It is research-based, inclusive of different methods and is evidence-led. The primary purpose is to generate in-depth understanding of a specific topic (as in a thesis), programme, policy, institution or system to generate knowledge and/or inform policy development, professional practice and civil or community action (p. 21).

Some specific strengths of choosing to use case study analysis for this research is that it enables the experience and complexity of a policy to be studied in depth and interpreted in the very socio-political contexts in which the policy is to be enacted. Furthermore, case study research can document multiple perspectives and explore differing viewpoints, in demonstrating the influence of key actors and interactions between them in telling a story about the policy in action. Case study research is useful for exploring and understanding the process and dynamics of change, through closely describing, documenting and interpreting events as they unfold in the 'real life' setting. It can determine the factors



that were critical in the implementation of a policy and analyse patterns and links between them. Finally, and importantly for this research, case study has the potential to engage participants in the research process, allowing a recognition of the importance of interaction and the validity of all points of view in the appreciation of the understanding of a particular topic (Simons, 2009).

In order to evaluate the opinions of stakeholders regarding the application of an ASM approach the research focused on a series of semi-structured interviews (refer to Appendix A for interview outlines). Semi-structured interviews were chosen because they have some degree of order, but maintain flexibility (Valentine, 1997). The general format was to use open-ended primary questions to initiate discussion and secondary questions to act as prompts that encouraged the interviewee to follow up or expand on an issue already discussed (Dunn, 2010). The order and direction of questioning was adapted based on the participant's response, so that the interviews were akin to a guided conversation (Yin, 2009).

According to Simons (2009) in-depth interviewing has four major purposes: (1) to document the interviewee's perspective on the topic; (2) the active engagement and learning it can promote for interviewer and interviewee; (3) the flexibility it allows to change direction and pursue emergent issues; and (4) the potential to uncover and represent the unobserved feelings and events that cannot be observed.

### 3.3.1 Interview participants

In the design phase of the research, it was decided to select key stakeholders in the Hurunui River catchment to interview. It was hoped that by interviewing those most closely involved in the implementation of ASM, and those who had strong connections to the river, that the research would be well-informed and well-positioned to learn about the issues surrounding nutrient management and the suggested ASM approach.

Interview participants were sought in several ways. Firstly, the Zone Committee Facilitator was approached and asked for his recommendation of industry groups and organisations which had an interest in the Hurunui River catchment. A letter of introduction was sent to each organisation explaining the nature of the research and asking for representatives from the organisation to interview (see Appendix B). Secondly, farming participants from the Upper and Lower Hurunui areas were selected after several members of the Zone Committee were approached, and asked for the names of farmers in particular localities who would be interested in talking about water quality issues and audited self-management. Thirdly, farmers surrounding the Pahau River were selected after the researcher firstly talked to the Amuri Irrigation Company (AIC) manager Andrew Barton, who then advised that a director of AIC be contacted who owned property draining into the Pahau River. This director advised the names of other farmers to contact. Finally, other farmers were contacted upon recommendation from farmers who were selected as described previously.

Representatives from the following different organisations were interviewed:

- Hurunui Water Project;
- Ngāi Tahu Properties;
- Ngāi Tahu Rūnanga;
- Fish and Game NZ;
- Forest and Bird Protection Society of New Zealand;
- Environment Canterbury;
- Dairy NZ;
- Irrigation New Zealand;
- Amuri Irrigation Company; and
- The Sustainable Farming Fund.

In total twenty eight interviews were conducted, with eleven being conducted with representatives from the organisations listed above (two being from Forest and Bird), and seventeen interviewees were farmers (see Table 2). The farmers selected were land users in three main areas (see Figure 3): the Lower Hurunui, Upper Hurunui (on the true right of the Hurunui River) and the area surrounding the Pahau River. A representative from Ngāi Tahu Properties was interviewed, and while they could be classified as a large farmer (farming the Balmoral Forest), for the purposes of this research they were classified as an organisation. It was originally intended that a minimum of seven interviews be conducted in each of the geographical areas, however due to difficulties scheduling interviews because dairy farmers were

calving and because of travel constraints, the final interview numbers were reduced to six each from the Upper and Lower Hurunui areas, and five from the Pahau River area.

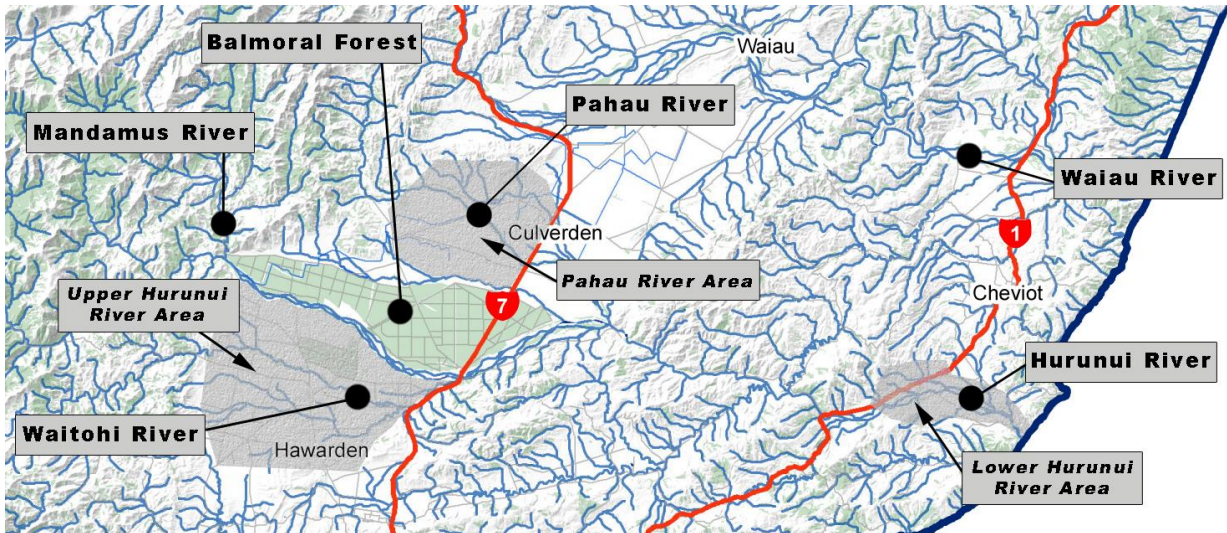


Figure 3: Localities of the geographical areas of the interview participants in the Hurunui River catchment (Adapted from: Environment Canterbury Regional Council, 2015. Retrieved 22 April 2015, from <http://ecan.govt.nz/get-involved/canterburywater/committees/hurunui-waiau/PublishingImages/hurunui-map.pdf>)

As discussed the farming interviews included participants from three main geographical areas: two sub-catchments of the Hurunui River - the Waitohi River (Upper Hurunui) and the Pahau River; along with the lower Hurunui River (see shaded areas of Figure 3 for localities). These areas were selected to examine if there were any notable differences in perspective with regards to managing water quality and the implementation of ASM within these geographical areas. They provided examples of different farming techniques (see Table 2). Three of the six farmers interviewed in the Upper Hurunui area (surrounding the Waitohi River) were sheep and beef farmers with some cropping, one provided dairy grazing and two were dairy farmers. There were similar farming techniques in the Lower Hurunui area with one dairy farmer and five sheep and beef farmers, whereas surrounding the Pahau River four participants were dairy farmers, with one operating dairy support.

Table 2: Description of interview participants

| Target Groups        | Participants | Description  |
|----------------------|--------------|--|
| <b>Organisations</b> | 11           | 10 organisations with two representatives from Forest and Bird                   |
| <b>Upper Hurunui</b> | 6            | 2 dairy farmers, 1 crop farmer providing dairy grazing, 3 sheep and beef farmers |
| <b>Pahau River</b>   | 5            | 4 dairy farmers, 1 dairy support   |
| <b>Lower Hurunui</b> | 6            | 1 dairy farmer, 5 sheep and beef farmers   |

Another factor which was considered when identifying areas from which to select farmers to interview, was to compare areas of high intensification (Culverden Basin), with areas of lower intensification (Lower Hurunui area). The Upper Hurunui area has the potential for further intensification in the future, as the Hurunui Water Project has a consent to dam and take water for irrigation from the Waitohi River (Hurunui Water Project, 2013).

As well as having different farming techniques, the different areas will be governed by different management collectives in the application of an ASM approach. The Upper Hurunui area will initially be managed by the management group based around Hawarden, and then if the Hurunui Water Project progresses, will be managed by the Hurunui Water Project. The area surrounding the Pahau River will be managed by the Amuri Irrigation Company. While in the lower Hurunui area, there will be a management group surrounding the Hurunui River, below State Highway 1. At the time of the interviews it was unclear if Ngāi Properties would form its own management group, or would join another's. Also it was unclear to which management group the land users in the gorge downstream of the Pahau River, but upstream of State Highway 1 would belong.

The three areas chosen also provided examples of different water quality in the water bodies themselves. The water quality of the Hurunui River above the Balmoral Forest to its confluence with the Mandamus River is of high quality; whereas the water quality of the lower Hurunui River at State Highway 1 is poorer, with dissolved nitrogen concentrations up to twenty times higher, and dissolved phosphorus about two – three times higher than upstream. At the water quality monitoring site located at State Highway 1 there are occasional breaches of *E.coli*, whereas at the water quality monitoring site located upstream of the confluence with the Mandamus River only very rare breaches have been

recorded (Brown et al., 2011). The Waitohi and Pahau rivers are classified as 'hill-fed river' types and are fed by rainfall in the foothills, but they also have spring-fed tributaries (Brown et al., 2011). Brown et al (2011) record that for both rivers the dissolved inorganic nitrogen concentrations were elevated, and that nitrate concentrations breached the 95% level for aquatic species protection of 1.7 g/m<sup>3</sup>, occasionally in the Waitohi River, and frequently in the Pahau River. Brown et al (2011) also record that concentrations of dissolved reactive phosphorus, and *E. coli*, as well as turbidity levels continue to breach guidelines on both rivers.

### 3.3.2 Human ethics

Ethical appraisal and approval from the University of Canterbury Human Ethics Committee was needed for this research (Approval number 2014/74), and consent from the participants was needed. To gain participants' consent a research information sheet (Appendix B) outlining the project and contact details of the researcher and supervisor, along with a copy of a consent form (Appendix C) were provided to participants and upon agreement the consent form was signed. Two different information sheets and consent forms were developed, one for participants representing organisations and one for individuals. The main difference between these forms related to the confidentiality of participants.

Interview participants were able to withdraw from the research at any time; their names and identifying material remained anonymous if participants wished, and the use of pseudonyms are used in the interview record; and participants were given the opportunity to review the interview transcription.

This research attempts to document and interpret the realities of the interview participants, in exploring how they view the rule changes in the catchment, and the application of an ASM approach (Dicicco-Bloom & Crabtree, 2006). Many of the interview participants were seen and interacted with several times after the interviews were conducted, when several points of clarification were sought, and initial preliminary findings of the research discussed with some of them. The fundamental ethical principle in research is to do no harm throughout the research process (Simons, 2009), and all steps have been taken to ensure participants felt their opinions and perspectives were valued and would be reported accurately, notwithstanding that the subjectivity of the researcher must be borne in mind.

### 3.3.3 Conscious reflexivity

A researcher's own position inevitably affects the research interpretation, as the researcher is the main source of data gathering through the interview process (Lincoln & Guba, 2002; Simons, 2009). Peshkin (1988) argues that subjectivity is inevitable in research, and therefore it cannot be eliminated, rather "researchers should be meaningfully attentive to their own subjectivity," and "should systematically identify their own subjectivity throughout the course of their research" (p. 17) to examine how it shapes the inquiry and outcomes. Subjectivity can indeed be seen as virtuous, as it is the basis of the researcher making a distinctive contribution to their research, as it results from their own personal attributes joined with the data they have collected (Peshkin, 1988). Nonetheless, the question of the researcher's subjectivity has been a point of criticism of case study research and the researcher should work to report all evidence fairly (Yin, 2009).

During the course of my research I have been struck by how often I agreed with the interview participants; hearing their stories from their perspective I often found myself nodding in agreement and feeling a sense of understanding with the participants. However, I noticed two primary areas of subjectivity often coming to the fore, and these are described in the following paragraphs along with a brief discussion of how they may have impacted this research.

I have a love for New Zealand's beautiful outdoors, and spend many hours on the river or in the hills. My love for the environment and in particular my love of rivers led me to often feel anger and in some cases disappointment at comments made by some of the participants. This love of the outdoors and feeling akin to those trying to uphold the environment, has the potential to lead me to over emphasise environmental concerns, at the expense of economic matters. Therefore there was a danger that at times during the research I could be too dispassionate to those farmers and representatives of organisations who relied on using the natural resources to obtain their livelihood.

Secondly, having looked at the literature relating to ASM and highly valuing a collective approach by users in the management of CPRs, I have concluded that management collectives, where the resource users self-organise amongst themselves to manage the resource, are the most promising approach to manage water quality issues. At times my enthusiasm for management collectives may have led some of the interview participants, rather than solely reporting their feelings and opinions surrounding the

application of ASM. Having a consciousness of this area of subjectivity, I have attempted to remain as objective as possible and this reflexivity has greatly aided the research.

#### 3.3.4 Interview structure

The structure of the interviews was designed to address the principal research aim and to address the five key objectives. The interviews aimed to assess the willingness of the various stakeholders in the Hurunui catchment to adapt to manage to the limits as set out in the Hurunui and Waiau River Regional Plan (Environment Canterbury Regional Council, 2013). Using a semi-structured interview approach allowed flexibility in what information could be obtained from the various participants, all of whom had differing perspectives and opinions.

As the interviewees varied between an Environment Canterbury staff member, representatives of environmental groups and industries as well as farmers, it was necessary to modify the interview questions depending on the occupation of the various participants. In total, surrounding the core set of questions, there were four different interview outlines used in this research. One interview outline was used for farmers, a slightly different one for environmental groups, another for collective bodies and a final outline for Environment Canterbury; copies of the interview questions are included in Appendix A.

The interviews began by a reiteration of the purpose of the research, a description of what was expected of the participants, and an outline of the procedure of the interview. Following Dunn (2010) the interviews started with background questions, for example for the farming participants the initial questions were about what type of farming system they operated and the type of irrigation they used, if any. This was followed by questions relating their opinions in regard to nutrient management and the application of ASM. Usually the nutrient allocation questions were asked at the end of the interview, as they were thought to be the most controversial, and were better placed at this stage of the interview after rapport had been established.

The interviews were conducted over three months, on several trips to the Hurunui catchment and Christchurch, beginning in August and finishing October 2014. During this time the dryland farmers became aware that the '10% rule' set forward in the Regional Plan was going to restrict their ability to expand their farming operations. At the August Hurunui Waiau Zone Committee meeting a group of dryland farmers raised concerns about the limitations imposed by the Regional Plan on their farming businesses. More than 330 people, attended the meeting which followed, to give support to a presentation asking for the Zone Committee's commitment to resolve the issues surrounding this perceived inequity (Eder, 2014). The interviews for this research were conducted during this period and no doubt reflect the feeling of some, particularly dryland farmers, who were upset at this time.

The interviews ranged in length from just under 30 minutes to around 90 minutes, with the majority taking approximately one hour to conduct. The interview locations varied according to the most convenient place for the participants. These ranged from a meeting room at the University of Canterbury Library, while several interviews were conducted at coffee shops or participants' offices, and the majority of the farmers were interviewed in their homes. The interviews generally followed the format of the interview questions, but the order would vary in some interviews according to responses to the questions. For example if the participant commented on the inequity of the Regional Plan early on in the interview, they might be asked at that point about their view of nutrient allocation, which would otherwise have been asked towards the end of the interview. Also occasionally some participants were not familiar with some of the terms being used (e.g. nutrient trading) or would ask questions regarding a rule in the Regional Plan. At these points the terms would be explained or discussion entered into, after which the interview would continue.

In some interviews not all of the questions were covered; the reasons for this varied from accidentally missing out a question, to purposefully omitting a question depending on answers to previous questions. For example one participant struggled to understand what headroom was, and struggled with the concepts of water quality, so was not asked about nutrient trading. On another occasion not all questions were asked as the participant had to go to another appointment. A different participant was so upset about the Plan, and held such negative opinions about audited self-management that several questions were not asked for fear of inflaming the situation.



### 3.3.5 Transcription and analysis

Qualitative research often depends heavily on the interpretive skills of the researcher, which are often personal and intuitive, and reflect different experiences from one researcher to another (Simons, 2009). In this research the data gathered relied largely on the interview questions and how they were asked. All interviews were recorded using an audio recording device, and transcribed using the 'Simplified Transcription Symbols' as listed by Silverman (Silverman, 2006). Participants were given the opportunity to review the interview transcripts and add to, change or delete material as they felt appropriate.

The transcripts of the interviews were then analysed using NVivo 10 software, where the material was firstly coded to align with the interview questions, and then grouped together with similarly coded text. As the interview material was examined through an iterative process, several different themes continued to emerge, and examples of these themes were grouped together. Coding helps to reduce data by putting it into smaller packages (Cope, 2010). Once the text was coded it was then able to be reviewed and examined (Cope, 2010; Dunn, 2010; Seidman, 2013) with emphasis on the geographical areas of the farmers and differences between organisations and individual farmers. The data thus organised, along with an interpretation of this data, forms the Results section of this thesis.

## Chapter 4

### Results

This chapter discusses the results of the interviews conducted with stakeholders in the Hurunui River catchment. For the most part participants have been placed into categories based on one of two criteria: the geographical area in which they farm e.g. Pahau River area, Upper Hurunui area and Lower Hurunui area; or the organisation of which they were a representative e.g. Fish and Game, Dairy NZ etc. For a full list of the organisations which were represented see Section 3.3.1.

Section 3.3.4 discussed the four different interview outlines employed in conducting the interviews based on the participant's occupation. In this chapter, Section 3.1 relates only to responses from farming participants; in Sections 4.2 – 4.5 the results were collated from all participants (excluding several subsections where this is made clear due to a question not being appropriate for organisations); and Section 4.6 relates to responses from those representing organisations.

#### 4.1 Farming management

In this section the farm type and irrigation methods employed by the farming participants are outlined.

##### 4.1.1 Farm type

Of the 17 participants who were farmers, a total of seven were dairy farmers, eight were sheep and beef farmers, and two provided dairy support. Of these three were sheep and beef farmers from the Upper Hurunui area, one provided dairy grazing and two were dairy farmers. In the Pahau River area four participants were dairy farmers, and one provided dairy support. In the Lower Hurunui area five participants were sheep and beef farmers, and one was a dairy farmer (see Figure 4).

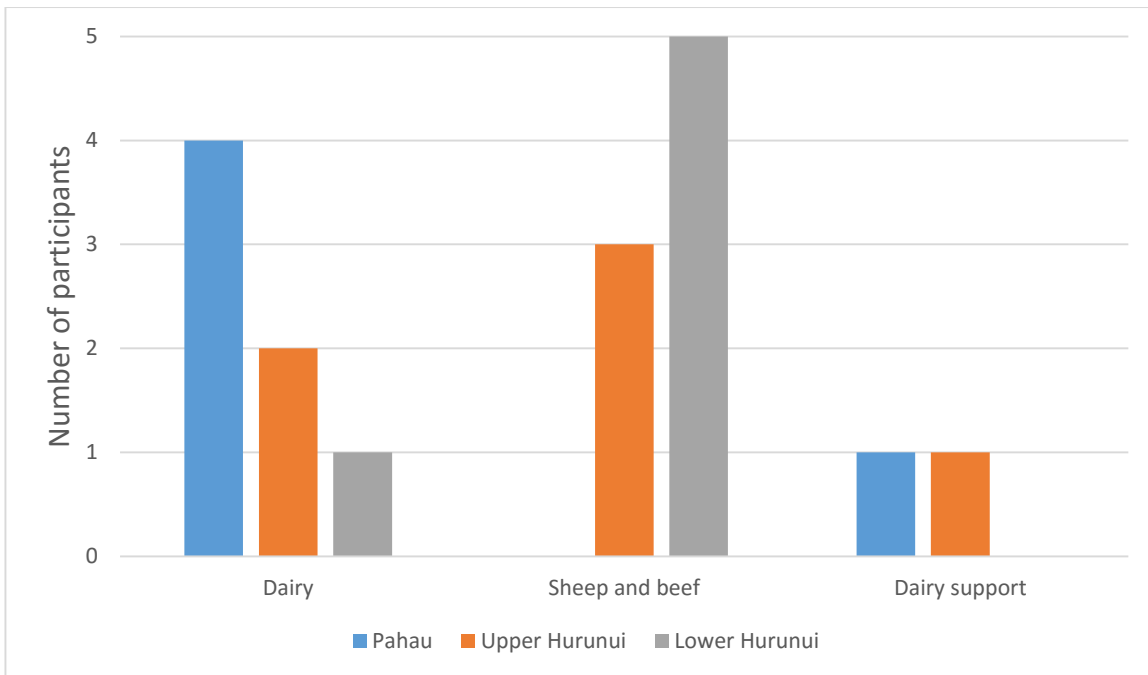


Figure 4: The main farming systems of the farming interview participants

Several farmers also offered supplementary farming practices in addition to the main farming systems operated. For example three farmers from the Lower Hurunui area also provided dairy support, as did one farmer from the Upper Hurunui area. In addition to the main operation of sheep and beef farming, one farmer from the Upper Hurunui area also farmed venison, and one also grew crops.

#### 4.1.2 Irrigation type

Of the 17 farming participants six used no irrigation, while the others used a combination of irrigation methods. The most common form of irrigation was the use of centre pivots, with 10 of the 11 participants irrigating using centre pivots. In addition five irrigated using long line sprinklers; three farmers utilised irrigation guns; two used rotar-rainers; one farmer was still using border dyke irrigation; and the remaining farmer used K-line irrigation.

## 4.2 Individual preferences

This section discusses the participants' views surrounding managing water quality in the Hurunui River catchment.

### 4.2.1 Load limits

All seventeen of the farming participants indicated that they were aware of nutrient limits on the Hurunui River and tributaries, as Participant M commented: "I think everyone is aware of it now." Most of the participants were further asked whether they were supportive of load limits on the Hurunui River and concentrations on the tributaries. Of these seven participants responded positively, one supported limits "within reason," while two supported limits but would prefer concentration levels rather than load limits on the Hurunui mainstem. For those who did support such limits, some added a qualification to this support, such as participant H who supported nutrient limits "as long as the levels have been set right." Of the remaining participants, three indicated that they did not support limits, and another answered that they would "like to see more science."

There appeared to be a correlation between levels of support for nutrient limits and the geographical location in which they farmed, which can be seen in Figure 5, where the category 'supportive' represents those who responded "yes" or "prefer concentration"; and 'non-supportive' represents those who responded "no", or "more science"; while 'partially supportive' represents those who answered "within reason." All participants from the area surrounding the Pahau River were supportive and participants from the Upper Hurunui area were mostly supportive. However, only two of the five participants from the Lower Hurunui area were supportive of limits on the Hurunui River and its tributaries.

Representatives from the key stakeholder organisations were also asked whether they supported load limits on the Hurunui River. Most of these participants responded positively to nutrient load limits (see Figure 5). Ngāi Tahu Properties have been classified in Figure 5 as partially supportive, as their representative commented that because load limits are calculated from concentration and flow, it is not a correct form of measurement. As the Ngāi Tahu Properties representative put it: "... we're saying well

it's not the absolute load that's important, it's the relative load". By way of further explanation the representative commented that the load limits were based on data from 2005- 2011 and questioned "...if we experienced 2005– 2011 flow regime again, would the load be more or less than it was in 2005– 2011? And we're saying, well the concentrations have gone down, and therefore the load, the relative load must have gone down." The other representative who was partially supportive acknowledged the need for limits, but was not sure if the limits that had been set were correct. The only participant who was not supportive of limits did not support them because they felt the limits were not stringent enough. Similarly, Fish and Game, while supportive of load limits on the Hurunui River, were not supportive of the nitrate concentrations set out in the Regional Plan, which they felt should be lowered.

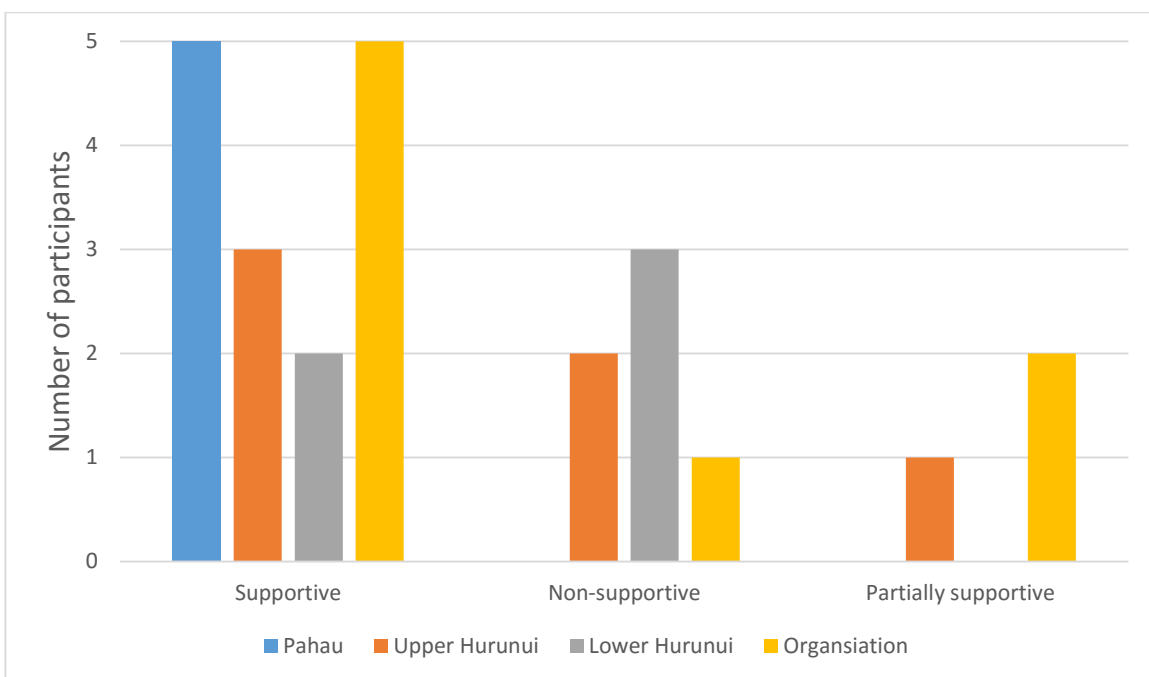


Figure 5: Participants' support for nutrient limits on the Hurunui River and its tributaries

#### 4.2.2 Managing water quality

Ten participants were asked whether there was a need to manage water quality, and while all indicated there was a need to maintain water quality, the responses varied as to whether there was currently a problem that needed to be managed. The four participants from the Pahau River area who were asked this question, all supported the need to manage water quality, with one indicating some confusion over

the level that needed to be attained, saying “I just get concerned that ...do they want a hundred and five percent water quality, or is ninety one percent fine, I mean where do we set the bar?” In the Upper Hurunui area, of the three participants who were asked this question, one thought there was a current need to manage water quality, one was “cautionally supportive” questioning whether the water could degrade a little before there was a real problem, while Participant K thought there was no current problem, asserting that the river “just looks like it has for forty years.” This participant further commented:

Everyone jumps up and down about all this slime in the river, I don’t see it... But that’s not to say that there’s not an issue, I appreciate there is an issue, but I think that a lot of the time it’s actually made far worse by media reporting it and by the environmental twist on it, than it actually is

In the Lower Hurunui area three farmers were asked this question with all three indicating that they thought the water was at as good quality as it had historically been, but indicating that if the science proved there was a problem they would support increasing management interventions (see Figure 6).

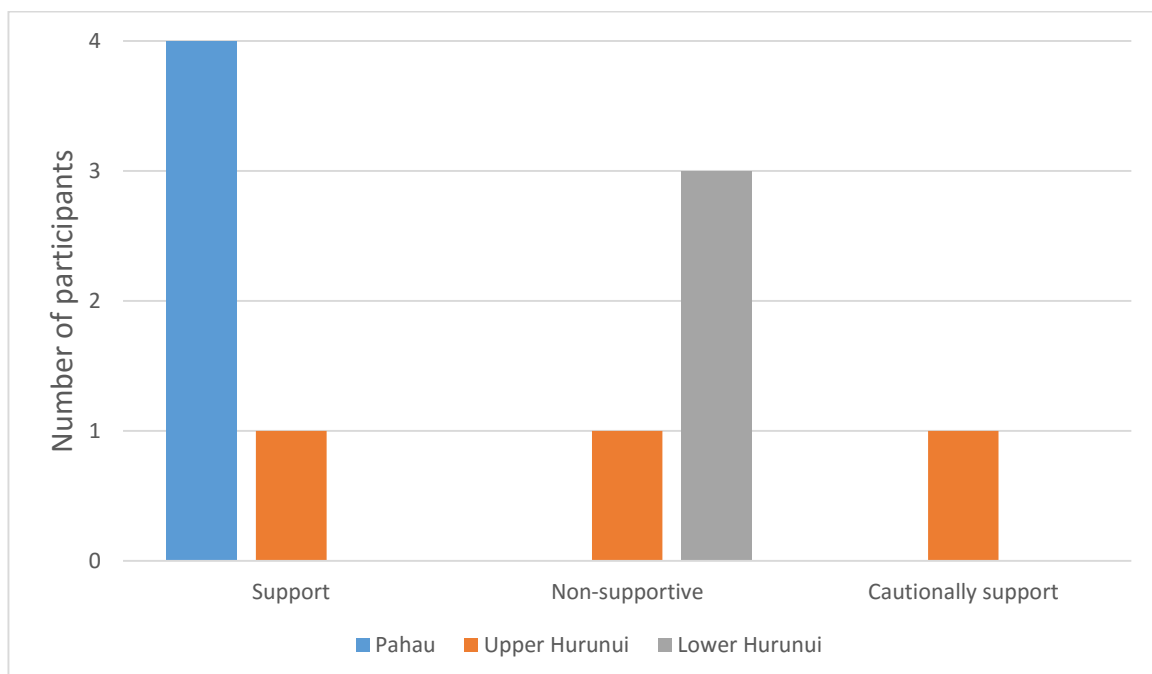


Figure 6: Participants’ support of the need to manage water quality in the Hurunui River catchment

### 4.2.3 Responsibility

Fourteen of the farming participants were asked if they were willing to take responsibility for the management of the water quality. Of the four farmers in the Pahau River area all responded that they were willing to take responsibility with participant D responding “yeah we have to be at the Matrix of Good Management, we have to be one of the best irrigated farms in Canterbury!” In the Upper Hurunui area, all farmers agreed that they were willing to take responsibility, however one farmer added that he was only willing to do so if the science proved there was a problem with water quality. Participant K expressed his exasperation when alluding to the 10% rule in the Regional Plan, he commented that he should identify the worst performing part of his farming operation, which relates to his wintering of dairy cows, and try to clean this up, he commented “...but as I’ve said before I don’t want to clean it up, ‘cause I want a big number, because someone made the rule.” He added his assurance however, that he was willing to improve land use practices if the rules in the Regional Plan were equitable. While all of the five participants in the Lower Hurunui area were willing to take responsibility for the management of the water quality, only two stated this without qualification, while the others answered that they would only do so if the science proved there was a problem (see Figure 7).

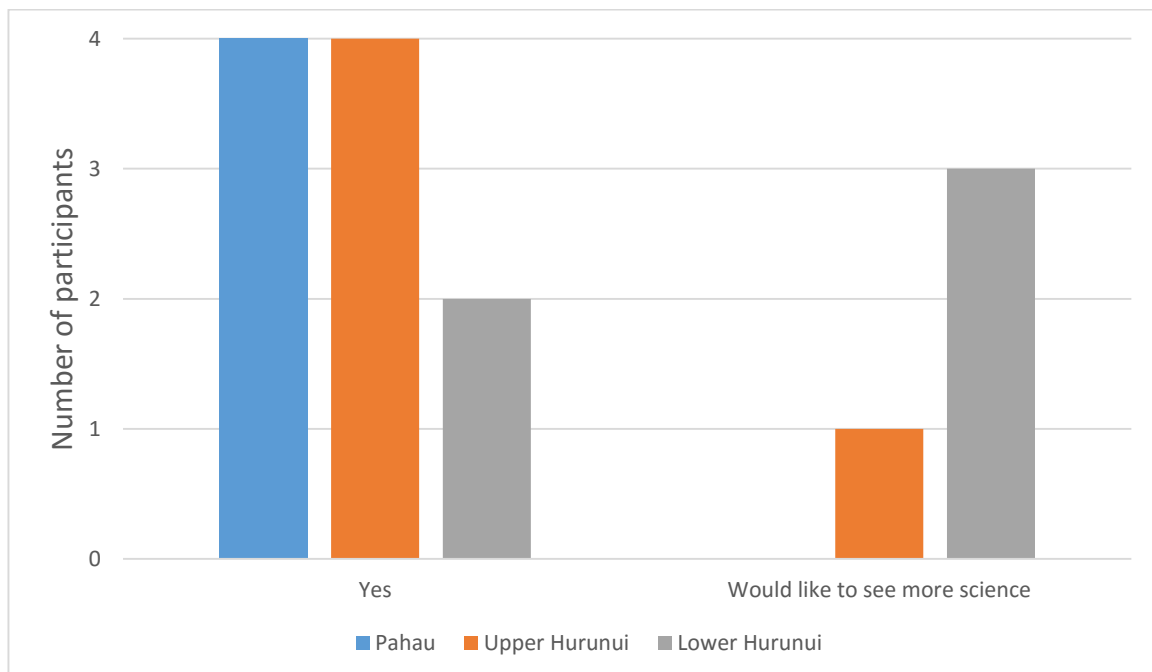


Figure 7: Participants’ willingness to take responsibility for the management of the water quality in the Hurunui River catchment

#### 4.2.4 Zone Committee

Interviewees were asked how they felt about the Zone Committee process: All three participants from the Upper Hurunui area that were asked this question supported the process. In addition, three from both the Pahau River area and the Lower Hurunui area also supported the process. One participant from the Pahau River area thought the process was undemocratic because of the selection and make-up of the Committee members; similar feelings were expressed by two participants from the Lower Hurunui area (see Figure 8). Even among those who did support the Zone Committee process, one from the Pahau River area and two from the Lower Hurunui area were frustrated because nutrient load limits found in the final Regional Plan for the Hurunui River were greater than those suggested by the Zone Committee. Thus, these interviewees felt that although the Zone Committee process itself was a success, they questioned how effective it was when the findings of the Zone Committee still had to pass through the Environment Canterbury Hearing Commissioners. Another of those who supported the Zone Committee process in the Lower Hurunui thought that the process had let the community down by allowing the 10% rule found in the Regional Plan (see Section 2.1.3).

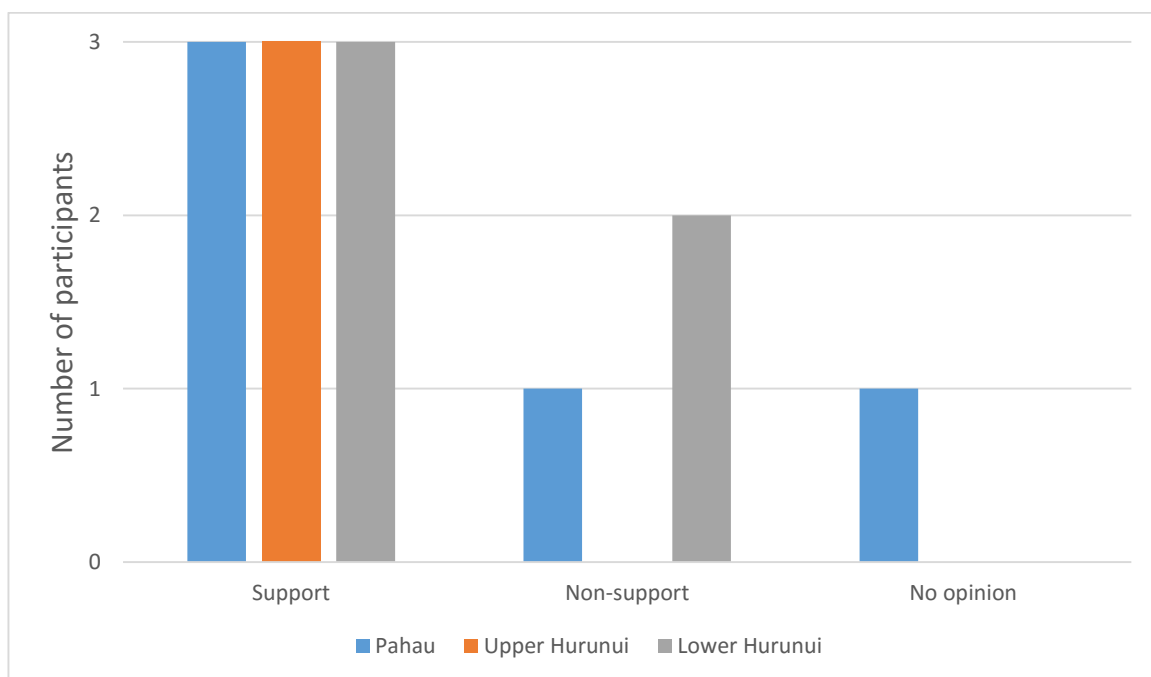


Figure 8: Participants' support for the Zone Committee process in the Hurunui River catchment



The representatives of the environmental groups and rūnanga were asked whether they supported collaborative governance and whether they thought it was working in Canterbury. Participant B responded that the approach has involved the community more than in the past, but continued:

What I'm not so fond of, about collaborative governance, is that there doesn't appear to be environmental bottom lines that have to be adhered to, in that the communities can decide on where levels are set, and more importantly and more dangerously, communities can decide how long it's gonna take them to reach some desired target.

Other participants felt that the Zone Committees were all focused on irrigation and economic benefit, sometimes at the expense of environmental values. One participant queried how truly collaborative the Zone Committee process was seeing the process as "...being kind of fettered at the start and at the end", because the outcomes of the Zone Committee went through "a sort of an approval process through ECan."

#### 4.2.5 Scale

The interview participants were asked about the scale at which they thought the water quality should be managed, for instance whether there should be a catchment-wide approach, a tributary-by-tributary approach or a farm-by-farm approach. Responses varied with only one of the participants reporting that a farm-by-farm approach was the most effective, 11 preferring a catchment scale approach, 11 favouring a tributary-by-tributary approach, and five expressing preference for a combination of approaches (see Figure 9).

Participant D, who supported a catchment approach, explained that he viewed this as the best management approach because "St Leonards Drain over the base of the hills...", which is a spring-fed stream, had high levels of nitrate due to high N loading in the groundwater which feeds the stream. Participant D questioned: "Who can you penalise for that? Do you penalise the farmer that farms against it?" or do you penalise based on numbers produced by a computer model? He concluded "I think that because we're in a geographic boundary everyone farms to the same rule." Similarly the representative from Amuri Irrigation commented:

In my view you've got a catchment, you've got a number of tributaries and a number of land uses in a catchment, we're better to manage that collectively, and you know if there's two problem areas, we're actually better off to pool our resources and spend it on those two problem areas, rather than everyone planting a few trees on their property – pool that money, pull it in and actually spend it where you're going to get the best value for buck in terms of improving water quality.

In contrast to this, Participant E preferred a tributary approach explaining "I like the idea of areas 'cause then you can break it down to see where the problems are..." and identify areas to target to improve water quality. Participant E felt that high emitters should be improving their land use practices, and that the "...the lower emitters shouldn't be going through so much regulation..." This participant summed up their thoughts "...but yeah I prefer the group area, like spreading it down the river to find out where the problems are and perhaps working on the higher emitters." Likewise Participant A also preferred a tributary-based approach. Participant A expressed the idea that other, larger-scale approaches were "too broad" stating that "...you can't make some individual decisions around how you can contribute to maintaining that water quality" if managing at a larger scale.

Of the five participants who suggested that there needed to be a combination of spatial areas considered in a management approach. Participant N's comment was representative of these views, as this interviewee put it:

I mean, it's gonna be a combination of everything but it does have to be reduced to the farm level at some point, and it has to be reduced to the sub-catchment at some point, but the emphasis which is put on each is only going to be relative to the contribution to water quality that each catchment's making.

Participant N commented that if it's established that the catchment isn't farmed intensively, and there were no significant problems "...I imagine the Farm Plans would roll through, the farmer behaviour would be looked at and that catchment would probably be allowed to roll through with a fairly simple management plan." This participant anticipated that where water quality issues were established in the catchment, that there would need to be a concentrated effort at these localities to improve land use practices.

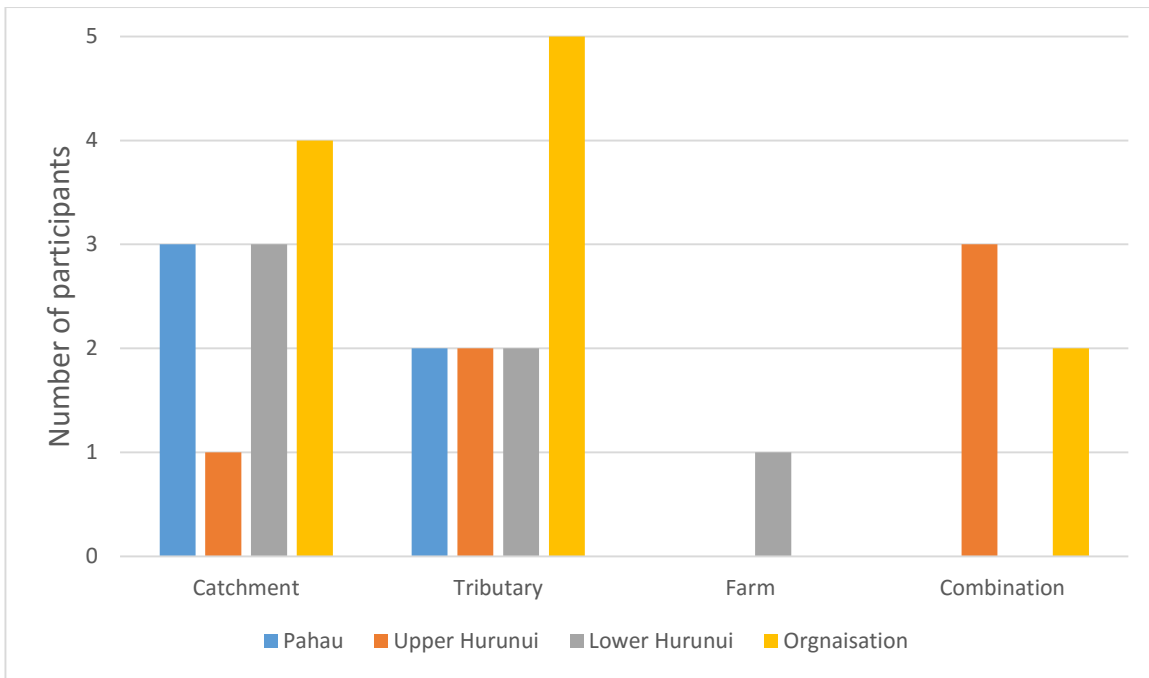


Figure 9: Participants’ preferred scale at which to manage water quality in the Hurunui River catchment

#### 4.2.6 Nutrient trading

When asked whether they supported a nutrient trading scheme, participants’ responses varied with the majority of farmers saying they were unsure about such a programme. Within the representatives of organisations, responses varied: two participants supported nutrient trading; four expressed support but felt it to be something that was needed at a future date; while five did not support nutrient trading at all (see Figure 10).

Of those who supported the nutrient trading concept, Participant C was representative. As Participant C commented: “Well if there’s science around it, it’s probably right isn’t it, because then it will flow efficiently to where it’s best used...” In contrast, the comments of the representative from Ngāi Tahu Properties were representative of those who opposed the scheme. As this participant stated, “...so we’re not interested in nutrient trading, we don’t think it’s an appropriate mechanism for managing N loss in a catchment, and/or for redistributing it...” The representative continued by commenting that a nutrient allowance should not be seen as an allocation, but rather a limit on your activities, asserting: “You don’t

have right to contaminate, they've been giving you some leniency and the limit to contaminate at a certain level, but you've got this overriding obligation to minimise it, and if you can you have to."

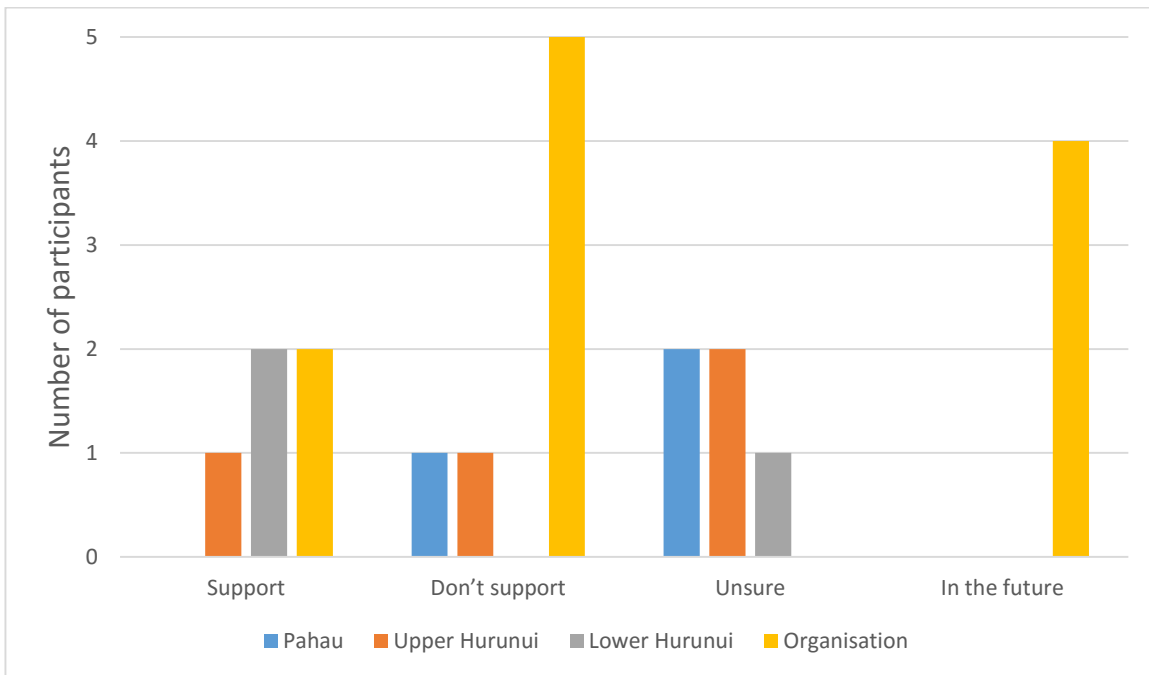


Figure 10: Participants' support for a nutrient trading scheme

#### 4.2.7 Alternative grazing

On the question of the use of herd homes, or feed pads to reduce nutrient leaching, all but one of the representatives from the organisations were supportive of their use. As the representative from Fish and Game commented: "Yip, supportive of infrastructure that ultimately allows the farm to be more sustainable." In contrast, the farmers' responses varied, with two participants from the Upper and Lower Hurunui areas supporting the use of herd homes, and one from the Pahau River area supporting them. Two participants from the Upper Hurunui area and one from the Lower Hurunui area were unsure of how they felt about the use of herd homes or feed pads, while two participants from the Pahau River, two from the Lower Hurunui and one from the Upper Hurunui areas did not support their use (see Figure 11). Of those who did not support the use of herd homes, Participant O's comments were representative, stating that putting cows in a herd home was "...just stupid, 'cause it's not profitable and actually we'd go broke...", this participant commented that within New Zealand those who did operate

herd homes make no money because “...their costs of production are too high to sustain a variable pay out.”

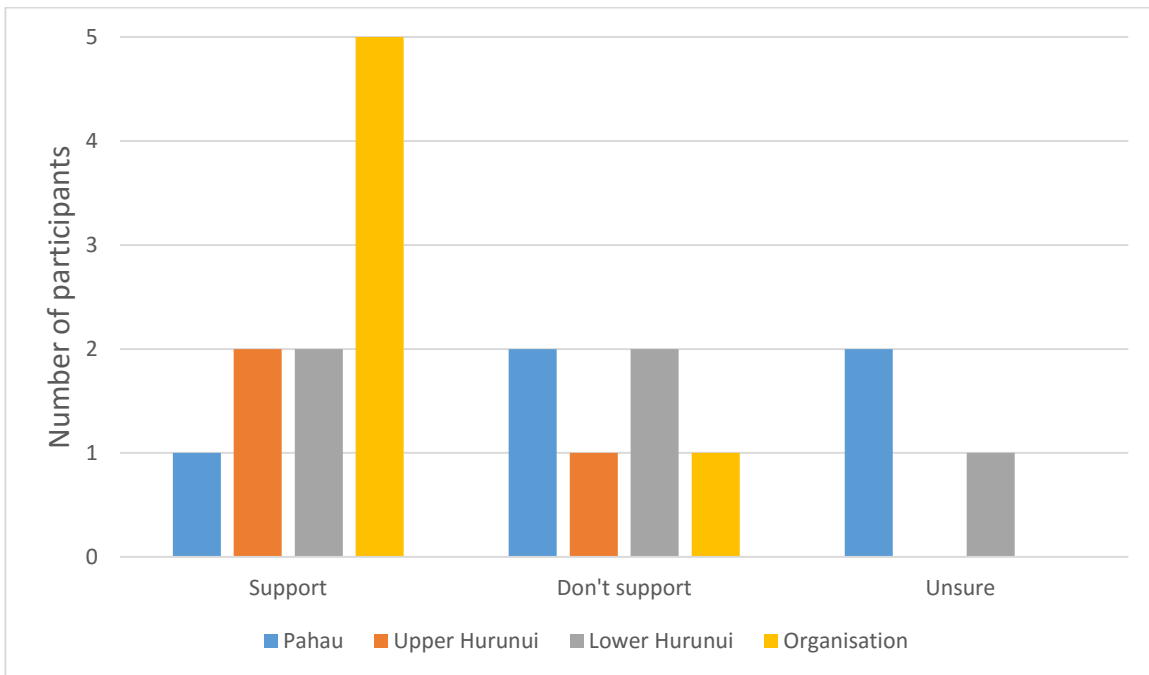


Figure 11: Participants’ support of the use of feed pads or herd homes in the Hurunui River catchment

#### 4.2.8 Stock densities

Eighteen participants were asked whether they could foresee a reduction in stock densities in the catchment if water quality was not improved. The two participants who were asked this question in the Pahau River area both responded that they thought stock reductions may have to be an option. In the Upper Hurunui area all five participants responded that stock reductions may be an option in the long term. However, among sheep and beef farmers the feeling was that the problem lay with the high intensive dairy farmers. An example of this sentiment was provided when sheep and beef farmer Participant K, who agreed that stock reductions may have to occur, answered: “Not me. Well again it comes back to if I’ve got seven it’s not my problem!” alluding to his low Overseer leaching number. In the Lower Hurunui area, one participant responded that they would support reducing stock numbers in the catchment, while the other two farmers in this area did not support this. Of the representatives

interviewed from the organisations, an equal number of participants were supportive and unsupportive of reducing stock numbers in the catchment (see Figure 12). One of those who did not support reducing stock, Participant A, stated: “My own view is I think science will overcome a lot of that.” Participant A went on to discuss the potential for technology to provide solutions for leaching of nutrients.

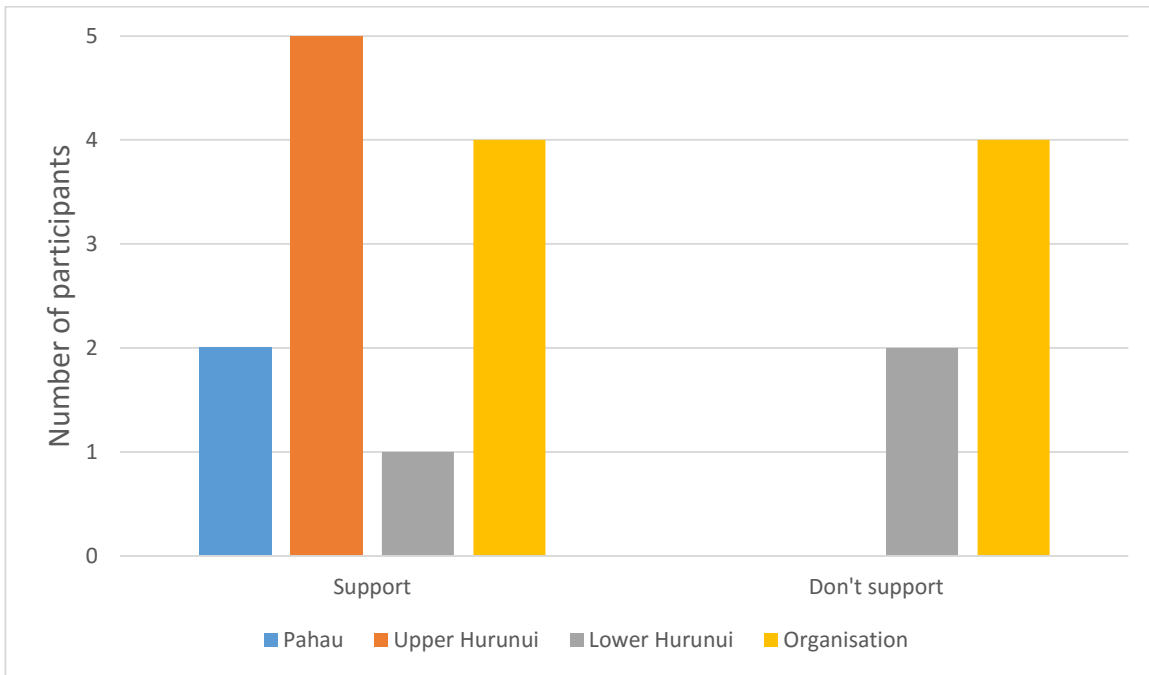


Figure 12: Participants’ support for stock reductions in the Hurunui River catchment if water quality deteriorates

#### 4.2.9 Mitigation

Sub-catchment scale mitigation measures may come in the form of wetlands or sediment traps. Participants were asked whether they supported such measures if the geographical features permitted. All participants from all areas supported the use of mitigation tools (see Figure 13). Several participants commented that before any mitigation measures were implemented an initial step would be for farmers to adopt best practice, and develop FEPs. Farm Environment Plans should identify on-farm hot spots, and whether the landscape features allow farm-scale wetlands, sediment traps or other more applicable mitigation measures.

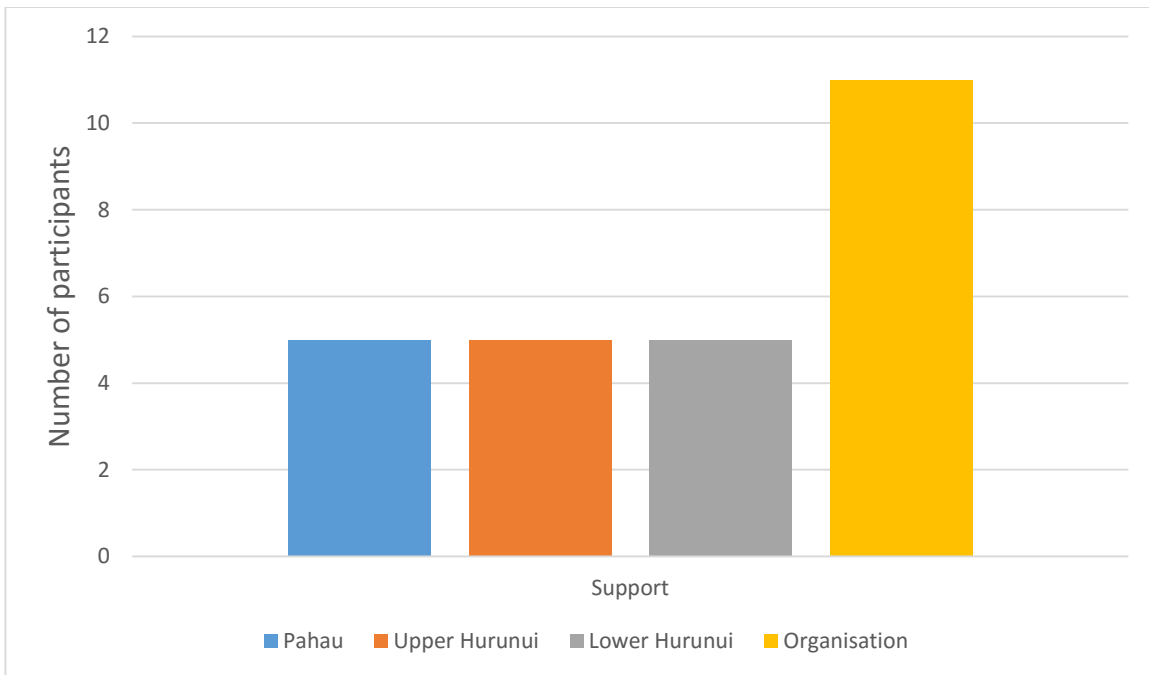


Figure 13: Participants' support for sub-catchment scale mitigation tools such as sediment traps or wetlands in the Hurunui River catchment

Beyond best practice, other mitigation tools may be required to further minimise adverse effects on the environment. These could be larger sub-catchment scale wetlands or sediment traps. The Amuri Irrigation representative for example explained their perspective:

Our initial focus is to adopt good management practice and achieve high irrigation efficiency to reduce nutrient loss into water through farm plans. The implementation of our EMS with farm plans may be sufficient to improve water quality significantly. If not, there may be opportunities to pump water from tributary systems with high nutrient concentrations to improve mainstem water quality. We will continue to monitor tributary streams and assess the success of the EMS.

### 4.3 Audited self-management

In this section the stakeholders' opinions relating to their support of the ASM concept, management collectives and farm environment plans are outlined. Also included in this section are stakeholders' opinions relating to achieving water quality targets, water quality monitoring, scientific understanding and whether ASM should link with other industry schemes.

#### 4.3.1 Support for audited self-management

Participants were asked whether they supported the audited self-management approach suggested in the Regional Plan. In total, 23 participants supported the ASM approach, with four opposed to it, and one being unsure. In the Pahau River area, four farmers supported ASM, with one being unsure saying "...to me I don't like making opinions on things that you haven't tried." Similarly, in the Upper Hurunui area, five supported the ASM approach, but in this area one did not as they felt that ASM was "open to manipulation." One of those who supported the ASM approach, Participant H, remarked that the system was "...better than probably being regulated..." and it was "a clever way for the council for doing it and keeping their costs down." In the Lower Hurunui area, four supported the ASM approach and two were opposed to it, with Participant J commenting about ASM: "Waste of time, waste of time!" Participant J thought that farmers wanted to do the right thing, remarking: "why not have a system that we used to have where you could have advisors come out that are connected with ECan – they were called Resource Care?" Of the representatives from the organisations, 10 supported the ASM approach, while one did not and questioned the robustness of the audits - a concern shared by several of the participants (see Figure 14). Participant A answered that he felt the ASM approach is a good management approach as long as farmers' confidence is obtained so that they can come together and actually make "...some decisions themselves."



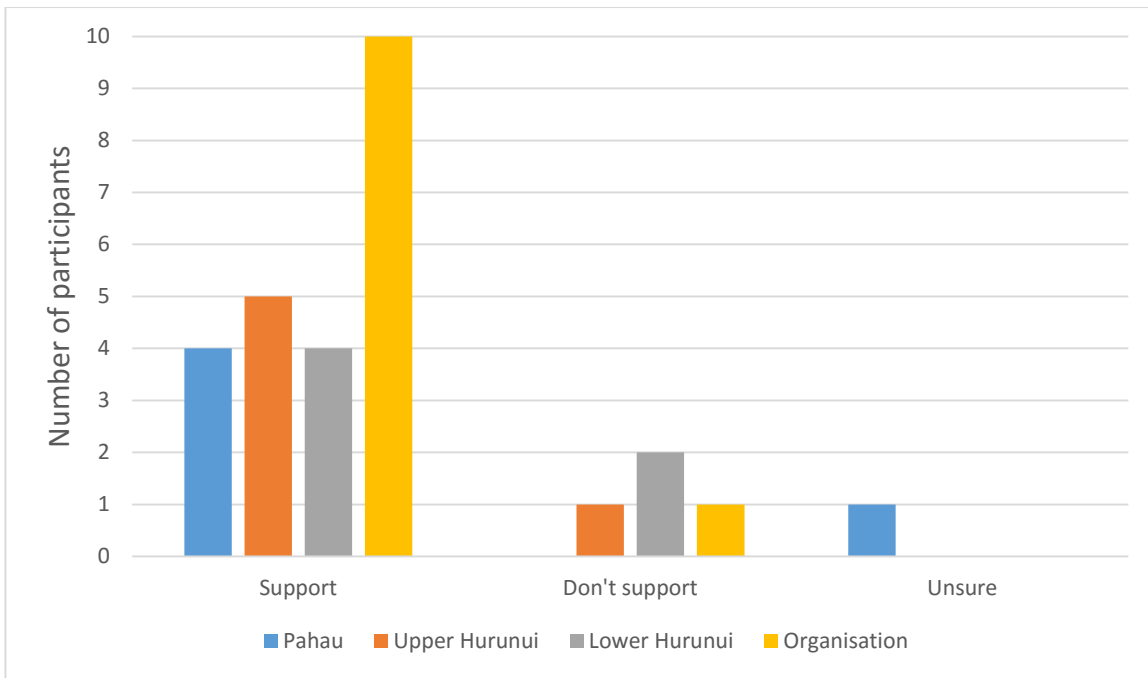


Figure 14: Participants’ support of an audited self-management approach for the management of water quality in the Hurunui River catchment

#### 4.3.2 Management collectives

The farmers were asked what they thought of management collectives and, for those farmers who were not shareholders of the Amuri Irrigation Company, whether they would be prepared to join a catchment group, or collective. For the most part farmers responded positively, with all in the Pahau River and Upper Hurunui areas supporting management collectives. In the Lower Hurunui area, five farmers supported the management collective concept, and one did not (see Figure 15). When asked what this farmer thought about the concept, this farmer quipped: “The one where we pit farmers against farmers and dob each other in if [they] step out of line – is that the one you mean?” Another farmer from the Lower Hurunui area, who although supportive commented that some farmers have different blocks of land in different areas, so under the current legislation such farmers would have to join several c management collectives. This farmer suggested that a better way to set up the management collectives would be for those who wanted to have input to be able to “join voluntary” rather than being compelled to join, as this farmer viewed was currently the case under the Regional Plan. This was reiterated by Participant E who while supporting the management collective concept commenting: “You can’t beat

working together, it's just the berries you know..." However, Participant E also cautioned: "...but don't tell us we have to do it or you're out. Because I think you'll end up with a huge backlash."

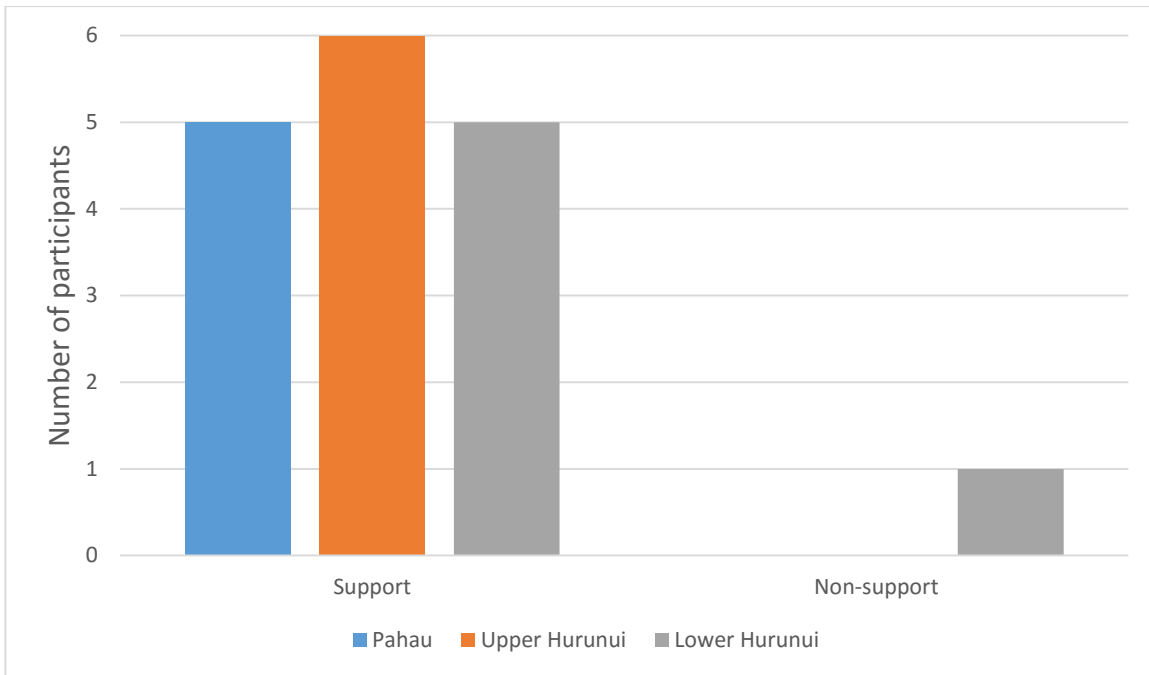


Figure 15: Participants' support for the management collective concept in managing water quality in the Hurunui River catchment

#### 4.3.3 Farm Environment Plans

Farmers were asked whether they had been through the process of developing a Farm Environment Plan (FEP). In both the Pahau River and Upper Hurunui areas some farmers had and some had not developed a FEP, whereas in the Lower Hurunui area no farmers had developed a FEP at the time of the interviews (see Figure 16). Those who had developed a FEP were asked if they found the process beneficial. The responses varied with participant P commenting that it was better to be part of the solution "rather than someone turning up and saying you do this, this and this, it's probably better to more solutions focussed."

In contrast Participant O commented on the development of their farm's FEP that it was "less useful to me than it could be, it's quite shallow." Participant O expanded:

No they're ticking off the obvious things, so you know you've got your waterways fenced and you're not doing anything grossly bad, but it's a very shallow at this stage, and I guess it will develop, but you can, you can see that when they collate it there's gonna be some cool numbers that they can give to the media. You know, it's a, it's a publicity thing.

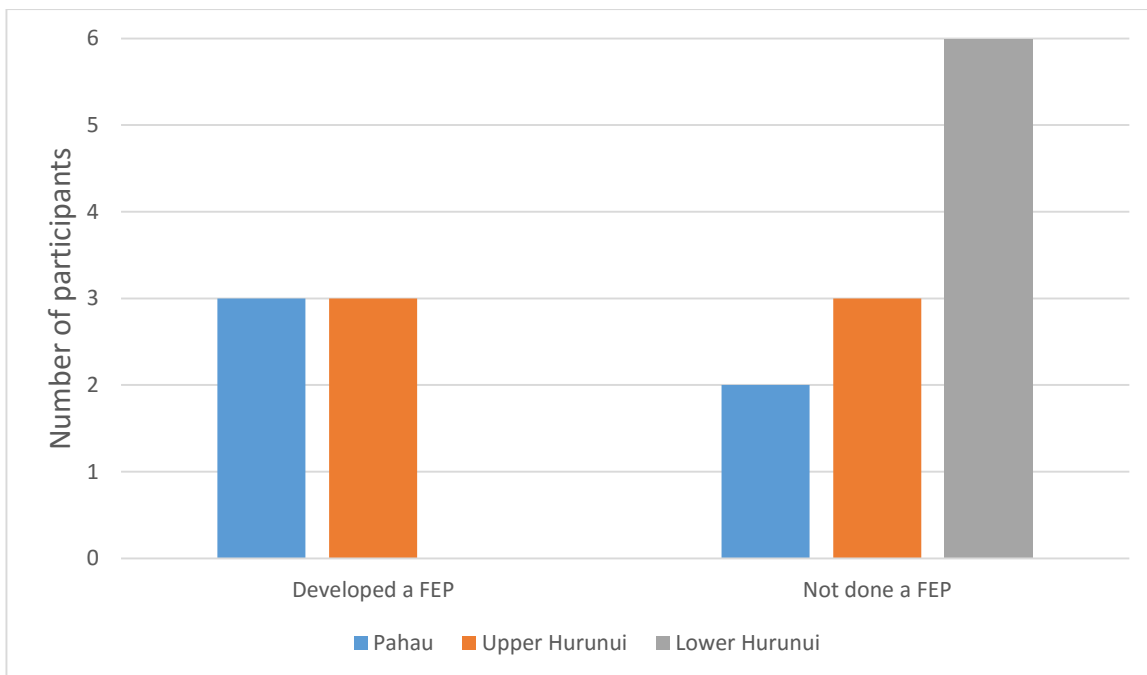


Figure 16: Participants who had developed a Farm Environment Plan (FEP) in the Hurunui River catchment

#### 4.3.4 Type of data required

Participants were asked what type of data they would need to meet nutrient limits set in the Regional Plan. Participants' responses varied, with the majority reporting that they either already had, or would want, accurate soil mapping of their farms. The other common response was a requirement for soil moisture strips, or probes. Several representatives from the organisations talked about grouping data within areas to try to save costs. The representatives expressed a feeling that rather than all farmers having to have several moisture strips on their farm, perhaps some modelling could be done based on representative catchment sites, each of which would have a moisture strip from which farmers could obtain data, thus allowing them access to soil moisture data without the high set up costs, and allowing

them to irrigate efficiently. The representative from Amuri Irrigation talked about finding a balance between “...everyone getting a soil moisture strip and investing in some weather stations and some really good representative sites that you can then use.” Other respondents favoured more accurate rainfall data being provided, collecting soil temperature data, making sure GPS was used for fertiliser application, and gaining more water quality monitoring data. One farmer also talked about wanting to have more up-to-date information on what different crops leach at the root zone on differing soil types.

#### 4.3.5 Water quality monitoring

An issue that arose in most of the interviews, not through questioning, but rather in discussion, was the need for more water quality monitoring sites. Interestingly this point arose in only one of the interviews with participants from the Pahau River area, but in interviews with three participants from the Upper Hurunui area and with all six participants from the Lower Hurunui area. In all cases, the participants were supportive of more monitoring. Among the representatives of the organisations, 10 supported more monitoring sites. Several participants also suggested they would consider undertaking their own on-farm water quality monitoring. Of these, one was from the Pahau River area, and there were two from both the Upper Hurunui and Lower Hurunui areas (see Figure 17).

The representative from Environment Canterbury expressed the opinion that there was a place “for collectives to be actually undertaking some of their own monitoring.” This same sentiment was shared by many of the participants, for example eight of the representatives from the organisations expressed this same idea. Interestingly, in the Lower Hurunui area, one farmer expressed willingness to contribute money so that the management collective could do further water quality monitoring. Two other participants indicated the desire to do monitoring if there were inexpensive tools available to them. Participant B looks forward to “...lots of catchment groups, taking ownership of their own catchment and having relatively inexpensive tools that allow them to do their own monitoring.” This participant felt there were positive benefits in involving the community, commenting “... ownership is a wonderful thing, and I think that’s where you’d start seeing some peer pressure coming on to say, ‘...what did cause that spike last month, what was going on in our little local group?’”

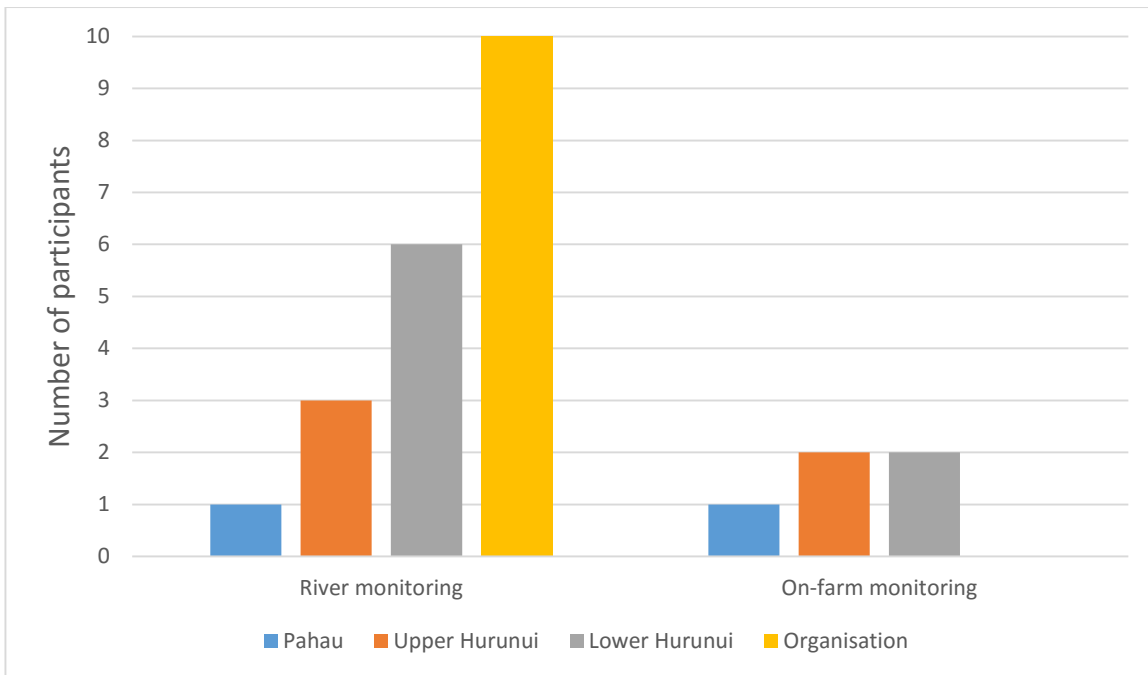


Figure 17: Number of participants in the Hurunui River catchment indicating that they would like more river and on-farm water quality monitoring

In contrast, one farmer, Participant C, who was not in favour of management collectives pooling resources and undertaking their own monitoring questioned: “Don’t we pay for that in our rates?” and continued “...I mean, we’re paying more and more and more for less and less and less and it’s just...you know the costs are going crazy aren’t they and there’s just double-ups everywhere you look...”

#### 4.3.6 Scientific understanding

Another topic that was brought up regularly in the interviews, but was not asked specifically was that there was further scientific understanding needed to ensure robust nutrient limits were in place, and for the overall understanding of how nutrients reached and affected the rivers and streams in the catchment. For instance, Participant C showed some concern over the setting of nutrient levels stating that “the science around the nitrates ah...yeah the nitrate levels is reasonably robust it sounds. But around P it doesn’t sound like it’s robust at all.” Similarly, when talking about nutrient limits Participant F commented that “...it’s got to be based on science, can’t be based on emotion”, and Participant E stated “I mean you can’t argue proof and science can you?” In total one participant from the Pahau River

area talked about the need for more scientific research into nutrient levels, while in the Upper Hurunui area, three participants talked of the need for further scientific understanding. In contrast, in the Lower Hurunui area all six participants emphasised the need for more scientific research (see Figure 18).

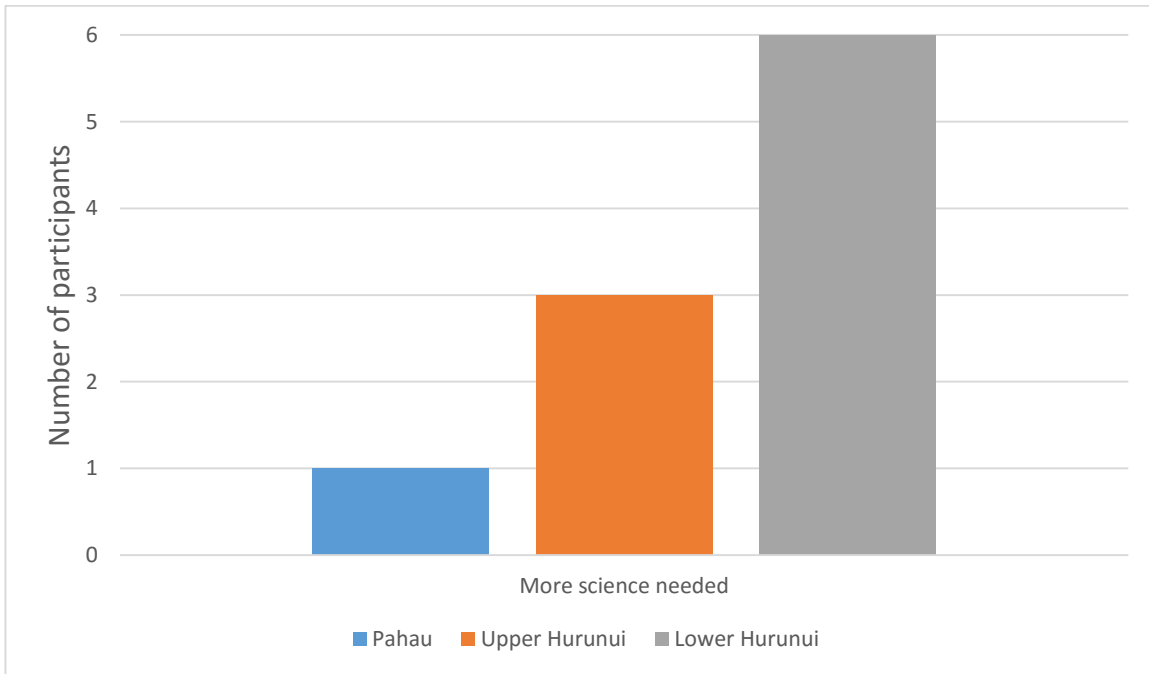


Figure 18: Number of participants who saw the need for more scientific understanding surrounding water quality limits in the Hurunui River catchment

#### 4.3.7 Linking with other industry schemes

Several of the representatives of organisations were asked whether they felt an ASM approach should be linked with other industry schemes. All those who were asked this question answered in the affirmative, emphasising that there needed to be a concentrated effort to minimise farmers having several different audits per year effectively covering the same or similar things. In this regard, it was interesting to note that both Amuri Irrigation and Dairy NZ indicated they were working alongside Fonterra in the Culverden Basin.

## 4.4 Audits and Enforcement

In this section the participants' view relating to the independence of auditors, audit results, how to deal with conflict within a collective, enforcement, incentive programmes and dealing with conflict between management collectives are presented.

### 4.4.1 Independence of auditors

The interview participants were asked whether they would like to see auditors of the FEPs being totally independent, partially independent, or if they had another preference. Responses to this line of questioning varied greatly, with several participants in each geographical area being unsure, and others questioning how independent an independent auditor would be. The Fish and Game representative felt that "...the main thing is that [auditors] are trained appropriately and then you're going to have to have some sort of auditing of the auditors basically." Whereas, in discussing the on-farm audit, the Irrigation NZ representative commented that "...whoever does the auditing has got to be independent of the farm full-stop." It was the preference of the Dairy NZ representative that the "on-farm auditing component [would] sit with a professional auditing organisation." Five of the representatives from the organisations also talked about there being a need for an audit of the collectives themselves, in order to be certain that their Environmental Management Strategies and the implementation of them are fit for purpose.

Participants' responses to the question surrounding the independence of auditors for the on-farm audit can be seen in Figure 19. In the Pahau River area, one participant thought the auditor should be totally independent, two thought they should be semi-independent (i.e. independent from the farm, but not necessarily from the collective), and one was unsure. In the Upper Hurunui area, one participant thought the auditor should be semi-independent, one maintained they should be totally independent (e.g. a consultant), and two were unsure. In the Lower Hurunui area one thought the auditor should be totally independent, one thought audits should be undertaken by Environment Canterbury, and two were unsure. Finally in regard to representatives from the organisations, two favoured total independence, two semi-independence, one thought audits should be undertaken by Environment Canterbury and two were unsure.

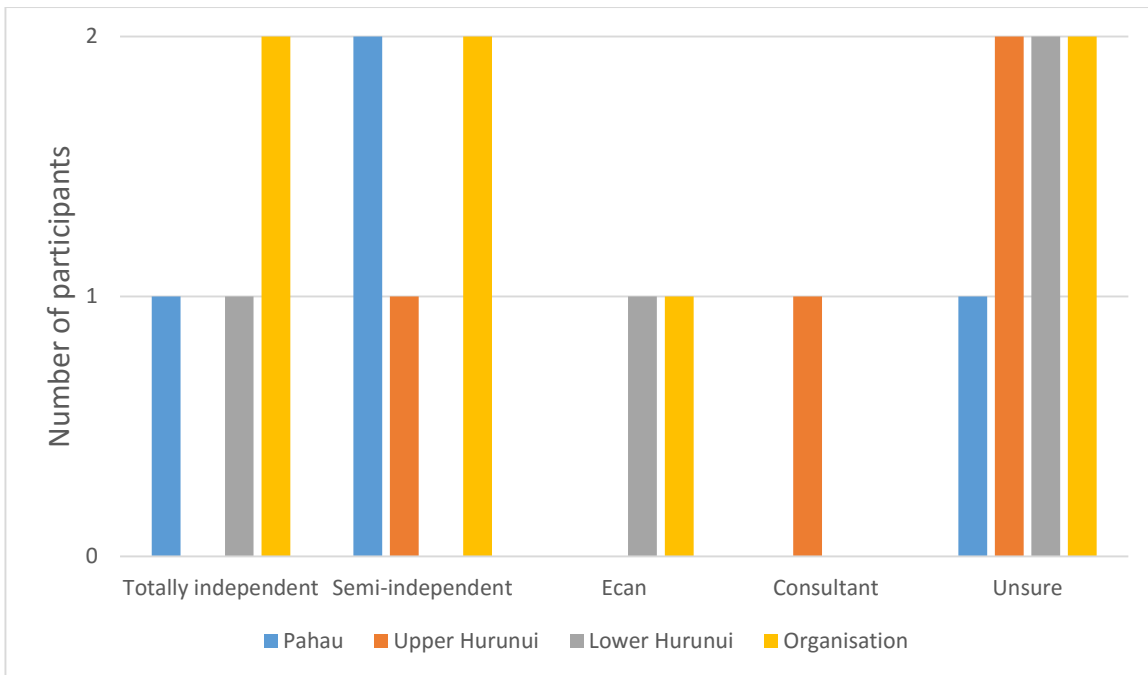


Figure 19: Participants’ preferences for who they think should audit the Farm Environment Plans as part of an audited self-management approach in the Hurunui River catchment

#### 4.4.2 Audit results

Participants were asked whether they thought the results of the audits should be made publicly available with each farm’s performance being open to the public, or whether only a summary of the management collective’s performance should be made publicly available. They were also asked whether they had any other suggestions regarding the publishing of audit results. Of the participants in the Pahau River area, four wanted a summary of the results to be made publicly available, and one wanted to keep them in-house. In the Upper Hurunui area, one participant wanted the results to be made publicly available, another preferred that a summary be made publicly available, two thought they should be kept in-house, and one was unsure. In the Lower Hurunui two participants maintained that only a summary of the results should be made publicly available, another felt the audit results should be made publicly available in their entirety, while one was unsure. Of the representatives from the organisations, seven expressed the view that only a summary report should be made available publicly and one preferred to keep data in-house (see Figure 20).



Of those who thought the audit results should be made publicly available Participant G’s remarks were representative, commenting that the audit results have got to be made publicly available “...otherwise people aren’t going to adhere to it quite as much.” Participant N raised an interesting point in favour of the public availability of audits stating that “...basically if you’ve got someone that’s a non-conforming property continually, if that property was ever sold, the purchaser would quite like to know that it was a non-conforming property.”

In contrast, several parties thought the audits should not be made publicly available. Participant B stated:

Oh I don’t know about publicly available, um there’s two aspects of it there’s your personal data, and there’s the metadata, that 80% of the farmers are hopping, skipping and jumping and the rest of them are swimming. So I think some of your personal data needs to be contained for privacy reasons...

This issue of privacy was raised by several of the participants. Participant A expressed concern that the Regional Council, upon obtaining information under an ASM approach “...can then turn around and use that information against you.”

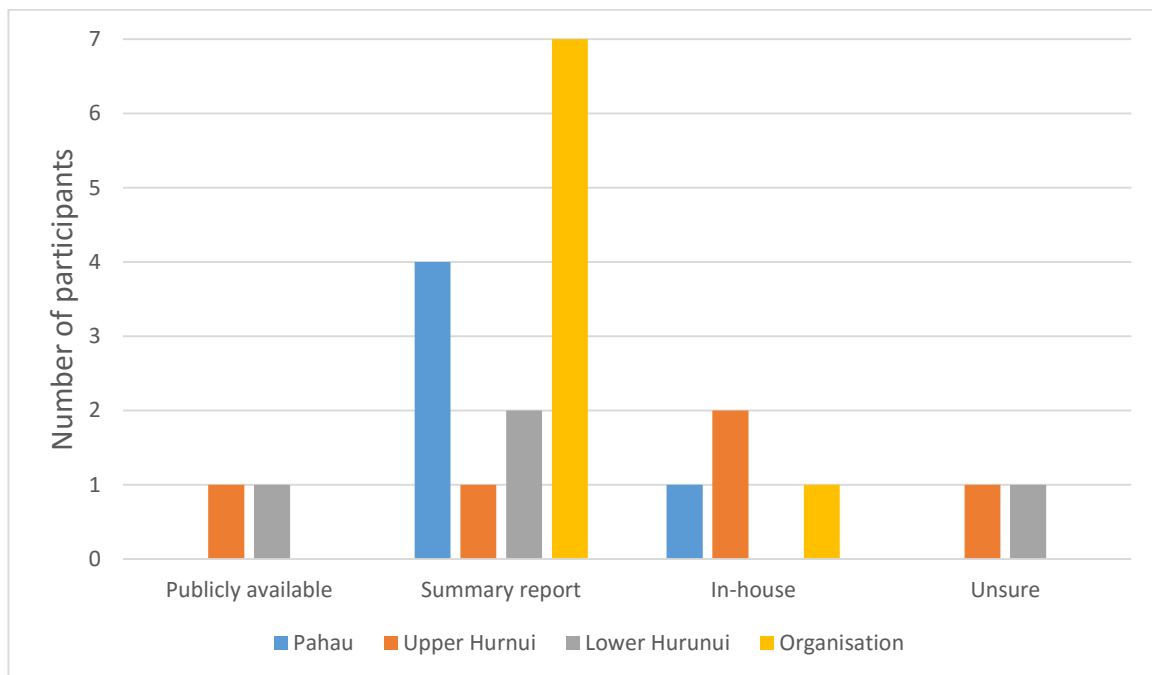


Figure 20: Participants’ opinions on whether audit results should be made publicly available

#### 4.4.3 Dealing with conflict within a collective

Participants were asked whether they would support a public complaints process, and if so, how that should operate in cases where farmers were not following best practice and how potential conflict between farmers could best be resolved. All five farmers from the Pahau River area responded that they thought monthly meetings of farmers was the best way to deal with problems, relying on peer pressure in order for resolutions to be reached. Participant H responded to the question as to whether farmers like meetings with other farmers positively, stating that “[a]ll dairy farmers through Fonterra and that definitely do, ‘cause we don’t need any scandals you don’t need any negatives you know.” Interestingly Participant H had misgivings about the current public complaints measure, that of the ECan hotline commenting that “...someone can complain, without disclosing who they are or whatever. So all it does is breed distrust.” Among participants from the Upper Hurunui area, three supported meetings of farmers to discuss how best to work through issues and put peer pressure on farmers who were not performing at best practice, while one supported having a sub-committee of the management collective to report problems to. In the Lower Hurunui area, one participant supported a sub-committee of the management collective, one supported monthly meetings of farmers, and two preferred reporting to Environment Canterbury – as ECan would have more authority to penalise farmers who were not operating at best practice. Several participants did not like the idea of farmers telling other farmers what to do. For instance, Participant G was against such a practice “[b]ecause then you’ll get that real hate, farmer against farmer thing happening.” Of the representatives of the organisations, three supported sub-catchment committees, three favoured meetings of farmers and two preferred reporting directly to ECan (see Figure 21).

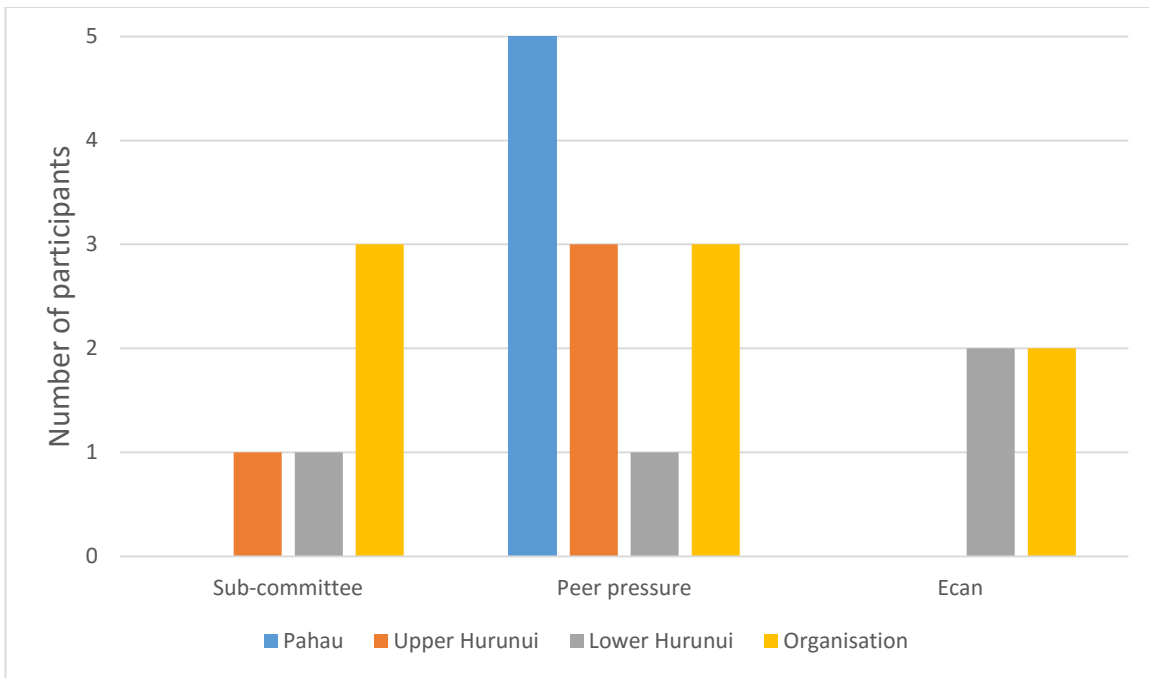


Figure 21: Participants’ preferences as to how best to deal with farmers who were not operating at best practice

#### 4.4.4 Sanctions

Interview participants were asked whether they would support some flexibility in imposing sanctions. For example, if a farmer was not operating at best practice in a particular area, whether they would be willing to allow the individual time to adopt best practice. Suggested examples included increasing audit frequency from one year to every six months, and if the farmer still did not adopt best practice, other increasingly severe measures such as restricting irrigation water supply, and with an extreme measure of the farmer being asked to leave the collective and being refused irrigation water altogether. The participants’ responses for all areas were similar- with the majority supporting increasing the severity of sanctions and giving farmers a chance to change farming practices in order to adopt best practice (see Figure 22). One participant thought that there should be no increasing severity in the level of sanctions, but rather felt that coming down harshly on infringers would send a message to other land users. Participant I remarked that “[i]t should be bang because it would send a message to all the other farmers. Don’t do this, because, I mean if it was really big bang, people would be too scared.”

One other interviewee did not support sanctions at all. Participant F argued that the odd land user may not take up best practice, but “if things work and they’re practical and sensible, people are going to take them up.” If measures are not practical and sensible Participant F asserted that “...you’re going to get people’s backs up and they’re not going to take them up.” This participant went on to say that people should not “worry about the slacker...” as “...they’re not there forever - things change.”

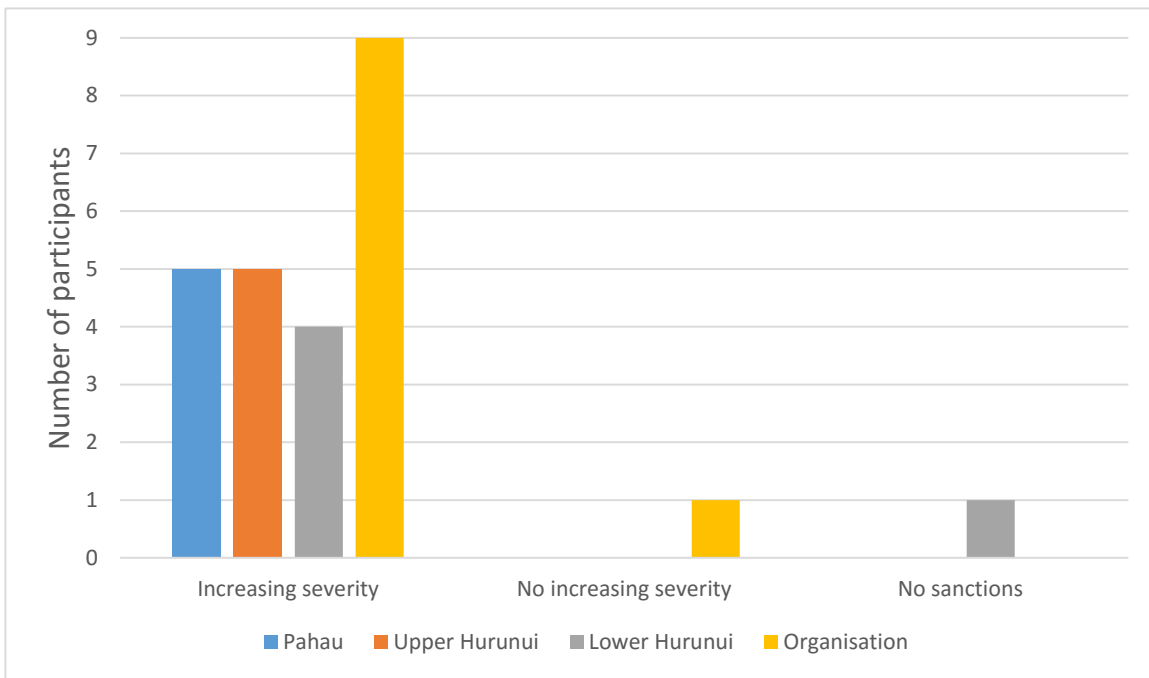


Figure 22: Participants’ preferences relating to an increasing severity of sanctions for land users who are not moving to best practice in the Hurunui River catchment

One of the representatives from the organisations, Participant B, had specific views on the frequency of audits. Participant B stated: “I think a larger number of them need to be audited in the first year, than subsequent years...” and if there are positive results or an improving trend, that the “...the frequency of audits could fall off, but I think there needs to be a certain amount of randomness about it.”

#### 4.4.5 Incentive programmes

Participants were questioned about whether they would support an incentive programme if one were available to encourage resource users operating at best practice. The specific nature of the incentive programme is unknown, but participants were directed to the Synlait milk incentive programme as an example, in which a premium is paid for milk to farmers who operate using best management practices. Several participants mentioned that a similar type of incentive programme to Synlait's scheme may possibly be able to be offered through meat companies, or perhaps through fertilisers companies. The responses to this line of questioning varied, with three of the four participants who were asked this question in the Pahau River area supporting incentives; in the Upper Hurunui area two participants supported them, and three did not; and in the Lower Hurunui area two supported incentives and one did not. Of the organisations eight participants supported incentives, and one did not (see Figure 23).

As can be seen from Figure 23 not all participants supported incentive programmes. Some were not interested in monetary incentives, but preferred other measures, which to them are more valuable. For example Participant N commented:

I prefer that if there was an incentive or a subsidy it's really got to come in the form of science and really gauging what's happening in the catchment. Good communication strategies on behalf of the farmers you know. That would be the good subsidy. That would be the good incentive for a start.

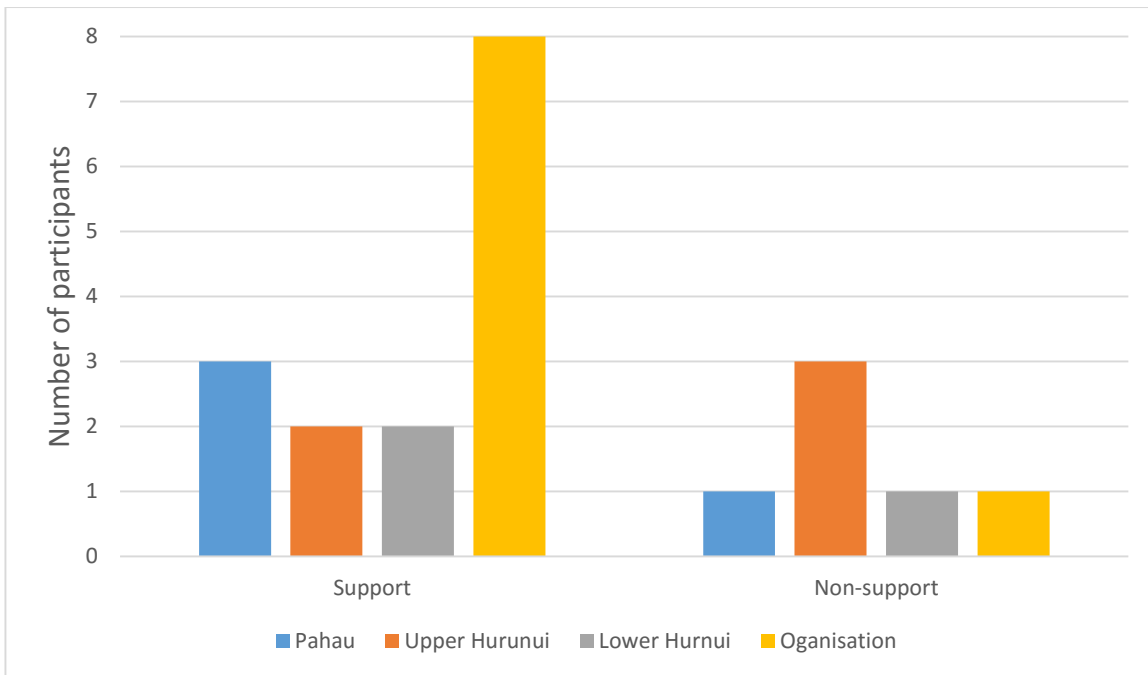


Figure 23: Participants’ support of incentive programmes under the application of an ASM approach to water management in the Hurunui River catchment

Participant H suggested a further different form of incentivising. Participant H commented that the “incentive is the passion and the pride” of being a dairy farmer, and living “in a nice environment” and being able to employ many different people to work on the farm. Similarly Participant L discussed being able to meet face-to-face in a management collective and talk over farming strategies and share ideas and commented “I’d believe that would have the most positive benefits for everyone.” Yet another participant, who was a dairy support farmer, believed the real incentive was the pride in doing a good job and getting paid more for cows in a better condition after wintering.

#### 4.4.6 Conflict between management collectives

Participants were asked how they thought conflict between management collectives could be resolved. In the Pahau River area while one participant was unsure, three responded that the best way to deal with conflict was to work things out together. Participant P’s response was typical, stating “...we may have to do some giving, a wee bit of giving, but perhaps it’s better to try and sort it out than have it sorted for you.” In the Upper Hurunui area, four participants stated that the best way to resolve conflict

was to work things out together. Again one was unsure, Participant K commented: “...you know our social time is in the community, and if we start pitching catchment groups against other groups, you know the haves and the have nots. It’s very divisive.” This participant feared that “...the collaborative approach is not going to work, because it’s gonna pitch them against us, it’s gonna divide.” In the Lower Hurunui area only two participants were asked this question and both responded that the best way to resolve conflict was through Environment Canterbury. Of the representatives from the organisations, three thought working through things together was the best way to resolve conflict, and four thought the best way was through appeals process to the Environment Court. For example the Irrigation NZ representative commented: “I suppose ECan’s the first point of call, you’ve got your Zone Committee” to help with mediation, but ultimately “...it’s going to come down to the Environment Court if it’s that serious” (see Figure 24).

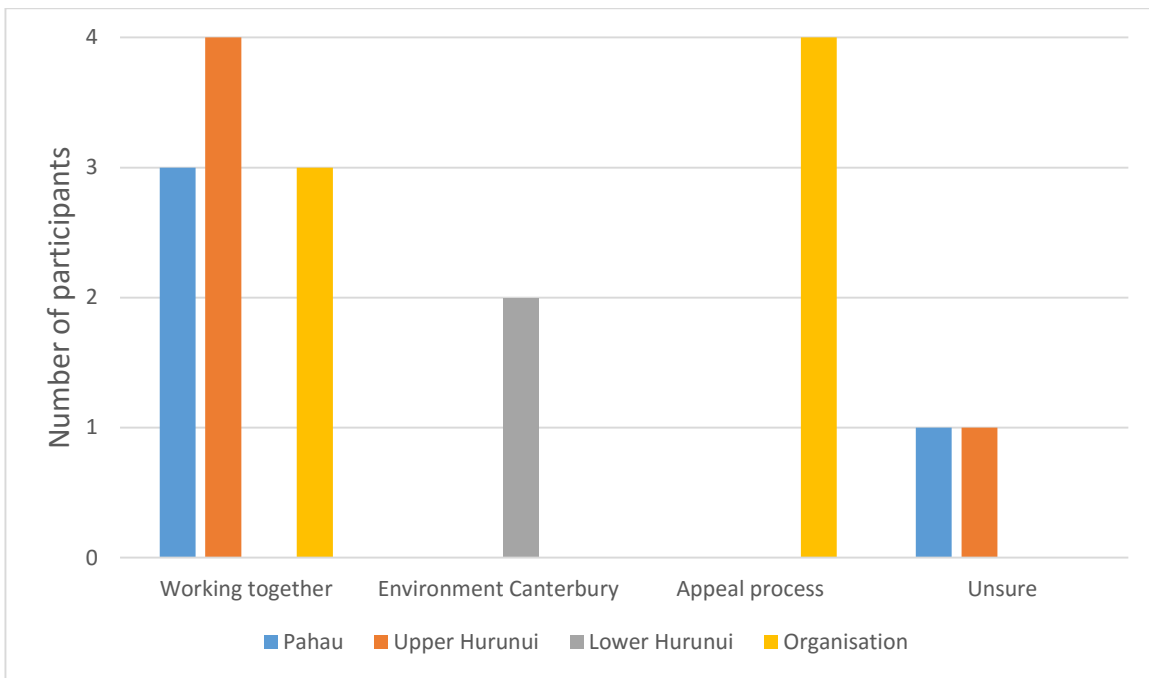


Figure 24: Participants’ opinions on the most effective ways to deal with conflict between collectives in the application of an ASM approach for water management in the Hurunui River catchment

## 4.5 Nutrient allocation

This section explores the participants' opinions relating to nutrient issues including those of headroom, and nutrient allocation.

### 4.5.1 Headroom

Farming participants were asked whether they were willing to improve their land use practices to create 'headroom' in nutrient limits, which would allow for further intensification in the catchment, and if so what they thought should happen to this headroom. In the Pahau River area while one participant was unsure what should happen to any headroom created, four participants responded that they should keep it. For example Participant O commented: "Well why would I create headroom if I was just going to give it to someone else?" Participant D, who shared this view, expressed concerns that both dryland and dairy farmers were "...in the same boat that we need to increase production by 4% every year just to keep up with inflation." This participant felt the technical skills were lacking to be able to efficiently halve nutrient loads and share the reductions around the catchment and still remain profitable. In exasperation Participant D remarked: "So what's the point in half irrigating our place to go and half irrigate another place? And virtually you make both the places uneconomic."

In the Upper Hurunui area two participants thought the best idea was for any headroom created to be pooled for the overall use of the catchment, three participants were unsure what should happen to any headroom created, and one thought any gains should not be used for agriculture but were good for the environment. Participant L stated that if you can put in place best practice to get nutrient leaching rates down and if they are under the limits "... well that's a win for the environment!"

In the Lower Hurunui area three participants thought any headroom created should be pooled for the entire catchment. Participant G's comments were typical of these respondents. Participant G thought any headroom created "...should go into a pool for everybody in the future to be able to apply for, or to be able to get more production." In this area one participant was unsure about what could be done with any headroom that was created, and one thought any gains should not be used for agricultural purposes but were good for the environment. In this regard Participant J asserted that the concept of 'headroom'



should never have been introduced, explaining because “...then everyone starts thinking well I want some of that headroom, whereas no one owns that headroom.” Participant J maintained that the introduction of the ‘headroom’ concept had shifted the focus in the catchment, continuing: “...it’s shifted the focus, the focus should be on best practice on the farm and adopting practices that are good for the environment, it’s shifted the focus about oh we’ll do those things because we’ll create headroom and then we can expand more!” (See Figure 25).

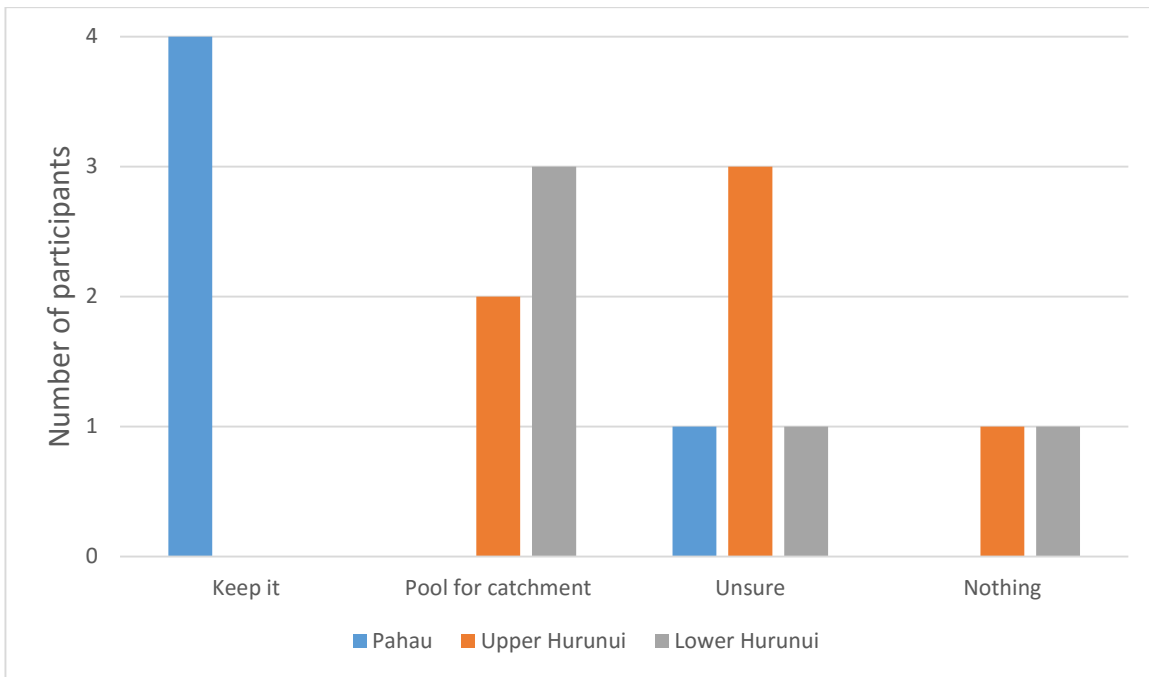


Figure 25: Participants’ opinions on what should happen to any headroom which is created in the Hurunui River catchment

#### 4.5.2 Nutrient allocation

Participants were asked how they would prefer the nutrients to be allocated in the catchment. In the Pahau River area all five participants were unsure. In the Upper Hurunui area three participants were unsure, two supported the idea that everyone should move to best practice according to their current farming type, and one thought there should be a grand parenting approach. In contrast in the Lower Hurunui area all six participants preferred a nutrient allocation model based on best practice and soil and rainfall values. Among the representatives from the organisations, two participants were unsure

which nutrient allocation model they preferred, and seven thought adopting a best management practice model was the preferable option (see Figure 26).

It is interesting to note that the subject of best management practices or good management came up in 23 of the 28 interviews. This seems to reflect the overall feeling in the catchment at the time of the interviews. At this time there was a lot of uncertainty surrounding the 10% rule in the Regional Plan, with dryland farmers engaging to ensure they have flexibility to intensify.

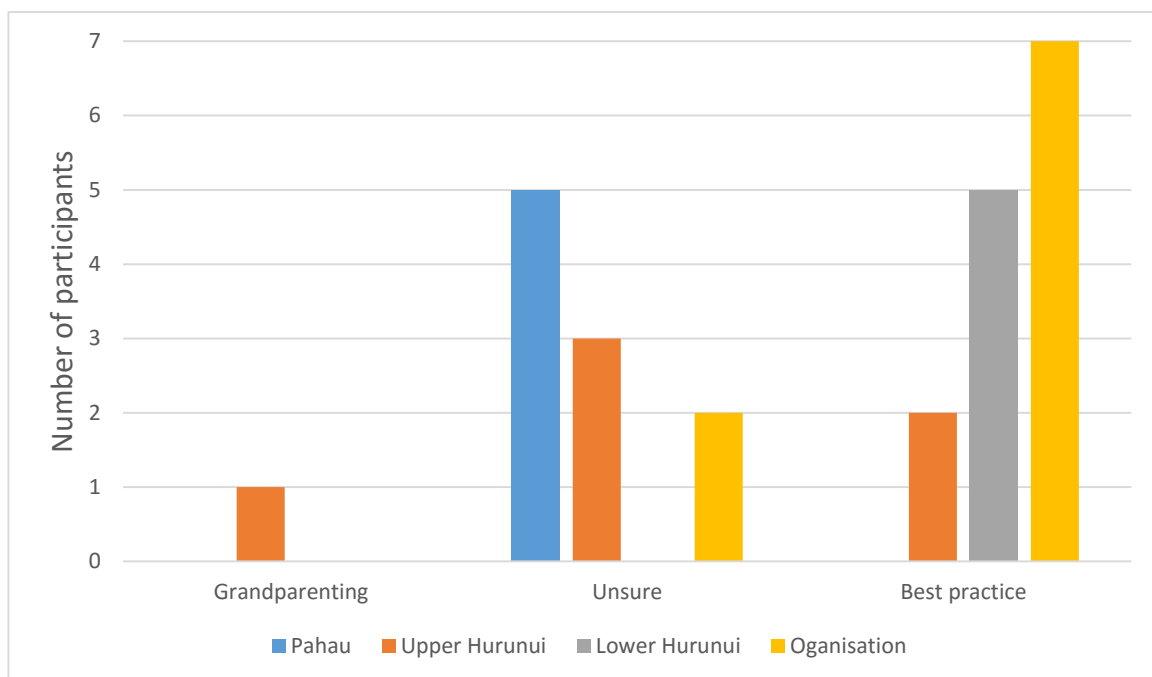


Figure 26: Participants' preferred nutrient allocation approach in the Hurunui River catchment

## 4.6 Collective governance interviews

As discussed in Section 3.3.1 there were different sets of interview questions asked of participants depending on whether they were farmers or the type of organisation they represented. This section addresses several issues surrounding the running of an audited self-management approach. These questions were asked of those participants representing the organisations, some of whom will be involved with the setting up and operation of an ASM scheme.

### 4.6.1 Willing to take responsibility

The irrigation companies were asked whether they were willing to take responsibility for the management of the water quality in their area. The answer from all participants was 'yes,' with much of the discussion centring around moving farmers under their influence to best management practices. The representative from the Amuri Irrigation Company favoured taking responsibility, stating that this organisation would do so "...to the extent that Amuri can manage it," going on to discuss that there is land in the catchment that does not belong to Amuri shareholders, for which they could not be held responsible.

### 4.6.2 Contribution

The representatives of the organisations were asked about the proportion land users should contribute to the maintenance of the water quality in the catchment. For example they were asked about the contribution each land owner should make towards the maintenance of a wetland or other mitigation measure, and specifically whether this contribution should be in proportion to the amount of land farmed. The responses varied slightly with some participants indicating that that kind of expectation would not be reasonable on a sheep and beef farmer with a large land area. Dairy NZ suggested there might be a type of rating system based on the value of an operation within the catchment which could help in determining an equitable contribution regime.

The general feeling was that as a first step in the improvement of water quality in the catchment that all land users should move to best practice, and that the development of Farm Environment Plans would highlight areas on farmers' land where improvements could be made. In these situations there was an expectation that farmers will implement any improvements identified in their FEP.

#### 4.6.3 Sharing knowledge

The representatives of the organisations were asked whether they supported having contribution from shareholders, particularly farmers, in the development of their ASM approach. Responses varied with most of the participants commenting that to allow the input of everyone would be far too time consuming. Others discussed how in their opinion having input from farmers would result in dissatisfied groups and splinter groups, whereas having the managing body, such as Amuri Irrigation, develop the ASM approach would be advantageous. The participants emphasised that there were avenues for farmers to have their input. For example the Hurunui Water Project representative commented that their shareholders had the opportunity to contribute indirectly to the process through their farmer liaison committee; while the Dairy NZ representative said they had held several community meetings over the past few of years to allow farmers to contribute to areas of the development of an ASM approach.

#### 4.6.4 Management systems

The representatives of the organisations were asked what type of management systems they felt should be in place for ASM to work effectively. The responses varied, providing an interesting snap-shot of the thoughts of different participants, perhaps illustrating that a lot more thought is needed in this area. The Environment Canterbury representative discussed the type of data they required explaining:

What we're wanting is to know that that area is covered by a collective, that the collective is made up of twenty five farms, that all those farms have a Farm Plan and they've all been audited in the twelve months after that and they've all been audited and they've all got successful audit

grades, and the audit report's been submitted. Some of the other detail within that we don't actually necessarily need to know.

Environment Canterbury's approach puts a lot of onus on the management groups gathering the data, whereas their primary concern is that water quality in the catchment is not deteriorating.

The representative from Irrigation NZ talked about possibly needing a management committee of some sort to collate data from different areas throughout the catchment and concluded "...yeah lots of those things haven't been thought about yet so far." The representative from Dairy NZ expressed their views on the type of data management system that will be needed, saying:

It's likely to be held in a secure independent database. It might be governed by a collective, irrigation scheme, the primary industry, and that could be even in partnership through an MPI thing with Beef and Lamb and other parties – not sure yet. But it's sort of envisaged, that it would sit in a space like that probably with auditable software so it can actually track any time you make a change to any of your data. So that that can be used to report directly from there to ECan. So we don't see ECan holding the data, but there's a body that holds the data and supplies reports to ECan. And that body of data that's held would need to be audited through the audited self-management and that's still, I suppose the process or the formal part to that is still to be developed.

Participant B expressed fears about the standardisation of data collection and analysis commenting that:

It is a big fear of mine that the appropriate database structure is not there, and that standardized data will not be collected in these early rounds...my concern is the way we're going is that some people are going to report things numerically, some are going to report them textually, and whatever the storage system it is you won't be able to query it to get reporting and analysis. That's my concern about ASM is that it'll be done and people will get the big tick, but what will it tell us? Because we have this deficiency of data about the state of play in Canterbury.

When asked about management systems the representative from Amuri Irrigation discussed using GIS mapping software to identify areas on farms which had been irrigated, and/or where fertiliser had been applied. In addition, the Fish and Game representative discussed allowing an ASM approach to be useful for farmers, suggesting a model where it was possible for farmers to input data themselves, and where

fertiliser information was provided by the supplier to “...make it really, really easy and kind of almost useful to the farm to actually be able to understand what they’re putting in...” This representative expressed their desire that the software should be able to package the data and show “trend diagrams about what fertilisers you’re using.” With these capabilities the Fish and Game representative asserted that an ASM data management model would allow farmers to review their own performance and look at ways to potentially save money.

#### 4.6.3 Training

For an ASM approach to work effectively there must be a significant shift in mind-set among land users. Given this imperative, representatives of the organisations were asked what kind of training they would be willing to provide to enable an ASM approach to operate effectively. Participant A shared their vision stating that initially there will be a need for “a number of workshops that are facilitated by consultants and people who have got ...a lot of expertise.” This participant indicated there was a need for a “workshop on Overseer, so that if someone does their Overseer model, they can actually understand and extrapolate what it actually means.”

The representative from Irrigation NZ talked about the need for training to upskill people to “first of all explain what is good management practise - explain how to meet it and if the shortcomings of the people’s knowledge, skills, whatever, then they’ve got to provide training for it.” Dairy NZ plan to provide training in those areas where there was a need. Their representative commented: “as the information from the Sustainable Milk Plans comes through we’ll get more clarity about the level of practices and maybe some of those areas where improvements are required...” Based on this data the representative suggested that there will be an identification of “common gaps within those farms” and went on to say that based on this information there would be a number of “extension activities” organised to meet the needs including field days and training courses for staff. The representative explained: “We’ve already done a few farm systems discussion groups where we’re incorporating the Sustainable Milk Plan just through looking at what the standards of practices we’re expecting in that.” The Dairy NZ representative maintained that the aim of this type of education would be to: “Get the farmers brain storming themselves – what they should be doing, how can they demonstrate that they’re doing the right thing – those types of things so they’re already aware.”

#### 4.6.4 Communication

The representatives from the organisations were asked how they envisaged keeping lines of communication open not only to resources users, but also to the community. All the participants agreed that it was important to provide communication to both their users and the wider community, and all were willing to communicate as well as they were able. The Hurunui Water Project representative discussed how their users were also their shareholders and as such were kept informed through general meetings. In order to communicate with the wider community, they traditionally had a stall at the Hawarden A&P show. Several of the collective representatives pointed to their attendance at Zone Committee meetings and involvement with the Zone Committee as an illustration a wider communication with the community. The representative from Ngāi Tahu Properties reported giving regular feedback to their two rūnanga with monthly meetings.

#### 4.6.5 Environmental values

The representatives of the environmental groups and rūnanga were asked whether they felt their values were being recognised and supported regarding the management of the water quality in the catchment. Participant B commented that they considered that while their values were recognised, they questioned whether they were being supported. Participant commented, "...supported is an interesting one, because, it became evident during the Plan process that there's a deficiency in data in many areas environmental." This participant went on to comment that there was a deficiency in ecological modelling during the Regional Plan decisions, continuing that there "sometimes appears to be what I would consider a short-term view about looking at economic and social well-being under current circumstances as opposed to saying ten years out – how do we need things to be?" Other participants stated that they felt their group's values were being recognised somewhat, but the general feeling was that less importance was placed on environmental values than other values.

## Chapter 5

### Discussion

Relevant literature regarding the subject of user self-management was discussed in Chapter 2. Informed by this literature Chapter 3 introduced the conceptual framework upon which this research is based, including the means by which the research was carried out, which was primarily semi-structured interviews with relevant stakeholders. In Chapter 4, the results of the interviews were outlined. In this chapter, the results of the interviews with stakeholders are compared with the relevant literature to address the research objectives set out in Chapter 3. This chapter is divided into five sections, each of which addresses one of the research objectives.

#### 5.1 Stakeholders' opinions on water quality

*Research objective: To assess stakeholders' opinions as to whether they believe there is a water quality problem and whether they are prepared to act to manage the water quality.*

All of the farmers interviewed were aware of nutrient limits on the Hurunui River and its tributaries, with the majority of farming and organisation respondents supporting the limits that had been set. Those who did not support the nutrient limits set, reported being either unsure whether the limits were set correctly, and/or wanted to see further scientific understanding surrounding water quality (see Section 4.2.1). While all interview participants agreed there was a need to manage water quality, there were varying responses as to whether there was a current problem in the Hurunui River and its tributaries, with some farming respondents commenting that they used the river more than anybody and they had not noticed water quality deterioration in recent years (see Section 4.2.2). All of the farming interview participants reported being willing to take responsibility for the management of water quality in the catchment (see Section 4.2.3). However, many added the qualification that science had to prove that



there was a problem. Of the 17 farming participants, 10 mentioned they felt there was a need for increased clarity of scientific results regarding the state of the water quality in the catchment (see Section 4.3.6).

There are high levels of uncertainty surrounding the setting of nutrient limits in the Hurunui River and its tributaries (Norton & Kelly, 2010). Therefore, it is perhaps not surprising that there is confusion over the understanding of science in the catchment with apparent disagreements between those setting the limits and the land users (Memon et al., 2012). Section 2.2.4 outlined the Regional Plan's requirement for further investigation into the reason for cyanobacteria blooms in the catchment in Policy 5.4A. The Plan sets forward the requirement for change, if change is necessary, to amend nutrient load limits (Environment Canterbury Regional Council, 2013b). Based on the literature reviewed, when considering managing to a single limiting nutrient such a plan change may well be necessary in the future, with a lowering of nutrient load limits in the Hurunui River (Heath et al., 2015; Jarvie et al., 2013; Quiblier et al., 2013). Given the comments from the farmers suggesting the water quality in the catchment is as good as it has historically been, it is unlikely that a potential further tightening of nutrient limits in the river would be anticipated.

While the participants were willing to manage water quality if there was a problem, the lack of conviction expressed by the farming participants surrounding scientific understanding could prove to be a major hurdle in its effective management in the catchment. In Section 2.3, the way in which the effectiveness of collaborative governance resides in stakeholder participation was discussed (Lees et al., 2012; Reed, 2008). In the Hurunui District, the Zone Committee was a means whereby stakeholders could participate in the governance of the water resources of the region. While the majority of participants did in fact support the Zone Committee process, there were questions raised about this process by some. In particular, some questioned the setting of load limits on the Hurunui River and the 10% change in land use rule contained in the Regional Plan (see Section 4.2.4). This frustration led one farmer to suggest that he may intentionally perform more poorly to raise his nutrient leaching numbers as calculated by Overseer! This farmer's suggestion is in line with the observations of Ostrom and Cox (2010) in which they observe that if stakeholders do not feel involved in the planning of a project (in this case the setting of nutrient limits), they can in some cases directly or indirectly undermine the project. Lees et al. (2012) suggests that farmers' confidence was first and foremost needed for any effective community management. This apparent lack of feeling of involvement felt by some of the farming stakeholders may yet be rectified through the introduction of management collectives, in which farmers will work together

to manage water quality in their catchment. However, there is also the potential that the current ill feelings of some may override any positive movements the management collectives may make.

In Section 4.5.2, interview participants' opinions regarding nutrient allocation were considered. In the majority of responses the interview participants supported an allocation regime that relied on a best management approach to land use practices. A related topic that of creating 'headroom' in nutrient limits was also discussed (see Section 4.5.1), about which there were various opinions on what should happen to any headroom that was created. The concept of 'headroom' does occur in the ZIP (Hurunui Waiau Water Management Zone Committee, 2011). Section 11.1.3 of the ZIP discusses improving land use practices to lower nutrient levels in the river and in parenthesis adds "i.e. reduce current loads to create 'headroom' for new irrigation development" (p. 35). Participant J asserted that the concept of headroom should never have been introduced because then "...everyone starts thinking 'well I want some of that headroom' whereas no one owns that headroom." Participant J's comments are insightful in illustrating the tension the concept of headroom has created. Equally salient were the comments of Participant D who, when speaking about dairy and dryland farmers said, "you know we're both in the same boat that we need to increase production by 4% every year just to keep up with inflation..." An aspect which may help to alleviate some of the strong emotions surrounding the setting of nutrient limits, nutrient allocation, headroom, and the 10% rule found in the Plan is the Nutrient Working Group. The Nutrient Working Group was set up at the time the interviews for this research were being completed. In this group farmers throughout the catchment have been discussing how best to move forward with objections to the 10% rule found in the Regional Plan, and other nutrient allocation issues, in the hopes of finding an equitable solution for all land users.

There is a vision to increase production found in both the CWMS and the ZIP through further irrigation development. This vision, however, has the potential to fragment the community, with correspondingly negative implications for the management of the water quality in the catchment. Both the CWMS and the ZIP saw a vision of increasing economic prosperity while maintaining environmental values. However, it was noted that the representatives of the environmental groups and rūnanga, who were interviewed, felt that environmental values were given a lesser place than other values, such as economic values in the management of the water quality in the catchment (see Section 4.6.5). Farmers, on the other hand, felt that they were being hamstrung with the copious rules they had to follow and paperwork that they had to do. As discussed earlier, many farmers felt that the water quality was improving and there was not a significant environmental problem. With these differing perspectives

from those in key management positions in the community it is apparent that some common ground needs to be found.

Participants were asked several questions intended to investigate how water quality concerns would be addressed in the catchment. Nutrient trading (see Section 4.2.6) received a mixed response, with the majority of the representatives of the organisations not supporting the measure, whereas others felt it may come in the future. Farming participants varied in their support of herd homes and feed pads (see Section 4.2.7), with questions raised over their profitability. However, all but one of the representatives from the organisations supported their use. Again, responses varied between interview respondents on whether they thought reduction of stock densities may have to be an option in the catchment (see Section 4.2.8). Responses indicated that the general feeling was that there would not have to be reductions in sheep and beef numbers, but possibly in the number of dairy cows if water quality targets were not met. There was optimism, however, that technology, coupled with good management practices, would address many of the concerns over water quality, so there would not be a need for stock reductions. The area that received unanimous support from the participants was mitigation measures such as those outlined by Brown et al. (2011). As a first measure, participants suggested that land users should be moving to good management practices, and then investigate farm-scale mitigation options, but beyond best practice sub-catchment scale wetlands or sediment traps may be necessary and these were supported.

This section has discussed how there was a willingness from all participants to adopt good management practices, and all were supportive of appropriate mitigation measures. However, questions remain over the state of the water quality and whether there is currently a problem in the catchment. There was a lack of conviction amongst the interviewees that science has proven there to be a problem. The push of economic values above environmental values also appears to be cause of concern for some. Further concerns surround nutrient allocation and the headroom issue. Time will tell whether the issues raised in this section can be resolved. However, as a means of overcoming scientific uncertainty, further monitoring of the water quality in the catchment should continue, particularly towards the hapua. If the community is invited to submit and discuss their concerns relating to scientific understanding, and offer suggestions as to how they could be alleviated, a far greater level of stakeholder buy-in will be promoted.

## 5.2 Audited self-management features stakeholders support

*Research objective: To determine which features of an audited self-management system the key stakeholders in the Hurunui catchment support, and how these align with ASM literature.*

Land users in the Hurunui River catchment are required to be subject to an ASM scheme by 2017. As an ASM approach is a relatively new approach to the management of water resources, participants were asked whether they supported this approach. Twenty-three of the 28 participants that were interviewed supported an ASM approach, with four indicating that they did not support this approach, and one being unsure (see Section 4.3.1).

In Section 2.3.2 the key features of an ASM approach were introduced and discussed: governance arrangements; farm environment plans; audits; enforcement; and communication. In this section, the opinions of the participants are discussed and compared to these five key features of an ASM approach.

### 5.2.1 Governance

The Regional Plan requires any land use resulting in the discharge of nutrients to water to be subject to a Plan, System or Agreement, which has as a minimum an environmental management strategy, management objectives and a description of an audit and reporting process (Environment Canterbury Regional Council, 2013b). In some areas the managing body organising the environmental management strategy, objectives, audit and reporting process would be the irrigation company. This is the case around the town of Culverden, where the Amuri Irrigation Company supplies irrigation water to the majority of the farmers. In other areas, however, there is the need for a management collective to operate where farmers get together to collectively manage water quality. This collective acts as the managing body. The majority of farming participants did support the management collective concept, with some holding reservations around being forced to join a management collective, and one being worried about how management collectives would be operated, especially if they pitted farmers against farmers (see Section 4.3.2). Under the Regional Plan, farmers are not necessarily forced to join a management collective; an alternative route is provided for those not wishing to join such a group to

apply for a resource consent. However, this alternative was not viewed as attractive, hence the suggestion that joining a management collective was compulsory.

For a managing body there is a need for an environmental management strategy to be developed. As discussed in Section 2.3.2, one of the features embodied in the EMS is in the provision of education. Participants representing the organisations were asked about the type of training they thought would be necessary for an ASM approach to work effectively. There were a number of excellent ideas set forward by the participants (see Section 4.6.3). These suggestions emphasised the importance of training days and workshops for the upskilling of land users, with particular training being aimed to address specific areas of deficiency if these become apparent.

The representatives of the organisations were questioned about the management systems that they viewed as necessary in the implementation of an ASM approach (see Section 4.6.4). Several participants felt that there needed to be more work carried out, and more thought given, as to how data would be stored. While there were several suggestions about management systems that might be necessary, there was little common ground between participants other than that Environment Canterbury should not hold the data. Ideas that were suggested were that collectives should gather the data and organise it, or possibly that a management committee should collate the data. There was discussion suggesting there is a need for a secure database with auditable software, and the need for standardised data. As Mulcock and Brown (2013a) discuss, there is a requirement for a specific data management solution for the effective application of an ASM approach. However, at the time of the interviews little work had gone into the development of such a data management system, and therefore this area is identified as one which requires further consideration.

### 5.2.2 Farm Environmental Plans

A crucial aspect of an ASM approach for the management of water quality is that of farm environment plans (FEPs). At the time of the interviews, only six of the farming participants had been through the process of developing a FEP, so there was limited ability to ask about how they viewed the process. One participant commented they had found it beneficial developing a FEP, however, another participant (participant P) reported that it was “quite shallow” and could have been more useful (see Section 4.3.3). This may be because this participant had previously given a lot of thought to their farming processes, and was already aware of nutrient leaching and runoff issues. Participant P did however anticipate that the FEP process would develop to be more helpful in the future.

There are a number of positive aspects involved in the development of the FEP anticipated by the representatives of the organisations (see Section 4.3.3). The thoughts expressed appear to be similar to the intentions of the development of the FEPs found in the literature which according to Mulcock and Brown (2013a, 2013b), are to improve knowledge about water management and to promote good management practices. Therefore, as more FEPs are developed throughout the catchment, it would appear likely there may be a corresponding improvement in water quality, provided that with each iteration of the process of FEP development there is an increase in helpfulness to land users.

### 5.2.3 Audits and compliance

Monitoring of water quality in the catchment can help to reassure the public that a self-management approach is effective in protecting the environment. The question of the need for further water quality monitoring was not asked of the participants, but many of them commented on this issue during their interviews. Participants’ responses are outlined in Section 4.3.5, from which it is apparent that there was a feeling amongst the stakeholders that more monitoring was required in the catchment. One area in which several participants indicated they would like to see more monitoring was at the hapua of the Hurunui River. This is an appropriate sampling location as the cumulative effects of poor water quality are often seen in such areas (Hayward et al., 2009; Parkyn & Wilcock, 2004). Several of the participants were prepared to undertake their own on-farm monitoring. Similarly several participants indicated, that through their management collective, they would be prepared to undertake further monitoring. With

such a willingness amongst the stakeholders in the catchment, an increase in monitoring, if undertaken systematically, could help to contribute to not only the scientific understanding of water quality throughout the catchment, but also alleviate community concerns regarding the self-management of the water resources.

The managing body's EMS should require land use practices to be audited against the objectives and targets as outlined in the FEP. As discussed in the literature, this is a crucial aspect of an ASM approach, as it gives both the regulators and the public confidence that the ASM approach is working effectively (Carruthers, 2011; Gunningham, 1995). The Land and Water Forum (2012b) describes three levels of audit:

1. first party audit – carried out by an individual land user within the scheme;
2. second party audit – carried out by the ASM collective, sector or scheme or an agent thereof;  
and
3. third part audit – carried out by a party independent of the ASM collective, sector or scheme.

Participants were asked about their preference surrounding the independence of auditors. There were a variety of thoughts surrounding this topic, with some feeling that an auditor needed to be totally independent, and others that a representative of the collective could perform the audits provided they were appropriately trained and had not been involved with the development of the FEP (see Section 4.4.1). Gunningham (2007) commented that the self-monitoring of an enterprise could lead to misrepresentation, and this could be a temptation if a representative of the managing body was to audit their farms. However, this would be guarded against somewhat by a totally independent audit of the governing body's EMS, an issue which was discussed in Section 4.4.1. It seems appropriate that such an audit should include auditing of a proportion of some of the farm systems in the managing body's scheme, along with an assessment of whether the managing body is achieving their objectives and targets. It is suggested that for public confidence, and for transparency reasons such an auditing process is a necessity to provide confidence to the regulatory body and the public that management objectives are being achieved.

#### 5.2.4 Enforcement

A further key element of an ASM approach is that of enforcement. Once the audit of the farming systems are obtained in an objective and transparent fashion, the question of what might happen to any non-complying farms must be addressed. Participants were questioned about their views on enforcement, the responses to which are discussed in Section 4.4.4. In this section, it is noted that the majority of participants supported an increasing severity of sanctions, with the most extreme form of sanctions being to ask the non-conforming land user to leave the collective, denying them irrigation rights altogether. This agreement, that there is a need for sanctions, aligned well with the literature which suggested that there is a need for an enforcement programme (see for example Mulcock and Brown, 2013b).

In the situations where irrigation companies form the managing body of the collective, the irrigation company will likely administer the enforcement measures. This may also be true in situations where there is a management collective formed, with the managing body administering enforcement measures. However in other situations the agreed upon enforcement measures may be administered by a higher level authority, such as Environment Canterbury. These arrangements could be the subject of two criticisms. Firstly, the variety of parties administering the enforcement may raise questions from the community and further afield as to why there are such differences. However, as long as the resource users themselves have the opportunity to contribute who they believe should administer the enforcements, then their buy-in should be obtained, resulting in greater levels of compliance (Reed, 2008). Secondly, the reliability and effectiveness of the enforcement measures may be called in question for those collectives undertaking their own enforcement measures. In these cases there is an even greater need to ensure the public's fears are relieved by ensuring a clear and transparent auditing process conducted through an independent auditor (Carruthers, 2011; Gunningham, 1995, 2007).

The participants were also asked if land users should be encouraged operate at best practice through an incentive programme. Responses to this line of questioning varied, with some supportive of monetary incentives and some un-supportive (see Section 4.4.5). In fact, some land users thought that the incentive for them was not a monetary incentive at all, but incentives were to be found in such things as the dissemination of good communication, the pride of farming in an environmentally friendly way, and being part of a community in which to share ideas. The literature on this topic does not suggest that



it is necessary to include incentives in the application of an ASM approach, rather indicating that an incentive to work collaboratively may come from the fact that land users are not required to obtain a resource consent. The literature also suggests that stakeholder participation can lead to empowerment (Reed, 2008), and although an ASM approach is yet to be implemented, the responses of participants suggest that this will indeed be the case in the Hurunui River catchment.

#### 5.2.5 Communication

As part of an ASM approach for the management of water quality, the literature outlined the need for there to be effective communication from the managing body to those aligned to it, and from the managing body to the community (Carruthers, 2011; Holley et al., 2012; Lees et al., 2012; Ministry of Agriculture and Forestry & The Primary Sector Water Partnership, 2011). All of the organisation representatives expressed a commitment to provide the members of the collectives along with the wider community adequate communication (see Section 4.6.4).

One aspect discussed in the literature are the results of the audits and how these are communicated to the public, and whether they are made publicly available or not (Mulcock & Brown, 2013b). Questions about these audit reports were asked of the participants, with most participants thinking that a summary report should be made publicly available (see Section 4.4.2). The suggestion of one of the participants that the audit report should have quantifiable data, and be reported in a manner that generates corrective action is particularly applicable here. This type of audit report would in turn assure the community that the objectives and targets are being met, and that the managing body's management structure is robust, and alleviate the concerns surrounding self-regulation outlined by Gunningham (1995, 2007).

In Section 4.4.3, the responses of participants when asked about their opinions relating to how to deal with conflict within a collective are outlined, with numerous different avenues of thought being put forward. For the most part, the farmers tended to support a management collective approach which would involve monthly meetings of farmers where any issues relating to land use could be openly and frankly discussed. This suggested approach emphasised peer pressure to improve farming practices. This

idea is similar to that described by Ostrom (1990) in her design principle relating to monitoring, in which she maintains that an effective form of monitoring is when the monitors themselves are members of the local community, thus there is an emphasis on peer pressure involved in the management of the resource (see Section 2.4.4). There were farmers, however, who did not support the idea of getting together in management collectives to discuss issues and relying on peer pressure to resolve conflict within the collective. Other ideas included having a sub-committee of the management collective to approach with any concerns, or possibly continuing with the Environment Canterbury hotline, which is currently in operation, and taking complaints raised from the public. Again, the use of a sub-committee of the management collective to field concerns is a similar concept to that described by Ostrom (1990), as it relies on the sub-committee being accountable to the members of the management collective. While the Environment Canterbury hotline appears a good idea for the public to contact regarding concerns, it is questionable whether this is an appropriate level to deal with problems in an ASM approach, as the majority of the participants suggested that the management collective level was the more appropriate level at which to deal with conflict. If however, the resource users, within a management group, themselves agreed that working through Environment Canterbury was the most appropriate way to deal with conflict, then this approach may be sustainable.

A related issue discussed in the literature is that of conflict resolution between different management collectives. When participants were asked their opinions on the best way to deal with such conflict, several respondents reported that sitting down and working things out together would be the best approach. Other respondents thought that working through Environment Canterbury and the ability to appeal to the Environment Court was the best solution, as this approach was already currently in use (see Section 4.4.6). The literature indicates that low-cost conflict resolution mechanisms would be the most appropriate (Ministry of Agriculture and Forestry & The Primary Sector Water Partnership, 2011), although they may not be the only sustainable way of dealing with conflict between collectives.

## 5.3 Design principles

*Research objective: To determine the type of institutional arrangements key stakeholders in the Hurunui catchment support and how these align with Ostrom's eight design principles.*

In Section 2.4 the design principles of successful CPR management, as set forward by Elinor Ostrom (1990), were introduced and discussed. In this section the institutional arrangements preferred by stakeholders in the Hurunui River catchment are discussed and compared to Ostrom's eight design principles.

### 5.3.1 Principle 1: Well defined boundaries

Ostrom (1990) identified the need for well-defined boundaries as a first step in organizing for collective management. Other scholars have regarded this principle as having two parts: the presence of well-defined boundaries around a community of users; and boundaries around the resource system the community uses (Agrawal, 2002). In the Hurunui River catchment, the surface water of the resource system itself is relatively well-defined, with the Hurunui River draining the catchment itself, and many tributaries entering the Hurunui River as it makes its way to the ocean. The anthropogenic influences on the resource system do affect the resource boundaries, as the Amuri Irrigation Company takes water from the Waiau River to irrigate land, some of which ultimately drains into the Hurunui River. Such influences can lead to confusion surrounding the clarity of well-defined boundaries of the resource system, and in turn could eventuate in potential conflict between management groups. Ostrom (1990) however, in this principle, was concerned only that boundaries were defined, and not with other potential areas of conflict between management groups.

Within the community of users there are various issues to consider, with several management collectives being formed, or in the process of being formed. On the north side of the Hurunui River, the Amuri Irrigation Company provides irrigation water to many within the Culverden Basin, and has probably done the most work towards the implementation of an ASM approach. On the southern side of the Hurunui River, near Hawarden, the Hurunui Water Project has applied for and been granted consent to dam part

of the Waitohi River and to provide irrigation water to land users. However, construction has yet to begin, and consequently the Hurunui Water Project has not made a great deal of progress towards implementing an ASM approach; as a result a management group has been set up in the upper Hurunui area, near Hawarden. Another management group has been set up, which includes land owners on the lower Hurunui River, with all members farming below State Highway 1. What is less clear is where those land owners who farm above between the Pahau River and State Highway 1 fit in. There are possible links with the Amuri Irrigation Company, but at the time of writing no firm arrangements were in place. If indeed, these land users do in time join the Amuri Irrigation Company's collective group, the boundary surrounding the community of users would be defined by the users belonging to this scheme. Whether Ngāi Tahu Properties choose to belong to another managing group, or form their own independent collective is also unknown. Therefore, at the time of writing, the boundaries are not well-defined, and in order to meet this design principle progress should be made to finalise management group boundaries.

### 5.3.2 Principle 2: Congruence between appropriation and provision rules and local conditions

The second design principle outlined by Ostrom (1990), that of congruence between appropriation and provisions rules and local conditions, again addresses two separate conditions: that appropriation and provision rules conform to the local conditions, and that congruence exists between appropriation and provision rules (Agrawal, 2002). While it is early in the implementation of an ASM approach within the Hurunui River catchment, to categorically comment upon whether the first of these conditions is being followed, it appears that the development of FEPs will facilitate these conditions, with local land users identifying targets and objectives on their own farms. Furthermore, the organisation representatives felt that there were avenues in which stakeholders could have input into the implementation of an ASM approach (see Section 4.6.3). Certainly within the provision of irrigation water, appropriation and provision rules appear to conform to local conditions, with the Amuri Irrigation Company having supplied irrigation water to land users in the Culverden Basin for many years.

The second condition of this principle, that congruence will exist between appropriation and provision rules, was addressed in Section 4.6.2, where the results of interviews with representatives of the organisations were presented. It was noted that some of the interviewees felt that if all farmers moved to best practice then the water quality could be managed appropriately. This is contrary to the findings

of the CWMS, which concluded that best management practices throughout Canterbury may not be sufficient to meet nutrient limits (Canterbury Water, 2010). Other participants felt that an equitable contribution regime needed to be developed. In either case, there would be congruence between appropriation and provision rules.

### 5.3.3 Principle 3: Collective-choice arrangements

Ostrom's (1990) third principle that of collective-choice arrangements, recognises that those affected by operational rules in the governance of a CPR are able to modify those rules to better suit their local conditions. A management collective is an arrangement where land users come together to manage the resource collectively (Lees et al., 2012). The majority of farming participants supported the concept of management collectives (see Section 4.3.2), and therefore it is expected that they will be actively involved in their governance, with the resulting input into the operational rules of the management of the water quality in the catchment.

In Section 4.6.3 it was noted that the representatives of the organisations felt that there were avenues for land users to have input into the rules governing the water quality in the catchment. However, Ostrom's (1990) design principle allows appropriators direct input into the modification of the governing rules, whereas the input and knowledge sharing promoted by the representatives of the organisations interviewed allowed input in part, but suggested that to allow all land user's input would be too time consuming. However, for enduring governance of a CPR, the input of those who use the resource, and thus have the most influence upon the land, is essential and should be actively sought (Lees et al., 2012). While the avenues suggested by the representatives from the organisations are a positive step towards fulfilling the requirements of this design principle, it is probable that there may not be enough input from the stakeholders and land users in the catchment. To aid in meeting this design principle therefore, stakeholder input should be actively encouraged. A way of achieving this would be for the management groups to present how they purpose to implement an ASM approach to the resource users, inviting the resource users' input and opinions into the proposal.

#### 5.3.4 Principle 4: Monitoring

The fourth design principle, that of monitoring, is seen as a necessary attribute of successful CPR management, particularly when the resource appropriators either monitor themselves, or when monitors are accountable to them (Ostrom, 1990). Several of the participants, when asked of their opinions on how to deal with farmers who were not moving to best practice, felt that to rely on peer pressure was an effective means of ensuring compliance to rules set forth by the managing body (see Section 4.4.3). This type of arrangement, by which all land users worked together to suggest ways of improving land use management within the collective, resembles Ostrom's (1990) monitoring design principle. It is likely to be effective, because through peer pressure, this arrangement encourages land users who are not operating at best practice to improve their farming practices. In addition there are positive benefits to be gained by the monitors themselves, as was discussed Section 2.4.4.

Cox et al. (2010) point out that scholars have also emphasised the importance of environmental monitoring when considering this principle. As has already been discussed many of the participants were supportive of more environmental monitoring throughout the catchment. Participants felt the need for this monitoring in order to allow for further information about the state of the water quality in the catchment to be known, which would in turn allow adaptation to appropriation and provision rules as suggested by Cox et al. (2010).

#### 5.3.5 Principle 5: Graduated sanctions

The fifth design principle relates to graduated sanctions and was seen by Ostrom (1990) as a necessary component of enduring management of CPRs. All but two of the participants accepted an increasing severity of sanctions (see Section 4.4.4). The most common agreement was with regard to an increasing audit frequency, with an ultimate penalty of being asked to leave the management collective. This acceptance is similar to that which Ostrom (1990) describes, as she indicated that not only should monitoring be done by the resource users, but sanctions should as well. In the application of an ASM approach, enforcement measures are likely be carried out by the management collectives, at least in some situations, as they form the managing body which directs all ASM elements (Mulcock & Brown,

2013b). Therefore, having all members of the management collective in agreement that an increasing severity of sanctions is appropriate, is likely to allow for effective implementation of these sanctions.

### 5.3.6 Principle 6: Conflict-resolution mechanisms

Concerning the principle of conflict-resolution mechanisms, Ostrom (1990) explains how systems with low-cost conflict resolution mechanisms are more likely to survive than those which do not have such mechanisms. The participants were asked whether they supported conflict resolution mechanisms within a management collective and how they envisaged their operation. The responses indicated that the majority of participants thought that the most effective process would be for groups of farmers to meet monthly to discuss issues that arise. This arrangement would certainly be a low-cost conflict-resolution mechanism (see Section 4.4.3).

The participants were also asked how they envisaged conflict could be resolved between management groups (see Section 4.4.6). There were three main responses to this question, with some of the organisation representatives indicating that the status quo, which is going through the appeals process to the Environment Court, was the most applicable. Farmers in the Lower Hurunui area preferred to resolve conflict between management groups through Environment Canterbury, this is probably because they would like the Regional Council's involvement to assist them in dealing with the effects arising from upstream management groups. While others indicated that sitting down and working together would be their preferred approach. While working together certainly would be a low-cost conflict-resolution approach, working through Environment Canterbury is unlikely to be, and going through an appeals process would not be (Ministry for the Environment, 2015). While Ostrom (1990) suggested that conflict-resolution mechanisms be low cost, even if the mechanism selected was through an appeals process, it could still fulfil the requirements of this principle, as the main criteria she discussed was that there was a mechanism through which to resolve conflict, and that the resources users have input into its design.

### 5.3.7 Principle 7: Minimum recognition of rights

In the design principle dealing with the minimum recognition of rights, Ostrom (1990) noted that in enduring examples of CPR management local users created their own institutions which were not challenged by external government. These institutions may vary between management groups, however provided that the resources users' institutions are not challenged this design principle will be realised. In Section 4.6.4, the comments from the representative from Environment Canterbury illustrate that this organisation is expecting the management collectives to organise themselves to effectively manage the water quality in the catchment. In the opinion of the representative from Environment Canterbury, as long as the water quality maintains a certain standard, and the collective's audit report is submitted, they will be happy to allow local users to make and enforce their own rules.

### 5.3.8 Principle 8: Nested enterprises

In this final design principle, that of nested enterprises, Ostrom (1990) noted that in enduring examples of complex CPR management, there were rules organised in multiple layers of nested levels. Such levels could be between user groups and government departments, or between different user groups themselves (Cox et al., 2010). In the Hurunui River catchment, there are certainly rules organised on a nested scale, with the CWMS overriding water management in Canterbury. The Hurunui and Waiau Regional Plan is formulated under the CWMS, and within this is a requirement for an ASM approach to water management. An ASM approach operates under the Regional Plan, with its own institutional arrangements as discussed under Principle 7. The degree to which there are horizontal linkages between different catchment groups or collectives, is yet to be known, and thus, at the time of writing is not possible to comment upon. What can be commented upon, however, is how these linkages can be achieved, which would be through the Zone Committee and Environment Canterbury acting in their role at the constitutional-choice level of organisation (Ostrom, 1990).



## 5.4 Comparison of preferences in different geographical areas

*Research objective: To compare the preferences in ASM features and institutional arrangements supported by land and water users in three different geographical areas.*

In Section 4 the majority of responses from the interviews conducted are grouped into the geographical area of participants. In the previous sections of this chapter, the participants' responses have been analysed to examine the ASM features and institutional arrangement which are supported in the catchment. In this section, the farming participants' opinions regarding the ASM features and institutional arrangements are outlined for the different geographical areas in which they are land users.

### 5.4.1 Audited self-management features

In Section 5.2 the stakeholders' preferences relating to the key features of an ASM approach for the management of water quality in the catchment were discussed. The first key feature of an ASM approach identified relates to governance arrangements. While the majority of farming participants supported the management collective concept, the one participant who was not supportive was from the Lower Hurunui area. So also were two participants who, while supporting the concept, felt that participation should be voluntary. There may be some relationship therefore, between geographical area and participant responses regarding this particular ASM feature (see Section 4.3.2).

The second key feature of ASM relates to farm environment plans. The only participants who had developed a FEP were from the Pahau River and Upper Hurunui areas, with no participants having developed a FEP from the Lower Hurunui area. With so little data on this feature, there are no significant geographical differences on which to comment upon.

The third ASM feature identified relates to the audits and compliance aspects. All six interview participants from the Lower Hurunui River area felt that there was need for further monitoring in the catchment, with three from the Upper Hurunui area and one from the Pahau River area thinking similarly

(see Section 4.3.5). There were no significant differences between geographical areas in the participants' responses relating to the requirement for an independent auditor (see Section 4.4.1).

The fourth ASM feature relates to enforcement. There was a consistent response from participants throughout all geographical areas regarding their views on whether they would like to see an increasing severity of sanctions, for those land owners who were not operating at best practice (see Section 4.4.4). There were also similar responses throughout the geographical areas regarding the participants' opinions on whether they supported incentive programmes (see Section 4.4.5).

The final ASM feature relates to communication. Four participants from the Pahau River area wanted to see a summary report of audit results made publicly available, while in the Upper and Lower Hurunui areas the responses varied with only one and two participants respectively wanting a summary report made publicly available. Only one participant from each of the Upper and Lower Hurunui River areas wanted the actual audit results made publicly available, while none from the Pahau River area thought they should be made publicly available (see Section 4.4.2).

All five participants from the Pahau River area would like to see farmers working together through peer pressure to get all farmers to operate at best practice, with one farmer commenting that dairy farmers do not need any scandals so it was best to keep things in-house; three farmers thought similarly in the Upper Hurunui area; while two from the Lower Hurunui area thought that working through Environment Canterbury would be the most effective way of bringing all farmers to best practice (see Section 4.4.3).

The majority of participants from the Pahau River area supported working together to deal with conflict arising between collectives. This view was shared by those from the Upper Hurunui area, while the participants from the Lower Hurunui area thought that working through Environment Canterbury would be the most effective way of dealing with conflict between collectives (see Section 4.4.6)..

Within this sub-section the results of ASM features supported by the farming participants have been outlined based on the geographical area in which they farm. Farming participants from the Lower Hurunui area were the least supportive of the management collective concept, and were also less supportive of relying on peer pressure to move all land users to best practice, and of management

collectives working together to resolve conflict. Instead farmers from the Lower Hurunui area preferred to work through Environment Canterbury. In contrast, farmers from the Pahau River area were more likely to support working together to resolve differences and relying on peer pressure to bring all land users to best practice. They also felt that it was better to release a summary report of audit results rather than allowing all audit results to be made publicly available. To farmers in this area, bad publicity would be seen as extremely negative, and therefore the features of an ASM approach which they support were those which would initially allow the managing body to organise and manage the water quality 'in-house'. It should be noted, however, that farmers from the Pahau River area do support audits to ensure the ASM approach adopted is robust. The responses of farmers in the Upper Hurunui area tended to fall somewhere in between those of the Lower Hurunui and Pahau River areas in their support of the ASM features discussed. They expressed a stronger support of the need for further water quality monitoring than those in the Pahau River area, but a stronger support of relying on peer pressure and working together to encourage farmers to work together and the resolution of conflict between management collectives than those in the Lower Hurunui area.

#### 5.4.2 Institutional arrangements

Having discussed the farming participants' opinions relating to an ASM approach for the management of water quality in the catchment, this sub-section further discusses Section 5.3, which considered the farmers' opinions relating to Ostrom's (1990) design principles. In this sub-section farmer's opinions are considered based on the geographical area in which they farm.

The first two of Ostrom's (1990) design principles related to well-defined resource boundaries and congruence between appropriation and provision rules and local conditions. For both of these principles there is no data based on geographical area upon which to comment.

Ostrom's (1990) third design principle relates to collect-choice arrangements. As discussed in Section 5.4.1, all but one of the farming participants supported the management collective approach for the management of water quality, where local users could arrange their own operational and management rules. The farmer who did not support the approach, and the two farmers who while supporting the

concept felt that participation should be voluntary, were all from the Lower Hurunui area (see Section 4.3.2).

The fourth design principle relates to monitoring. As described in Section 5.4.1, all six interview participants from the Lower Hurunui River area felt that there was a need for further monitoring in the catchment, while three from the Upper Hurunui area and one from the Pahau River area thought similarly. From the Pahau River area all five participants responded that they saw peer pressure as a means of getting all farmers to move to best practice, three farmers thought similarly in the Upper Hurunui area. In contrast two from the Lower Hurunui area thought that working through Environment Canterbury would be the most effective approach (see Section 4.4.3).

The fifth design principle that of graduated sanctions was supported by all but two of the farming participants. Although there were no noteworthy difference in responses on the basis of geographical boundaries, the one participant who did not support sanctions at all was from the Lower Hurunui area (see Section 4.4).

The sixth design principle relates to the presence of conflict-resolution mechanisms. In Section 5.4.1, the results of the interviews are presented with regard to geographical area. It can be seen that the greatest support for low cost conflict-resolution mechanisms is found in the Pahau River area, followed by the Upper Hurunui area; whereas participants from the Lower Hurunui area preferred working through Environment Canterbury, which would involve a significant increase in conflict-resolution costs.

In the seventh design principle there is the recognition by higher level government departments of the local user's institutions. In Section 5.3.7, it was noted that this principle was really addressed by the Environment Canterbury representative, and therefore there are no geographical variations to consider. Similarly, there are no geographical variations to consider for the final design principle that of nested enterprises. As described in Section 5.3.8 there do exist nested governance arrangements in the Hurunui River catchment and these are accepted by all participants.

A similar pattern can be seen in this sub-section to that which was seen in Section 5.4.1. Farmers from the Pahau River area supported those institutional arrangements which align with Ostrom's (1990)

design principles, whereas farmers from the Lower Hurunui area were less likely to support those arrangements. Farmers from the Upper Hurunui area were somewhere in between the other two geographical areas in their support of such arrangements.

### 5.4.3 Geographical differences summary

The previous two sub-sections have examined the differences in ASM features (see Section 5.4.1) and institutional arrangements (see Section 5.4.2) supported by farmers according to the geographical area in which they farm. In this sub-section the possible reasons for these preferences are outlined in more detail.

In Section 4.2.1 the interview participants' responses to the question of whether they supported limits on the Hurunui River and its tributaries were discussed. Participants from the Pahau River area all supported limits on the waterways, while the responses from those in the Upper Hurunui and Lower Hurunui areas varied between being supportive and un-supportive. This variation in response may in part be explained by a consideration of the responses outlined in Section 4.2.2, where it can be seen that all participants from the Pahau River area were in favour of the need to manage water quality. Whereas there was a mixture of responses from participants from the Upper Hurunui area, while three respondents from the Lower Hurunui area did not see a current need to manage water quality as they thought it was as good now as it had historically been. A similar pattern was seen in Section 4.2.3, where all participants from the Pahau River area were willing to take responsibility for the management of water quality in the catchment, while in the Upper Hurunui area the majority were willing; whereas in the Lower Hurunui area the majority of respondents were willing to take responsibility if science proved there to be a problem. All participants from the Lower Hurunui area thought there was a need for more scientific understanding to prove there was a water quality problem, with three indicating the same from the Upper Hurunui area, while only one indicated this feeling from the Pahau River area (see Section 4.3.6). Similarly while all participants from the Pahau River area supported an ASM approach, in the Upper Hurunui area one did not, and in the Lower Hurunui area two did not (see Section 4.3.1). A further difference between the geographical areas was seen in Section 4.5.1, where the majority of farmers from the Pahau River area thought that any headroom that they created, through improved farming operations should be retained by them. Conversely, in both the Lower and Upper Hurunui areas

no farming participants thought headroom should be retained by them, rather three participants and two participants respectively thought that to pool any headroom to use for the catchment would be the best option.

There are several potential reasons as to why there is this pattern of difference in opinion between the different geographical areas, in the following paragraphs I offer my suggestions for the patterns observed. One possible reason for these patterns is that the types of farming undertaken by the farming participants was quite different between the geographical locations (see Section 4.1.1). All farmers from the Pahau River area conducted dairy or dairy support farming operations; while in the Lower Hurunui area all but one participant (a dairy farmer) were sheep and beef farmers; whereas in the Upper Hurunui area there were both dairy farmers (two participants), dairy support (one participant) and sheep and beef farmers (three participants) amongst those interviewed. This difference in farming type may help in an understanding of why there was such a variation in the farmer's response with regard to what they thought should happen to any headroom that may be created in the catchment. While dryland farmers probably would rely on less costly mitigation measures such as nutrient management plans (see Section 2.2.6), dairy farmers run on high cost systems. For this reason they would be acutely aware that to improve their land uses would require large expenses. In fact, this sentiment was expressed by one participant who commented about profitability. Shareholders in the Amuri Irrigation Company are also aware that the irrigation company has aspirations for expansion, which could in turn relate to lower costs of irrigation water to individual irrigators. Therefore, it would make sense that farmers in the Pahau River area felt this way about the creation of headroom.

Secondly the timing of the interviews may have had an impact on the opinions expressed by interviewees. As discussed in Section 3.3.4 dryland farmers became aware of the implications of the Regional Plan and how it affected their ability to change land use and increase productivity during the months of the interviews. Therefore, the general feeling expressed through the interviews may be a natural response from land users operating different farming systems. It is perhaps not surprising therefore that farmers from the Lower Hurunui area were less supportive of several of the ASM features and institutional arrangements at this time, as all but one of the farming participants from this area are sheep and beef farmers. Therefore at the time of the interviews there was a general feeling of distrust amongst the land users in this area. Within the Upper Hurunui area, the farming participants operated a variety of farming types, with three sheep and beef farmers and three dairy farmers, or dairy support. It is therefore not surprising that the responses from this area present a mixture of opinions, lying

somewhere between support and non-support of the ASM features and institutional arrangements, with dairy farmers supporting, and dryland farmers not supporting some aspects.

Thirdly, as all of the farmers interviewed from the Pahau River area were supplied irrigation water from the Amuri Irrigation Company, they are used to having structure and being answerable, at least in part, to a governing organisation. Several of the farmers in this area also belonged or contributed to the Pahau Enhancement Group, so they had been involved in collective action for the maintenance of water quality in the past. Therefore some of the features of an ASM approach are not new to them, and may therefore be more readily accepted. The more positive opinions expressed may also reflect the fact that some of the dairy farmers are familiar with collective working, with an awareness of the Dairying and Clean Streams Accord for example. This may also explain the greater support amongst the Upper Hurunui participants compared to the Lower Hurunui participants.

Finally, the geographical location in which the participants farmed appears to have had a significant influence on their responses. The participants from the Lower Hurunui area are affected by the land use upstream, as all water in the catchment effectively drains past them. This combined with the realisation that the rules in the Plan had an impact on them, and the general feeling of discontent felt from low emitting dryland farmers compared to high emitting dairy farmers, probably had a large impact on their opinions, and possibly explains why it was farmers from the Lower Hurunui area who wanted to see more monitoring in the catchment, especially towards the mouth of the river and possibly in the hapua itself. Such monitoring would allow the farmers in this area to see the impact they were having on the water quality in the river, as at the time of the interviews the final reoccurring sampling point in the catchment was at the State Highway 1 Bridge. By comparing the difference in water quality results between the bridge and the hapua, an accurate measure of the impact from the farmers in this area could be calculated.

## 5.5 Scale

*Research objective: To examine stakeholders' views on the scale at which they think the water quality should be managed.*

In Section 2.5 it was noted that management literature in New Zealand, and specifically relating to the Hurunui River catchment, suggests that different scales of management are required for effective resource governance. This section seeks to examine the participants' opinions regarding what scale the water quality should be managed at.

The participants, when asked at what scale they thought the water quality should be managed at, replied with a variety of responses (see Section 4.2.5). A catchment-wide approach and a tributary-by-tributary approach both received equal support from the participants. Five participants supported a combination of a farm-tributary-catchment approach, while only one participant supporting a farm-by-farm approach. Those who felt a catchment-wide approach was the most appropriate suggested this because of the geographic boundary of the catchment, reporting that to combine resources would be the most effective way of managing the water quality in the catchment. Those who supported a tributary-based approach felt that this size was more appropriate to target those who were high emitters, and any larger geographical area would make it too hard to make individual decisions. Both of these approaches have been subjected to criticism by some scholars (Budds & Hinojosa-Valencia, 2012; Cohen & Davidson, 2011). In particular the second and third challenges presented by Cohen and Davidson (2011) are relevant in the Hurunui River catchment. As discussed previously, there are differing views between the different geographical areas of the catchment, so to ensure accountability and involvement in management decisions of the stakeholders throughout the catchment has been difficult, and will probably continue to be so in the future. As was discussed in Section 5.4, there are differences in support of ASM features and institutional arrangement between land users operating different farming styles in the catchment, as well as challenges to overcome between farmers and environmental groups. These particular challenges are similar to the fourth challenge outlined by Cohen and Davidson (2011).

A combined approach, similar to the nested approach as described by Holling et al. (2002) and Walker and Salt (2006), was supported by five of the interview participants. It was felt that focussing on nested scales was a more applicable approach than relying on one particular scale, and that by examining the



catchment and then reducing the management resources to specific areas where there were problems, would be the most effective means of management. This nested approach certainly has merits as it allows for transformational changes occurring at lower levels to influence and eventually facilitate catchment scale changes (Folke et al., 2010), and therefore incorporates all of the benefits of watershed and river basin scalar perspectives. A nested-scale management approach would also avoid the limitations of conceptualising water management as based on specific scales (Budds & Hinojosa-Valencia, 2012; Cohen & Davidson, 2011).

A nested approach if accompanied by a recognition of the nesting of rules in CPR governance (Ostrom, 1990) would align with the approach presented in the CWMS. If those implementing an ASM approach recognised and embraced this nesting arrangement, questions relating to the scale at which governing arrangements should be made, could be easily addressed. Such an arrangement would allow resource users and higher level authorities an effective framework with which to address water quality issues. Problems such as adverse environmental effects could be dealt with on a catchment level through the Zone Committee, or Environment Canterbury. Whereas specific water quality problems relating to a tributary could be addressed at the collective-choice level, through a management collective. While specific land-use decisions would be addressed at the operational level on the farm. At all levels there will be a need for an environmental outcome to be targeted, and an assessment of whether these targets are met.

There are obvious benefits associated with the recognition that the catchment is linked through different biophysical and social levels. Focussing on a nested multi-scale approach provides an effective framework wherein there is likely to be a robust and enduring management of the water quality in the catchment. This area is one in which there is a need for more consideration, particularly because many of the representatives of the organisations thought differently on this aspect, and some of these will be undertaking the management of the ASM approach. Therefore having differences at this level could prove to be problematic and should be addressed. An effective means of addressing this concept would be to run workshops for those organisations which are to provide management at the collective-choice level. This would allow a thorough discussion to take place with the hope of reaching consensus among those undertaking the management of an ASM approach.

## Chapter 6

### Conclusion and Recommendations

In Chapter 3 the conceptual framework for this study was developed based on the relevant literature. This framework formed the basis by which the research was undertaken, and upon which the research aim and objectives were developed. Based upon this methodology semi-structured interviews were carried out to ascertain stakeholders' opinions on different aspects of the application of an ASM approach for the management of water quality. In Chapter 4 the results of the semi-structured interviews are outlined, and in Chapter 5 these results were discussed and compared with relevant literature. This final chapter will reassess the study's findings to address the research aim and objectives. It outlines limitations that have affected the quality of this research. The chapter also presents several recommendations for those undertaking the implementation of an ASM approach in the Hurunui River catchment.

#### 6.1 Conclusion

This section reassess the study's findings to address the research objectives, following a similar pattern to that of the Discussion chapter.

### 6.1.1 Stakeholders' opinions on water quality

*Research objective: To assess stakeholders' opinions as to whether they believe there is a water quality problem and whether they are prepared to act to manage the water quality*

This study found that all of the stakeholders who were interviewed agreed there was a need to manage water quality and all were willing to take responsibility if further scientific understanding proved there to be a problem with the water quality in the catchment. This lack of conviction as to whether there is a current problem could prove to be a hurdle in the effective management of water quality, as stakeholder involvement and buy-in is of paramount importance to any collaborative management initiative (Lees et al., 2012; Reed, 2008). As a means of overcoming uncertainties further monitoring of the water quality in the catchment should continue, particularly towards the hapua. Further monitoring could be undertaken by management groups in their specific geographical locality, as it was indicated by many of the participants that they would be willing to contribute to such monitoring. Along with helping to overcome scientific uncertainty, further monitoring would likely result in a greater understanding of the contribution arising from each of the management groups. Further stakeholder education as to the impacts of land use practices upon the environment is likely to induce stakeholder motivation and engagement, in order to maximise the potential for real and substantial environmental improvements through collaborative governance.

A further finding from this research was that while many of the farmers who were interviewed felt that the water quality in the catchment had remained as good as it currently is for many years, the representatives of the environmental groups and rūnanga felt that the economic values were being promoted over environmental and cultural values. Again this particular problem may be alleviated somewhat through further clarity surrounding scientific understanding of water quality accompanied by effective communication throughout the catchment.

Additionally this research found that there was a lack of feeling of involvement felt by many of the participants, leading to frustration over rules contained in the Regional Plan and an overall feeling of distrust and concern over where the management of water quality was heading. There was also concern over the concept of 'headroom' and what would happen to any room in nutrient limits which may be created in the catchment. These feelings have led many to feel overly constrained by nutrient limits

which have been set in the Regional Plan and this research identifies this area as a particular problem which needs addressing. At the time of writing many stakeholders had been involved in the Nutrient Working Group to resolve some of these issues<sup>1</sup>. The requirement found in the Regional Plan for land users to be subject to management groups may also present an opportunity to further stakeholder involvement and knowledge sharing throughout the catchment, which could help to alleviate some of these concerns.

This thesis found that despite substantial stakeholder involvement and consultation in developing the Regional Plan, as well as the Zone Committee process which encouraged stakeholder participation, there is still a need in the Hurunui River catchment for further stakeholder engagement. If the stakeholders of the Hurunui River catchment were invited to submit and discuss their concerns relating to scientific understanding of the water quality in the catchment, and offer suggestions as to how they could be alleviated, some of these concerns may be addressed. In addition it is hoped that with a further appreciation of scientific understanding of the water quality in the catchment, effective communication through land user management groups, and an equitable solution to nutrient allocation issues, there will be a corresponding stakeholder buy-in, which will result in the effective management of the water quality in the Hurunui River catchment.

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<sup>1</sup> At the time of writing, the Hurunui Waiau Zone Committee had agreed to take leadership of progressing and deciding options for managing the 10% rule found in the Regional Plan. The strategy for addressing this issue comprised three options which the Zone Committee considers complementary:

1. An advice note from Environment Canterbury;
2. A memorandum of understanding; and
3. A dryland collective agreement (email correspondence from Ian Whitehouse, Zone Committee Facilitator, 22 April, 2015).

### 6.1.2 Audited self-management features stakeholders support

*Research objective: To determine which features of an audited self-management system the key stakeholders in the Hurunui catchment support, and how these align with ASM literature*

The research examined key stakeholders' opinions regarding the features of an ASM approach they supported. The study found that regarding the governance arrangements of an ASM approach, it was too early to comment on which features the management systems would hold, and the exact type of data management arrangements to used, however the participants did see a need for such systems. The organisation representatives supported the fact there needed to be an upskilling of personnel throughout the catchment and were prepared to operate training days and workshops to help in addressing any areas of apparent deficiency, including workshops addressing the nutrient loss model Overseer, and the implementation of good management practices. Another area which was too early to make positive conclusions on was in the development of FEPs, with the majority of farming participants at the time of the interviews having not developed a FEP. While one of the participants who had developed a FEP felt that a more in-depth plan would be of greater usefulness; the intentions behind farm plan development discussed by the organisation representatives were very similar to those discussed in the literature, which is to improve knowledge about water management and how to implement actions on the ground (Mulcock & Brown, 2013b). While the intention behind the development of FEPs aligns with the literature, care should be taken, to ensure that FEPs provide for continuing usefulness to land users, by requiring more detail each time they are developed.

The study found that the participants had varying opinions regarding the independence of auditors, but at some point all participants suggested that there was a need for either an independent audit or review of the governing body's EMS. Again this requirement for independence and transparency in audit results was found in the literature (Carruthers, 2011; Gunningham, 2007). Additionally the study found a strong support among interview participants for an enforcement programme, which was a requirement found in the literature. There is a difference, which appears in the literature, regarding who should administer enforcement programmes. For example some scholars identify the need for third-party enforcers (Gunningham, 1995), while others maintain that the operational level of a scheme is a more appropriate level, with enforcements being administered by users themselves (Ostrom, 1990). The interview participants also showed a variation in preference surrounding who should administer the enforcement programme. Some viewed the most appropriate level as at the management group level (similar to

Ostrom, 1990), while others viewed Environment Canterbury as a more appropriate level (similar to Gunningham, 1995). While both preferences could ensure robust management of the resources, it is important to note that if a management group administered its own enforcement, public confidence could be lost unless there was a clear and transparent auditing process conducted through an independent auditor. Therefore, in these situations it is even more important that a third-party should perform the auditing.

Finally it was found that interview participants supported good and effective communication both within the management collective and between the management collective and the wider community. Such communication measures promote the opportunities to diffuse innovations and enhance capacities through wider learning, but also promote management improvement through the accountability of governments (Holley et al., 2012; Ministry of Agriculture and Forestry & The Primary Sector Water Partnership, 2011). An area of communication which should as a minimum be made publicly available was a transparent summary report of the managing body's performance (Mulcock & Brown, 2013b). Further aspects which the stakeholders supported were the need for a public complaints service, and the need for a process to deal with conflict both within and between collectives.

### 6.1.3 Design principles

*Research objective: To determine the type of institutional arrangements key stakeholders in the Hurunui catchment support and how these align with Ostrom's eight design principles*

The research examined key stakeholders' opinions regarding the institutional arrangements needed within an ASM approach and how these aligned with Ostrom's design principles. The need for well-defined boundaries on a biophysical level is an obvious requirement and although there are complicating factors in the Hurunui River catchment, such as irrigation water being taken from the Waiau River and entering the Hurunui River, the resource boundaries are relatively well-defined. The boundaries surrounding the community of users however, were still in process of formation at the time of the interviews, with the catchment groups and collectives still being formed and organised. This particular

design principle is necessary as it is the foundation upon which others are built, therefore, as first step in the application of an ASM approach, should be resolved.

At the time of the interviews it was too early to comment upon the second design principle with any certainty (congruence between rules and local conditions), although it appears that the implementation of an ASM approach including the development of FEPs will align with this principle. This research suggests however, that it is unclear whether the ASM approach to be implemented in the Hurunui River catchment will align with the third design principle that of collective choice arrangements. The reason for this is due to the hesitation of the organisation representatives to allow land users to have direct input into the governing rules surrounding how an ASM approach will be applied. While the organisation representatives maintain there were avenues for this to occur, it is probable that the opportunities are insufficient. Therefore, it is suggested that the managing groups communicate how they propose to implement an ASM approach in the catchment and actively seek the resource users' input into the proposal.

The research suggests that the implementation of an ASM approach will align with Ostrom's (1990) fourth and fifth design principles, those of monitoring and graduated sanctions. The stakeholders interviewed suggested that there is a need for more monitoring in the catchment and expressed a desire to conduct monitoring themselves. Aligning with the fifth design principle, the majority of stakeholders interviewed accepted that an increasing severity of sanctions would be the most effective way of ensuring all land users moved to best practice.

The conflict-resolution mechanism supported by interviewees within a management group was a low-cost option, by relying on peer pressure to diffuse conflict. However, there were a variety of preferences of the conflict-resolution process between management groups. While some of the farmer participants preferred to resolve conflict between management groups by working together - a low-cost solution, others preferred to work through Environment Canterbury, and some of the organisation respondents' preference was to appeal to the Environment Court in extreme situations. Farming participants from the Lower Hurunui area preferred to resolve conflict between management groups through Environment Canterbury, this is probably because they would like the Regional Council's involvement to assist them in dealing with the effects arising from upstream management groups. While those farmers upstream were happy to manage conflict by sitting down and working things out with other management groups.

Although working through Environment Canterbury is not a low-cost mechanism, the fundamental observation Ostrom (1990) made in her sixth design principle, was there was a need for some sort of conflict-resolution mechanism. Therefore, provided that the resource users have the ability to have input into which mechanism is used, this design principle will be met.

The research identified that both the seventh principle that of recognition of rights to self-organise, and the eighth that of nested enterprises were supported by the stakeholders, therefore, the implementation of an ASM approach would align with both of these principles.

#### 6.1.4 Comparison of preferences in different geographical areas

*Research objective: To compare the preferences in ASM features and institutional arrangements supported by land and water users in three different geographical areas*

The research found that there were differences in the ASM features and institutional arrangements supported by land users in the different geographical locations. Farmers in the Lower Hurunui area were the least supportive of several of the ASM features including getting together as groups of farmers to discuss management options (the management collective concept), and relying on peer pressure to move all land users to move to best practice. Farmers from the Pahau River area in contrast supported all ASM features discussed in the literature, as also did the majority of farmers from the Upper Hurunui area.

A similar pattern, based on geographical area, can be seen for the institutional arrangements the land users support and how these align with Ostrom's (1990) design principles. Farmers from the Lower Hurunui area did not support low cost conflict resolution mechanisms, but would prefer consulting Environment Canterbury to resolve conflict not only within the management collective, but between management collectives also. As farmers from this area were less supportive of the management collective concept, they were consequently less supportive of the arrangements which align with the third design principle. In contrast the institutional arrangements farmers from the Pahau River area



supported more closely aligned with Ostrom's (1990) design principles, with one exception that they were less likely to see the need for environmental monitoring. Again farmers from the Upper Hurunui for the most part supported the institutional arrangements which aligned with Ostrom's (1990) design principles.

Possible explanations for the difference in support the ASM features and institutional arrangements based on geographical location were offered. These included the different make up of farming operations within each geographical area; the timing of the interviews as they fell when dryland farmers became aware of the implications of the Regional Plan; the farmers' backgrounds with those from the Pahau River area having previously operated under a governance structure; and finally the realisation of the geographical location, which for those from the Lower Hurunui area means that they are affected by what happens in the catchment above them.

#### 6.1.5 Scale

*Research objective: To examine stakeholders' views on the scale at which they think the water quality should be managed*

The research examined the stakeholders' opinions regarding the scale at which they felt was the most appropriate to manage the water quality. There was equal support for a catchment-wide and a tributary-based approach. Those who supported a catchment approach felt that because the catchment is drained by one large river, there was less confusion in viewing water management from this scale. They also thought that more would be gained by pooling the resources of land users throughout the catchment, rather than several tributary groups working with less resources. On the other hand those who supported a tributary-based approach felt that this was a more manageable way to break down the catchment to identify where problem areas were. There was also support amongst participants for a nested catchment-tributary-farm approach. Those who preferred this approach felt that water management was going to have to be undertaken at each scale at some point. To deal with cumulative effects would be best dealt with at the catchment scale. At other areas of the catchment there would be a need to improve land use practices surrounding a specific tributary, and to aid this management

approach would require a farm-by-farm approach. A nested approach would incorporate the benefits of both a catchment and tributary-based approach, by allowing resources to be pooled to address specific problem areas, and by focussing on smaller management areas where appropriate.

The catchment-tributary-farm approach would avoid problems outlined in the literature surrounding both catchment and tributary-based approaches (Budds & Hinojosa-Valencia, 2012; Cohen & Davidson, 2011). A nesting perspective also aligns with the nesting of rules in CRP governance as outlined by Ostrom (1990). With such a framework of the nested socio-ecological influences acting on water management in the catchment, there is an allowance for transformational changes at different levels to facilitate catchment scale changes with resulting benefits for water quality (Folke et al., 2010). At all levels there will be a need for an environmental outcome to be targeted, and an assessment of whether these targets are met. In a nested approach the Regional Council would continue to describe the nature of collaborative governance in the catchment, and also deal with cumulative effects and in identifying the issues to be addressed. While stakeholder groups could address specific water quality problems at the tributary, or river reach level. And day-to-day land use decisions would be addressed on the farm level.

The divergence in understanding and opinions amongst the stakeholders is an area which requires addressing. There is a risk that this lack of consensus, amongst stakeholders, as to the appropriate scale at which to manage the water quality in the catchment, could result in management issues as an ASM approach is implemented. This is particularly relevant due to the CWMS being framed in a nested fashion. Therefore these differing views particularly amongst the organisation representatives, some of whom will be undertaking the management of an ASM approach, should be united. To remedy this situation it is suggested that workshops are held for the organisation representatives to fully discuss the pros and cons of different levels of management, and to foster an environment in which a consensus can be reached.

## 6.2 Research limitations

This section details some possible limiting factors arising from this research. There are two main limitations identified, that of the timing of the interviews and the makeup of the interview participants.

This research presents findings taken from a snap-shot in time. The interviews conducted were undertaken over a period of three months, and within this time dryland farmers became aware that their expansion opportunities were limited by the legislation contained in the Regional Plan. The timing of this research is therefore a particularly limiting factor, and is offered as a possible suggestion in explanation of the responses and opinions expressed by some of the interview participants, especially those of the dryland farmers.

The timing of this research presents a further limiting factor in that several aspects of an ASM approach, particularly around the governance arrangements still needed a significant amount of work and thought before their implementation, at the time the stakeholder interviews were conducted. This being the case there is also the possibility that conducting the research at this stage has some positive benefits. For example, the timing allows the findings of this research to contribute to the stakeholder understanding of ASM at this time. In addition, the research offers suggestions for areas in need of further investigation and thought. In particular this research has identified potential obstacles to the effective application of an ASM approach which was a primary aim of this study.

A second area of limitation relates to the number and identity of participants who were interviewed for this research. The initial number of farming participants from the different geographical areas was hoped to be a minimum of seven from each area. However, due to the timing of the interviews (coinciding with calving season), the numbers of interviewees was reduced. The selection of farmers also presents a possible source of limitation, as those who agreed to be interviewed were generally those who held stronger opinions on nutrient management, and as such it was suggested they be contacted to interview. Interviewing farmers holding strong opinions, resulted in the opinions of others with less strong views not being heard.

An additional limitation is that the geographical areas which the farming participants have been grouped into, is unlikely to be representative of the final makeup of the management collectives in the catchment. There were participants located above State Highway 1, who were grouped into the Lower Hurunui area classification adopted in this study. It is understood however, that these participants will not be part of the management group based in the lower Hurunui River area. This difference should be taken into account when assessing the findings of this research based on geographical location. Finally, because of the geographical localities from which interview participants were obtained, there were many areas throughout the catchment where there were no participants involved, but land users from these areas may have had valuable contributions to make, therefore this aspect adds to the limitations of this research.

### 6.3 Recommendations for further research

In this section recommendations are made for further investigation. These recommendations have been discussed in more detail in the Discussion Chapter, and are reemphasised here.

1. The stakeholders of the Hurunui River catchment should be invited to submit and discuss their concerns relating to scientific understanding of the water quality in the catchment, and offer suggestions as to how they could be alleviated;
2. Based on the suggestions of the community and as a means of overcoming scientific uncertainty further monitoring of the water quality in the catchment should be undertaken, particularly towards the hapua. These findings should be effectively communicated to stakeholders and community members;
3. Final boundaries for management collectives should be defined and agreed upon;
4. Further consideration and investigation should be given to management collective governance, with particular emphasis on data management systems;
5. To ensure FEPs are helpful to land users, by requiring more detail each time they are developed, with the resulting benefit for both land users and the environment;
6. To ensure independent audits are undertaken, with auditors being fully trained and accredited;
7. To ensure that audit results are reported in a manner that generates corrective action, and allows for a transparent appreciation of scheme performance;

8. Investigate knowledge sharing opportunities amongst stakeholders in the catchment, and provide times and opportunities for them to frame rules governing the application of an ASM approach; and
9. Examine scalar politics through workshops to ensure management collectives have an agreement for the most effective form of water management within the catchment.

## 6.4 Overall conclusion

Audited self-management is set forward as an effective way of managing nutrient discharges and maintaining water quality. This research has attempted to address the research aim, which was: To identify the features and institutional arrangements stakeholders are willing to support, and to identify and address potential obstacles in the effective application of ASM to manage nutrient losses in the Hurunui catchment. It can be seen from the preceding chapters that in general the stakeholders support the key ASM features as identified in the relevant literature and that the institutional arrangements supported by key stakeholders in the catchment align well with the design principles as set forward by Elinor Ostrom (1990). This research has identified several potential obstacles in the implementation of an ASM approach, along with several recommendations for further investigation and research. It is hoped that on the basis of the findings arising from this case study area, a far more robust and enduring management approach will be implemented in the Hurunui River catchment. It is further hoped that lessons gained from this study can aid in the application of an ASM approach in other areas throughout Canterbury and across New Zealand.

## Appendix A Interview Outlines

### Farmer interview

#### *Individual preferences*

1. What type of farm is this?
2. What are your current land management practices? E.g. hill country, dairy support. Etc.
3. Do you irrigate? And if so what type of irrigation?
4. Were you aware of nutrient load limits on the Hurunui River?
5. Are you supportive of load limits on the river and its tributaries?
6. Do you perceive a need to manage WQ?
7. Are you willing to take responsibility for the management of water quality?
8. Are you supportive of the Zone Committee and do you feel you have had the opportunity to contribute to the ZIP process?
9. What scale do you think the water quality in the river should be managed at e.g. farm, tributary or catchment scale?
10. Are you supportive of a nutrient trading scheme?
11. Would you be willing to house animals through winter, or use feed pads to reduce nutrient leaching?
12. Would you be willing to reduce stock densities if necessary?
13. Would you consider a collective project for lessening the effect of pollutants? E.g. dams or weirs to trap sediment or large scale strategically located constructed wetlands providing nutrient mitigation benefit to an entire sub-catchment.

#### *Audited Self-Management*

14. Would you prefer the Regional Council to regulate, property rights, or an audited self-management approach to manage to water quality?
15. Would you be prepared to join a collective which can support you in managing to nutrients limits? Are you willing to work with other local land users to find agreement on ways to manage

your land under a collective working? Or would you prefer to adopt rules given to you, providing you had certain autonomy?

16. What type of data would you require to meet Plan nutrient limits (e.g. soil moisture data, GIS, relatively prompt WQ results etc.)?
17. Do you have a FEP or NMP?

#### *Enforcement and incentive program*

18. Would you like audits to be conducted by a totally independent auditor?
19. What should happen to the audit results – should they be made publicly available?
20. Do support and would you be willing to use a public complaints process – so users can advise of non-compliance?
21. Would you recommend exercising flexibility in imposing sanctions? – in cases of emergency allow deviation and not impose harsh sanctions, but when this happens again the sanction is stronger e.g. ranging from increased audit frequency (three yearly in BMP cases, yearly for improvement and twice yearly if not going well), to non-compliance in extreme cases water restrictions, or water being turned off?
22. Would you support an incentive programme i.e. less frequent audits, e.g. Synlait incentive program where a premium is paid for milk to those farmers who operate using best management practices which is not only more productive but more profitable!
23. How would you resolve conflict, both between collectives, e.g. local council?

#### *Allocation*

24. Would you be willing to improve land use practices to create headroom in nutrient limits, and what do you think should happen to this headroom? E.g. to provide dairy support through winter, create room to take on new users?
25. How would you accommodate new users?
  - Would you like a grandfathering approach – where historic nutrient leaching rates are taken as the current limits?
  - Or would you prefer nutrient allowance based on GMP and current stock use?
  - Or would you prefer nutrient allowance based on land area? Do you think nutrients should be allocated in proportion to the amount of land owned/farmed?

## Collective body interview

### *Farming management*

1. Are you willing to take responsibility for the management of the river in your locality? Are you willing to work with other collectives to find agreement on ways to manage land to meet WQ limits?
2. Are you supportive of load limits on the river and limits on its tributaries?
3. What scale do you think the water quality in the river should be managed at? E.g. farm, tributary or catchment scale. Why?
4. Can you see a nutrient trading mechanism working if one were available?
5. Do you support the use of herd homes and feed pads to reduce nutrient leaching?
6. Do you think reducing stock densities may be necessary?

### *Contribution*

7. Would/do you encourage your users to use GMPs?
8. Would you consider organising a collective catchment or sub-catchment project for mitigating the effect of pollutants? E.g. dams or weirs to trap sediment or large scale strategically located constructed wetlands providing nutrient mitigation benefit to an entire sub-catchment.
9. Would you like to see farmers contribute to maintenance of the system, in proportion to the amount of land each of them irrigates or owns?

### *Allocation*

10. What should happen to any headroom in nutrient limits which is created? E.g. to provide dairy support through winter, create room to take on new users?
11. How would you accommodate new users?
  - Would you like a grandfathering approach – where historic nutrient leaching rates are taken as the current limits?



- Or would you prefer nutrient allowance based on GMP and current stock use?
- Or would you prefer nutrient allowance based on land area? Do you think nutrients should be allocated in proportion to the amount of land owned/farmed?

### *Audited Self-Management*

12. Would you prefer the Regional Council to regulate, property rights, or an audited self-management approach to manage to water quality?
13. What type of data would you require to meet Plan nutrient limits (e.g. soil moisture data, GIS, lysimeters, relatively prompt WQ results etc.)?
14. Would you be willing to aid with communication? Both between ASM users and feedback to the community – including reporting, and consultation with stakeholders?
15. What should farm plans include? e.g.:
  - Property land use information
  - Description of different land management units within the farm
  - an assessment of risks to WQ and quantity from their farming system, including:
    - irrigation
    - stock
    - cultivation
    - fertilisers
    - effluent application
  - objectives and targets for WQ and quantity
    - Irrigation management
    - Soils management
    - Nutrient management – requires nutrient budget
    - Wetland and riparian management, and
    - Collected animal effluent management
  - and actions and practices to achieve objectives and targets; once these have been identified what need for timelines for improvements
16. Would you like to retain flexibility to determine your own management practices?
17. Would you be willing to begin with small groups of stakeholders to share knowledge, and together develop an ASM approach?

18. What type of training do you think would be needed to enable an ASM approach to operate effectively? Would you be prepared to offer support to help an ASM approach, and if so what type of support would you provide (e.g. an education and adaptive management programme etc.)?
19. What type of management systems would need to be in place for ASM to work?
20. Should an ASM approach be linked in with other existing industry schemes?

*Enforcement and incentive program*

1. Will your audits be conducted by a totally independent auditor?
2. What will happen to the audit results – will they be made publicly available?
3. Do support and would you be willing to implement a public complaints process – so users can advise of non-compliance?
4. Would you recommend exercising flexibility in imposing sanctions? Ranging from increased audit frequency (three yearly in BMP cases, yearly for improvement and twice yearly if not going well), to non-compliance in extreme cases water restrictions, or water being turned off? And in cases of emergency allow deviation and not impose harsh sanctions, but when this happens again the sanction is stronger etc.?
5. Would you support an incentive programme i.e. less frequent audits, e.g. Synlait incentive program where a premium is paid for milk to those farmers who operate using best management practices which is not only more productive *but* more profitable!
6. What is the best way to resolve conflict, both between collectives, e.g. local council?

## Environment Canterbury interview

### *Farming management*

1. What scale do you think the water quality in the river should be managed at e.g. farm, tributary or catchment scale?
2. Can you see a nutrient trading mechanism working if one were available?
3. Do you support the use of herd homes and feed pads to reduce nutrient leaching?
4. Do you think reducing stock densities may be necessary?

### *Contribution*

5. Would you recommend the organisation of a collective catchment or sub-catchment project for mitigating the effect of pollutants? E.g. dams or weirs to trap sediment or large scale strategically located constructed wetlands providing nutrient mitigation benefit to an entire sub-catchment.
6. Should the farmers or the collective take responsibility for the management of the resource in their locality? Should this contribution be in proportion to the amount of land each of them irrigates?

### *Allocation*

7. What should happen to any headroom in nutrient limits which is created? E.g. to provide dairy support through winter, create room to take on new users?
8. How would you accommodate new users?
  - Would you like a grandfathering approach – where historic nutrient leaching rates are taken as the current limits?
  - Or would you prefer nutrient allowance based on GMP and current stock use?
  - Or would you prefer nutrient allowance based on land area? Do you think nutrients should be allocated in proportion to the amount of land owned/farmed?

### *Farm management requirements and ASM*

9. Could you please explain the consenting process a little more e.g. does the collective hold the consent?
10. What type of training do you think would be needed to enable an ASM approach to operate effectively? Would you be prepared to offer support to help an ASM approach, and if so what type of support would you provide (e.g. an education and adaptive management programme etc.)?
11. Would you be willing to aid with communication? Both between collective, ASM users and feedback to the community – including reporting, and consultation with stakeholders?
12. What type of management systems would need to be in place for ASM to work? And would you be prepared to aid in the implementation of this?
13. What type of data do you envisage will be needed for an ASM approach to work effectively? What will happen to this data?

### *Enforcement and incentive program*

7. Would you like audits to be conducted by a totally independent auditor?
8. What should happen to the audit results – should they be made publicly available?
9. Do support and would you be willing to implement a public complaints process – so users can advise of non-compliance?
10. Would you recommend exercising flexibility in imposing sanctions? Ranging from increased audit frequency (three yearly in BMP cases, yearly for improvement and twice yearly if not going well), to non-compliance in extreme cases water restrictions, or water being turned off? And in cases of emergency allow deviation and not impose harsh sanctions, but when this happens again the sanction is stronger etc.
11. Would you support an incentive programme i.e. less frequent audits, e.g. Synlait incentive program where a premium is paid for milk to those farmers who operate using best management practices which is not only more productive *but* more profitable!
12. How would you resolve conflict, both between collectives, e.g. local council?

## Environmental group interview

### *Individual preferences*

1. Do you think that your values are being recognised and supported?
2. Do you support collaborative governance – is it working in Canterbury?
3. Are you supportive of load limits on the river and limits on its tributaries?
4. What scale do you think the water quality in the river should be managed at e.g. farm, tributary or catchment scale?
5. Can you see a nutrient trading mechanism working if one were available?
6. Do you support the use of herd homes and feed pads to reduce nutrient leaching?
7. Do you think reducing stock densities may be necessary?

### *Contribution*

8. Would you recommend the organisation of a collective catchment or sub-catchment project for mitigating the effect of pollutants? E.g. dams or weirs to trap sediment or large scale strategically located constructed wetlands providing nutrient mitigation benefit to an entire sub-catchment.
9. Should the farmers or the collective take responsibility for the management of the resource in their locality? Should this contribution be in proportion to the amount of land each of them irrigates?

### *Audited Self-Management*

10. Would you prefer the Regional Council to regulate, property rights, or an audited self-management approach to manage to water quality?
11. Would you recommend communication? Both between collective, ASM users and feedback to the community – including reporting, and consultation with stakeholders?
12. What type of training do you think would be needed to enable an ASM approach to operate effectively? Would you be prepared to offer support to help an ASM approach, and if so what

type of support would you provide (e.g. an education and adaptive management programme etc.)?

13. What type of management systems would need to be in place for ASM to work?

#### *Enforcement and incentive program*

14. Would you like audits to be conducted by a totally independent auditor?

15. What should happen to the audit results – should they be made publicly available?

16. Do support and would you be willing to use a public complaints process – so users can advise of non-compliance?

17. Would you recommend exercising flexibility in imposing sanctions? Ranging from increased audit frequency (three yearly in BMP cases, yearly for improvement and twice yearly if not going well), to non-compliance in extreme cases water restrictions, or water being turned off? And in cases of emergency allow deviation and not impose harsh sanctions, but when this happens again the sanction is stronger etc.?

18. Would you support an incentive programme i.e. less frequent audits, e.g. Synlait incentive program where a premium is paid for milk to those farmers who operate using best management practices which is not only more productive *but* more profitable!

19. How would you resolve conflict, both between collectives, e.g. local council?

#### *Allocation*

20. What should happen to any headroom in nutrient limits which is created? E.g. to provide dairy support through winter, create room to take on new users?

21. How would you accommodate new users?

a. Would you like a grandfathering approach – where historic nutrient leaching rates are taken as the current limits?

b. Or would you prefer nutrient allowance based on GMP and current stock use?

c. Or would you prefer nutrient allowance based on land area? Do you think nutrients should be allocated in proportion to the amount of land owned/farmed?

## Appendix B Information Sheet

Waterways Centre for Freshwater Management

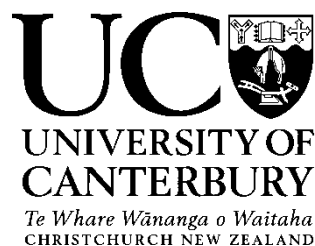
University of Canterbury

Private Bag 4800

Christchurch

Telephone: 027 286 4611

Email: [craig.simpson@pg.canterbury.ac.nz](mailto:craig.simpson@pg.canterbury.ac.nz)



Date: 29 July, 2014

My name is Craig Simpson and I am a Master in Water Resource Management student at Canterbury University. I am the principal researcher for my master's topic: **The Application of an Audited Self-Management System to Manage Nutrient Leaching in the Hurunui Catchment**. As part of my study I am investigating the collaborative approach in applying an audited self-management system to manage to nutrient limits in the Hurunui catchment. I am seeking the opinions of stakeholders relating to the features of an audited self-management approach and accompanying institutional arrangements, which are supported by stakeholders in the Hurunui catchment.

The research for this project will be based on semi-structured interviews, where I will be interviewing participants to ascertain their views relating to the application of an audited self-management approach. Participation is entirely voluntary and participants can withdraw at any stage, any information gathered from withdrawing participants will not be included in data analysis.

Although participation is voluntary I would be very grateful if you would agree to be interviewed. It is expected that interviews will take between 1 and 2 hours, and will be conducted in a venue that is convenient to you, and if desired you are very welcome to have a support person present for the interview. The interviews will be recorded using a Dictaphone, and transcribed, and a copy of the transcription will be made available to participants who can choose to review and amend the transcription if required.

If you do agree you may receive a copy of the project results at the conclusion of the project, in addition a copy of a synthesized report will be given to all participants.

A thesis is a public document and will be available through the University of Canterbury Library. The results of the project will be published, but you may be assured of the complete confidentiality of the data gathered in this investigation: your identity and any identifying material will not be made public. To ensure confidentiality real names will not be used in the final write up of the research. The data will be made available to my supervisors and myself, and after the transcripts and audio recordings have been analysed copies will be kept at Canterbury University in a locked cupboard for a period of five years, after which they will be destroyed. Password protected electronic copies will also be held for a period of five years.

This project has been reviewed and approved by the University of Canterbury Human Ethics Committee, and participants should address any complaints to The Chair, Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch ([human-ethics@canterbury.ac.nz](mailto:human-ethics@canterbury.ac.nz)).

If you are interested in participating in this research, please contact me either by email ([craig.simpson@pg.canterbury.ac.nz](mailto:craig.simpson@pg.canterbury.ac.nz)) or telephone (027 286 4611). From there we can schedule an interview time and venue that is convenient to you. At the time of the interview I will ask for your consent to participate to be recorded by filling out the consent form attached (copies of which I will bring with to the interview).

The project is being carried out under the supervision of Bryan Jenkins (senior supervisor), who will be pleased to discuss any concerns you may have about participation in the project, he can be contacted at: [bryan.jenkins@canterbury.ac.nz](mailto:bryan.jenkins@canterbury.ac.nz). Alternatively should you wish to discuss this research further with myself, please feel free to contact me. Thank you very much for your interest in my study.

Yours truly,

Craig Simpson



## Appendix C Consent Form

Waterways Centre for Freshwater Management

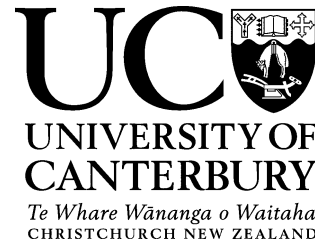
University of Canterbury

Private Bag 4800

Christchurch

Mobile: 027 286 4611

Email: [craig.simpson@pg.canterbury.ac.nz](mailto:craig.simpson@pg.canterbury.ac.nz)



Consent form for the research project:

### **The Application of an Audited Self-Management System to Manage Nutrient Leaching in the Hurunui Catchment**

I have been given a full explanation of this project and have had the opportunity to ask questions. I understand what is required of me and I agree to take part in this research.

I understand that participation is voluntary and I may withdraw at any time without penalty. Withdrawal of participation will also include the withdrawal of any information I have provided should this remain practically achievable.

I understand that any information or opinions I provide will be kept confidential to the researcher and supervisors, and that any published or reported results will not identify the participants or organisation to which they belong. I understand that a thesis is a public document and will be available through the UC Library.

I understand that all data collected for the study will be kept in locked and secure facilities and/or in password protected electronic form and will be destroyed after five years.

I understand that I am able to receive a report on the findings of the study by contacting the researcher at the conclusion of the project.

I understand that I can contact the researcher Craig Simpson ([craig.simpson@pg.canterbury.ac.nz](mailto:craig.simpson@pg.canterbury.ac.nz)) or supervisor Bryan Jenkins ([bryan.jenkins@canterbury.ac.nz](mailto:bryan.jenkins@canterbury.ac.nz)) for further information. If I have any complaints, I can contact the Chair of the University of Canterbury Human Ethics Committee, Private Bag 4800, Christchurch ([human-ethics@canterbury.ac.nz](mailto:human-ethics@canterbury.ac.nz)).

By signing below, I agree to participate in this research project.

Name:

Date:

Signature:

## References

- Agrawal, A. (2002). Common Resources and Institutional Sustainability. In E. Ostrom, T. Dietz, N. Dolšak, P. C. Stern, S. Stovich, & E. U. Weber (Eds.), *The Drama of the Commons*. Washington DC: National Academy Press.
- Ausseil, O. (2010). Hurunui River - Influence of the middle reach tributaries on water quality of the lower Hurunui River (2005-2008). Christchurch: Environment Canterbury Regional Council.
- Biggs, B. J. F. (2000). New Zealand Periphyton Guideline: Detecting, Monitoring and Managing Enrichment of Streams. Wellington: Ministry for the Environment.
- Briggs, S. L. K. (2006). Do environmental management systems improve performance? (Vol. 39, pp. 78). Milwaukee: American Society for Quality Control, Inc.
- Brown, I., Norton, N., Wedderburn, L., Monaghan, R., Harris, S., Hayward, S., & Ford, R. (2011). Nutrient Management in Hurunui: A case study in identifying options and opportunities. Christchurch: Environment Canterbury Regional Council.
- Budds, J., & Hinojosa-Valencia, L. (2012). Restructuring and rescaling water governance in mining contexts: the co-production of waterscapes in Peru. *Water Alternatives*, 5(1), 119-137.
- Canterbury Water. (2010). Canterbury Water Management Strategy: Strategic Framework - November 2009. Targets updated July 2010. Christchurch: Environment Canterbury Regional Council.
- Carruthers, G. (2011). Auditing and critical review in environmental management systems (EMS) in agriculture: Is there value for similar approaches in New Zealand's proposals for audited self-management? In L. D. Currie & C. L. Christensen (Eds.), *Adding to the knowledge base for the nutrient manager* (pp. 22). Fertilizer and Lime Research Centre: Massey University. Retrieved from <http://flrc.massey.ac.nz/publications.html>.
- Cohen, A., & Davidson, S. (2011). The watershed approach: Challenges, antecedents, and the transition from technical tool to governance unit. *Water Alternatives*, 4(1), 1-14.
- Cope, M. (2010). Coding qualitative data. In I. Hay (Ed.), *Qualitative research methods in human geography* (3rd ed., pp. 280-294). Oxford; New York: Oxford University Press.
- Cox, M., Arnold, G., & Tormás, S. V. (2010). A Review of Design Principles for Community-based Natural Resource Management. *Ecology and Society*, 15(4), 502-538.
- Davie, T. (2014). *Hurunui Nutrient Load and Concentration Measurements*. Paper presented at the Hurunui Waiau Zone Committee meeting 22 September, 2014, Waikari
- Deans, N., & Hackwell, K. (2008). Dairying and Declining Water Quality. *Why has the Dairying and Clean Streams Accord not delivered cleaner streams?* : Fish & Game New Zealand, Forest & Bird.
- Dicco-Bloom, B., & Crabtree, B. F. (2006). The qualitative research interview. *Medical education*, 40(4), 314-321. doi: 10.1111/j.1365-2929.2006.02418.x

- Dietz, T., Dolšak, N., Ostrom, E., & Stern, P. C. (2002). The Drama of the Commons. In E. Ostrom, T. Dietz, N. Dolšak, P. C. Stern, S. Stovich, & E. U. Weber (Eds.), *The Drama of the Commons*. Washington DC: National Academy Press.
- Duhon, M., Young, J., & Kerr, S. (2011). *Nitrogen Trading in Lake Taupo: An Analysis and Evaluation of an Innovative Water Management Strategy*. Paper presented at the New Zealand Agricultural and Resource Economics Society Conference, Nelson, New Zealand.
- Duncan, R. (2013). Converting community knowledge into catchment nutrient limits: a constructivist analysis of a New Zealand collaborative approach to water management. *Nature and Culture*, 8(2), 205.
- Duncan, R. (2014). Regulating agricultural land use to manage water quality: The challenges for science and policy in enforcing limits on non-point source pollution in New Zealand. *Land Use Policy*, 41, 378-387.
- Dunn, K. (2010). Interviewing. In I. Hay (Ed.), *Qualitative research methods in human geography* (3rd ed., pp. 101-138). Oxford; New York: Oxford University Press.
- Earl-Goulet, J. (2011). *Audited Self Management at Environment Canterbury: The current approach*. Environment Canterbury Regional Council. Timaru.
- Eder, D. (2014). Nutrient management and allocation in the Hurnui catchment - progress and challenges. Retrieved 9 December 2014, from <http://ecan.govt.nz/get-involved/canterburywater/committees/hurunui-waiiau/our-stories-hw/hw-stories/Pages/nutrient-management-allocation-hw.aspx>
- Environment Canterbury Regional Council. (2012a). Land Use and Water Quality. Retrieved 8 May 2014, from <http://ecan.govt.nz/get-involved/water-projects/land-use-and-water-quality/Pages/Default.aspx>
- Environment Canterbury Regional Council. (2012b). The preferred approach for managing the cumulative effects of land use on water quality in the Canterbury region *A working paper*. Christchurch: Environment Canterbury Regional Council.
- Environment Canterbury Regional Council. (2013a). *Hearing Commissioner Recommendation to the Proposed Hurunui and Waiau River Regional Plan and Proposed Plan Change 3 to the Canterbury Natural Resources Regional Plan*. Christchurch: Environment Canterbury Regional Council.
- Environment Canterbury Regional Council. (2013b). *Hurunui and Waiau River Regional Plan*. Christchurch: Environment Canterbury Regional Council.
- Environment Canterbury Regional Council. (2014a). Notification. Retrieved 25 April 2015, from <http://ecan.govt.nz/get-involved/consent-projects/ngai-tahu-forest-estates/Pages/notification.aspx>
- Environment Canterbury Regional Council. (2014b). *Proposed Land and Water Regional Plan: Decisions Version*. Christchurch: Environment Canterbury Regional Council.

- Federated Farmers. (2014). Most recent North Otago news. *Welcome to Federated Farmers*. Retrieved 6 May 2014, from <http://www.fedfarm.org.nz/membership/Provinces/North-Otago.asp>
- Feldman, D. L. (2007). *Water Policy for Sustainable Development*. Baltimore, Maryland: The Johns Hopkins University Press.
- Folke, C., Carpenter, S. R., Walker, B., Scheffer, M., Chapin, T., & Rockstrom, J. (2010). Resilience Thinking: Integrating Resilience, Adaptability and Transformability. *Ecology and Society*, 15(4), Art. 20.
- Goulding, K. (2000). Nitrate leaching from arable and horticultural land. *Soil Use and Management*, 16, 145-151.
- Gunderson, L. H., & Holling, C. S. (2002). *Panarchy: understanding transformations in human and natural systems*. Washington: Island Press.
- Gunningham, N. (1995). Environment, Self-Regulation, and the Chemical Industry: Assessing Responsible Care. *Law & Policy*, 17(1), 57-109.
- Gunningham, N. (2007). Incentives to improve farm management: EMS, supply-chains and civil society. *Journal of environmental management*, 82(3), 302-310.
- Hardin, G. (1968). The Tragedy of the Commons. *Science*, 162(3859), 1243-1248.
- Hayward, S., Meredith, A., & Stevenson, M. (2009). NRRP water quality objectives and standards for rivers and lakes in the Canterbury region (Report No. R09/16 ed.). Christchurch: Environment Canterbury Regional Council.
- Heath, M. W., Wood, S. A., Brasell, K. A., Young, R. G., & Ryan, K. G. (2015). Development of Habitat Suitability Criteria and In-stream Habitat Assessment for the Benthic Cyanobacteria *Phormidium*. *River Research and Applications*, 31(1), 98-108.
- Holley, C., Gunningham, N., & Shearing, C. (2012). *The New Environmental Governance*. Abington, Oxon; New York, NY: Earthscan.
- Holling, C. S., Gunderson, L. H., & Peterson, G. D. (2002). Sustainability and Panarchies. In L. H. Gunderson & C. S. Holling (Eds.), *Panarchy: understanding transformations in human and natural systems*. Washington: Island Press.
- Hurunui Waiau Water Management Zone Committee. (2011). Hurunui and Waiau Zone Implementation Programme. Christchurch.
- Hurunui Water Project. (2013). Resource consent granted for Waitohi irrigation and Hydro Scheme. Retrieved 6 May 2014, from <http://www.hurunuiwater.co.nz/news-update.php>
- Irrigation New Zealand Inc. (2008). Decision Support Systems for Audited Self Management: Opihi Catchment: Executive Summary Report *Contract Report for Ministry for Environment. Project No. 2243*. Christchurch: Irrigation New Zealand Inc.

- Jarvie, H. P., Sharpley, A. N., Withers, P. J. A., Scott, J. T., Haggard, B. E., & Neal, C. (2013). Phosphorus Mitigation to Control River Eutrophication: Murky Waters, Inconvenient Truths, and "Postnormal" Science. *Journal of environmental quality*, 42(2), 295-295.
- Jenkins, B. R. (1996). *Best Practice Environmental Regulation - The Western Australian Approach*. Paper presented at the Environmental Management Beyond 2000 Conference, Griffith University, Brisbane.
- Jenkins, B. R. (2007). *Water Allocation in Canterbury*. Paper presented at the New Zealand Planning Institute Annual Conference, Palmerston North.
- Jenkins, B. R. (2012). *Water Issues in Canterbury*. Paper presented at the Agronomy Society of New Zealand Annual Conference 2012, Lincoln University, Christchurch.
- Jenkins, B. R. (2013). *Progress of the Canterbury Water Management Strategy and some emerging issues*. Paper presented at the NZARES Conference, Lincoln University, Christchurch.
- Jenkins, B. R., & Hine, P. T. (2003). Benchmarking for Best Practice Environmental Management. *Environmental monitoring and assessment*, 85(2), 115-134.
- Land and Water Forum. (2010). Report of the Land and Water Forum: A Fresh Start for Fresh Water.
- Land and Water Forum. (2011). A Common Direction for Water Management in New Zealand Retrieved 16 March 2015, from <http://www.landandwater.org.nz/>
- Land and Water Forum. (2012a). Second Report of the Land and Water Forum: Setting Limits for Water Quality and Quantity, and Freshwater Policy-and Plan-Making Through Collaboration.
- Land and Water Forum. (2012b). Third Report of the Land and Water Forum: Managing Water Quality and Allocating Water.
- Lees, A., Robertson, G., Garvan, N., Barnett, J., & Edger, N. (2012). Community-owned Rural Catchment Management: A guide for partners. Hamilton: NZ Landcare Trust.
- Lincoln, Y. S., & Guba, E. G. (2002). Judging the Quality of Case Study Reports. In A. M. Huberman & M. B. Miles (Eds.), *The qualitative researcher's companion* (pp. 205-215). Thousand Oaks, CA: Sage Publications.
- Margerum, R. D. (2008). A Typology of Collaboration Efforts in Environmental Management. *Environmental Management*, 41(4), 487-500.
- Marsh, D. (2012). Water resource management in New Zealand: jobs or algal blooms? *Journal of environmental management*, 109, 33-42.
- Matson, P. A., Parton, W. J., Power, A. G., & Swift, M. J. (1997). Agricultural Intensification and Ecosystem Properties. *Science*, 277(5325), 504-509.
- McDowell, R. W., Wilcock, B., & Hamilton, D. P. (2013). Assessment of Strategies to Mitigate the Impact or Loss of Contaminants from Agricultural Land to Fresh Waters: Report RE500/2013/066 prepared for Ministry for the Environment.

- McKergow, L. A., Tanner, C. C., Monaghan, R. M., & Anderson, G. (2007). Stocktake of diffuse pollution attenuation tools for New Zealand pastoral farming systems *Report: HAM2007-161*. Hamilton.
- Memon, A., Duncan, R., & Spicer, A. (2012). *The Hurunui Waiau zone implementation programme as a collaborative planning process: a preliminary review*.
- Ministry for the Environment. (2014). *National Policy Statement for Freshwater Management 2014*. Wellington: Ministry for the Environment.
- Ministry for the Environment. (2015). *An everyday guide to the RMA: Your guide to the Environment Court*. Wellington: Ministry for the Environment.
- Ministry of Agriculture and Forestry & The Primary Sector Water Partnership. (2011). *Workshop Report: Building Knowledge and Understanding of Audited Self-Management*. Ministry of Agriculture and Forestry & The Primary Sector Water Partnership,.
- Molle, F. (2009). River-basin planning and management: The social life of a concept. *Geoforum*, 40(3), 484-494.
- Mulcock, C., & Brown, I. (2013a). *Audited Self-Management for Irrigation: 'How-to' Guide*. Christchurch: Irrigation New Zealand.
- Mulcock, C., & Brown, I. (2013b). *Managing Water Quality and Quantity within Limits*. Christchurch: Irrigation New Zealand.
- Norman, E., & Bakker, K. (2009). Transgressing Scales: Water Governance Across the Canada-U.S. Borderland. *Annals of the Association of American Geographers*, 99(1), 99-117.
- Norman, E., Bakker, K., & Cook, C. (2012). Introduction to the themed section: Water governance and the politics of scale. *Water Alternatives*, 5(1), 52-61.
- North Otago Irrigation Company. (2014). *Audited Self Management*. North Otago Irrigation Company. Oamaru.
- Norton, N., & Kelly, D. (2010). Current nutrient loads and options for nutrient load limits for a case study catchment: Hurunui catchment *Report No. R10/066*. Christchurch: Environment Canterbury Regional Council.
- Olsson, P., Folke, C., & Hahn, T. (2004). Social-Ecological Transformation for Ecosystem Management: the Development of Adaptive Co-management of a Wetland Landscape in Southern Sweden. *Ecology and Society*, 9(4), Art. 2.
- Ostrom, E. (1990). *Governing the commons: the evolution of institutions for collective action*. Cambridge: Cambridge University Press.
- Ostrom, E., & Cox, M. (2010). Moving beyond panaceas: a multi-tiered diagnostic approach for social-ecological analysis. *Environmental Conservation*, 37(4), 451-463.
- Parkyn, S., & Wilcock, B. (2004). Impacts of agricultural land use. In J. S. Harding, M. P. Mosley, C. P. Pearson, & B. K. Sorrell (Eds.), *Freshwaters of New Zealand*. Christchurch: New Zealand Hydrological Society Inc. and New Zealand Limnological Society Inc.

Resource Management Act (1991).

Peshkin, A. (1988). In Search of Subjectivity. One's Own. *Educational Researcher*, 17(7), 17-21. doi: 10.2307/1174381

Quiblier, C., Wood, S., Echenique-Subiabre, I., Heath, M., Villeneuve, A., & Humbert, J.-F. (2013). A review of current knowledge on toxic benthic freshwater cyanobacteria--ecology, toxin production and risk management. *Water research*, 47(15), 5464.

Quinn, J., Wilcock, R., Monaghan, R., McDowell, R., & Journeaux, P. (2009). Grassland farming and water quality in New Zealand. *Tearmann: Irish Journal of Agricultural-Environmental Research*, 7, 69-88.

Ravitch, S. M., & Riggan, M. (2012). *Reason & rigor : how conceptual frameworks guide research*. Thousand Oaks: Sage Publications.

Reed, M. S. (2008). Stakeholder participation for environmental management: A literature review. *Biological Conservation*, 141(10), 2417-2431.

Scholz, R. W., Lang, D. J., Wiek, A., Walter, A. I., & Stauffacher, M. (2006). Transdisciplinary case studies as a means of sustainability learning: Historical framework and theory. *International Journal of Sustainability in Higher Education*, 7(3), 226-251. doi: 10.1108/14676370610677829

Seidman, I. (2013). *Interviewing as qualitative research: a guide for researchers in education and the social sciences*. New York: Teachers College Press.

Shortle, J. (2013). Economics and environmental markets: Lessons from water-quality trading. *Agricultural and Resource Economics Review*, 42(1), 57-74.

Silverman, D. (2006). *Interpreting qualitative data: methods for analysing talk, text and interaction*. London: SAGE.

Simons, H. (2009). *Case study research in practice*. London; Los Angeles: SAGE.

Singleton, S., & Taylor, M. (1992). Common Property, Collective Action and Community. *Journal of Theoretical Politics*, 4(3), 309-324.

Stake, R. E. (2000). The Case Study Method in Social Inquiry. In R. Gomm, M. Hammersley, & P. Foster (Eds.), *Case study method : key issues, key texts*. London, Thousand Oaks, Calif.: SAGE.

Tanner, C. C. (2012). Potential of wetlands to reduce nutrient loads from Lowry Peaks and St Leonard's Drains to the Waiau and Hurunui Rivers. Hamilton: National Institute of Water & Atmospheric Research Ltd.

Valentine, G. (1997). Tell me about...: using interviews as a research methodology. In R. F. D. Martin (Ed.), *Methods in Human Geography*. Essex, England: Addison Wesley Longman Limited.

Vogel, E. (2012). Parcelling out the watershed: The recurring consequences of organising Columbia River management within a basin-based territory. *Water Alternatives*, 5(1), 161-190.



Waikato Regional Council. (2011). Nitrogen sourcing and trading in the Lake Taupo catchment. Retrieved 11 June 2014, from <http://www.waikatoregion.govt.nz/Community/Your-community/For-Farmers/Taupo/Nitrogen-trading-in-the-Lake-Taupo-catchment/>

Walker, B. H., & Salt, D. (2006). *Resilience thinking: sustaining ecosystems and people in a changing world*. Washington, D.C: Island Press.

Yin, R. K. (2009). *Case study research: design and methods* (Vol. 5.). Los Angeles, Calif: Sage Publications.