



Adaptive Governance and Evolving Solutions to Natural Resource Conflicts

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NEW ZEALAND TREASURY

WORKING PAPER 07/03

MARCH 2007



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**NZ TREASURY
WORKING PAPER
07/03**

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Conflicts

MONTH/YEAR

March 2007

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ACKNOWLEDGEMENTS

I would like to thank David Galt in particular, Sue Powell,
Rienk Asscher and Michele Lloyd for comments made on drafts of or
presentations on this paper.

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Abstract

New Zealand is facing increasing challenges in managing natural resources (land, freshwater, marine space and air quality) under pressures from domestic (population growth, agricultural intensification, cultural expectations) and international (climate change) sources.

These challenges can be described in terms of managing ‘wicked problems’; i.e. problems that may not be understood fully until they have been solved, where stakeholders have different world views and frames for understanding the problem, the constraints affecting the problem and the resources required to solve it change over time, and no complete solution is ever actually found.

Adaptive governance addresses wicked problems through a framework to engage stakeholders in a participative process to create a long term vision. The vision must identify competing goals and a process for balancing them over time that acknowledges conflicts cannot always be resolved in a single lasting decision. Circumstances, goals and priorities can all vary over time and by region. The Resource Management Act can be seen as an adaptive governance structure where frameworks for resources such as water may take years to evolve and decades to fully implement.

Adaptive management is about delivery through an incremental/experimental approach, limits on the certainty that governments can provide and stakeholders can demand, and flexibility in processes and results. In New Zealand it also requires balancing central government expertise and resources, with local authorities which can reflect local goals and knowledge, but have varying resources and can face quite distinct issues of widely differing severity.

It is important to signal the incremental, overlapping, iterative and time-consuming nature of the work involved in developing and implementing adaptive governance and management frameworks. Managing the expectations of those involved as to the nature of the process and their role in it, and the scope and timing of likely outcomes, is key to sustaining participation.

J E L C L A S S I F I C A T I O N Q28 Renewable Resources & Conservation – Government Policy

Q58 Environmental Economics – Government Policy

K E Y W O R D S Adaptive capacity; governance; resilience

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Adaptive Governance and Evolving Solutions to Natural Resource Conflicts

1 Introduction

New Zealand has immediate and increasing economic and ecological problems arising from the way we manage and use our natural resources including freshwater, soils, marine space and fisheries.¹ The use of some natural resources in some areas is now at or above the sustainable level, so will need to be reduced (e.g. water from ground or surface sources). At the same time new demands are appearing, environmental expectations are rising, and the role of a robust environment in supporting social, economic and recreational outcomes is becoming clearer.

To meet these conflicting demands, even in part, requires re-allocating resources to higher value activities, and improving the efficiency of resource management and use.² These conflicting demands are common internationally as demand for higher quality environmental outcomes mirrors rising national income (Rothenburg 2003, p6).³ The concept of a 'wicked' problem (see Glossary) appears relevant.

A comprehensive response needs a vision that can draw together the full range of challenges and identify the responses needed. '**Adaptive governance**' (see Glossary) is the evolution of institutions (in the widest sense of agencies, laws, rules and norms) to move us closer to an optimum balance of goals over time. At the same time we need an '**adaptive management**' response (see Glossary) to break the responses into practical steps, and allow for local differences in circumstances and goals.

The paper is therefore focused on processes to link institutions, goals and disciplines and does not attempt to provide rigorous economic analysis of all the concepts reviewed and how they might be applied.

Section 2 assesses current pressures in New Zealand and the issues that have emerged from them. Section 3 discusses the process of understanding goals and defining a vision, including core concepts such as sustainable development, adaptive governance and

¹ Non-renewable resources (e.g. minerals) are not discussed in this paper as sustainable management is of limited relevance.

² Use covers industrial, commercial, farming, recreational and cultural uses, and 'non-use' categories such as in-stream flows. New Zealand's response to date has included programmes on freshwater and marine space. See <http://www.mfe.govt.nz/issues/water/prog-action/index.html> and <http://www.mfe.govt.nz/issues/oceans/>. Freshwater issues overlap with climate change due to the impacts of land use (e.g. forestry uses water, has low pollution runoff and absorbs carbon).

³ Economic growth also pushes up land values, as does purchasing land for reserves, pushing farmers to intensify land use and move further towards monoculture to generate adequate returns (Brouwer 2002). This intensification has environmental impacts (Luijt 2002) and can reduce environmental and social benefits from traditional land management approaches (Brouwer 2004).

resilience (the glossary in section 7 defines these and other key terms). Section 4 deals with tools relevant to delivering on the vision and overcoming the many challenges involved.

Section 5 draws together implications for future paths in New Zealand's approach to natural resource management in terms of the "big picture" and "delivery" at both central and local government levels. Section 6 concludes.

2 New Zealand's Natural Resource Management Challenges

New Zealand is facing fundamental pressures on its natural resources of varying intensity by area. The necessary responses are likely to be both time and cost intensive for regulators and users, given the value of the resources involved and the scale and length of life of the associated investments. This makes the resilience of any new management systems particularly important for future economic growth and environmental outcomes. This section therefore attempts to identify the key issues involved in managing change in those systems and ensuring that the systems endure and achieve their goals.⁴

2.1 Impacts of change and making it last

Institutions can be formal or informal, organisational or in the form of customary practices. Whatever form they take, however, the depth of institutional change that is called for can translate directly to the level of time and effort required to make that change endure.

In terms of natural resource management in New Zealand, this relationship can be usefully portrayed in terms of Williamson's levels of social analysis as summarised in Table 1. The different social levels illustrated in Table 1 evolve intermittently and at different rates, with time lags in the interactions between them.

⁴ This paper does not go into issues of regulatory design or property rights in natural resources, both of which have been discussed in previous papers (Guerin 2003a, b, 2004).

Table 1 – levels of social analysis

	Change process	New Zealand examples	
1	Resource allocation and employment	Continuous at a system level – possibly through multiple separate or parallel decisions within a longer-term framework. Specific decisions can be short-term, for decades or even irreversible.	Approval of individual resource consents to take water. Changes in land use from dryland sheep farming to irrigated dairying.
2	Governance arrangements	One to ten years.	Regional planning processes undertaken every decade under the Resource Management Act (RMA).
3	Institutional environment	Ten years to a century.	Resource Management Act (RMA) replacing the previous planning regimes in 1991. Creation of Environment Court.
4	Informal institutions and customs	Potentially centuries.	Customary rights. Expectations of public access.

Source: (Williamson 2000)

Pressures within levels 1 and 2 can normally be managed within existing institutions. However some pressures (whether physical or social/cultural⁵) can require more substantive responses. Responding to pressures, without first identifying how deeply the response will affect the existing institutions, risks generating a response from stakeholders which may defeat the purpose of the reform itself.⁶

Certainty and fairness

Certainty and fairness are also both important in making change last. Certainty is particularly difficult to deliver in environmental policy design (Table 2) and the issues involved are discussed further in the sections on complexity and sustainable development.

Several dimensions of certainty are relevant. The first dimension is certainty about the length of the process itself. A fast process delivers an earlier outcome, thereby minimising the period when stakeholders don't know what their future rights and obligations will be. This limited duration of uncertainty reduces delays in investment and foregone use.

⁵ Physical - depletion of gas reserves, exhausting the capacity of a lake to absorb nutrients without ecosystem change, or fully allocating the flow of major river systems. Social/cultural - changes in environmental expectations, demands for redress for native title grievances, or changes in current public expectations for land access.

⁶ Relevant research in New Zealand includes the research programme on Planning Under Co-operative Mandates (PUCM) which aims to determine whether a devolved and co-operative system of governance for planning under New Zealand's 1991 Resource Management Act (RMA) and Local Government Act (LGA) will significantly improve environmental outcomes, as well as social, cultural, and economic well-being of communities, including iwi interests. <http://www.waikato.ac.nz/igci/pucm/index.htm>

Table 2 – how uncertainty affects environmental policy design

Uncertain benefits and costs	There is uncertainty on underlying processes, economic impacts of environmental change and over possible technological responses. Costs and benefits functions tend to be nonlinear, and their shapes of the functions are often unknown particularly the thresholds for change or 'tipping points'. Uncertainty favours 'hybrid' policies mixing multiple instruments.
Irreversibilities	Up-front sunk costs of action e.g. in capital intensive abatement equipment. Damage is partially or completely irreversible. Irreversibilities favour either stringent action now or waiting for more information, with no firm preference. How we predict and value catastrophe is important.
Very long time horizons	Potentially centuries versus typical business horizons of 20 or 25 years. This reduces the ability to predict outcomes and favours using lower discount rates.

Source: (Pindyck 2006)

The second dimension is certainty about the durability of the new regime and the security of any rights created under it, both of which can be undermined by the ability to push change through rapidly or frequently. This type of uncertainty can have long-run costs through limiting the type and level of investment.

The final dimension is certainty about the outcomes of change, which may or may not be desirable to individual parties, but is definitely relevant to perceptions of procedural fairness. If a process is seen to have a predetermined outcome, or be biased towards particular outcomes or parties, that will affect the acceptance of the change itself.

In Resource Management Act processes all these dimensions of certainty emerge:

- arguments for faster resource consent processes tend to focus on the benefits of delivering outcomes early;
- supporters of wide participation and consensus-based decision processes in resource management tend to emphasise the benefits of durability; and
- debates about central government intervention in planning processes often centre around questions of how intervention will be perceived.

The durability dimension of certainty overlaps with the question of procedural fairness which can be seen as an outcome in itself, although its importance can vary widely. A clearly defined process for input by those affected, and transparent consideration of views, can reduce the stresses of designing and implementing change.

“Individuals gain procedural utility from such participation possibilities over and above the outcome generated, because they provide a feeling of being involved and having influence, as well as of inclusion, identity and self-determination” (Frey 2004). The extent to which perceptions of procedural fairness can be achieved will be influenced by the circumstances at hand, including urgency and economic constraints, but boosting such perceptions can increase the resilience of policy.

Real or perceived breaches of procedural fairness on the other hand can lead to exhaustive appeals and other opposition, as well as having long lasting effects in reducing the openness of the group in question, or other observers, to future action. New Zealand examples include the construction of the Clyde Dam and the diversion of Whanganui River water into the Tongariro hydro scheme.

The change process

The design of change processes also needs to recognise that they do not take place in a static environment. Users and regulators of resources will themselves be responding to

pressures through developing new technology, applying new techniques and policies, or modifying contractual structures or pricing. Identifying the appropriate government responses is unlikely to be straightforward, and government intervention risks crowding out private or community responses by acting too soon or being unnecessarily restrictive.

Sequencing of change can be a controversial topic but there is at least some evidence that the order in which measures are taken is less important than the overall completeness of the package (stability, reformed property rights, and effective institutions) and its tailoring to the physical, institutional and political characteristics at hand (Rozelle 2004). Designing change so that it reflects external trends and interfaces with them as smoothly as possible is therefore desirable.

2.2 Can our institutions adapt?

So is it possible to design a regulatory environment (institutional and legal) for natural resources that can adapt smoothly to changing circumstances without undermining investment incentives, ecological viability and the New Zealand way of life?

As a first step toward answering that (rather large) question, this section discusses New Zealand's current resource management frameworks. The remainder of the paper then explores available concepts and experience before trying to pull an answer together.

New Zealand has tightly knit central government institutions and interest groups. Individual experts and officials can stay in place for some time and have good linkages, and relevant groups can be easy to draw together. There is a risk that individual animosities or limited institutional capability will be difficult to address in such small groups, but no solid evidence of that occurring.

In New Zealand a single statute controls access to and use of most natural resources:

- Central government issues guiding policies and binding standards, and can refer decisions to independent panels or the Courts;
- Regional governments develop region-wide policies, and specific plans for publicly owned or managed natural resources where necessary, and issue consents for resource use; and
- Territorial governments issue land-use consents for private land.

The concentration of most resource management issues under a single statute (the RMA) and of most operational activities within regional councils is one clear advantage. Another is the catchment basis of regional council boundaries which brings most water related issues under one jurisdiction, avoiding a overseas problem found overseas of having multiple venues to challenge decisions (Scholz 2005).⁸ Potential downsides include too great a burden on council resources (which vary widely) and divergences between regional and national priorities and interests.

⁷ Responses by users to pressures for change can precede the change process and evolve as pressures grow and the likely nature of change becomes apparent. Users may alter intensity or scale of activities (bigger fishing boats) or the extent of fixed or activity-specific investment (multi-purpose boats), partially or complete exit from activities (leasing fishing quota), or arrange with other users to alter relative rights or usage (e.g. side-deals over water use to avoid challenges to a new application).

⁸ This is less of an issue in New Zealand as resource management on land is under a single Act (the RMA which requires balancing of many competing interests) and water management is integrated at the catchment level.

RMA – strengths and weaknesses

The Resource Management Act (RMA) is the core legislation for natural resource management in New Zealand.⁹ It emphasises consultation, local democracy and balancing objectives, and can be seen as a framework for identifying goals, rights and responsibilities and managing their evolution through public planning processes.

The RMA incorporates a concept of nested institutions, with national guidance framing regional decisions and local implementation. It also offers a participative approach, including iwi (tribal) plans and community submissions, with flexibility for plans to adapt and their interpretation to evolve as goals and circumstances change.

At the same time the RMA demonstrates the difficulties and costs of such integration in terms of the time lags involved and remaining inconsistencies in application of the framework between sectors and across the country. The administering councils also have varying capabilities and priorities which can frustrate resource users. The RMA also has drawbacks in managing long-term resource allocations as rights have limited duration and tend to be allocated administratively.

Businesses have called for more speed in RMA processes and for limitations on participation by those not directly affected by planning or consent decisions. Such conflicts are to be expected given the objectives being balanced in that Act and the issues of certainty and fairness discussed above. Meeting these business concerns might itself incite criticism of the process for being too dismissive of broader public interests. The appropriate balance can be expected to be continually tested.

Overall, though, after difficult adjustment periods, the various stakeholders in regimes such as the RMA and the Fisheries Act appear to understand the legal instruments involved, their relative roles in the various process and the rights and obligations held. They and the government have made a substantial investment in that institutional structure. Even at the highest conceptual level, interpretations of key terms such as “*sustainable management*” have been explored and developed over time to form a common understanding¹⁰.

These legislative regimes can cope with many low level changes without major disruption. Their resilience to more substantive change has not been fully tested. For example the question of security of water rights relating to investments such as those in hydro dams which outlive the legislation that governs them remains open.¹¹ Where such unresolved conflicts affect significant investment decisions there will be an incentive to generate one-off solutions (e.g. the special legislation to develop a water plan for the Waitaki

⁹ Even with the RMA, however, there are issues of overlap with the Local Government Act, co-ordination between regional and territorial councils, multiple statutory plans and uncertainty about the nature and extent of central government's role in setting standards and funding activities.

¹⁰ “*sustainable management*” means managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural wellbeing and for their health and safety while

- (a) Sustaining the potential of natural and physical resources (excluding *minerals*) to meet the reasonably foreseeable needs of future generations; and
- (b) Safeguarding the life-supporting capacity of air, *water*, soil, and ecosystems; and
- (c) Avoiding, remedying, or mitigating any adverse effects of activities on the *environment*

¹¹ The closest parallel is literature dealing with firms facing rate of return regulation and risking stranded investments, but this does not address the mixture of economic, cultural and ecological interests in such decisions as the re-consenting of the Tongariro Power Diversion. There is no legal framework for guaranteeing either side's interests for the duration they desire beyond the default preference now introduced for existing users to have first rights unless a plan provides otherwise.

catchment). If one-off solutions proliferate, however, or have particularly large impacts, they may undermine the broader regimes.

A unique New Zealand challenge?

Beyond the RMA and government structure issues, another important aspect of the New Zealand situation is that we have relied to a greater extent than more intensively developed nations on the geographical segregation of natural resource uses to minimise potential conflicts.

The move to separate commercial forestry areas from the conservation estate a generation ago, and the historic separation of farming and conservation activities, make New Zealand practice very different to what is common in more densely populated societies such as in Europe.¹²

New Zealand is now, however, reaching the limits of its ability to expand commercial and recreational use of natural resources (e.g. freshwater and coastal space) in some regions without significant levels of direct conflict between competing users and interests. In a sense the 'frontier' is closing and reopening it will require institutions that can better facilitate changing resource use.

Adopting the multifunctionality approach used in Europe (paying farmers separately for environmental outcomes and their agricultural products) is problematic due to the lesser degree of overlap between agricultural and conservation goals in New Zealand, the potential for subsidies to become a trade policy rather than environmental tool, and the risk that ill-designed subsidies may generate more environmental damage than environmental good. Therefore we need another route to manage our growing use conflicts.

What we need

Whatever route New Zealand takes in addressing its natural resource management challenges must have the resilience to cope with shifting scientific understanding and inherent gaps¹³ in information, be able to adequately identify and allow for potential future pressures,¹³ and manage stakeholder conflicts (particularly gaps between scientists, policy makers and other stakeholders).¹⁴

¹² France operates parallel systems of National Parks, where at least a central area is mostly uninhabited, and Regional Nature Parks, which balance conservation and development goals in an ecosystem which may be largely created by human activity (Brouwer 2004). The UK equivalent is the Environmentally Sensitive Areas policy where "the conservation interest is dependent on the adoption, maintenance or extension of particular farming practices" (Brouwer 2002, p142).

¹³ An example is where a resource is allocated but it is then found that the allocation exceeds supply. Where allocations are absolute rather than proportional, such situations can be very costly to resolve (e.g. fishing quota in New Zealand).

¹⁴ As evidenced in attempts in New Zealand to identify ecosystem service values – see http://www.nzcee.org.nz/adobe/files/LT1_439_PM1_2_Cole.pdf.

Flexibility versus **certainty/security** is a debate that will never go away. Investors want certainty on resource access but flexibility in resource use. Other stakeholders want their interests to be considered, either on expiry of rights or where circumstances change significantly during the term of the rights. Decision-makers can be reluctant to:

- give certainty to resource users if it may be seen as creating windfall gains, or constraining the ability to meet other objectives during the term of the rights;
- adopt flexible response mechanisms due to:
 - not wishing to acknowledge uncertainty or fallibility, or up-front acceptance of an explicit risk of failure, even where valuable lessons may be learned;
 - wanting to be able to guarantee a specific process or outcome,
 - fear that discretion can lead to errors or corruption; or
 - reluctance to be seen as endorsing some of the available response options.

Greater public awareness of the advantages and disadvantages of flexibility and security may help widen the options available to decision-makers. Key aspects that could be better communicated (e.g. through mechanisms such as National Policy Statement or consultation material), preferably drawing on overseas and domestic case studies, include:

- the severity, complexity and geographical diversity of the challenges faced;
- the limitations of current knowledge about problems and solutions, and time lags in understanding the effects of action or inaction; and
- the advantages of an incremental/experimental approach to gathering information, testing hypotheses, and tailoring solutions.

It will also require a more explicit trade-off between providing certainty to stakeholders on the one hand and safeguarding flexibility for regulators to adapt policy to changing circumstances on the other hand. Longer term permits support investment but can hinder change (Berardo 2005). Those with significant investments and supply obligations may value adaptive approaches only if they include stability for them (over the life of a project at least) or at least a stable framework for managing change during a project. Such design issues should be considered whenever rights structures are being designed.

That unavoidable trade-off becomes “less favourable, the further is the initial allocation of rights from the socially optimal allocation”, making early action desirable where institutions or transaction costs prevent self-adjustment (Quiggin 2006, p430).¹⁵ Water policy in New Zealand may now be facing such legacy issues with demand to take water exceeding supply and runoff from land use at unacceptable levels in some areas.

Overall, the tight-knit nature of New Zealand’s central government structures and the integrated legislative framework may help pull together the necessary natural resource management responses and maintain those responses over the length of time needed to generate meaningful results.¹⁶

The major question addressed in the remainder of this paper is whether and how international experience can help us do so.

¹⁵ It is evident from history, however, that action seldom occurs during the “expansory” stage of resource development but is only taken during the “mature” phase by which time the legacy of previous policies can seriously hinder adjustment (Quiggin 2006). While early action may reduce the costs of change, it faces the challenge that the benefits of change are not yet obvious, so only limited opposition may be necessary to prevent any movement.

¹⁶ For example eutrophication issues in the Rotorua lakes involve groundwater movements that can take 60 years. http://www.pce.govt.nz/reports/allreports/1_877274_43_7.pdf

3 Adaptive Governance - Defining a Vision

Does international experience offer **frameworks** and **tools** that can help us identify and meet the challenges we face in managing demands on our natural resources? This section looks at lessons available in managing the frameworks challenge while the next deals with tools.

The first stage in identifying and meeting the challenges ahead is to acknowledge the complexity of what is being managed; i.e. interacting social and ecological processes operating at national, regional and local level and evolving over months, years or decades. Water use for example can involve dams that last a hundred years, millions of dollars to convert an extensive pastoral farm to intensive irrigated dairying, and groundwater impacts that may take decades to emerge.

The next stage is to define what we mean by sustainable development and determine what exactly we are trying to preserve or create; this can then lead on to decisions about whether to promote resilience or adaptability in policies, institutions and ecosystems.

So how do we manage complexity, what is sustainable development, what does resilience really mean, and how can the necessary vision be pulled together and sustained?

3.1 Managing complexity

Growing pressures on natural resources are a worldwide issue. Common problems include competing objectives from the same resources (e.g. irrigation, electricity generation, wildlife preservation, canoeing and fishing), growing public expectations of access to nature and for its preservation and business demands for investment certainty.

All of these demands exist in a context of growing volatility in environmental systems (e.g. more extreme weather shifts), and a growing risk of state changes (e.g. a change in dominant plant or animal species) because ecosystem resilience has been reduced (Folke 2005). These factors combine and interact to create the 'wicked' problems we now face.

Complexity is inherent in ecosystems because of external impacts (e.g. irrigation can deplete groundwater and can lead to contamination in streams), uncertain internal interactions (what are the critical functions performed by any given plant or animal and how is it affected by land use changes?) and threshold effects (e.g. lake eutrophication¹⁷ once pollution reaches certain levels or the effect of over-fishing of predator species on the makeup of marine populations).

Scale issues can be spatial; e.g. the need to manage air quality in cities, water systems at the catchment level, and climate change globally. They can also be temporal; e.g. time lags in ecosystem changes and investment decisions.¹⁸ Where issues must be managed across multiple scales, this puts pressure on management structures to co-ordinate and sustain efforts.

¹⁷ Eutrophication involves an increase in nutrient levels which can lead to increased algal growth, reducing transparency and oxygen levels in the water, among other effects.

¹⁸ Looking at the correct temporal scale helps avoid side-effects of partial management – e.g. stopping bush fires in the short term can result in uncontrollable longer term outbreaks. "Environmental and renewable resource issues tend to cross temporal and spatial scales ... [and] have to be tackled simultaneously at several levels" (Folke 2002a, p907-908).

Finally social and ecological changes interact. Social components of *social-ecological systems* include diverse groups of varying size (families, fishers or boaties, tribes, etc), with different goals and impacting the environment through different practices (e.g. agriculture, hunting, walking and swimming. Likewise ecosystems operate at many different overlapping scales. Social behaviours shape and are shaped by the environment, and social and cultural values also slowly shift over time. Managing either social or ecological effects without accounting for the other risks ultimate failure.

Social-ecological systems: Interconnected societies and ecosystems, with changes in each affecting the other and creating feedback.

Traditional approaches to public policy face difficulties in addressing natural resource pressures because of the above issues. This is a concern if it is correct to argue that “evidence points to a situation where periods of abrupt change are likely to increase in frequency, duration and magnitude” (Folke 2005, p442),¹⁹ such as the more volatile weather that has been predicted as a consequence of climate change.

Complexity can of course be managed and is. Effectively managing complex interactions and competing objectives requires integrating multiple levels of government, resources users and stakeholders, in a manner that does not result in ‘paralysis by analysis’ or ‘consultation fatigue’.

Such an integrated approach includes balancing multiple overlapping goals, comprehending ecological and social conditions that are changing in uncertain ways, incorporating evolving scientific understanding and multiple data sources, and increasing the resilience of policy frameworks and ecosystems. This challenge can be argued to be beyond the scope of traditional ‘*scientific management*’ approaches and single purpose statutes and agencies (Brunner 2005).

There is some literature, and limited experience, on describing the task discussed above and developing a framework within which to address it. Core concepts from this literature and experience include *sustainable development*, *resilience* and ‘*adaptive governance*’.

3.2 Sustainable development

So what are we trying to achieve in this complex world? The simple answer is sustainable development. Even commonly accepted definitions of that term, however, raise questions given uncertainties about the longer-term impact of activities and debates around the relative weightings of future and present needs.

Other complicating factors include incompatible demands (e.g. clear-cutting of timber versus carbon sequestration), demand exceeding supply in the absence of appropriate price signals and rights (e.g. for water in fast-growing urban areas), limited scientific

¹⁹ Institutions of conventional resource management have been successful in producing yields and economic growth in the short term, but have not been very successful in safeguarding the dynamic capacity of ecosystems or in managing ecological and social systems for long-term well-being” (Folke 2002a, p907-908). An “institutional framework for improved linkages between dynamic ecological and social systems is arguably the biggest challenge” facing governments, although partially hidden by the extent to which mining existing resources and new technology conceal underlying losses (Hughes 2005, p383).

understanding of ecological conditions, and the interaction of social constraints and ecological conditions (Brunner 2005).²⁰

Sustainable development is therefore “a ‘wicked’ or unstructured problem for government”, but it can still provide a useful wider focus for coordination of long-term policies (Kemp 2003, p2).²¹ Such a focus role fits well with an adaptive policy framework that recognises a range of goals but does not itself attempt to resolve them. Rather it allows the appropriate resolution to vary regionally and over time and is resilient to change in goals and circumstances.

Sustainable development: “development which meets the needs of the present without compromising the ability of future generations to meet their own needs”.²²

This type of role moves us from trying to deliver equilibrium outcomes or particular “desirable states” to “resilience analysis, with a simultaneous focus on adaptive ... governance” (Walker 2004). In other words rather than try to produce a particular environmental equilibrium, we should aim to develop a regulatory regime that can adapt itself to changing social and environmental conditions, and to put the ecosystem into a state where it can cope with shocks.

An example of such a regime could involve specifying the level of resource use permitted (e.g. water abstracted from an aquifer) based on rolling measures of rainfall with buffers built in to prevent a collapse in pressure. Abstraction rights could then be traded and send signals about scarcity that would encourage efficient use.

One of the key factors in unsustainable resource use tends to be lack of price signals regarding the scarcity of resources (e.g. water) or the third-party impacts of an activity (e.g. runoff into waterways).

3.3 Resilience and realistic goals

That fact that answers can vary by location and time is a primary reason why ‘resilience’ in institutions, societies and ecosystems is at the core of sustainable development policy. The goal of assessing and actively managing resilience is therefore to increase the capacity of regulatory regimes and the underlying social-ecological systems²³ to absorb shocks without environmental degradation or triggering a state change.²⁴ We therefore preserve our options for the future.

²⁰ These problems are reflected in the difficulty of measuring value in integrated ecological economic systems. http://www.nzcee.org.nz/adobe/files/LT1_439_PM1_2_Cole.pdf.

²¹ It fits this description since it can't be measured, there is no consensus on what should be sustained, it can be defined at local or national or global levels, and achieving it seems to involve fundamental change without short-term benefits. It can also be seen as an “example of a wider class of policy issues where there is a lack of consensus as to some fundamental aspects of the problem that raise difficult ethical questions” (Hodge 2004, p341).

²² <http://www.beehive.govt.nz/hobbs/30199-med-susined-developpm.pdf>

²³ ARC Centre of Excellence for Coral Reef Studies Program 5: Resilience of linked Social-Ecological Systems Program Leader: Professor Terry Hughes. This novel program will provide new solutions to managing resilience and coping with change, uncertainty, risk, and surprise in complex social-ecological systems. The objective is to improve the governance and management of natural systems and enhance their capacity to sustain human and natural capital. A major outcome will be developing information, guidelines and tools for coral reef managers and planners on climate change risks and adaptation options.

²⁴ This concept is relevant to natural disasters also as illustrated by the “Building Resilience” title of the recently released discussion document on reviewing New Zealand's on-farm adverse events recovery framework, focusing on the “Four Rs”: risk reduction; readiness; response and recovery. <http://www.maf.govt.nz/mafnet/rural-nz/assistance/adverse-events/index.htm>

Resilience: The “capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity and feedbacks”²⁵.

A more formal hypothesis is that “because of positive feedbacks causing non-linear dynamics and regimes shift in social-ecological systems a resilience approach will be required for guiding management and policy towards sustainability” (Folke 2006).

To put it another way, ignorance of what drives ecosystem change increases the importance of giving ourselves more margin for error. If we make a mistake, a more resilient policy regime or ecosystem may give us time to correct it. An example is adapting to the consequences of climate change. A better system for managing water use, such as designing water use rights to allow for flow variation, or facilitating infrastructure investment, can help farmers deal with the greater volatility of water availability that climate change is likely to bring.

Resilience is used here rather than robustness because of the longer-term focus on institutions that can be able to adjust to changing goals and circumstances, rather than developing a single lasting solution. While robust institutions are desirable at any point in time or even over lengthy periods to minimise the frequency of change, the reality of change and the ability to accommodate it needs to be recognised and built in.

Preserving our options like this is itself a demanding task. It requires us to focus on resilience at multiple scales, understand natural processes and socio-economic drivers and take account of multiple possible outcomes, system dynamics, uncertainties and thresholds.

Simply putting together the ecological, biological and social science information to support such an approach is a major challenge (Hughes 2005) but can be done or at least begun. Environmental classifications, data collection, research and development of policy responses all form part of the mix.

If the necessary understanding can be achieved, the next step of actually building resilience is also complex. It requires recognising the interdependence of social systems with nature, providing for flexible collaboration, and creating indicators of change and thresholds for action (Folke 2002b).

Examples could include providing planners with methods for determining environmental flows in different types of water-bodies, requiring comprehensive and consistent metering of water takes, and providing alternative allocation methodologies to suit different hydrological circumstances and use combinations.

A further challenge is the tension between building the resilience of an existing system and building its capacity for major transformation if resilience proves insufficient (Walker 2004). Too rigid a system may collapse completely in response to a major external shock such as climate change.²⁶

Resilience may be positive if you are trying to preserve a given habitat or species, but negative if you need to change farmers’ current mode of operations to a more sustainable one.

²⁵ (Folke 2005, p443).

²⁶ “resilience and adaptability are merely system characteristics; intrinsically they are neither good nor bad” (Matthews 2006, p203).

This then raises the question of what are we trying to sustain? “*Valued environments are typically products of the co-evolution of human and semi-natural systems*” with greatly varying ability to recreate them (if possible) (Hodge 2004, p339). An example is the current state of the South Island high country after more than century of extensive sheep farming. Are we trying to set that (or some other status quo) in stone, or to build the dynamic capacity of ecosystems to survive in whatever form best suits changed conditions?

Climate change will increasingly face us with such decisions. We may increasingly be faced with considering how long we can afford to defer a change in a particular system (years or decades?), or of deciding how we want to shape that change.

3.4 Adaptive governance and defining a vision

The above discussions have illustrated the complexities involved in understanding and applying concepts such as sustainable development and resilience.

Doing so in practice and over time needs a secure foundation such as an agreed vision that recognises the complexity of the challenges and goals faced, allows for their evolution, and balances demands for resilience and adaptability in policies and outcomes.

Defining such a vision, and sustaining it over the timeframes and geographical dimensions (local/national/global) required, calls for a robust governance structure.

Adaptive governance: enhancing society’s ability to “*adjust, and adjust to, the rules and institutions ... in light of changing circumstances*”.²⁷

Adaptive governance aims to create institutions that can bring together a range of stakeholders and knowledge, commit to action at the necessary spatial and temporal scales (e.g. in New Zealand at the national, regional, territorial authority or community level), and evolve as demands and circumstances change.²⁸

An adaptive governance structure would need to co-ordinate multiple stakeholders, perspectives, knowledge bases and goals across levels of government, national and regional dimensions. It would also support multiple policy instruments, communications methods, participation processes and timelines. Co-ordination and integration are major challenges but also unavoidable ones.

New Zealand’s existing tightly knit central government structures and integrated RMA framework, as discussed previously, put us in a good starting position to try and meet the challenges of adaptive governance. Central-local government relationships, and the balance between consistency and local variation, remain challenges.

²⁷ (Straton 2005, p42)

²⁸ There are also non-ecological concepts of adaptive and reflexive governance from Europe (van der Meer 2004):

- adaptive governance in this context involves setting general targets and allowing groups to develop their own policies to achieve those targets;
- reflexive governance is where the government sets process requirements (procedural justice) but leaves the participants to reflect on the consequences. The two approaches can also be combined at different levels of a process; e.g. adaptive policy and reflexive implementation

Another non-ecological approach is interactive governance, involving citizens, enterprises and other stakeholders in the early stages of policy making. This can also be known as participatory policy making, interactive decision making, community governance, or deliberative democracy. (Edelenbos 2005).

4 Adaptive Management – Delivering the Vision

If the governance challenges of natural resource management can be met, and an overall vision of what is to be achieved can be provided, then the next challenge is to create the management structures and tools to deliver that vision.

So what does adaptive management look like, what scope is there for flexible and incremental approaches to policy, what are the specific challenges posed by such approaches and what tools exist to meet them?

4.1 Adaptive Management

Adaptive management can mean different things to different people, but the focus here is on sustainably managing natural resources; e.g. “there is a need for water rights systems that can adjust over time, not freezing into a single equilibrium pattern of allocation, but adaptively responding to continuing shifts in water availability, demand, and societal priorities” (Bruns 2005, p296-297).

Traditional approaches such as “*scientific management*” and centralised prescriptive regulation have limited effectiveness in responding to ecological problems across different scales, particularly in interpreting and responding to ecological feedback or intersecting issues (e.g. managing groundwater and surface flows, salinisation and nutrient enrichment, seasonal or annual rainfall variations, differences in agricultural practices or recreational demands, and urban growth).

One response to conflict is risk aversion, such as strong interpretations of the ‘*precautionary principle*’ which require action and place the burden of proof entirely on proponents of an activity to prove its safety (Paterson 2006). This tendency can be particularly prominent when faced with the risk of state changes in ecosystems (where the thresholds for change and its likely magnitude may be unknown and the change irreversible; e.g. collapse of an aquifer). Prescriptive precautionary measures may achieve their goal but carry the risk of doing so at an unnecessarily high cost.

Adaptive management: is flexible management but within the context of a governance framework and vision within which it operates and to which decisions are cross-referenced. Management informs governance and vice versa over time.

A key element of an adaptive approach, on the other hand, is to lower the cost of collaboration and conflict resolution through legislation and policies which support and enable creativity in delivery (Folke 2005). Local experiments can often inform national policies, and vice versa, as part of a strategic approach to innovation.

Enabling creativity can require treating policies as hypotheses, and individual government actions as experiments, placing stress on traditional government procedures (Folke 2005). Formal governmental institutions can often have difficulty with incorporating flexibility into systems that require assurance that proper procedures were followed, that those procedures were fair and efficient, and are expected to deliver certainty in outcomes. At the same time, the reality is often that practical delivery of government decisions and services is more flexible, pragmatic and driven by unofficial social norms than the official picture would suggest.

The effort of enabling flexibility, however, can be rewarded over time. Diversity (in institutions, responses and outcomes) can function as a form of insurance against policy or implementation failure, as long as the risks of duplication, inconsistency and transaction costs are well managed (Folke 2005).²⁹

Adaptive management does not mean a free-for-all. To be effective over time, adaptation must be guided by a consistent vision, aim at achieving an agreed set of outcomes and keep stakeholders engaged. Delivering it requires increasing the formal or informal ‘*adaptive capacity*’ of institutions (Folke 2002b), allowing them to live with change, combine different knowledge systems and encourage diversity.

Any viable framework for adaptive management must take into account the interaction of ecological and social constraints. Sustainable development means “*co-optimizing economy and environment*” (Kemp 2003), or in simpler terms delivering the combination of economic and ecological outcomes that maximises sustainable national welfare.

Local solutions

Viewing a social-ecological system as a whole also may open up alternatives to a stark choice between open access and central control. Locally evolved solutions (e.g. rules for inshore fisheries) may demonstrate high resilience.³⁰ Such local solutions recognise the extent to which “*collective management and governance of common pool resources emerges from interactions between people linked in communities. There are formal and informal rules ... cultural and social norms and ... laid out by organisations, legislation or government departments*” “*often observable only at the community level*” (Straton 2005, p40-41).

Local solutions do, however, often require wider support in such areas as effective and low-cost monitoring and verification, a moderate pace of change, frequent communication, low exclusion costs and user support for monitoring and enforcement (Dietz 2003). They may also depend on an assurance that outcomes will be respected by higher levels of government and sustained over time.

*Fiordland marine management as an example of multi stakeholder participation:*³¹ A National Park has covered the terrestrial area of Fiordland since 1952. A Guardians group formed in 1995, including commercial and recreational fishing, Maori, scientists, boat operators and environmentalists. The group developed an overall strategy but the need for enforcement and conflicting obligations under existing specific laws meant the strategy needed legislative backing. Specific legislation was passed to achieve this.

Distinguishing real examples of delegated authority to co-management groups, from stakeholder consultation bodies set up to reduce conflicts, can help manage expectations and avoid disruptive disillusionment (Folke 2005). This includes clearly identifying whether the involvement of stakeholders is sought purely for consultation, to carry out a

²⁹ There can be conflicts between adaptive management, and political demands for certainty of outcomes and consistency in rules. An example is the application of the RMA in New Zealand where the requirement on decision makers to assess each application against a number of statutory objectives can make outcomes hard to predict – achieving greater certainty for applicants and objectors would require more prescriptive and inflexible rules. It also takes time for a new regime to settle in and for the range of viable policies to be defined. Rushing that process carries its own costs in terms of insufficiently informed decisions.

³⁰ For example, a law to provide for co-management of Maine lobsters moved from trying to create state-wide rules to zone management with rules in each zone set by the fishers and confirmed by the state.
<http://www.umaine.edu/mcsc/MPR/Vol9No2/LobMan.htm>

³¹ <http://www.mfe.govt.nz/issues/biodiversity/fiordland/index.html>

particular function, or as part of a truly interactive process. Over-promising on participation can be worse than not having it at all.

Transition, experimental and incremental processes

As noted above, experimental or incremental approaches are an important component of an *adaptive* natural resource policy³² because of the extent of uncertainty and the degree of variation in causes and outcomes.

Some material uses the terminology '*transition management*' which may be more palatable to some interests, but there is a real argument that processes such as sustainable development either cannot be managed but just influenced, or have no actual stable end point so can not really be seen as transitional.³³

Whatever the terminology, adaptive or transitional proposals can be evaluated for immediate impacts and contributions to the overall goal but do not necessarily involve a pre-selected path to that goal. The approach is incremental, shaped by long-term thinking (Kemp 2003).³⁴

Incremental policies can be essential due to initial lack of information or consensus: In the Maine lobster fishery the first step was a cap on trap numbers by zone (supported by small fishers). This led to controls on expansion by existing fishers within the cap and then on the entry of new fishers (supported by large fishers), followed by zone boundary rules. Previous attempts to impose up-front comprehensive rules state-wide had repeatedly failed in the face of disagreements within the industry.³⁵

Incremental approaches also require planners to "*think very carefully what will keep relevant stakeholders committed to the process*". (Rothenburg 2003, p25) Building in some 'quick wins' that don't compromise longer term goals can help buy the time to achieve substantive and sustainable change. For the longer term, monitoring and evaluation must be built in along with fostering public support such as through participation in policy development and programmes (Kemp 2003).

Variation

As mentioned previously, any policies that deal with social and ecological issues need to be defined on appropriate temporal and spatial dimensions. Is this a problem that will manifest or can be fixed today, next year or over decades? Is it local, regional, national or global and at which level is it best managed?

³² That uncertainty can be caused by an "*incomplete understanding of ecological system dynamics and insufficient scientific understanding*" or simply by an inability to define all possible outcomes or adequately measure all potential variables (Brunner 2005, p28).

³³ Evolutionary governance is another term for much the same process.

³⁴ Markets (e.g. in ecosystem services) are an example of an adaptive tool to bypass information and co-ordination limits; i.e. the market will determine prices and uses drawing on information held by participants but not available to planners.

³⁵ <http://www.umaine.edu/mcsc/MPR/Vol9No2/LobMan.htm>

Getting spatial dimensions right is important: The '15 mile reach' programme in Colorado, USA followed an initial attempt to preserve fish species while meeting other needs. That attempt lacked specific goals and a process for certifying progress, while a revision focused on completion of recovery actions rather than actual recovery, and both covered too large an area to link actions to outcomes. The current work targets a single area large enough to make a difference but small enough to monitor. The approach also allows for new development in stages based on species response with review mechanisms built in (Coe-Juell 2005a).

These dimensions affect the appropriate legal and administrative boundaries. Difficulties are likely where responses do not match the spatial or temporal nature of the problems being addressed, or have effects that spill over boundaries (of whatever type). Often this will have to be managed through co-ordination rather than unification given the impossibility of centralising all administration of all issues.³⁶

Co-ordination relies on legal, institutional and financial frameworks (Olsson 2004). Where it can be done as in Colorado's 15 mile reach (above), the payoff can be significant. Managing variation within existing institutions is not, though, a straightforward process. Government institutions are often designed with a single purpose to facilitate efficient delivery. This can mean compromise only occurs when the cost of not doing so becomes high and transparent; i.e. in a crisis.

The New Zealand experience with trying to develop an integrated approach to managing freshwater illustrates the complexity of such co-ordination, but also the need for it. Uses of water cross regional boundaries, regional decisions can have national impacts (e.g. implications of water planning in the Waitaki catchment for electricity generation)³⁷, and regional governments have limited resources.³⁸ Central government has more resources and greater powers but less ability to customise responses to regional circumstances. One option is the creation of central tools, such as rights registries or methodological standards, which can then be used regionally.

Conflicting priorities across government levels inhibit action: The Broads Authority in the UK attempts to balance multiple objectives within a single area. The objectives are conservation of wildlife, conservation of cultural heritage, promotion of understanding and enjoyment, and protection of interests of navigation. This varies from other UK national parks where nature conservation has primary status. The Authority has faced problems, however, because of the EU's "rather 'static' interpretation of nature protection". This is not consistent with a flexible approach to dynamic and multiple use ecosystems, where nature protection is just one goal being sought alongside recreation, cultural and commercial benefits (Turner 2003).

Demands for local or issue-specific accountability and monitoring by the full range of parties affected can also conflict with top-down accountability for each source of funding or regulatory authority (e.g. to meet parliamentary reporting obligations of government departments or local consultation needs for councils) (Cromley 2005).³⁹

³⁶ Defining regional council boundaries in New Zealand by catchment has reduced overlaps in natural resource management.

³⁷ Irrigation may deliver local benefits through population growth and farm expenditure, while hydro generation may have national benefits through reduced electricity costs, increased security of supply and reduced greenhouse gas emissions.

³⁸ <http://www.mfe.govt.nz/issues/water/prog-action/index.html>

³⁹ Biosecurity is an example of a problem involving national level decisions and international obligations, but region and industry specific impacts. Specialised groupings for each preparation and response initiative partially internalise externalities, align incentives and share burdens. The transaction costs and required duration/permanence may vary widely (Cook 2006).

There can also be conflicts between the interests of different levels of government. For example *“policies for reducing water pollution from agriculture that are sensitive to local costs and benefits are more likely when policy choices are made by governmental authorities that serve the collective interests of the citizens who bear the costs and benefits. However, a purely decentralized approach is not optimal given pollution spillovers ...”* (Shortle 2002, p165).

It is difficult to develop a regime (adaptive or not) that is flexible and specific enough to meet stakeholder concerns but also sufficiently comprehensive, optimised and enforceable to meet strict legal obligations that may apply to regulators or users. The outcome of flexible institutions may also be more easily challenged on strict legal grounds (Dedekorkut 2005).

Legal protection for flexible regimes is difficult:
Camino Real implementation was delayed by people outside the agreement challenging it in court (Steelman 2005). An Oregon attempt to manage fisheries locally for multiple goals to avoid the constraints of an endangered species listing was prevented by a court ruling that unenforceable actions (voluntary agreements for funding or actions) could not be taken into account by regulators (Coe-Juell 2005b).

One option is to create nested institutional arrangements operating across multiple spatial scales, balancing centralised and decentralised decision-making. An example is the RMA in New Zealand where the national government sets goals and strategies, which are then reflected in regional policies, and serve as the framework for regional and local planning decisions. Such nested systems are likely to be difficult to create from scratch, as demonstrated by the continuing evolution of the RMA regime after 15 years, but where they are ultimately successful can offer the best aspects of both consistency and diversity.

4.2 Challenges

So given the above discussion on what adaptive management means and involves, what are the main challenges in applying it to the various policy discussions ahead on natural resource management in New Zealand (see Table 3)? This section explores lessons from overseas literature and experience.

Table 3 – challenges to making adaptive governance work⁴⁰

(Scholz 2005) and (Dietz 2003)	<ul style="list-style-type: none"> • achieving and maintaining adequate representation, operating a consistent and effective decision process, resolving conflicts and inducing compliance, • defining and meeting information needs, fostering a process of scientific and public learning • providing infrastructure and ensuring preparedness for change, problem responsiveness – ensuring that solutions actually work
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Sources: see references in table.

⁴⁰ There are overlaps with a set of identified challenges to sustainable development: inequality, short-termism, fragmentation, externalities, uncertainty and insufficient precaution (Kemp 2003). This is not particularly surprising.

Representation and decision processes

Participation is crucial to achieving robust change in natural resource management because of the range of goals sought and interests affected. How decisions are made and by who is therefore important.

Wide engagement from the start improves problem definition and buy-in, with social networks facilitating information flow and combining information sources (Olsson 2004). Designing a mechanism to keep everyone in the tent, however, may require careful design of obligations and phasing of actions. Focusing on intermediate steps is one option which can involve moving away from defining success as the adoption of a preferred model, to viewing it as an expansion of the range of choices available (Edwards 2005). Another option is to create means of credible commitment by the parties.⁴¹

Adequate representation helps achieve buy-in and avoid legal or political challenges but adequacy remains in the eye of the beholder (Andrew 2005).⁴² Larger groups can provide wider engagement and are more likely to be seen as fair, but smaller groups reduce complexity and can generate greater internal cohesion.

Cohesion in turn, combined with stable membership and the authority to commit, can help build trust but has to be balanced against the representatives losing touch with those they are representing. That contact matters particularly where stakeholders are fragmented (e.g. iwi planning processes) or the process must engage with multiple regimes and venues (e.g. Auckland regional transport) (Rothenburg 2003).

Whether wider involvement helps or hinders depends on circumstances:

- Environmentalists stayed out of the Suwannee River Partnership through “*fear that the Partnership will undercut regulation*” (Scholz 2005, p33).
- Fenholloway River work involves environmentalists at the cost of greater contention, but potential gains from resolving scientific issues jointly (Scholz 2005).
- Apalachicola-Chattahoochee-Flint basin compact was agreed by negotiators but undermined by lack of stakeholder involvement (Leitman 2005).

A balance must be drawn in each case between breadth and depth of engagement, involving those who can add to the process and have incentives to achieve progress.

Integration of representative group processes with government processes can also be contentious when an open and equal discussion process leads into a government controlled decision-making process. It can help to clarify up-front whether the stakeholder involvement is purely for consultation, to carry out a particular function, or as part of an interactive process. Participation does not necessarily translate to an obligation to achieve consensus and full-scale community collaborative planning exercises, while desirable (Painter 2006), may not be generally practical.

⁴¹ A New Zealand example is fishing industry committing to closing 1.2 million square kilometres of the Exclusive Economic Zone (EEZ), almost one third of the total area, to bottom trawling and dredging with the agreement incorporated in the statutory regime. <http://www.beehive.govt.nz/ViewDocument.aspx?DocumentID=24902>

<http://www.beehive.govt.nz/Documents/Files/EEZ%20Bottom%20Trawl%20Proposal.doc>

⁴² The pitfalls of actions taken without a full participative process are illustrated by the recent Kelo court case in the United States. The Supreme Court validated the rights of governments to take private land (with compensation) for public purposes even where those purposes are as generic as the generation of more tax revenue. The resulting backlash has not only severely limited the powers of a number of states to take land, but even their ability to restrict land use through zoning controls.

Up-front process design matters:

- The Apalachicola-Chattahoochee-Flint basin discussions in Florida, USA, were undermined by lack of mediation arrangements or performance criteria, discussing individual policies rather than packages, mixing policy and technical discussions, and limited opportunities for stakeholder feedback (Leitman 2005).
- The *Kävlinge River Programme* in Sweden benefited from an independent mediator and a communications strategy for initial successes (Cooper 2006).

Continuity of participation on the government side of a process is important. Maintaining institutional memories matters when dealing with long-term investments and lasting social expectations. Government institutions are however, bound by external constraints such as constitutional requirements, parliamentary majorities and elections which will limit their ability to commit within any specific process.

Responses to this commitment asymmetry can include specific legislation (as for the Fiordland example noted in an earlier box), planning mechanisms that require significant cost and time to change, legally enforceable contracts and long-term trust deeds as proposed in New Zealand for the Lake Taupo cleanup.

Can the Government commit to long-term engagement?

- The Camino Real Ranger District in New Mexico USA faced multiple goals (grazing, firewood, employment and conservation), conflicts between rights and customs and new residents with divergent interests. The response was in-depth consultation, changing commercial forestry to a scale matching local employment needs, combining forest restoration work with harvesting, and a management plan agreed with the community. The personalised approach was, however, difficult to generalise and vulnerable to loss of momentum on staff departure (Steelman 2005).

Funding of involvement also needs to be addressed up front (Leitman 2005). Without adequate funding many groups may not be able to participate but public funding can also result in exaggeration of real problems or public concerns. Linking funding to the delivery of specific actions or results, and requiring co-funding by stakeholder groups, can help alleviate that risk by requiring a demonstration of their commitment and interest.

Even if information is available to justify change, that change will normally impose net costs on someone (which often rise with the significance of the change proposed) so change must be justified to those affected (Rothenburg 2003). Change is also disruptive, so inertia is a powerful force against it. A clear overall vision, as discussed earlier, can help break such a log-jam.

The status quo will often be regarded as giving some form of vested right to those who benefit from it, for equity if no other reason. Debates about change will therefore often manifest as a debate about stranded investments.⁴³ The discussion earlier in this paper about certainty versus flexibility is relevant here.⁴⁴

⁴³ E.g. where irrigation infrastructure was built on the basis of existing water permits which are now revoked or scaled down to a point at which the investment is no longer economic.

⁴⁴ Longer term permits support investment but can hinder change (Berardo 2005). Those with significant investments and obligations may value adaptive approaches only if they include stability for them (over the life of a project at least) or at least a stable framework for managing change. Such design issues should be considered when rights structures are being designed.

Movement may require external shocks: Progress on water supply in the Tampa Bay region of Florida was slow until key personalities changed, parties saw the risk of an externally imposed solution, and scientific uncertainty was reduced (Scholz 2005).

Social and cultural values can be as important as actual legal rights when it comes to getting agreement to change. For water, for example, even without discussing Maori or other New Zealand perspectives, water “*is both natural and cultural*” and the “*core meanings and values encoded in water are extraordinarily powerful*” and “*seep into every decision made about water use*” (Strang 2004, p245) These values shift slowly over time and that also has to be allowed for.

All of the above again reinforces the importance of agreement by the parties at the level of ‘vision’. For example once a ‘bottom line’ is agreed (e.g. a level of flow in a river that meets basic human and animal needs) discussion can move to goals and values that need to be balanced (e.g. protection of ecosystems at a higher level, extension of the irrigated area, recreational activities and spiritual needs).

Without such a vision, more detailed discussions can be expected to run up against unresolved conflicts. Representatives may require protection against being seen to sign away interests without guarantees. Users may not want to be seen to agree to regulation without acceptance of their interests. Environmentalists may not want ineffective action as a “*loophole for farmers to avoid pollution limits*” (Scholz 2005, p37). Conversely once a vision is settled it can be possible to move forward on individual actions because participants are confident that other steps will follow.

Information and science - scientific and public learning – analytic deliberation

All regulatory approaches have information requirements. A good general guide is that prescriptive regulation has high initial information needs to get the policy settings right but low ongoing needs, while more flexible (or adaptive) regulation is the reverse. Information requirements in natural resource management are a combination of basic scientific understanding, tailoring that generic knowledge to local conditions, and monitoring what is actually happening.

To the extent that scientific uncertainty can be limited it will be through multi-scale (temporal and spatial) ecological and social information to assess cumulative and interactive effects. This may include targeting specific species, functional groups of species or integrated ecosystems (Hughes 2005).

In the New Zealand context, efforts to put in place standard marine environment and river classifications have already facilitated planning decisions. Development of a standard model for assessing nutrient impacts of farming practices has allowed an integrated approach to water quality management in the Lake Taupo catchment. Given the lead times for such exercises, and the cost of performing them, early identification of where they are justified is valuable.

The time factor must be considered: desired water quality levels won't be achieved in Florida's Suwannee River till 2028 (Scholz 2005) and targets for New Zealand's Lake Taupo are for 2080.⁴⁵ Long time frames create uncertainty and corresponding demands for precaution from all stakeholders which make finding common ground more difficult.

Acceptability of data matters: an advantage in Tampa Bay was having only one recognised source of quality scientific data which allowed faster decision making. (Scholz 2005).

Scientific data alone will also not always be sufficient. When dealing with social-ecological interactions, dialogues among scientific disciplines and between scientists, users and the public can be an important step (Dietz 2003). Without engagement, participants often won't trust results or have trust in the research programme and its results (Leitman 2005). Such engagement may extend to explanation of analytical choices and joint decisions on what to collect and how (Ozawa 2005).⁴⁶ Failure to agree how data should be presented, how to use agreed data, or the objectives to be assessed would obviously hinder resulting policy processes.

Issues of misunderstanding can also arise between scientists and policy makers who may draw on different types of information and use it in different ways (MAF policy 2006).⁴⁷ It is helpful to treat scientific dialogues as a learning process for all involved, and a means of developing understanding bounded by the problem rather than by any single discipline or interest.⁴⁸

Even with the best data of course "*scientific uncertainty is endemic to environmental and natural resource policy making and implementation*" (Paterson 2006), so ultimately a decision will have to be made while taking uncertainty into account.

The policy toolkit

Ultimately, whether or not we have successfully matched problems and institutions, achieved adequate scientific understanding, and developed appropriate representation and decision processes, we still must ensure that the policy tools available are adequate.

Decisions over which tools should be in the toolkit can be contentious in themselves. Examples include from the United States "*clear unwillingness to even consider market instruments*" at the state level due to concern about voter reactions (Rothenburg 2003, p4).⁴⁹ This is where up-front agreement on the overall 'vision', as discussed above, can be crucial. Once the problem is recognised and the need for action accepted, the argument to use a full range of tools is easier.

⁴⁵ <http://www.ew.govt.nz/policyandplans/taupo/documents/proposedvariation1.pdf>

⁴⁶ In Sweden and Canada local users have done monitoring to understand dynamics and generate warnings (Olsson 2004).

⁴⁷ Australia has made progress on devolution of natural resource decision making but is still working on underpinnings such as trans-disciplinary research (Pero 2005). Environmental Planning For Natural Resource Management: Enhancing the role of local government in cooperative regional natural resource management. <http://www.coastal.crc.org.au/epnrm/> Cooperative Research Centre for Coastal Zone, Estuary and Waterway Management (the Coastal CRC). Also see <http://www.csus.edu/ccp/projects/recent.htm> Center for Collaborative Policy, a joint program of California State University, Sacramento, and McGeorge School of Law, University of the Pacific.

⁴⁸ Integrated interdisciplinary assessment can help ensure information is "communicated in a meaningful and persuasive way to both decision-maker [sic] and those affected by decisions" and boost "public support for and trust in decisions" (Brouwer 2003, p20).

⁴⁹ Specific arguments such as about the use of 'markets' or the availability of certain pesticides can divert attention from the real goal; ensuring that users face the opportunity cost of natural resource use. This means decisions should take into account the costs (private, social and ecological) created by their use and the potential benefits foregone from that resource not being available for other higher value uses. Markets are a key means of communicating opportunity cost but not the only one.

Blaming market failure for inappropriate resource use can be an easy response, but does not in itself identify why markets have not worked or how they can be fixed or created. Market mechanisms can work highly effectively to maximise value or minimise costs within a regulatory framework.

Table 4 – factors faced in adopting environmental best practice

Barriers to adoption	Positives for adoption
Labour constraints and financial costs	Sound practical scientific and local knowledge
Missing markets for externalities	User and community awareness of environmental issues
Lack of data or scepticism of science	Effective regulatory framework and institutional capacity
Lack of clear targets or options to achieve them	Willingness to comply
Internal or external resistance to particular options	Practical and economically viable options
	Ability to monitor and measure environmental impacts
	Shared vision of the future

Sources: (MAF policy 2006)

Early exclusion may be very costly at a later stage if an inadequate toolkit forces undesirable compromises between goals or prevents consensus on how to address specific goals. “The chance of being able to successfully design environmental policy programmes around one particular tool or approach is very low” (MAF policy 2006). Conversely, the wider the range of tools is, the more likely that a solution can be found to deal with a range of social and ecological circumstances (see Table 4).

A balance is also required between consistency and tailored solutions; e.g. between catchment based water planning, and farm-specific management techniques for efficient water use and runoff control.

Where rights or obligations are established, their design should be fully considered. Failure to do so can cause long-term problems; e.g. seniority based systems (where first users in time have priority but only as long as they continue their use) can seriously constrain flexibility of use. Also communities may use planning powers to restrict transfers of water outside their region or to activities that generate fewer local jobs or don’t use (and help pay for) shared infrastructure, even if transfers are of national benefit (Shaw 2005).⁵⁰

Non-regulatory tools should also not be overlooked, on their own or in tandem with regulatory solutions. Success of such measures will be more likely where strong social networks exist, environmental impacts are obvious, options are not complex, information is accessible, and change can be easily measured (MAF policy 2006).

Finally it is important to build in monitoring and review arrangements (Guerin 2003a). Good monitoring can facilitate diffusion and adaptation of successful models and correction of unsuccessful ones.

⁵⁰ Other structural issues include whether the environment is recognised as a ‘use’ (so that rights for non-use, such as in-stream flows of water, can exist), and whether rights are created in a form that allows for division, transfer and use as security for loans.

4.3 Summary

The discussion on goals and frameworks and delivering them illustrates the overall complexity of sustainable development. It also illustrates the potential for successful delivery of practical outcomes from a staged process within an overall vision, as opposed to a ‘big bang’ policy process that may take years to develop and be extremely difficult to keep on track. Once a vision is in place, individual challenges can be addressed through flexible policies and institutions.

‘People look at our environmental problems with waste and climate change and say “Quick, quick, fix it”. But these things don’t lend themselves to simple solutions. It requires the mobilisation of the entire economic, social and environmental fabric of a nation to reorient things. It involves change and making change happen is hard stuff.’⁵¹

A balance is important between addressing immediate crises in a manner consistent with the overall vision, and ensuring that no particular area is left too far behind. It may be found that “a parallel-track approach to water reform is likely to prove faster and more effective”, developing and adjusting laws, standards, rights, plans and consent formats in a mutually reinforcing manner (Bruns 2005, p296).

Issues of governance, tenure and transferability would also be addressed comprehensively rather than in sequence. Such parallelism is complex but reduces the risk of a long and costly policy process that cannot then be implemented.

Adaptive management depends crucially, however, on the coherence and resilience of the vision and on patience. “The relevant time scale for reform may be better measured not in a few months or a few years, but in decades” while ‘attempting to avoid this debate will, at a minimum, reduce the effectiveness of reforms, and may generate opposition that stalls the entire process’ (Bruns 2005, p294).

5 Future Paths for New Zealand

Going back to the discussion of New Zealand’s natural resource management needs earlier in this paper, the overall goal was to build in the potential for more flexibility without undermining those areas where certainty is essential, with an intermediate objective of building resilience. This goal is driven by the growing awareness of approaching problems (Folke 2005) and the need to co-optimize economic and environmental outcomes (Kemp 2003).

A key theme identified is a long-term vision within which experimental and incremental (adaptive) approaches to regulation can be applied.⁵² Such approaches are consistent with government efforts to boost innovation in New Zealand but may require a greater tolerance of diversity in regulation over time.

⁵¹ Hugh Logan, CE of the Ministry for the Environment, The Dominion Post, Thursday, October 26, 2006, C9.

⁵² As opposed to regulation that prescribes particular means of achieving outcomes – either deliberately (e.g. to reduce risk around key outcomes or minimise compliance costs) or unintentionally through not considering alternative options. Prescriptive and performance-based regulation can both be appropriate in the right circumstances; e.g. following a specific regime can be a cheap and certain means of compliance for small business, while a performance-based approach can allow large businesses to develop systems to achieve regulatory goals at lower cost to themselves.

Freshwater⁵³ and the marine environment⁵⁴ may be examples of where adaptive approaches can be applied. Both the oceans and water debates involve multiple perspectives, conflicting interests, strongly held values, uncertainty over impacts, multiple agencies and levels of government, and long time frames.

Progress on oceans policy has been slow and interrupted but each stage has built on work to that point, and provided an overall vision. In water policy, after extensive public consultation and stakeholder engagement, Cabinet has endorsed an approach to work with stakeholders to deliver guidance to support changes to water management to address quantity and quality issues. Table 5 illustrates key implications for New Zealand drawn from the discussions above.

Table 5 – key implications for New Zealand

a long-term vision supported by intensive stakeholder involvement	Agreeing the 'common interest' or defining the 'bottom lines' across all goals (e.g. a functioning ecosystem). Identifying other 'core' goals and values, and accepting that trade-offs between these will occur and change over time, and that the goals and values will themselves change (slowly).
good science and information	Determining what level of scientific understanding and information gathering is feasible, and what that means in terms of managing risks and opportunities.
a balance between providing certainty to stakeholders, flexibility to regulators, and procedural fairness.	Accepting: <ul style="list-style-type: none"> the need to encourage and enable (legally and administratively) diverse, incremental and experimental policy responses across multiple governance levels, rather than always seeking comprehensive solutions; that the balance between certainty and flexibility will continue to evolve and cause contention: <i>Certainty is normally sought by users that rights will continue in a form and size to support investments and financing, and by all parties that minimum targets will be achieved for each "core" goal and over the processes that will apply to any change. Flexibility is sought by regulators responding to shocks. Innovation gives rise to pressures from users wishing to adapt their activities, and social and cultural interests to extend their goals where circumstances allow: both seeking to obtain a share of any available benefits.</i> Given the extent of conflict and difficulty of sustaining a single agreed set of outcomes, exploring how: <ul style="list-style-type: none"> to achieve consistent and effective representation, and meet expectations of fairness in process and outcomes of natural resource management.

Sources: developed for this paper.

Lake Taupo and the Rotorua lakes have also demonstrated the value of an incremental or experimental approach with long time lags and different models to reflect local circumstances.⁵⁵ Both lakes have also required new approaches to governance such as a Trust jointly funded by central, regional and local government to address water quality issues in Lake Taupo, and the Rotorua Lakes Strategy Joint Committee.⁵⁶

Adaptive approaches have also been adopted at the regional level for urban planning with the Auckland Regional Growth Strategy noting that “*adaptable mechanisms means being*

⁵³ <http://www.mfe.govt.nz/issues/water/prog-action/index.html>

⁵⁴ <http://www.mfe.govt.nz/issues/oceans/>

⁵⁵ As part of the Te Arawa Lakes Deed of Settlement the central government has legislated for a permanent Rotorua Lakes strategy body with Te Arawa having membership as of right. This removes uncertainty issues around the long-term management at the expense of constraining the flexibility of future councils. Long-term funding issues remain open as do demands for central government funding of what is essentially a regional issue. See <http://www.envbop.govt.nz/Water/Lakes/Action-Programme.asp>, <http://www.ew.govt.nz/policyandplans/taupo/index.htm> and http://www.pce.govt.nz/reports/allreports/1_877274_43_7.pdf.

⁵⁶ An overarching management group made up of representatives from Environment Bay of Plenty, Te Arawa Trust Board and Rotorua District Council. It coordinates policy and actions to improve the Rotorua lakes. The committee is now established in law, as part of the Te Arawa Lakes Settlement.

able to select a range of appropriate techniques to implement the strategy over its 50-year lifetime”.⁵⁷ Those techniques include statutory and non-statutory mechanisms such as plans, strategies, design guides, road pricing, public funding, memorandums of understanding and joint ventures.

Delivering real progress from adaptive approaches, rather than policy paralysis and endless consultation, requires balancing broad participation with effective action. This task may be easier at the vision level in New Zealand than larger countries because we are a small country with a strong central government. Conversely, actual delivery may be harder in a system that so extensively delegates environmental decisions to the local level. Resolving the relative roles of central and local government in environmental management has been a key issue in the processes cited above, and is likely to remain so.

6 Conclusion

The discussion in this paper has illustrated the range of issues involved in delivering robust and effective responses to ‘wicked’ problems, focusing on using natural resource management issues such as water and land use.

It has shown that achieving and applying agreement on the problems faced and how to address them requires linking vision and implementation in a mutually reinforcing process over what may be quite lengthy periods. Such a linkage requires an informed consensus of stakeholders and effective institutions, as well as recognition that it will often not be possible to agree on a single set of **outcomes** at any point in time or resolve conflicts among those outcomes in any single lasting set of decisions.

Rather, any vision may recognise conflicting demands and a **process** for balancing them over time. The RMA can be seen as providing such a structure. Adaptive management approaches more broadly attempt to deal with such conflicts, within the overall vision, through a wide and flexible policy toolkit and processes to incorporate changes in science, information, and socio-economic and environmental priorities.

The necessary institutions are likely to involve varying levels of central government, local government and stakeholder involvement to suit the specific circumstances. Such variations may require explicit acceptance of a more flexible and diverse system of governance for environmental issues in New Zealand as demonstrated in the Fiordland, Lake Taupo and Rotorua Lakes initiatives cited earlier.

Actions should avoid imposing unnecessary limitations on future options but facilitate evolution of appropriate solutions over time (which may vary by region). This is not about “picking winners” but letting winners emerge and evolve over time in response to changing demands and opportunities – what can be seen as experimental/incremental policy or institutional learning.⁵⁸

⁵⁷ Auckland Regional Growth Strategy, chapter 4, p64 http://www.arc.govt.nz/arc/library/x28200_2.pdf

⁵⁸ A recent study of water reforms worldwide reached similar conclusions, concluding that “the most crucial lessons for institutional design from the studies in this volume concern carefully considering the time dimension of water rights reform, particularly the importance of closely linking legal and regulatory practices with learning from past practices and pilot implementation, allowing enough time for stakeholder participation and for institutional change, and establishing enabling institutional frameworks adaptable to evolving basin priorities” (Bruns 2005, p306).

Such an approach requires policy frameworks that acknowledge the need for flexibility and incorporate informal and formal institutions with incentives to seek realistic compromises, and able to make adjustments when required. It also requires a flexible toolkit, ranging from regulation (prescriptive or outcome-based), to market instruments that can signal changing conditions to users and encourage and reward innovative responses, and informal or non-binding tools such as agreed strategies. Whatever tools are used need to be well grounded and sustained over the longer term.

Finally, it is important to signal the incremental, overlapping, iterative and time-consuming nature of developing and implementing adaptive governance and management frameworks. Managing the expectations of those involved as to the nature of their roles (e.g. consultative or decision-making), and the limited scope of likely outcomes from any individual project, is key to sustaining such complex processes over what may be decades rather than years of development and implementation.

7 Glossary

Term	Description	Alternative terms
adaptive governance and management	<p>Evolution of institutions able to: (Scholz 2005) generate sustainable solutions to ‘wicked problems’ involving co-ordinating multiple social-ecological systems of users, knowledge, authorities and interests under uncertainty across government, spatial and temporal levels (Walker 2004) (Hughes 2005); through multiple means, policies and general principles and diffusion and adaptation of successful approaches (Brunner 2005) (Folke 2002b) (Olsson 2004) (Folke 2005).</p> <p>Also described as a “consensus-seeking, pro-active, adaptive, participatory approach to make ... decisions that stand the test of time” (Painter 2006) to:</p> <ul style="list-style-type: none"> ▪ deal with perceptions of being solely reactive, ▪ treat consensus as an aim rather than a necessary goal, and ▪ avoid unrealistic expectations that can be created by using terms such as co-management rather than participatory decision-making.⁵⁹ 	Community co-management
complex open systems	A complex open system is a system of many parts, at different scales, coupled in a nonlinear fashion which draws on inputs from outside and has outputs with external effects. ⁶⁰ Ecosystems can be seen as complex adaptive systems with higher level patterns and processes resulting from localised interactions and feedback (Olsson 2004).	
Ecosystem services	Processes by which natural assets are transformed by their ecosystems into services and commodities valued by society, such as air and water purification; erosion control and flood protection; and detoxification and decomposition of wastes.	
evolutionary governance	Designing policies and institutions to allow for variation, and relying on selection among variations to incorporate different perspectives and adapt to change. (Kemp 2003)	
Incremental/experimental	<p>Approaches involving the validation of multiple approaches to resolving a problem, sequentially or consecutively, preferably within a single vision or set of goals.</p> <p>Can be described as “analysis of future potential scenarios” rather than “management experiments” to address sensitivities (Painter 2006). Disadvantage of this is that it downplays the role of practical trials involving real situations in trialling alternative techniques.</p>	scenarios
institutions	<p>The term institutions has two meanings, both of which are referred to in this paper:</p> <ul style="list-style-type: none"> • social structures and social mechanisms of social order and cooperation governing the behaviour of two or more individuals. Institutions are identified with a social purpose and permanence, transcending individual human lives and intentions, and with the making and enforcing of rules governing cooperative human behaviour. • formal organizations of government and public service. http://en.wikipedia.org/wiki/Institutions 	
nested institutions	Where policies or organizations operate at multiple levels, with the lower levels operate within constraints set above. An example could be the Resource Management Act where the legislation authorises national policy statements and environmental standards, which must be reflected in regional policy statements and plans, which then shape district plans.	
precautionary principle	<p>1992 Rio Declaration (Principle 15): “Where there are threats of serious or irreversible damage, lack of full scientific evidence shall not be used as reason for postponing cost-effective measures to prevent environmental degradation.”</p> <p>Variations of the principle exist with key differences including whether action is required, who bears the burden of proof, and whether liability is assigned and to whom.</p>	

⁵⁹ In the Australian context, adaptive management has been described in a narrow technical context as the ability to adjust water allocations on renewal (for environmental reasons) without compensation, as opposed to increasing environmental flows through market mechanisms. This concept is akin to a planning vs market distinction, which carries some implications for relative certainty of rights under each approach (Bruns 2005).

⁶⁰ http://en.wikipedia.org/wiki/Complex_system http://en.wikipedia.org/wiki/Open_systems:

Term	Description	Alternative terms
resilience	The "capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity and feedbacks". ⁶¹ Or in simpler terms: the ability of a system to recover from a shock. Can be measured by (Walker 2004) latitude –extent of change from which recovery possible, resistance – difficulty of making change; precariousness – how close to a limit or threshold; and panarchy –extent of influences from states and dynamics at other scales (higher or lower, temporal or spatial).	Future proofing
scientific management	An approach to managing systems that assumes stable relationships, targets single goals, uses centralised control and emphasises role of science and experts (Brunner 2005).	
social-ecological system (SES)	Interconnected societies and ecosystems, with changes in each affecting the other and creating feedback. ⁶² "Surprises in ecosystem management can come from unexpected flips that affect fish, forests, crops and people. That is, ecological and social-ecological systems (SESs) behave as complex adaptive systems in which multi-stable (distinctly different) states are the norm, not the exception." http://www.resalliance.org/index.php?id=564	economic-ecological systems
Sustainable development	Sustainable development has many definitions but the New Zealand Government's Sustainable Development Programme of Action defines it as "development which meets the needs of the present without compromising the ability of future generations to meet their own needs". http://www.beehive.govt.nz/hobbs/30199-med-susined-developpm.pdf	
'wicked problems'	Four defining characteristics are: the problem is not understood until after formulation of a solution, stakeholders have different world views and frames for understanding the problem, constraints and resources to solve the problem change over time, and the problem is never solved. ⁶³	

⁶¹ (Folke 2005, p443).

⁶² "people in communities interact with each other and with the natural systems surrounding and supporting them in 'social-ecological systems' " (Straton 2005) Four key attributes of successful SES management (Hughes 2005): embracing uncertainty and change; building knowledge and understanding of resource and ecosystem dynamics; management practices that measure, interpret and respond to ecological feedback; and supporting flexible institutions and social networks in multi-level governance systems.

⁶³ http://en.wikipedia.org/wiki/Wicked_problems (Conklin Ph.D., Jeff; "Dialog Mapping: An Approach for Wicked Problems," CogNexus Institute, 2003] The following characteristics further describe wicked problems:

- (a) no exhaustive set of potential solutions.
- (b) Every wicked problem can be considered to be a symptom of another problem.
- (c) Discrepancies in representing a wicked problem can be explained in numerous ways--the choice of explanation in turn determines the nature of the problem's resolution.
- (d) wicked problems are essentially unique--lessons-learned are hard to transfer.
- (e) Wicked problems are often "solved" (as well as they can be) through group efforts.
- (f) Wicked problems require inventive/creative solutions.
- (g) Every implemented solution has consequences, and may cause additional problems.
- (h) Wicked problems have no stopping rule(s).
- (i) Solutions to wicked problems are not true-or-false, but better, worse, or good enough.
- (j) There is no immediate and no ultimate test of a solution to a wicked problem.
- (k) The planner or designer has no inherent right to solve the problem, and no permission to make mistakes.

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