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Understanding Factors Leading to Non-compliance With Effluent Regulations by Dairy Farmers

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Executive summary

In the past the primary policy initiative to assist farmers' compliance with effluent regulations and best management practices has been extension. Extension has focused on influencing dairy farmers' attitudes and practices towards effluent management by communicating the benefits of utilising effluent and by providing technical assistance for system design. Despite this investment, activities to increase compliance have resulted in unexpected responses by landholders and the level of non-compliance with relevant regulations is, in some cases, still at an unacceptable level. In response regulating authorities have questioned the effectiveness of using extension alone and have increased regulatory efforts in recent years.

This research explores the factors leading to dairy farmers' compliance or non-compliance with effluent management regulations to protect water quality in the Shepparton Irrigation Region (SIR) Victoria, Australia and the Waikato region, New Zealand. This study comprises two qualitative case studies in these areas of intensive dairy farming. Interviews were conducted in a manner that enabled farmers to describe their systems, their management routines and their perceptions of their compliance with the regulations.

The I_3 Response Framework (Murdoch, et.al. 2006), a framework designed to predict likely behavioural response to policy interventions, along with insights from literature on compliance and deterrence, are used to interpret the findings and gain understanding of where future policy intervention may focus to improve compliance rates.

Findings

In the SIR and Waikato region farm context plays a key role in the type and management of dairy effluent systems. Variation in soil type, topography, rainfall and fit with existing irrigation infrastructure determined the types of technologies in place. Effluent application decisions were determined by dairy shed position, slope and linkages to the existing farm irrigation network. Farm management was also a contributing factor in decisions about system design with owners seeking to minimise errors in operation by farm staff.

In terms of technical advice on system design Waikato farmers were concerned about the lack of specific technical material and unbiased advice with some frustrated by Environment Waikato (EW) focus on a particular regulatory outcome but lack of technical assistance on how to achieve this outcome. Farmers in the SIR were able to access technical assistance on system design from the Department of Primary

Industries (DPI). For some, fear of onerous requirements or scrutiny of their present systems made them reluctant to approach either DPI or EW. Other influences on system decision were frustration caused by lack of information on 'good' systems and reluctance to invest in system upgrades like solids traps and storm water diverters because of others' experiences. For some, particularly in the SIR where recent drought has reduced farm incomes, there was little willingness to prioritise investment in effluent systems.

Few farmers from both regions were calculating nutrient budgets for their farms. In SIR most farmers did not alter their fertiliser programmes as a result of effluent application. In the Waikato most farmers stated they altered fertiliser amounts on effluent irrigated land mostly by judgement rather than by comparative soil testing.

System design has potential implications for compliance. In both areas management of solids or sand traps, pump failures and blockages, pipe or drain blockages were common problems farmers experienced regardless of the effluent storage or disposal system in place. In the Waikato, farmers could lack suitable application areas or experience overflows due to limited storage at times of high or prolonged rainfall. Waikato farmers with travelling irrigators referred to a range of mechanical or operational failures when running irrigators. Where holding capacity was limited waiting periods for replacement parts can potentially contribute to non-compliance. In the SIR some farmers have only a few bays available for effluent irrigation, potentially requiring capital investment to extending application areas. Some farmers' practice of leaving ponds until solids overflowed or with no capacity to assimilate solids led to runoff. However, farmers considered that even with runoff, effluent was contained on the farm by the reuse dam.

In both areas the majority of farmers interviewed believed they complied with the regulations. However, from the regulatory agencies perspective farmers' practices such as inadequate storage and application area, using reuse dams for effluent containment and stockpiling dried effluent after de-sludging is a risk factor. It appears farmers' perceptions of how to interpret the regulation and their decision making are not-aligned with the regulatory agencies assessment of risk.

Applying the I_3 Response Framework identified the relationships between farmers' attitudes towards the issue of effluent management, their attitudes towards particular measures for managing effluent, and their actual management practices. The I_3 Response Framework is underpinned by the idea that an individual's level of involvement will significantly influence their response to a regulation. The Framework identifies two key dimensions of this involvement: involvement with the issue and

involvement with the intervention. The I_3 Response Framework (Murdoch et al., 2006) can be used to determine farmers' involvement in the policy issue, in this case water quality, and their involvement in any associated policy intervention.

The farmers interviewed were placed in the I_3 Response Framework, based on qualitative interpretation of their involvement with the issue and intervention. Farmers from the SIR were placed in Quadrant 1 as they exhibited low involvement with the issue and with the intervention. These farmers had low involvement with the issue because the issue of water quality was irrelevant to the decision making around management of their effluent systems. At the time of interviewing SIR farmers were characterised as having low level of involvement of with the intervention as effluent systems were generally integrated into the farm irrigation system so that they required little attention or effort. In addition, the EPA had not yet audited the catchment, and compliance monitoring in the area to date had been limited.

Murdoch et.al. (2006) suggest that the likely response by farmers in this segment is unwitting compliance or non-compliance. Farmers interviewed in the SIR demonstrated a willingness to comply with the regulations, but may have lacked robust management practices, which could lead to non-compliance. Murdoch et.al., (2006) further suggest that to ensure compliance by those that have low involvement with the issue (because for example, their livelihood is not at risk) then a suitable policy intervention might be to remove the policy risk.

Farmers in the Waikato region were placed in Quadrants 3 and 4. Some Waikato farmers who were considered to have high involvement in the issue and the intervention were placed in Quadrant 3. They expressed social and normative motivations to comply, raising concerns about the declining image of the farming industry and market access and stating personal beliefs aligning with the regulations goal. The framework suggests that their likely behaviour is compliance, as meeting regulatory obligations provide a benefit. When involvement with the intervention is high, this relationship is further assessed and divided to indicate whether farmers have a positive or negative attitude towards the intervention. Farmers in Quadrant 3 held generally positive attitudes towards the regulation seeing the business benefits of complying. For individuals in Quadrant 3 a compliance strategy could include industry acting as the regulator with the agency playing a watchdog role monitoring and promoting compliance.

Waikato farmers that were placed in Quadrant 4 had low involvement with the water quality issue, but, in comparison, had high involvement with the intervention due to recent high profile enforcement activity and the nature of the effluent disposal

technology. Farmers in Quadrant 4 held generally positive attitudes on the regulation and/or were not adversely affected by the regulation. Costs of compliance were not high and practices that were necessary for compliance were aligned with practices needed to run the farm efficiently, given their choice of effluent technology. Murdoch et.al. (2006) suggest that farmers in this quadrant would tend to comply. Thus the policy response is to maintain compliance by a mix of inspection and promotion (promotion includes extension).

Although not strongly held there were some negative attitudes expressed towards EW's recent enforcement activity with respect to fairness and credibility. Given that many contextual factors led to non-compliance, farmers accept that at times they might fail to comply, but would expect past compliance would be taken into consideration. There is the potential to promote negative attitudes towards the intervention if this does not occur. Individuals that perceive the intervention to have negative consequences or to be unfair will not comply or comply reluctantly, and where negative sentiment is strong, may voice disapproval and gain broader public support.

The Framework's application to these case studies has highlighted its significant potential in predicting people's likely behavioural responses to effluent management obligations and where future policy intervention may focus to improve compliance rates.

Conclusions

The application of the I_3 Response Framework along with insights from the compliance and deterrence literature has identified potential risks to the implementation of regulations and the need for responses to differences in context through a mix of non-regulatory and regulatory methods. The following suggestions for each case study may help regulatory agencies reduce the factors that lead to non-compliance.

In the SIR to assist compliance status:

- Continue to provide technical assistance with a focus on ongoing management.
- Assist in research into the development of systems that meet farmers' desired benefits for low maintenance, simple, foolproof systems that reduce the risk of non-compliance.
- Address the misalignment between the EPA's and farmers' assessments of what constitutes risk to the environment, and develop objective critical control measures for farmers.
- Consider the development of a subsidised inspection and/or system maintenance service to provide farmers with objective assessment of maintenance needs and/or minimise or reduce the risk of non-compliance.

In the Waikato region to assist compliance status:

- Address the gap in the provision of technical assistance for system design and management.
- Assist in research into the development of systems that meet farmers' desired benefits for low maintenance, simple, foolproof systems that reduce the risk of non-compliance.
- Investigate an assistance option for unforeseen equipment malfunction or unpredictable environmental variations, such as an emergency exchange service for pump and travelling irrigators.
- Provide incentives that contribute to buffers in systems that reduce the likelihood of non-compliance, for example increased holding capacity.

In both regions:

- Determine the appropriate level of inspection needed to enhance the perception of the risk of being caught. In doing so, consider a risk assessment approach to any inspection/audit regime to assist with allocation of resources. This could include benefit-cost analysis to assess marginal costs.
- Determine the appropriate level of penalty taking into account factors that influence perceived credibility and enhance fairness of enforcement procedures.
- Understand the effect of enforcement officers' styles and review current approaches to ensure they enhance rather than detract from farmers' compliance and are aligned with agency strategy.
- Review local planning provisions that require new or redeveloped dairy sheds and dairy effluent systems to have a permit and have appropriate system design standards incorporated.
- Ensure there is continued awareness of enforcement activities and that fines have been imposed to enhance general deterrence and assist in the maintenance of farmers' compliance status.
- Review information already provided in the form of print and web publications for redundancy, consistency, relevancy, accuracy and accessibility.
- Ensure consistency and accuracy of information provided to farmers by identifying all those in the private sector involved in effluent management systems and addressing any gaps in information on compliant systems.
- Consider the role of incentives to assist the upgrade of systems.
- Continue to evaluate the effectiveness of current policy interventions and the effect of any further interventions, for example incentives on enabling compliance.

1 Introduction

The Shepparton Irrigation Region (SIR) Victoria, Australia and the Waikato region, New Zealand are areas of intensive dairy farming. In both areas, government agencies have raised concerns about the level of non-compliance with dairy effluent management regulations. Insufficient management of dairy effluent by farmers is a factor in the continued degradation of water quality in both areas. Mismanagement can result in increased levels of nutrients, sediments, pathogens and other pollutants and reduced BOD (biological oxygen demand) in waterways (McDonald, pers.comm, 2006).

In the past the primary policy initiative to assist farmers' compliance with effluent regulations and best management practices has been extension. Those involved in provision of extension to this sector, have focused on influencing dairy farmers' attitudes and practices towards effluent management by communicating the benefits of utilising effluent (where previously this by-product of farmers' businesses was viewed as a waste); and by providing technical assistance for system design (with technical assistance provided by the public sector to a much greater extent in Victoria than in the Waikato region). However, farm surveys revealed significant non-compliance with effluent regulations leading regulating authorities to question the effectiveness of using extension alone in seeking to increase the level of compliance with the regulations. As a result there have been increased regulatory efforts in recent years.

In both areas regulation governing dairy effluent management could be described as obligatory yet flexible, focusing on the outcome and not prescribing how it is achieved, thereby farmers have the freedom to decide which systems best fit their farm context. Farm context can be defined as the mix of practices and techniques used on the farm, and the biophysical and financial resources available to the farm business (Crouch 1981, Kaine and Lees, 1994).

This study comprises two qualitative case studies of 16 farmers in the Waikato region and 19 farmers in the SIR. Interviews were conducted in a manner that enabled farmers to describe their systems, their management routines and their perceptions of their compliance with the regulations. Interviews were not intended to be an assessment of compliance. In describing systems and their management however, farmers were open about factors contributing to their non-compliance and were asked to make a qualitative assessment of their own compliance.

This report outlines the theoretical framework utilised to interpret this research, namely the I_3 Response Framework proposed by Murdoch et.al., (2006). The results of the two

case studies are presented and discussed to shed light on why farmers' practices may, or may not be, aligned with the regulation. The I_3 Response Framework, along with insights from the literature on compliance and deterrence, are used to assist in understanding how interventions can be designed to reduce the factors that lead to non-compliance and achieve the desired outcome, which is, improving water quality.

2 Background

There are 5100[1] dairy farmers in the Waikato region. The region's dairy industry is traditionally characterised by pasture based, dryland activities (i.e. not irrigated). More recently intensification of this industry resulted in amalgamations of farms, irrigation, increasing herd sizes and moves to feed pads and herd homes. Rainfall is a significant contributor to the management of effluent systems (average annual rainfall is 1,250 mm) as is variations in soil type and topography.

Figure 1: Map showing the Waikato region, New Zealand.

Environment Waikato (EW) is the local government authority (regional council) responsible for the integrated management of the natural and physical resources of the

[1] Source: www.maf.govt.nz/statistics/primaryindustries/land-use-and-farm-counts/tables/02-ft-rc.xls Data as at 30 June 2002. Downloaded 20 July 2006.

Waikato region. Environment Waikato carries out policy and plan development, as well as monitoring and compliance activities to implement relevant national environmental legislation and policies for the region. One of these, the Resource Management Act 1991 (RMA) stipulates that all discharges of dairy effluent to land or water that may result in contamination of waterways require a resource consent (permit) unless a Regional Plan says otherwise (section 15(1) of the RMA).

Under the Waikato Regional Plan (WRP) farmers can choose between a consented system (typically pond systems that discharge treated water to waterways) or to comply with regulations that govern the application of effluent onto the land under the Permitted Activity rules (WRP Section 3.5.5). Farmers are able to choose suitable systems for their property, while taking heed of the conditions of the rule. Consented systems carry application, annual and monitoring charges. Currently, Permitted Activities carry no specific charges, though farmers may need a consent for some aspect of their system if they do not meet Permitted Activity rules. Twenty per cent of dairy farms have consents for their effluent systems, with the majority of the rest predominately using travelling irrigators for land-based application as per the Permitted Activity rules (Franks, pers.comm 2007). District councils[2] generally require a building consent for new dairy sheds. However, there is no planning provision for any effluent disposal associated with a new shed and no referral process to EW in place (Dragten, pers.comm 2006).

Within the Goulburn Broken catchment, the SIR is also an area of intensive dairy farming. There are over 2054 dairy farmers in the catchment (Montecillo, 2006), most of which are within the SIR. The region's dairy industry is also mainly pasture based, but differs significantly from the Waikato with flood irrigation systems dominating. The area has predominately alluvial soil types and the flat topography of a flood plain. Average annual rainfall is 400-500 mm[3].

[2] There are 12 district councils within the Waikato region. District council functions include controlling the effects of the use of land, issuing building permits and providing infrastructure such as water, sewerage, waste facilities.

[3] Source: http://www.dpi.vic.gov.au/dpi/vro/gbbregn.nsf/pages/gbb_climate Data as at 30 November 2006. Downloaded 19 February 2007.

Figure 2: Map showing the Shepparton Irrigation Region, Victoria, Australia.

The main regulation for dairy effluent is under the State Environment Protection Policy (SEPP), Water of Victoria Schedule D (2003) enforced by the Environment Protection Authority Victoria (EPA Victoria). This outcome-focused regulation requires farmers to contain effluent on their land; not leaving their property or entering a waterway. It is not prescriptive as to how this goal is achieved. In Victoria, around 80 per cent of dairy farms now have pond effluent systems in place (Watson, 2006). At the local government level, most Victorian authorities have no specific provisions in place for dairy effluent systems or even dairy sheds. There are three local government authorities in the SIR (City of Greater Shepparton, Campaspe and Moira Shires). None have planning provisions specific to effluent systems. However, planning provisions may trigger referrals to relevant agencies - in the SIR, the Goulburn Broken Catchment Management Authority (GB CMA) - if earthworks for dams are over a certain size, but this is rarely the case for effluent ponds (Botting, pers.comm 2006). In addition, if farmers want to site effluent systems near Goulburn-Murray Water's (G-MW) assets[4] (for example, put pipes over or under G-MWs channels) they will be referred to G-MW (Smith, pers.comm 2006). Farmers can, in most instances, build a dairy shed or put in an effluent system and not have to take account of any planning provisions. They may

[4] Goulburn-Murray Water (G-MW) manages the area's water storage, delivery and drainage systems.

be referred to DPI for technical assistance if the local authority's planner follows the guidelines published by the GB CMA (Botting, pers.comm 2006).

DPI has an advisory role in compliance, but no enforcement role. It provides technical assistance in the design of effluent management systems, supplying a detailed Effluent Management Plan at no cost to landholders.

In both areas non-regulatory programmes have been well established over the last 10 years to encourage compliance with the respective regulations. SIR dairy farmers are able to get technical assistance from DPI, find a plethora of fact sheets available through print and web, attend field days and or visit demonstration farms. In the Waikato region farmers have been able to access a number of EW led education initiatives such as industry guideline documents and fact sheets and extension methods such as discussion groups and demonstration farms. However, a striking difference between the two areas is the provision of government support for effluent management plans by DPI.

As stated in the introduction, in the Waikato region and the SIR a recent focus on enforcement of dairy farmers' effluent management practices has found varying levels of non-compliance with the relevant regulations.

In the Waikato region, EW's review of the contracted services for dairy effluent compliance monitoring found that insufficient information was being gathered to reliably review the Waikato Regional Plan. In response EW undertook a random survey of farms in March 2005 and found a 57 per cent non-compliance rate (Brodnax, pers.comm 2006). This led to a re-thinking of the way monitoring for compliance was undertaken and a trial helicopter surveillance project confirmed that rates of non-compliance were higher than those reported through the contracted service providers. Recent monitoring resulted in a 'from the air' non-compliance assessment of 43.5 per cent, which dropped to 23.5 per cent with ground inspections of suspect properties. In total 9 per cent of farms monitored (600) were given infringement notices of $750 and 14 per cent were given warnings. While infringement notices could have been issued to many of those receiving warnings, relationship building is considered part of the enforcement approach (Franks, pers.comm 2006).

The EPA Victoria, have undertaken a small number of audits of dairy effluent systems in catchments recently. Rates of non-compliance with effluent regulations and best practice were found to be between 72 and 45 per cent (EPA, 2003). In March and April (2006) EPA's trial audit in the SIR found most of the twenty-eight farms inspected to be non-compliant or at risk of non-compliance (Edwards, pers. comm 2006). Fifteen farms

were issued with risk letters and 11 were issued Minor Works Pollution Abatement Notices (PAN), all farms inspected were offered assistance by DPI for review of their systems. Only 2 farms passed inspection. A graduated scale of infringement is in place whereby officers have the discretion to issue warnings, risk notices or pollution abatement notices within guidelines.

While in both areas, the agencies involved are working with industry to improve dairy effluent practices and compliance with regulations – through the Fonterra Accord in the Waikato and the DairyGain$ initiative in Victoria – the enforcement approach is different. In Victoria the EPA is taking a co-operative approach and is working in partnership with DPI in an enforcement-education push-pull strategy to bring Victorian dairy farmers up to speed with best practice. In the Waikato, EW is not facilitating such a one-to-one extension programme with those found to be in non-compliance, though as stated previously enforcement officers have some discretion as to when a warning or infringement notice is given.

3 Theoretical framework

Understanding the factors that influence compliance or non-compliance with dairy effluent management policies is important when selecting appropriate policy instruments.

The I_3 Response Framework can be used to understand an individual's likely response to a particular intervention such as incentives or regulation, and assist in policy decisions on agency responses and where to allocate resources (Murdoch et al., 2006). The framework achieves this by describing an individual's involvement in relation to the policy issue the intervention aims to address (in this case water quality), and to the intervention itself (compliance with dairy effluent disposal rules).

In the I_3 Response Framework, involvement is conceptualised as how motivating, important and relevant the issue and/or the intervention is to the individual. In marketing terms, involvement refers to the personal relevance or importance of a product or service to the consumer, and is not an attribute of a product. Put simply, high involvement purchases are those where we put considerable effort into thinking about the purchase decision prior to, and post the purchase for example, purchasing a car. Whereas with low involvement purchases such as buying bread, we generally put little cognitive effort into the decision preferring to rely on brand, price or other attributes like 'it's the one the kids eat'. Therefore, an individual's level of involvement is important because of its motivational role in decision making and critically influences their response to an intervention (Murdoch et al., 2006).

Figure 3 below illustrates the framework for considering individuals' behavioural responses. The figure shows the level of involvement from low to high with the policy issue (on the vertical axis) and with the intervention (on the horizontal axis). For a particular issue and intervention individuals' responses will fall within a particular quadrant. Based on their level of involvement with the issue and intervention the likely responses will be: compliance, unwitting compliance/non-compliance, non-compliance or compliance with conflict and non-compliance or compliance with outrage.

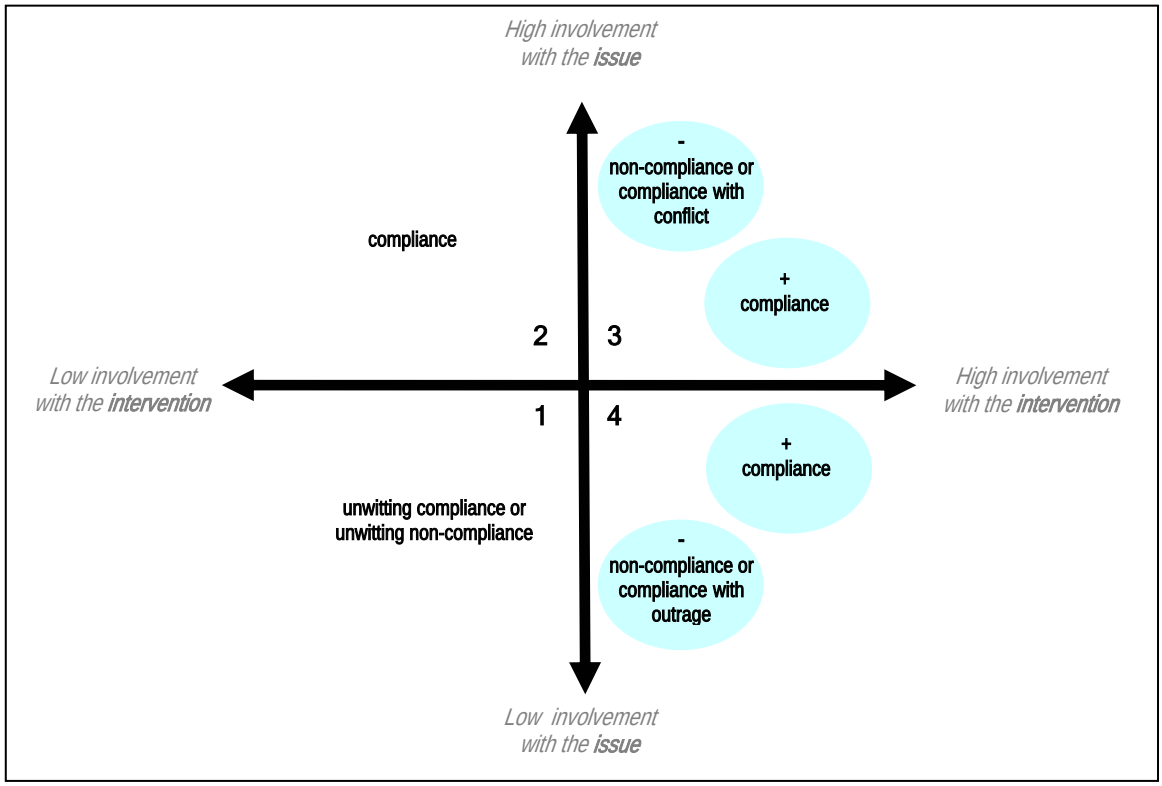

Figure 3: I_3 Response Framework outlining likely behavioural responses (Murdoch et al., 2006).

For individuals who have low involvement with the policy issue and the intervention the framework suggests that they would be largely unaware of the details of the issue and any intervention requirements (Quadrant 1). Therefore, they may or may not be complying with the intervention and are unlikely to have considered their own practices or adopted any best practice in relation to the issue. In addition, as level of involvement tells us about the effort people put into decision making, it is likely these people would spend little time on information processing - sourcing information or even scanning information they may receive. In contrast, those with higher involvement in the issue, yet relatively low involvement with the intervention will comply, because it does not require them to do anything, or little, differently to what they already do (Quadrant 2). The issue's greater relevance to the individuals in Quadrant 2 means that it is likely they have already found, processed and acted on information enabling them to respond to the issue in a way that is aligned with the intervention directives.

Individuals in Quadrant 3 are those with high involvement with the issue and with the intervention. Therefore, their involvement in the issue is likely to lead to compliance if they view the intervention positively. That is to say it does not result in them needing to make significant changes to their usual practice and they perceive the benefits of complying outweigh the costs of compliance, for example by reducing risk of disease. However, those who view the intervention negatively as the costs outweigh any benefits they receive from compliance are likely to either intentionally choose not to comply or comply reluctantly. Murdoch et.al., (2006) suggest this may result in individuals expressing their desire for change to the intervention by lobbying regulatory groups or in forming groups opposed to the regulation.

In Quadrant 4 individuals have low involvement with the policy issue, yet high involvement with the intervention. While these individuals will not have sought or processed information about the issue itself, they are likely to have considered the requirements of the intervention because of its relevance to them and/or their business. As with Quadrant 3 individuals will perceive the intervention either positively or negatively. Again those whose attitude to the intervention is positive will likely comply. However, Murdoch et.al., (2006) suggest that individuals with a negative view of the intervention may choose not to comply or they may comply, but there is a risk of 'outrage'[5]. This is because they may perceive the intervention requirements to be unfair, risky, financially costly or of little relevance to them or their business. Murdoch et.al., (2006) suggest that this may lead to individuals publicly voicing their objection to the intervention and devalue its role in managing the issue. In addition, they may attract the support of the wider community.

Kaine's (2004) framework for understanding how farm context affects farmers' decision making around adoption of innovations is used in this research to place farmers in the I_3 Response Framework quadrants (for a fuller discussion of the Kaine Framework see the Appendix). Applying the Kaine Framework to understand farmers' effluent management practices gives insight into the extent to which factors in their farm context determines their ability to comply with regulations or not.

Theoretical concepts from criminology, compliance and deterrence literature briefly outlined below add further insights into how the regulated community responds. Firstly, it is useful to distinguish between enforcement and compliance. Whereby enforcement is regulatory by nature while compliance is a mixture of deterrence through the presence of enforcement and non-regulatory influences that is, social and normative motivations (Winter and May, 2001).

[5] Outrage is defined as the public's response to a risk or the behaviour of risk managers (Sandman, et.al.,. 1993).

Deterrence theory stems from the works of Cesare Beccaria (1738-1794) and Jeremy Bentham (1748-1832). Though the influence of their work on deterrence theory can be critiqued as being a product of their time (Mendes 2004; Nagin and Pogarsky 2001); deterrence theory remains the cornerstone of many enforcement policies and practices (Burby and Paterson 1993; Carlough, 2006; Mendes 2004; Nagin and Pogarsky 2001). The basic tenets are that a criminal is deterred from performing an illegal act by calculating the risk of being caught (certainty), how promptly the penalty is imposed (celerity) and the size of the penalty (severity).

The perceived risk of being caught is generally thought to be the determining factor in creating deterrence. While the size of the penalty is thought to have less of a deterrent effect than either the perceived risk of being caught or the promptness of penalty (Cohen 2000; Nagin and Pogarsky 2001). Economists and other social scientist working in this area base this on the seminal work of Becker (1968, as cited in Cohen 2000). Some argue the logic and weightings applied to calculations of effects of these three functions do not result in primacy of either celerity or certainty over severity (Mendes, 2004; Nagin and Pogarsky, 2001; Weber and Crew 2000). Some economists have demonstrated that the size of the penalty should rise proportionately to the size of the breach of regulation, and implemented in a transparent manner to provide an effective deterrent to polluting firms (Weber and Crew, 2000). However, in the case of environmental regulations, it is argued that more severe penalties are not as an effective deterrent because of the low likelihood of them being applied (Thornton et al., 2005). In all instances though, these three tenets of deterrence theory are widely applied today across a number of areas.

Rational choice theory also provides a calculation base for explaining criminal behaviour, where people are positioned as acting rationally, weighing up the benefits and costs of compliance and act accordingly (Akers, 1990; Winter and May, 2001). However, critics of deterrence and rational choice theories state that the central concepts of fear of punishment or reward/cost balance provide a narrow interpretation of behaviour, by excluding influences such as the role of informal social rewards and punishments, personal characteristics, family, friends and peers (Akers 1990; Carlough, 2006; Cohen 2000; Winter and May 2001).

Research including these influences has shown that non-legal consequences and social sanctions can be more influential than formal legal sanctions (Akers, 1990; Cohen 2000; Nagin and Pogarsky, 2001; Thornton et.al., 2005). Thus Winter and May (2001) suggest that an extended view of people's motivations to comply with regulations could incorporate social and normative motivations as well as calculated

motivations (as in deterrence and rational choice theory). Social motivations stem from the influence of social norms and wishing to stay in favour with peers or family; normative motivations stem from personal norms about moral or civic duty and assessment of the regulation in terms of intent and enforcement.

It is also useful to look at the role of specific and general deterrence in creating and maintaining compliance. Specific deterrence is the effect that enforcement targeting a particular firm has on that firm's ongoing compliance with regulations. In contrast, general deterrence is the deterrent effect on the rest of the regulated public created by awareness of enforcement activity (Carlough, 2006; Cohen 2000).

Additionally, studies showing the effects of enforcement officers' styles and agencies' choices on influencing compliance rates amongst dairy farmers in Denmark provide insights into how these are important in gaining trust, credibility and support for enforcement activities, the regulations and its stated goals (May and Winter, 1999)[6].

Finally, most people prefer to support legislation they feel is just and of benefit to society in general (Winter and May, 2001; Thornton et.al, 2005) and conform most of the time, such that over time conforming behaviour becomes largely self-controlled (Akers, 1990). However, as Burby and Paterson (1993, 766) clearly state, "Deterrent measures provide a needed backstop for dealing with recalcitrant firms …".

4 Method

To understand dairy farmers' decision making regarding compliance with dairy farming effluent regulations, their choice of effluent systems and management practices, it is appropriate to use qualitative research techniques. Qualitative research does not claim to quantify the range of experiences and perspectives found; rather, it seeks to explore the perspectives of participants and their diversity (Flick, 2002).

Nineteen interviews were conducted in the SIR. These were conducted prior to the EPA random audits in this area in late March 2006. Sixteen interviews were conducted in the Waikato region in late May/early June 2006. Agency stakeholder interviews were conducted in both areas.

Convergent interviewing was employed to gather the information. Using this process the information gathered forms the basis of recurrent themes, and interviews continue until no new data emerges to explain the phenomena of interest (Dick, 1998). In practice, this means that the size and selection of the sample is not predetermined;

[6] May and Winter qualify their findings as likely to apply to countries that are culturally similar in normative motivations to comply with regulations which are regarded as reasonable and fair (May and Winter, 1999).

instead the population sampled is a product of the information gathered (Dick, 1998). This process was followed in the SIR; however in the Waikato region, where soil type and topography were thought to be potential influences in effluent management, purposive sampling was also used to ensured a range of settings.

Farmers' perspectives were investigated through in-depth unstructured interviews employing the laddering technique. This technique seeks to reveal chains of reasoning behind people's decision making by discovering the attributes, consequences and values behind a purchase choice (Grunert and Grunert, 1995; Reynolds and Gutman, 1988). At least two interviewers conducted the interviews[7], either in the home of the interviewee or in view of the effluent system. Interviews were recorded in note form and copied to a database later, checked for consistency and accuracy between interviewers' notes and analysed thematically (Flick, 2002).

Semi-structured interviews were conducted with agency stakeholders to provide the researchers with subject area background and the governance context in which farmers' are making their decisions.

5 Results

5.1 Shepparton Irrigation Region

5.1.1 Effluent management practices

The size of interviewees' farms ranged from 24 ha to 202 ha with most farms being around 50-100 ha in area. All farms were on flat land with alluvial soils. Herd sizes varied with the smallest being only 22 cows and the largest being 530 cows, with almost half of those interviewed having herd sizes being between 200 and 350. A quarter of those interviewed indicated intention or had plans to increase herd size.

All but six of the farmers interviewed in the SIR had pond systems in place. These functioned as either two pond systems (anaerobic to aerobic) or as single ponds (some properties had multiple single ponds). Those without pond storage for their effluent chose to set aside an area of land for disposal, or to pump or gravity feed effluent straight to on-farm irrigation drains contained within their properties.

For those with ponds, the water content of the effluent was flood irrigated onto paddocks. This was either by a process of pumping or gravity feed to paddocks close to the ponds or into on-farm irrigation channels, where effluent water was diluted with irrigation water (shandied) and irrigated onto paddocks. Area of application was

determined by the proximity of the pond to the farm irrigation network, position of the dairy on the property, fall of the land or position of G-MW assets.

Some farmers who had recently purchased farms had inherited systems with the farm purchase and were not looking to change them. Other farmers had been on the property for between 30 and 40 years and had not changed their system in that time[8]. However, a number had made changes to their systems over time.

While one farmer had installed a pond system in response to direction from a government agency, most drivers for changes to effluent systems were either increasing herd sizes, which meant systems were operating beyond capacity, or the building (including re-siting) of a new dairy, which presented an opportunity to invest in more effective and efficient systems. Changes to systems did not always result in ponds being installed, with some farmers choosing to decommission ponds in favour of running effluent into a dry paddock or straight to the on-farm irrigation drains, and some combining two ponds to give greater capacity and enhance anaerobic functioning.

Herd size, pond size, amount of water generated off the yard and rainfall largely determines the time period in which ponds need de-watering or de-sludging. Farmers disposed of the effluent water from farm ponds by irrigating paddocks when the pond was full, with some de-watering at the end of the irrigation season to allow for winter storage. In the SIR there is wide variation in the time between farms de-sludging ponds. It appears that some ponds are left for quite extended periods without needing to be de-sludged. While, periods of 15 to 18 years were cited (some farmers had never cleaned out their pond in their time on the property), shorter periods of between one and up to five years were often quoted.

The main themes to emerge in response to questioning about how farmers know it was time to empty their ponds were:

- when the solids build up reducing the capacity for effluent water to be let off or let in [water] - "*can't get away*", "*won't come off*";
- when it was considered full - "*when there's no more capacity*, *let it dry out*", "*just do it [empty it] when it looks full*";
- when a slurry came off rather than water - "*stuff flowing out looks like porridge…solids have started to build up in the paddock*", "*what's overflowing is thick gooey stuff*";
- when capacity for storage is exceeded - "*starts to overflow*", or

[7] For fourteen interviews in the SIR three interviewers were present.
[8] Note that as stated previously the interviews were not undertaken to determine compliance or to judge the effectiveness of individual systems.

- a combination of all the above factors - "*looks full as more and more sludge gets there, less and less water comes out and it [the level] doesn't go down as much*".

De-sludging was most frequently done by excavator; solids were piled by the pond, dried out and spread at a later date with a muck-spreader. Some choose contractors that vacuum out to a slurry tank; solids are stirred and the slurry is spread onto paddocks.

Attending to re-occurring blockages with gravity or pump systems was considered a frustrating, time-consuming task by some. Solids traps required the most maintenance; cleaning out being a daily, weekly or monthly task depending on design. Those using a dry paddock for disposal also had regular tasks, either controlling run off or keeping the drain clear to ensure solids flowed to the paddock. Farmers running effluent into drainage/irrigation channels also cleaned out drains on a regular basis as solids built up.

While SIR effluent systems can be characterised as generally low maintenance, systems were not without problems and few felt their system was foolproof, requiring no effort at all. Some of those without solids traps found that gravel, rocks and sand entering ponds made the extracted solids less useful and ponds fill quicker. However, some felt that solids traps created more work, preferring not to have one.

Keeping pond surfaces clear of weeds is important for their functioning and capacity. However, for some pond size limited their ability to spray weeds effectively. Sludge/manure pumps were prone to blockages and wear, though those with gravity-fed systems also experienced blockages. One farmer was experiencing silting on the application paddocks resulting in uneven application and difficulties managing the paddock.

Farmers were looking to implement solutions to these issues by installing or remodelling their solids traps to allow tractor access to clean them, extending the effluent irrigation areas, or changing from gravity to pump systems or vice versa. As stated previously, both gravity-fed and pumped systems were reported as troublesome. Some were looking to upgrade systems along with the planned new dairy. A number of reuse systems for plate cooler water at the dairy shed had been installed to reduce water entering the effluent pond. However, most were deferring investment either because they were anticipating retirement ("*retiring, next bloke can do it", "turned 60, don't have to do this much longer, next bloke can worry about it*") or felt unable to invest in the short term ("*still paying off the drought", "got plans but not money*").

Some farmers also mentioned being reluctant to invest when outcomes of investment were uncertain as these quotes illustrate:

“Lot of ineffective systems out there, go and look at, hear about and go and have a look”

"trying to find good bits from a lot of systems"

“…haven’t seen a good system yet"

In the past farmers have sought information for pond design from a range of sources including excavator and dairy shed contractors, DPI staff or consultants, other farmers and industry publications. A number of farmers had commissioned Effluent Management Plans through DPI.

Those looking to make further changes to their systems said they had sought information from DPI or EPA staff or consultants, visited other farms, been involved with discussion groups or attended field days. However, not everyone was interested in discussion groups - *“Not into discussions groups …listen to elders who've had success…[go to] neighbours for advice”* - and some are hesitant to talk with any agency staff (EPA, DPI or CMA) preferring to do their own research, holding negative attitudes towards agencies and suspecting onerous demands in terms of system design - *"referred to somebody about effluent but didn’t want to go there, concern will have to do too much".*

Some held their own experience with previous systems to be more valuable than that of extension staff or consultants. Many asked the interviewers if they had knowledge of effective systems.

5.1.2 Views on effluent as fertiliser

Attitudes towards effluent as a benefit to the farm were mostly positive. Some described the benefits they saw from irrigation of the effluent water:

“it’s good fertiliser, first two bays are lush and green don't put nearly as much fertiliser on those paddocks".

“…can see which paddocks have effluent pumped on, much better”.

When solids were extracted and spread on paddocks most felt that there was value as fertiliser or as soil conditioner to build topsoil when redeveloping paddocks:

“it’s good fertiliser”, “… seen good growth on paddocks where it’s been spread”

“Scraped up the dry stuff, did lasering of a paddock it was a clay pan. Have been spreading the manure. Now it’s good, huge, huge benefit”

Only a few farmers calculated nutrient budgets for their farm, with most not making changes to their fertiliser programme as a result of applying nutrients derived from effluent: *"Soil test but don't use them to work out effluent application rates …what goes on goes on", "[nutrients] a bonus"*.

However, some felt there was no benefit *("effluent doesn't do a lot"),* or were sceptical about the true value of effluent. Some felt paddocks were more weedy - *"grass doesn't grow properly [and the] cows not thrilled with it"* - or raised concerns about the risk of diseases for cattle grazing paddocks where effluent has been applied or felt they had insufficient knowledge about withholding periods. One farmer also mentioned that market access issues might force changes to the regulations *"worried about future regulation changes that may stop effluent application to pasture due to disease risk".*

5.1.3 Behavioural responses

Farmers interviewed in the SIR case study were placed in the I_3 Response Framework, based on qualitative assessment of their involvement with the issue and the intervention. The issue was defined as water quality and the intervention was defined as the disposal rules which operate for dairy effluent management. Their level of involvement was determined through interview responses, which was then used to place them in particular quadrants of the Framework. The general characteristics that influenced individuals' level of involvement were identified for each quadrant of the Framework.

5.1.3.1 Quadrant 1 behavioural response

SIR farmers were placed in Quadrant 1 of the I_3 Response Framework; classified as such because of their low level of involvement in both the issue and the intervention. Farmers placed in Quadrant 1 had low or no involvement with the issue of water quality. These farmers had low involvement with the issue because the issue of water quality was irrelevant to their decision making about the management of their effluent systems.

Farmers in this quadrant described behaviour that was considered to be unwitting compliance/non-compliance. Most farmers interviewed were confident their system complied; their perception of the regulation meant they felt required to do little if any change in their practices. Lack of heavy rainfall (or any rain) in the catchment[9], belief that their property was sufficiently far enough away from community drains or waterways, or that they could contain any overflow due to heavy rains on their property in their farm recycle dam, contributed to this belief.

Some of the perceived reasons for confidence in their systems:

[9] In general, the SIR has low rainfall and had experienced dry seasonal conditions since 2000.

- having adequate storage, including during winter *"high bank, no overflow, thick crust with grass on top", "…never had any problems, half a mile to main drain, no issues in winter"*
- ensuring containment of any overflow on the farm *"Any runoff is just on a dry paddock… all fluid is on the farm …should think so [is complying], can't get off farm, would have to have a flood", "not concerned, got to do an awful lot to get off the farm… in a really wet winter everything is saturated", "in the winter there's some runoff, but not on drainage here, so not going far just saturating the ground"*

It should be remembered that this is their perception of compliance and that farmers held varying levels of awareness/understanding of the detail of effluent management requirements.

The lack of rainfall in the catchment meant that many farmers felt that the chances of getting a wet winter were slim:

> *"With two inches of rain, [effluent] will wash into the recycle drain and can wash into the channel, doesn't happen often. [Can happen] in a wettish winter, after rain, when paddocks are wet, may get into the recycle dam, and if recycle dam is full may get into the channel but that's very rare"*
>
> *"we'd be back into floods before it would be causing a problem"*
>
> *"Fortunate that we've had some dry years"*
>
> *"Holds a fair bit of waste but in winter will overflow" Overflows onto the dry paddock, but all fluid remains on farm. Can't get off farm, would have to have a flood, last flood in '93"*

The level of involvement of SIR farmers with the intervention was characterised as low at the time of interviewing as the EPA had not yet audited the catchment, and compliance monitoring in the area to date had been limited. In addition, SIR effluent systems were generally integrated into the farm irrigation system so that they required little attention or effort, and as described above, apart from regular maintenance of sumps and occasional pump and pipe blockages, ponds could be left for considerable periods without being emptied. Even less effort was needed by those continuing to use a dry paddock for effluent disposal. These farmers in particular had not changed their practices and had given the intervention little consideration.

Most knew the intent of the EPA regulation in relation to avoiding runoff to waterways (channels, drains) although they were unsure of the specific wording and few mentioned that effluent should be contained on the property *"don't have a clue really, I know the main target is that it doesn't get to waterways"*. Some quoted additional requirements relating to G-MW's assets or local authorities' planning provisions. When

asked who they would approach for information on compliance most said they would approach DPI staff, or use their consultants, and one interviewee mentioned he would consult his lawyer. Some had been to seminars on effluent management or been involved in farmer discussion groups where effluent management was raised. One was aware of services offered but felt approaching an agency was opening their system to agency scrutiny likening this to *"…opening a can of worms".*

Nevertheless, attitudes to the regulation and its goal were generally positive, in that it was not seen to be unworkable and some commented on the intent of the regulation positively:

> *"understand that something's got to be done …expect them [EPA] to get stricter"*
>
> *"only a matter of time before the EPA is about …so they [other farmers] should be made to fix up their systems"*
>
> *"[manages effluent to] stay away from any houses, stay away from any boundaries, stay away from G-MW [assets], maintain effluent within the property, all of which are targets you have with or without regulation"*
>
> *"conscious of the environmental issues, know as dairy farmers we're not allowed to get [effluent] into drains as it ends up damaging the rivers, get into the Goulburn [River] and to the Murray [River]"*

However, for some enforcement action is clearly seen as a potential future driver for them to comply with agencies' requirements, as these quotes illustrate:

> *"it's not that I don't want to do anything, it's money going out that's not gonna give me a return …one day wrong bloke will drive in"*
>
> *"Could have to build a pond …if powers that be go crook"*
>
> *"blokes like me that don't do it till they have to"*

Because involvement was low they would be expected to devote little or no effort to ensure compliance with regulatory obligations.

Only one farmer raised the issue of market access and industry image in terms of his concern about compliance *"…yeah, because of the image we're fighting against the dairy industry - that's the worst thing."*

5.2 Waikato region

5.2.1 Effluent management practices

In the Waikato region 16 dairy farmers were interviewed around Maramarua, Ohinewai/Tahuna, Ngatea, Matamata, Reporoa, Tokoroa, Ohaupo, Kaipaki and

Rotorangi. Soil types varied in these areas: farmers described their farms' soils as either peat, gley, sandy loams, clay, pumice or ash soils. Farm sizes ranged from 44 ha to 214 ha. The majority were in the 100-200 ha range. Herd sizes ranged from 120 to 700 cows. Most interviewees had no plans to increase herd sizes. All farms were on permanent pasture. About half the farms had feed pads in place, with some supplementing with feed[10].

Some of those interviewed owned or managed more than one farm so that in total 20 systems were described; 9 pond systems and 11 irrigated systems. Farms in the Waikato region are generally not irrigated, though two farmers did irrigate their farms.

A range of pond systems were in place: two pond systems (anaerobic and aerobic), three pond barrier ditch systems and multiple single pond systems, with the treated water being discharged to a drain, sometimes travelling through a swampy area first. Land-based disposal systems also varied, with most having a sump or holding tank at the dairy and some having a pond for storage, then irrigation of the slurry to land using a travelling irrigator. One farmer was using a gun irrigator as he was on a hilly property not suited to application with a travelling irrigator. Those using irrigator systems, run from a sump or holding tank at the dairy, generally only had 24 hour storage capacity and irrigators were run every day.

Those with ponds used in conjunction with land-based application had between 7-10 days and a month’s storage, giving flexibility with application timing. Some holding tanks had automatic float switches that allowed the level to be set for the pump to be triggered on or off. A number of systems had stone traps in place, and a number had storm water diverters in place so that rainwater off the yard and shed roof did not enter the pond/holding tank.

Some farmers had inherited land-based disposal effluent systems with farm purchase. However, there were a number that had made the change to land-based disposal over the last 2 -15 years, doing so for a range of reasons. For some this was a result of EW enforcement action (EW inspections failed the previous system, effluent had been pumped to a blind drain or to a creek, the pond/s was seeping/leaching, so a discharge consent was not granted). For a number of farmers increasing herd size meant the existing pond system was under pressure.

For those who chose to switch to land-based disposal, there was a range of motivations for the change of system type. Some did not like pond systems and felt they were dangerous as the quotes below illustrate:

[10] Such as, feed from on the farm or an off farm grazing block, imported grain and palm kernel.

"automatically chose a land-based system…always hated big oxidation ponds, dirty dangerous horrible things… going for land-based …[it's the] right solution";
"had ponds previously, unsightly, need to empty them, huge area of land covered in shit for short time, take up quite a bit of land space, had 2 ponds had to pump out every 6 weeks, pain in the arse things",
"we weren't in favour of ponds…not in favour when you've got two little kids"

Other reasons given were: the cost of holding a resource consent[11] and ongoing costs of employing contractors to pump ponds, wanting to capture the benefits of effluent (these farmers had had previous experience with land-based application) and anticipating a withdrawal of their discharge consent after reading about regulation changes - *"read articles could no longer discharge, also increase in cow numbers and more seepage in the first place".*

In the case of those inheriting satisfactory pond systems, the cost of changing to land-based disposal was considered prohibitive, even if the farmers recognised the benefits of direct application of effluent. In addition, some farmers on wet or gley soils felt pond systems suited them best and some on steeper land felt unable to use land-based disposal.

Pond systems required little labour input on a daily basis, though some were cleaned out 1-2 times per year, other were cleaned out every 2 years or up to every 3-4 years. Water from the second pond was often pumped into the anaerobic pond and stirred so that effluent slurry could be pumped onto paddocks. This generally took 2-3 days. Ponds were kept free of weeds by spraying; this was done in a limited way to keep banks from eroding. Farmers with ponds felt they were simple systems (an advantage when you employ staff), did not need the regular inputs of time needed for irrigation systems and did not require as much maintenance as irrigation systems. Some felt they got a better spread of effluent when the pond was pumped out. However, some thought nutrients decayed in the pond and did not give the same nutrient value once extracted and pumped to paddocks compared with daily-irrigated effluent.

In contrast, most irrigated systems required labour on a daily basis and farmers needed to check on how the irrigator was performing. The daily running of the travelling irrigator took about half an hour of labour. Shifting the irrigator between paddocks took about 1 - 2 hours. Shifting between paddocks was generally done every 2-3 days.

[11] Pond systems generally discharged to a waterway for which discharge consent (permit) was required. Over the years farmers in the Waikato have been steadily adopting the land-based application technology allowed under the Permitted Activity rule. Today about 80 per cent of farms have land-based disposal with the remaining 20 per cent operating pond systems.

However, those with irrigation systems felt they were generally:

- not time consuming -*"doesn't take that much time out";*
- easy to operate -*"been doing it a long time it's pretty easy";*
- and were run as part of daily routines - *"deal with it daily, it's part of the system, easier to manage", "part of the cowshed, should run perfectly 300 days a year"*.

Application areas were determined by, or in some cases restricted by, the placement of hydrants, topography (particularly on flat wet soils) *"certain times of year can't spray the 12ha …would run off", "some soils get waterlogged… don't operate in those paddocks",* pumping capacity, proximity to domestic or farm water supply, or the capturing of nutrient benefits *"area [for application] far exceeds requirements [to dispose of effluent] … we do it for the benefit of the effluent"*.

Decisions on when to apply effluent were generally governed by grazing rotation, with farmers choosing application to recently grazed paddocks for application. Farmers generally rested paddocks where effluent had been applied between 14 days and a month, though some did not worry about cows being in the same paddock - *"cows just won't eat it …long as it's had rain on it [the effluent] no disadvantage"*. However, young stock and stock that were calving were not put back onto these paddocks because of the likelihood of milk fever - *"have to give it a month… need to keep off the calving cows… milk fever"*.

Farmers in the Waikato region had a number of problems to resolve with their various systems. For example, holding tank shape, which meant effluent was not mixed well, or capacity (particularly for those on flat wet soils); extending application area to give choice in wet weather (again particularly those on flat wet soils) or to get nutrients to other areas; needing to change systems to reduce mishaps such as removing sand traps (because farm staff failed to regularly clean them out).

Farmers with feedpads stated that the increased dry matter (as uneaten feed combines with effluent on the feedpad) had caused numerous blockages and their system design had been altered to take into consideration the extra water needed to dilute the extra manure and dry matter entering the system - *"everything was sweet until we had the feedpad", "first thing [when installing a feedpad] you've got to consider is the effluent systems, there's so much dry matter"*.

Both farmers on pumice soil spoke about the application of effluent sealing the soil surface leading to ponding, which created the potential for non-compliance and a was pasture management issue for them - *"paddocks that have been on [used for disposal]*

are getting wetter and wetter … problem is that effluent does tend to seal the surface, can get ponding in the hollows [on Taupo Ash/pumice soil]."

A number of farmers suggested intent to further develop or alter their systems. There was a range of reasons given for the planned changes:

- to increase efficiency or reduce costs - adding a sandtrap, changing sandtrap design to enable the tractor access for maintenance, one farmer was considering purchasing a slurry pump so that he did not have the cost of paying contractors to do the application
- to ensure compliance by increasing storage capacity to increase flexibility to allow time to get parts if there are mechanical failures or to avoid overflow with heavy rainfall or by increasing application area to allow flexibility in where to apply

  "Set up system for 500 [now 750] need to increase the size of the system, have to go in a different direction [irrigation area] … need to have holding capacity for if something does break, got time to fix up what's wrong"

  "might extend mainline to irrigate other paddocks, problem's that effluent does tend to seal the surface, can get ponding in the hollows"
- to extend irrigation lines to capture nutrient benefits or for pasture management.

  "In time bring it [irrigator] over this side a bit and move the 6 ha of lucerne ,… and put it in grass, put a pipe under the race and put in a connection to give this side [where effluent is currently applied] a rest"

  "want to increase length of pipe to be able to spread over a larger area to capture the effluent fertiliser"
- to comply with resource consent conditions after an EW inspection also drove some changes i.e. one farmer was told to install a storm water diverter.

Farmers relied on their own or other farmers' experiences, used consultants, read articles or sought advice from the irrigator suppliers when planning changes or upgrades to their systems. Getting systems right was seen by some as a process of trial and error and correct advice by suppliers was not always given - *"had advice from commercial pump makers, information not always reliable was told to use an undersized stirrer, needed to increase the size of the pump and get a chopper, learning exercise along the way".* One farmer spent a year assessing information before investing in his system.

Those that had approached EW were frustrated by the lack of direction on system design with EW staff providing information on the rules, but not on how to design systems that would comply with them, as these comments articulate:

"not enough independent sound practical advice on [construction of] systems, bit of trial and error and that adds costs to the system…EW etc got to say what

is being sold that is not working…booklets say what must comply with rather than how that should happen"

"…EW needs to work with the farmers, give us solid advice, quick to jump up and down [when not complying] but not prepared to tell you what to do in the first place, have to rely on the industry that make them. EW needs to put out info[rmation] on what they want"

"EW wouldn't make a lot of recommendations, wouldn't tell me what we were and weren't allowed to do, said tell us the system you want to run and we'll say if it's ok. Would've been better to have been told what we could do, they're quick to tells us what we shouldn't do."

Farmers mentioned a number of factors involved with the running of effluent systems that lead to non-compliance and had a range of indicators that they monitored to ensure they were complying with the regulations.

Farmers with ponds stated indications of when it is time to de-sludge their pond:

"keep an eye on the level, starts to thicken up, weed on top"

"reduced capacity of any kind, as season progresses generally get the idea of how full it's getting"

One farmer using a pond for storage and pumping to an irrigator stated that the amount of build up of solids was visible due to the position of the tractor (using Power Take Off to drive the pump):

" keep an eye on level and position of the tractor… when it's pumped [after it's been stirred] as low as they [farm staff] can, the tractor is back towards the centre of the pond; if it's moved to the far end of the pond [farm staff] haven't used the stirrer."

In contrast, travelling irrigators needed monitoring whenever they were running. Farmers knew how far their irrigator should travel in a set time and also monitored whether it was moving, for example checking if it had come to the end of the line or had a kinked hose, as these quotes illustrate:

"Check twice a day before milking to see if enough run length left, not kinked, flowing and irrigator turning, moving"

"If it hasn't run down the paddock as far as expected, can see it all the time"

Farmers with holding tanks also monitored capacity, especially in wet weather: *"Watch capacity with heavy rainfall events".* Application rates were also monitored with "*not*

getting docks[12] *[pasture weed]*" given as an indicator of correct application by one farmer.

Managers/owners often stated farm staff were not being diligent around irrigator systems (irrigators were not observed to check that they were performing correctly or were not shifted when they finished the run or hoses were kinked) or as quick to respond to mechanical failures and this led to effluent spills, ponding or over-application, and sometimes farm staff failed to clean out stone traps leading to runoff.

Mechanical failures were commonly reported such as pumps breaking down, nozzles coming off irrigators, irrigators not grabbing the guiding wire or other gearing failures. However, pumps were considered easy to get fixed with most stating a same day service was available. Some mentioned irrigator parts were available by courier same day or overnight, while others had longer waits for replacement irrigator parts.

As stated previously, those with feed pads had difficulties with blockages, but also the application thickness of the effluent needed monitoring due to the increase in solid matter entering the system, which could lead to blockages of the travelling irrigator.

In wet weather, limited storage capacity for those farmers using land-based disposal with a travelling irrigator meant that for some there was a lack of suitable areas to apply effluent and that this could lead to ponding and runoff. Hence, on flat or wet land some stated that it can be difficult to keep within the application rules. Particularly high rainfall events led to overflow of tanks and some ponds, though this was at times seen as unavoidable. Some with a storm water diverter and feed pad questioned their use in heavy rainfall events, because the dirty water running off the feed pad goes on to the paddock.

In general though, most farmers felt they were complying with the regulations (and conditions of a resource consent if they had one). Those with pond systems viewed their inspection by EW staff and renewal of their resource consent as confirmation of compliance. Where problems arose they were addressed as part of the consent process.

Some farmers believed the EW monitoring helicopter had flown over their farm, and equated this to mean they must be compliant as they had not received a notice; while others took passing a snap property inspection as an indicator of compliance. Other indicators of compliance were lack of overflow from their holding tanks/sumps/ponds,

[12] Several species of dock (Rumex spp) are commonly found in New Zealand pastures and crops.

lack of seepage from ponds and farm water quality testing showing lack of pathogens. However, some farmers using irrigated systems told us about accidents in the past and did not rule out the possibility of mishaps in the future and a couple of farmers commented that they needed to check on the application rates and areas again as their herd sizes had recently changed.

Farmers with resource consents said consent conditions were the basis of their knowledge of the regulations, while those running irrigators (which do not require a consent) were less certain of the regulations, with comments of *“don’t know”* and *“sort of*’ common. However, many were still able to quote the rules concerning application rates and felt that generally they knew *“the main ones"*.

Sources of information about compliance were the EW and Fonterra (dairy company) guidelines, EW staff, EW posters, farm advisors, and reliance on inspections (with some mentioning the now redundant dairy shed inspectors) as their source of information on their compliance status.

5.2.2 Views on effluent as fertiliser

Most farmers doing land-based disposal of effluent thought it to be of benefit to their business in terms of providing nutrients:

> *"Let’s just debit the fertiliser account, NPK [Nitrogen, Phosphorus, Potassium] is a positive resource, need to change the mind set, instead of effluent being treated as a cost to the farm. Straight away save money and bloody good for the environment"*
>
> *"[farm] staff see it as a benefit - something they want to do, rather than have to"*
>
> *"went over to land-based, felt better benefit for pasture"*
>
> *"[effluent spills are a] pointless exercise in losing nutrients”*

A few felt benefits were derived mainly from the water content in the effluent:

> *"if moisture deficit, yes fantastic, in summer"*
>
> *"huge benefits over summer, mainly I believe the water not the N [nitrogen]".*

Similarly, farmers with ponds systems also felt that they got benefits from the effluent they spread on the farm when they pumped out their ponds in terms of nutrients *("just a little bit of a bonus is how we look at it", "valuable nutrients for the grass growth"*) and again, for some, benefits were thought to come from the additional water applied: *"it's a form of irrigation in a way, do it over the summer and notice the benefit of the water", "can water [pond] runoff onto the paddock, grass grows like hell, haven't tested to see what's in it but it has goodies".* Some stated that they felt nutrients decayed in the pond and fresh effluent gave more fertiliser benefit.

Most had made changes to their fertiliser programme as a result of spreading effluent based on judgement or soil tests. With only a couple saying they considered the nutrients derived from the effluent "*just a bonus*". Two farmers were calculating nutrient budgets (including effluent and supplement feed contributions in these).

A few gave estimates of the value of the nutrients gained by calculating the savings of reduced fertiliser purchases, these 'back of the envelope' calculation show:

> "*50 ha saving $15k - just do it mentally*"
>
> *"can quantify savings by avoiding [bought] fertiliser in terms of 60 units of P [phosphorus], which is equivalent to 500 kg of superphosphate per ha or $90 times 22 hectares [$1980], plus save 100 units of K [potassium, $4000], plus 100 units of N [nitrogen, $2800]. Pumping costs $6000 per year and given that freight rates are going up, so [at $2780 profit] breaks even and keeps it [nutrients] all on farm"*
>
> *"a third less fertiliser, saved about $1500"*

5.2.3 Behavioural responses

Farmers interviewed in the Waikato region case study were placed in the I_3 Response Framework, based on qualitative assessments of their involvement with the issue and the intervention. The issue was defined as water quality and the intervention was defined as the disposal rules that operate for dairy effluent management. Their level of involvement was determined through interview responses, which was then used to place them in particular quadrants of the Framework. The general characteristics that influenced individual's levels of involvement were identified for each quadrant of the Framework.

Waikato region farmers were placed in Quadrants 3 and 4 of the I_3 Response Framework. Both of these quadrants are characterised by individuals' higher involvement in the intervention. The type of effluent systems, particularly the use of travelling irrigators under the Permitted Activity rules, and the recent monitoring, and enforcement activity by EW, led to a greater involvement with the intervention, compared with farmers in the SIR. Travelling irrigation systems required attention, with most being run daily and requiring frequent monitoring. Those using these systems had high involvement because of the work created by intervention requirements for land-based disposal of effluent using this technology. EW increased monitoring, switching from contracted services to the use of helicopters for surveillance and media surrounding this (including published compliance rates) had increased Waikato farmers' awareness of and involvement with the intervention.

5.2.3.1 Quadrant 3 behavioural response

Those in Quadrant 3 were characterised as being more involved in the issue than those in Quadrant 4. This was expressed through their views on the growing importance of good environmental management linked to gaining market access as these quotes illustrate:

> *"part of industry now whether we like it or not … all for the marketing of the end product, gotta be seen as looking after the environment"*
>
> *"minds have been focused on the issue …got to manage the image we present… hate it when we're whingers, why do we have to be so negative? There is potential in this, can do it right"*
>
> *"environmental issues are the biggest challenge in the next 20 years"*
>
> *"time to be accountable…got to give a dam, we want money for our product, have to produce a good article… trying to get everything as good as you can"*

The obligations of the intervention were seen to provide a benefit to their business in terms of market access, above any compliance costs. Some farmers in this quadrant expressed social and normative motivations to comply. For these farmers changing attitudes amongst the dairy farming community to irresponsible effluent management were noted:

> *"everything is visual [on road frontage], can't hide it and if gets into waterways, someone's going to notice it under the road … like drunk driving … used to be funny [now] a thing of the past, no-one's going to do that now"*
>
> *"raw effluent into an open drain is frowned upon"*

The greater relevance of the issue to members of Quadrant 3 means they are likely to have already sourced and processed information to enable them to make decisions about the best way for them to meet the interventions requirements. All individuals in Quadrant 3 were have placed on the positive side of this quadrant as they held positive attitudes towards the intervention, seeing the business benefit of complying with regulatory obligations and noting the change in attitudes towards the inappropriate disposal of dairy effluent.

However, as the quote below illustrates goodwill can be eroded and the role of the regulatory agency's approach and enforcement officer's style are important in maintaining good relationships with the regulated community (May and Winter, 1999).

> *"Snap inspection, no report back. No feedback [to say they complied]. Snap inspection when milking, told [by EW staff member] it [milking time] was part of the working day. There was an article in the Waikato Times saying how many failed but got no feedback on who passed"*

Farmers in this quadrant all described themselves as complying with the regulations and described behaviour consistent (in most instances) with compliance. Mechanical failures within the system were most often given as the cause of a few isolated instances that may have led to non-compliance, for example pipe blockages.

5.2.3.2 Quadrant 4 behavioural response

The farmers in Quadrant 4 were characterised by a lower involvement in the issue of water quality than those in Quadrant 3. In general, most farmers in Quadrant 4 held positive attitudes to the intervention. Some farmers particularly expressed support for the regulation and its enforcement as these quotes illustrate:

> *"…rightly so legislation in place, [effluent disposal] definitely improved a lot ….for helicopter inspections, got to clean up our act a bit and the rivers"*
>
> *"If we weren't compliant we would take it very seriously…governed by rules and hopefully can carry on using system … happy with way it works, but if rules changed would meet those"*

However, there were a number of issues raised about EW's policies, monitoring and enforcement approach that could erode goodwill on the part of farmers. As stated previously, a number of farmers had mentioned the helicopter monitoring as their indicator of compliance. One farmer suggested an approach for EW was to record the compliance status for those assessed during helicopter monitoring so that a track record of compliance was held and could be taken into consideration in evaluating response to non-compliance in the future - *"if you fly over my place you'd better note that I'm complying, want it recorded, there is an ability for these things to fail, want a track record"*. This suggestion clearly illustrates farmer expectations that regulatory enforcement is seen to be fair.

Most farmers commented that under the previous monitoring regime inspections of effluent systems undertaken by dairy shed inspectors were cursory - *"They just look at it and wander off basically".* Their perception of the likelihood of getting fined under the old enforcement system was low. Awareness of the detail of current monitoring and enforcement regime for those not holding resource consents was low *"Used to come regularly, don't come around as much now" "not very certain what the monitoring regime is now".* However, most farmers were aware of the likelihood of regular aerial inspection and potential follow-up auditing. Those farmers with consents expected yearly inspections. Some without resource consents (operating as a Permitted Activity) thought there would be no inspection of a Permitted Activity. Some knew snap inspections were happening, most were aware of the helicopter inspections and felt that this kept attention focused on compliance, *"Spot check now - tend to stay on the ball the whole time"*.

Apart from uncertainty about the type of inspections regime in place currently, many farmers felt that EW had other policy changes in development that would impact on their business and some were already adding flexibility into their design or making design decisions in anticipation of further changes (for example, extra application area or not installing storm water diverters). These comments illustrate some farmers' frustrations with EW's perceived future policy directions:

> *"If they're going to keep changing the rules we have to think ahead and tried to build flexibility into the system"*
>
> *"Can't enforce the laws, they [EW] keep changing the rules, want things done differently. Told holding ponds weren't acceptable, then told land-based everyday, now saying big holding ponds, but irrigation only in the summer".*

Common views held on EW's future policy directions can be summarised as:

- EW would eventually move everyone to land-based application (some assessed that they would be unable to do so "*want us to get away from pond system to go to land based. Steeper country can't do it*")
- EW would ban the use of storm water diverters
- EW would revise the application area rules, attention would be turned to farm races, nutrient budgets would need to include feed, and feed pads will need to be linked to the effluent system.

While negative attitudes were not strongly held by farmers in Quadrant 4, the following quotes illustrate the negative sentiment held by some farmers. Where they were held it was in relation to goal of the regulation and therefore its legitimacy, with one farmer commenting - *"personally feel environment is pretty much under control"*, and towards the recent enforcement actions by EW because they felt the media attention the helicopter monitoring had attracted had a negative effect on the image of dairy farmers, particularly following on the heels of the Dirty Dairying campaign run nationally by the Fish and Game lobby group in 2001 and the Parliamentary Commissioner for the Environment's 2005 "Growing for Good" report on the dairy industry.

> *"helicopter put the shits up everyone, sick of being branded …dirty dairying [campaign] … all branded with it; really pisses us off, get quite cross about it particularly when we've made the investments we have"*

A farmer who had received an infringement notice and penalty following a helicopter inspection, felt the enforcement action by EW was unjustified as ponding on the property was due to mechanical failure. He described EW's enforcement approach as dictatorial and was aware that others in his area had only received warnings for actions that he considered were comparable.

"…. had trouble with the irrigator, wasn't put back in gear properly, wasn't binding on the rope, didn't see it for an hour, didn't think it was a major, helicopter went over 2 days later and spotted the ponding … the paddock was grazed out. Fine was a nuisance, system cost [$]50K to set up…didn't set it up to get environmental errors, you do what you can, no system's perfect …[felt EW was being] dictatorial ... $750 fine just a nuisance… circumstantial, we were waiting on a part"

This landholder considered they were doing the best they could and did not believe they behaved in a way that justified the action taken against them.

Some of the farmers whose attitudes towards the intervention fell on the negative side of Quadrant 4 may be in part due to the role or style of the officers responsible for implementation. This farmer also commented on the enforcement officer's style regarding it as not co-operative because of the lack of advice given on how to comply with the regulations *"…[EW staff] never looked at the rest of the system …no advice …gave a pamphlet on the regulations".* The lack of advice offered by the agency officer at the time of inspection did little to enhance the relationship between EW and the farmer, or contribute to the farmer's understanding of system design issues and therefore his ability to comply.

Although the farmers in Quadrant 4 that held somewhat negative attitudes towards the intervention considered themselves to be in compliance with the regulations, these farmers could be said to be reluctantly complying with the intervention when compared with those in Quadrant 3.

6 Discussion

This research sought to understand the factors leading to non-compliance with dairy effluent disposal regulations. As stated previously, the interviews were not intended to audit farmers' effluent systems. By their own assessment most farmers in the Waikato and Shepparton Irrigation regions believed their systems were complying with the relevant regulations. Therefore, the factors leading to non-compliance outlined here are taken from farmers' knowledge of what constitutes breaches of compliance, and inferred from the management practices described that could present an environmental risk in terms of the regulatory agencies' requirements.

As indicated by the framework proposed by Kaine (2004), at times of capital investment, farmers in both areas were highly involved with the design and purchase of effluent systems and undertook complex decision making to ensure they got a system that suited their farm context. This led to differences in the systems in the two regions. Consistent with Bewsell et.al. (2005) in the Waikato variation in soil type, topography and rainfall determined the types of technologies in place; either pond systems or land-based disposal (with holding tank or pond storage). In the SIR, flood irrigation was chosen for land-based disposal as this technology fitted with the irrigation infrastructure already in place (farm irrigation drains and laser-graded paddocks).

In both regions, choice of effluent application area was determined by the position of the dairy shed on the farm and slope of the land, and in the SIR, linkages to the farm irrigation network. Farm management was also a contributing factor in decisions about system design with owners seeking to minimise errors in operation by farm staff.

As Kaine (2004) suggests farmers' high involvement in re/design of systems resulted in a search for information, refinement of purchase criteria and evaluation of the system post-purchase. Farmers sought information from a range of sources. In SIR some farmers had commissioned Effluent Management Plans through DPI, but either the ‘drought’ or plans to increase herd size (leading to a re-thinking of a plan) had put off investment. Information sought about and consideration of system specifications was not only around compliance factors such as storage capacity or application area, but also had a strong focus on low effort, easily managed systems that could be incorporated into the general running of the farm[13].

Waikato farmers were able to access an abundance of generic material on system design. However, they were concerned about the lack of technical material and

unbiased advice. Some found the lack of technical assistance with system design provided by EW particularly frustrating. Farmers assessed information from irrigation suppliers, though some farmers were wary of irrigation suppliers' recommendations. Farmers in the SIR who had accessed DPI technical assistance with design were more confident. However, not everyone approaches DPI and farmers expressed frustration with lack of information on 'good' systems.

These Waikato findings are similar to those of Blackett (2004) who cites a range of information sources available to Waikato farmers, but difficulties in obtaining key documents and a dearth of relevant material, despite an abundance of generic material on system design. However, some farmers fearing onerous requirements or scrutiny of their present systems were reluctant to approach either the DPI or EW.

It could be argued that the regulations do not assist farmers' understanding of how to comply. While the EW regulation carries some specific requirements such as application distances to waterways, it leaves it open for farmers to interpret these for their context (for example, whether a drain is classed as a waterway). Similarly the risk-based SEPP regulation leaves farmers to interpret compliance practice. The regulated communities' understanding and interpretation of rules is the key to enhancing compliance (Burby and Paterson 1993; Carlough, 2006; May and Winter 1999).

From the regulatory agencies' perspective, inadequate system design such as lack of solids traps and storm water diverters, inadequate storage and application areas have potential implications for compliance. Both regulatory agencies have concerns about overloading of nutrients due to inadequate application area. In the SIR some farmers have only a few bays available for effluent irrigation. Extending application areas for some could therefore require capital investment. In the Waikato, farmers on flat and/or wet soils could lack suitable application areas at times of high or prolonged rainfall. Other farmers with limited storage also found this limited their ability to plan application around rainfall, and some storage systems overflowed in high rainfall events. Some farmers were tentative about system upgrades like solids traps and storm water diverters because of others' experiences. For some, particularly in the SIR where recent drought has reduced farm incomes, there was little willingness to prioritise investment in effluent systems.

The type of effluent irrigation technology for land-based disposal determined the management effort required. The dominance of pond-to-flood irrigation in the SIR contrasts with the holding tank-to-travelling irrigator systems in the Waikato. Effluent

[13] Parminter's (2000) study of Victorian dairy farmers also found farmers wanted to reduce time spent on maintenance of effluent systems.

systems in SIR can be characterised as low effort, requiring little attention. In contrast, Waikato irrigated systems took more effort and required greater attention as irrigated systems were run daily and required farmers to monitor the irrigator's functioning to ensure compliance.

In the Waikato region pond systems can be characterised as needing the lowest management effort. In general, once systems were in place most farmers describe them as ‘just another job’; this was more apparent in the Waikato where the daily routine was likened to the running of the dairy shed.

Waikato farmers with travelling irrigators referred to a range of mechanical or operational failures when running irrigators that can lead to non-compliance where over-application, runoff or ponding occur. Most Waikato farmers reported accessing a same day service for pumps; however, while some were confident about getting irrigator parts promptly others reported longer waiting periods for replacement parts. Consequently, irrigator breakdowns contributed to non-compliance where holding capacity was limited.

In the SIR, there were a number of practices that potentially could lead to non-compliance, though as stated previously farmers were largely confident of their compliance. Some farmers' practice of leaving ponds until solids overflowed or they had no capacity to assimilate solids led to runoff. However, farmers stated that even with runoff, effluent was contained on the farm by the reuse dam. Use of reuse dams for effluent containment is a risk factor, in EPA's view, as dams link to community drains. In addition a number of farmers’ stockpiled and dried effluent to one side of their pond after de-sludging, this practice also has the potential for point source pollution. Parminter et.al., (2000) notes that Victorian farmers lacked identified critical control points for regular maintenance of systems. It appears farmers' perceptions of how to interpret the regulation and their assessment of the risk of non-compliance are not-aligned with the EPA's assessment of risk.

In both areas management of solids or sand traps, pump failures and blockages, pipe or drain blockages were common problems farmers experienced regardless of the effluent storage or disposal system in place. From the regulating agencies’ perspective they are concerned about mismanagement of these aspects of systems as they can lead to nutrient loading of paddocks and/or runoff.

In terms of best practice few farmers from both regions were calculating nutrient budgets for their farms. In SIR most farmers did not alter their fertiliser programmes as a result of effluent application (water or solids), while in the Waikato most farmers

stated they altered fertiliser amounts on effluent irrigated land (similar to Bewsell et al. (2005) study of New Zealand dairy farmers' effluent management practices). This was done mostly by judgement rather than by comparative soil testing. However, this finding is in contrast with those of Blackett (2004) where few Waikato farmers had altered their fertiliser practices on effluent irrigated land.

Understanding the factors that lead to non-compliance from on-farm practices is important to determine the appropriate policy instrument or mix of instruments. The I_3 Response Framework is underpinned by the notion that an individual's level of involvement will significantly influence that person's response to a regulation. The Framework identifies two key dimensions of this involvement, involvement with the *issue* and involvement with the *intervention*. The I_3 Response Framework (Murdoch et al., 2006) can be used to determine farmers' involvement in the policy issue, in this case water quality, and their involvement in any intervention. The diagram in section 3 sets out this framework for understanding compliance response.

The farmers interviewed were placed in the I_3 Response Framework, based on their involvement with the issue and intervention. Farmers from the SIR were placed in Quadrant 1 as they exhibited low involvement with the issue and low involvement with the intervention. As described previously, these farmers had low involvement with the issue because the issue of water quality was irrelevant to the management of their effluent systems. Whilst some farmers may consider water quality important it is not necessarily highly involving in terms of managing and making decisions about dairy effluent.

At the time of interviewing the level of involvement of SIR farmers with the intervention was characterised as low, as the EPA had not yet audited the catchment, and compliance monitoring in the area to date had been limited. Their experience to date of the implementation of the regulation for dairy effluent in the SIR has mainly been through the DPI's extension programme, with not all farmers taking the opportunity to have Effluent Management Plans prepared. In addition, SIR effluent systems were generally integrated into the farm irrigation system so that they required little attention or effort.

Murdoch et al. (2006) suggest that the likely response by farmers in this segment is unwitting compliance or non-compliance. Farmers interviewed in the SIR demonstrated a willingness to comply with the regulations, but may have lacked robust management practices, which could lead to non-compliance. Murdoch et al. (2006) further suggest that to ensure compliance by those that have low involvement with the issue (because

for example, their livelihood is not at risk) then a suitable policy intervention might be to remove the policy risk.

In SIR this could be achieved by providing farmers with reminders prior to winter, or with a subsidised monitoring and maintenance service to ensure all ponds were emptied prior to winter, or by offering incentives to encourage upgrading of systems focusing on storage capacity and application area. The challenge for promoting regulatory obligations to these farmers is that they are unlikely to be alert to information due to their low level of involvement. Alternatively, to achieve compliance policy makers need to make the issue more relevant. This may be by focusing on issues farmers may be more involved in and would still achieve the desired outcomes, and/or change the enforcement context so that involvement in the intervention is higher. A risk-based approach could be taken to determine which practices contribute the most to environmental risk and a benefit-cost approach could be used to determine which combination of policy interventions are more efficient at achieving the desired outcome. Farmers, who under current conditions may be compliant with dairy effluent regulations, may no longer be compliant under changes in context such as wet seasonal conditions.

Farmers in the Waikato region were placed in Quadrants 3 and 4. Some Waikato farmers who were considered to have high involvement in the issue and the intervention were placed in Quadrant 3. They expressed social and normative motivations to comply, raising concerns about the declining image of the farming industry and market access and stating personal beliefs aligning with the regulations goal. The framework suggests that their likely behaviour is compliance, as meeting regulatory obligations provide a benefit. A compliance strategy could include letting industry act as the regulator with the agency playing a watchdog role monitoring and promoting compliance.

However, similar to SIR farmers, Waikato farmers placed in Quadrant 4 had low involvement with the water quality issue, but, in comparison, had more involvement with the intervention due to recent high profile enforcement activity and the nature of the effluent disposal technology. When involvement with the intervention is high, this relationship is further assessed and divided to indicate whether there is a positive or negative attitude towards the intervention. Farmers in Quadrant 4 held generally positive views on the regulation and/or were not adversely affected by the regulation. Costs of compliance were not high and practices that were necessary for compliance were aligned with practices needed to run the farm efficiently, given their choice of effluent technology. Murdoch et al. (2006) suggest that farmers in this quadrant would tend to comply. Thus the policy response is to maintain compliance by a mix of

inspection and promotion (promotion includes extension). Taking a risk-based approach to targeting inspections by enforcement agencies could provide further efficiencies (Cohen, 2000).

It is worth mentioning that where strongly negative attitudes are held, for example when the regulation, the enforcement or the costs of compliance are deemed unjust, the regulated public's response is likely to be non-compliance. Although not strongly held there were some negative attitudes expressed towards EW's recent enforcement activity with respect to fairness and credibility. Given that many contextual factors led to non-compliance, farmers accept that at times they might fail to comply and assume a record of their compliant status is held by EW; suggesting enforcement fairness was expected when future breaches occur. This expectation needs to be considered because of its potential to promote negative attitudes towards the intervention if this does not occur. Individuals that perceive the intervention to have negative consequences or to be unfair will not comply or comply reluctantly and where negative sentiment is strong may voice disapproval and gain broader public support.

As the regulated public's exposure to the issue or to the intervention changes, their quadrant membership might also change. It is possible for goodwill towards enforcement activity to be eroded. Agency approaches that are too legalistic can result in resentment on behalf of the regulated community and foster retaliation by way of applying political pressure to change the enforcement regime (May and Winter 2001; Burby and Paterson 1993). May and Winter (2001) highlight the role of inspectors' styles in the agencies' overall approach. Formal styles where inspectors outline the rules and measures for compliance provide farmers with certainty by setting out the rules and means to achieve them. However, where officers are too formalistic and use coercion (inspectors rely on threats of penalty) they can be counter productive in promoting compliance. On the other hand, where officers were too flexible, emphasising relationship building and exercising discretion with penalties, meeting compliance can take longer (Winter and May 2001).

It is clear that the role of inspections in the Waikato had a general deterrent effect amongst some farmers; however given the contextual factors that lead to non-compliance it is unlikely that focusing on creating general deterrence alone is sufficient to enhance and maintain compliance. Enforcement and general deterrence are thought to be ineffective at enhancing compliance when unforeseen equipment malfunction or unpredictable environmental variations drive non-compliance. Instead, technical assistance has a role in enhancing and maintaining compliance status (Carlough, 2006). This suggests that incorporating technical assistance within EW's current approach may contribute to compliance. Without technical assistance efforts to comply

with the regulation might continue to be subject to malfunctions and limiting farmers' ability to maintain compliance.

7 Conclusions

Policy instruments to enhance and maintain compliance need to firstly, assist compliance status and secondly, to focus farmers' attention on compliance issues in response to differences in context through a mix of non-regulatory and regulatory methods.

In the SIR to assist compliance status:

- Continue to provide technical assistance with a focus on ongoing management.
- Assist research into development of systems that meet farmers' desired benefits for low maintenance, simple, foolproof systems that reduce the risk of non-compliance.
- Address the misalignment between EPA's and farmers' assessments of what constitutes risk to the environment, and develop objective critical control measures for farmers.
- Consider the development of a subsidised inspection and/or system maintenance service to provide farmers with objective assessment of maintenance needs and/or minimise or reduce the risk of non-compliance.

In the Waikato region to assist compliance status:

- Address the gap in the provision of technical assistance for system design and management.
- Assist research into development of systems that meet farmers' desired benefits for low maintenance, simple, foolproof systems that reduce the risk of non-compliance.
- Investigate an assistance option for unforeseen equipment malfunction or unpredictable environmental variations, such as an emergency exchange service for pump and travelling irrigators.
- Provide incentives that contribute to buffers in systems that reduce the likelihood of non-compliance, for example increased holding capacity.

In both regions:

- Determine the appropriate level of inspection needed to enhance the perception of the risk of being caught. In doing so, consider a risk assessment approach to any inspection/audit regime to assist with allocation of resources. This could include benefit-cost analysis to assess marginal costs.
- Determine the appropriate level of penalty taking in to account factors that influence perceived credibility and enhance fairness of enforcement procedures.

- Understand the effect of enforcement officers' styles and review current approaches to ensure they enhance rather than detract from farmers' compliance and are aligned with agency strategy.
- Review local planning provisions that require new or redeveloped dairy sheds and dairy effluent systems to have a permit and have appropriate system design standards incorporated.
- Ensure there is continued awareness of enforcement activities and that fines have been imposed to enhance general deterrence and assist in the maintenance of farmers' compliance status.
- Review information already provided in the form of print and web publications for redundancy, consistency, relevancy, accuracy and accessibility.
- Ensure consistency and accuracy of information provided to farmers by identifying all those in the private sector involved in effluent management systems (for example consultants, contractors, and suppliers) and addressing any gaps in information on compliant systems.
- Consider the role of incentives to assist with the upgrade of systems.
- Continue to evaluate the effectiveness of current policy interventions and the effect of any further interventions, for example incentives on enabling compliance.

Appendix

Kaine (2004) suggests that a way of understanding the likely adoption of innovations is to apply farming systems theory and consumer behaviour theory from the marketing literature to gain an understanding of the variability in the way systems have been installed and managed. Farming systems theory holds that farm context will determine the likelihood of farmers adopting an innovation, and indeed, the ability of farmers to adopt an innovation is determined by their farming systems, such that true value in bringing about change on farm is only evident when used in conjunction with other practices (Crouch, 1981. p 126).

This is demonstrated by Kaine and Lees' (1994) research on the adoption of confined calving of heifers and cows in the beef producers industry in south-eastern Australia. The practice calls for co-ordination of pasture management, animal husbandry and reproductive management. They found substantive differences in the adoption of this practice amongst the producers, with those who successfully adopted confined calving having the precursor 'herd management' in place and a belief in the importance confined calving has on profitability. In contrast another group of producers had only partially adopted the advanced management practices without adopting the techniques needed for successful adoption, and consequently calving rates were lower.

This suggests that technology transfer models and other models of extension practice that assume all farmers are in the position to adopt the new technology or practice (and will receive benefits of doing so), are misguided because a smaller population of adopters likely exists for a specific innovation. Kaine (2004) further proposes that by employing consumer behaviour theory we can begin to understand the likely population of adopters - both the size of the market and the segments within that market able to be persuaded to adopt an innovation on the basis of the benefits sought by the farmer.

Consumer behaviour theory brings understanding to the decision-making processes applied to purchase and consumption decisions or products and services. In general terms, purchase decisions can be categorised as being on a continuum between low and high involvement (Assael, 1998). Involvement refers to the personal relevance or importance of a product or service to the consumer, and is not an attribute of a product. Marketers seek to understand the level of involvement the target population has with a product in order to design suitable marketing strategies.

High involvement purchases are those where we put considerable effort into thinking about the purchase decision prior to, and post the purchase, for example purchasing a car. Whereas with low involvement purchases such as buying bread, we generally put little cognitive effort into the decision preferring to rely on brand, price or other attributes. The diagram below illustrates these concepts and the amount of decision effort consumers put in.

	High involvement purchase decision	*Low involvement purchase decision*
Decision making (More effort)	Complex decision making (e.g. cars) • High motivation to search for information • High effort into learning and discovery • Evaluation both prior to and after purchase	Variety seeking (e.g. snack foods) • Low motivation to search for information • Some effort into learning and discovery • Evaluation after purchase
Habit (Less effort)	Brand loyalty (e.g. athletic shoes) • Less effort into learning and discovery as consumer already has a product they are satisfied with • Evaluation based on experience with the product	Inertia (e.g. laundry detergent) • No motivation to search for information • No effort put into learning and discovery • Evaluation after purchase

Figure 4: Consumer purchase behaviour (source: Kaine and Johnson, 2004).

As the diagram illustrates decisions that are highly involving and require cognitive effort are likely to result in complex decision making. Complex decision making only occurs

when a need for a high involvement product or service is triggered. Kaine and Johnson (2004) state that “the recognition of a need can be triggered by many causes including experience, and immediate cue, new information or a change in circumstances or the environment” (Kaine and Johnson, 2004, p.4).

Once a need is triggered, high involvement decisions require gathering of information to assist the development of purchase criteria based on perceived attributes. This is an iterative process as more information often comes to light, or purchase criteria are revised, so new information is sought. Finally a purchase is selected and evaluated post-purchase – was it really the right decision? Cognitive dissonance plays a role in evaluation post-purchase as consumers often try to convince themselves and maybe others that they made the correct decision.

Kaine and Johnson (2004) state that adoption of innovations by farmers is often high involvement, especially where the innovation is novel and unfamiliar, needs integrating into current farm management and may have present financial implications as well as future ones. Thus consideration of an innovation will invoke complex decision making. Therefore, Kaine and Johnson (2004) purport that "where failure of an innovation can have serious consequences for their business, farmers may sensibly resist the introduction of new technologies or practices – thus non-adoption can be seen as a strategic and rational response to risk" (Kaine and Johnson, 2004).

By taking a marketing and farming systems approach to the adoption of innovations we can describe 'the market' of likely adopters for an innovation as those that are able to voluntarily adopt a particular innovation, that is their farm context is suited to the innovation. Additionally, we are able to segment this market of likely adopters to better understand the circumstances of adoption, that is, the different purchase criteria they hold which meet their needs and the benefits sought, and thereby design strategies to facilitate adoption by these segments.

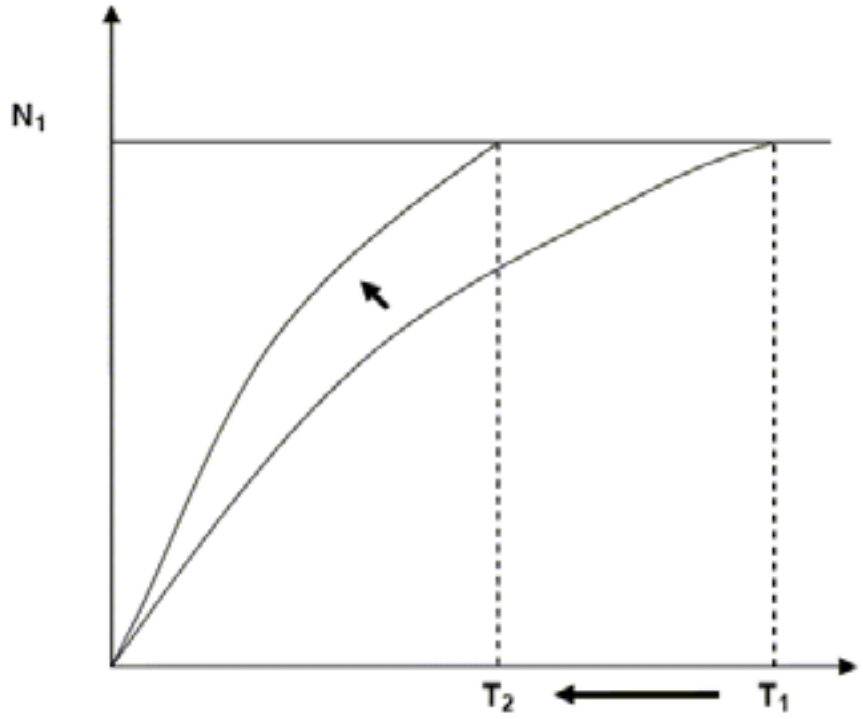

Figure 5: Accelerating the rate of adoption (source: Kaine and Johnson, 2004).

The graph above shows the total population (N1) that will likely voluntarily adopt a technology or innovation. The use of non-regulatory persuasive policy initiatives such as provision of extension, promotion or incentives aims to increase the rate of adoption in this population (ie shortening T1 to T2) (Kaine and Johnson, 2004, Pannell et.al. 2006).

However, often policies are in place to ensure environmental outcomes, which according to Kaine et.al., (2004) are generally 'value challenging' innovations. That is to say farmers' adoption of practices to meet environmental outcomes are not necessarily aligned with predominate values held by farmers, as they give preference to the adoption of innovations that are of benefit to their businesses over public benefits such as environmental outcomes (Pannell et.al. 2006; Kaine et.al., 2004). Gunningham et.al., (1998) also observe that voluntary agreements work best when there is strong overlap between public goals and private interests such that producers see short-term as well as long-term benefits to themselves.

The graph below illustrates how the implementation of a regulatory policy initiative can expand the population of potential adopters by creating a need for change in those not 'in the market' voluntarily. Regulatory policy initiatives are designed to create need and therefore trigger farmers to act, where previously they would not have voluntarily done so.

Murdoch et al., (2006) state that the likely responses of farmers to the introduction of policy interventions such as regulation can be considered using the I_3 Response Framework discussed in Section 3.

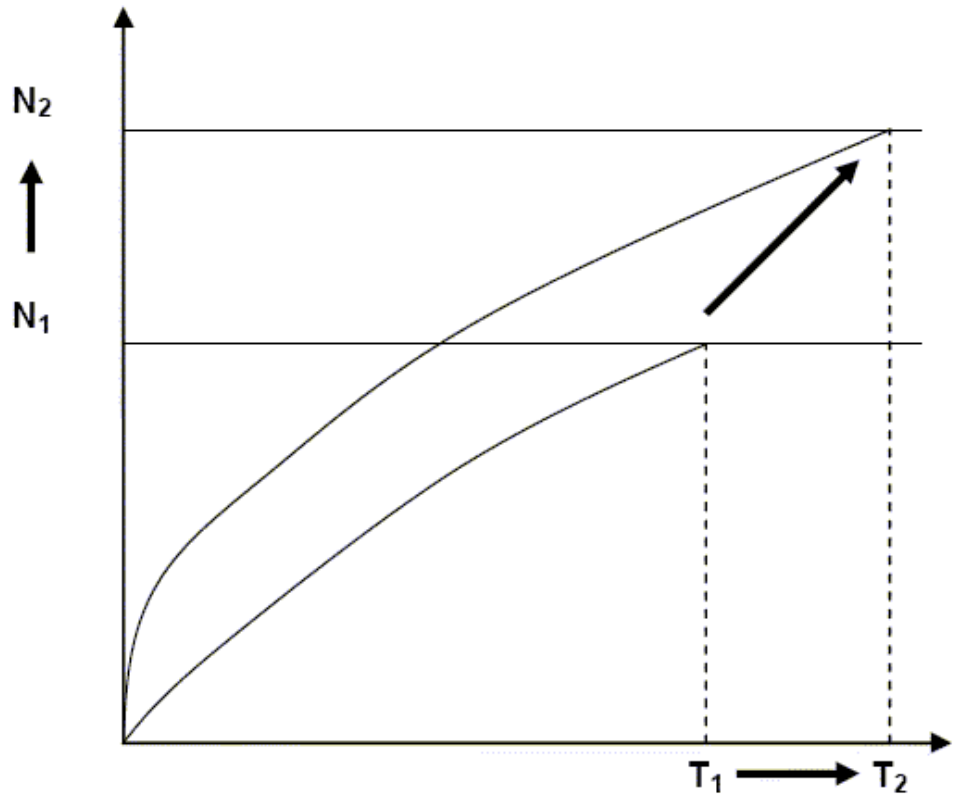

Figure 6: Increasing the population of adopters source: Kaine and Johnson, 2004).

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