Annual Update 2009/10

'Markets and water quality' is a joint project with NIWA, GNS and others in which researchers design and simulate a nutrient trading market for the Lake Rotorua catchment and work with a group of local stakeholders to develop practical policy. The project combines economics, law, hydrology, farm modelling and other disciplines in an attempt to explore these challenging regulatory design problems from all disciplinary angles. The programme has two components: building an integrated policy simulation model, NTRADER; and investigating nutrient trading policies and regulation frameworks under uncertainty.

Our prototype nutrient trading regulatory system is now complete so this year we have focused on developing our model, N-Trader, so we can give some empirical insight into some of the challenging design issues that were left open; addressing legal issues that would allow our prototype system to work within the Resource Management Act; and reviewing international literature on the design of efficient non-point-source water quality markets and on the value of water quality (completed by a PhD student at Waikato University).

1. Building an integrated policy simulation (decision-support) model - NTRADER

One key issue that can be explored only with an empirical model is the environmental and economic implications of the detail with which we account for groundwater lags in regulation. Another related issue is the length of the forward markets (where there are potentially credibility problems with markets that will not close until many years in the future). The distributional effects of different designs are also critical.

A fully functional initial version (V.1) of the NTRADER model has been achieved during the past research year. The model simulates both the geophysics of aquatic nitrogen (N) fate and transport to Lake Rotorua and the economics of a nitrogen trading scheme within the Lake catchment. Key outputs from the model include time series of N exports from the land surface, annual N loadings to the lake, spatial and temporal distributions of mitigation efforts, trading prices (marginal costs) of N for each simulation year, and total annual catchment costs associated with achieving a specified level of lake load reduction. Key user-defined model forcing functions include spatially-distributed catchment use, spatially-distributed groundwater mean travel times and their aggregation into spatial 'zones', generalized mitigation options and their cost, and an annual time series of Lake N "caps".

Preliminary model parameterization was achieved during the research year through GIS data management, extensive external simulations of supporting models, including ROTAN (NIWA), FarmMax (AgResearch), and OVERSEER (AgResearch), and incorporation of past empirical studies performed by GNS-Science. The current version of the model has been successfully applied and tested for scenarios that assume a single mean travel time for each parcel in the "regulatory model". In other words, the model assumes that each player in the trading program will have a single travel time assigned to their regulated groundwater exports, representing a combination of surface and groundwater pathways. Future work will focus on expanding the model to allow more than one travel times per parcel in the regulatory model (more accurately reflecting the unit response curve that the underlying

science suggests), for example two travel times could separately represent exports delivered through groundwater and surface water.

Two presentations, one on our prototype policy design and the other on NTRADER were made to a group from the Natural Capital Project at Stanford University (U.S.). The Natural Capital Project, a collaboration of Stanford University, University of Minnesota, the Nature Conservancy, and the World Wildlife Fund, is a research group developing tools for integrating natural capital into economic and management decisions. We are exploring the possibility of a closer collaboration with their project which is creating easily transferrable biophysical models for use in regions without detailed modelling capability.

2. Nutrient trading and other regulatory design under uncertainty

One key issue left open after our initial Nutrient Trading Study group process was complete and we produced the prototype nutrient trading system was complete was the legal feasibility of the administratively simple approach we proposed. A key aspect is the clarity of the conditions that a participant faces within each year. An individual trade does not require pre-approval by the Regional Council or any public process because the general rules are clearly established in advance. If these rules are found to be lacking they can be changed for subsequent years but not in the current year. This minimises uncertainty for land owners and minimises the costs of trading which in turn allows increased efficiency. This is very different however from existing nutrient trading systems such as the Lake Taupo system. Thus Chapman Tripp continued their legal work to explore how such a system could be legally implemented within the current Resource Management Act and specifically how the Regional Plan would need to be written to accommodate it. We also have conducted a review of international water quality trading programmes for non-point sources to explore how others have dealt (or not dealt) with issues of certainty and efficiency.

A critical issue in nutrient management is development of cooperation and willingness to comply with, and help enforce, any regulations that are chosen. During 2009/10 Suzi Kerr was a Visiting Professor in the Economics Department at Stanford University where she developed a new course on cooperative and regulatory approaches to environmental management. This was taught as an upper level undergraduate course at Stanford and will be adapted to New Zealand in the coming year. This complements work in a new Motu-led SLMACC programme, coordination and cooperation, where Andrew Coleman is developing ideas about how to enhance people's instinctive altruistic and cooperative tendencies.

Because Suzi Kerr was at Stanford during the year, our Nutrient Trading Study Group did not meet. We decided that this was a good time to engage an external person to evaluate our process both to improve this group going forward and also for input to a future agricultural dialogue group we are developing. Guy Salmon completed this work. We continued to explore ways to improve communication of the abstract concept of nutrient trading to wider audience with many conversations with game developers and educators. We are now close to decision on a process to expand the use of our existing games and short films to more effectively communicate our results on regulatory design and the likely effects of different options.