9 Urban planning and the natural environment

Key points

- The management of the natural environment requires an appreciation of the interactions between two complex adaptive systems – the built environment and the natural environment.
- Law and regulation to manage the natural environment is itself determined within a complex social environment, reflecting views, beliefs and values about the natural environment.
- Standard theories of regulatory control assume that the regulator is able to assess the risk to the natural environment and then decide on the action it will take. Yet in reality the regulator may lack an understanding about the dynamic processes that control natural systems and have only partial control over or awareness of, human actions with respect to the natural environment.
- Future planning regulation should set clear limits and standards within which development can occur to ensure the integrity of natural systems (ecosystem sustainability), maintain standards of environmental quality (ecosystem services) for the liveability of the built environment and recognise community preferences (including Māori interests).
- Above these limits and standards, and within the rules for the built environment, developments should be able to proceed with minimal oversight. If developments breach community standards for the natural environment, then decision makers should balance the benefits of development against the impacts on the natural environment. Clear legislative objectives and principles will help to guide decision making.
- The current system is not generating the level of information and analysis required for adaptive decision making. Yet such data is critical for detecting longer-term changes in the natural environment and for understanding whether current approaches are achieving their stated objectives.
- System architecture should make clear the roles of all component parts of the system. Key players in the system (central government, local government and Independent Hearings Panels (IHPs)) should each play a part in establishing and enforcing environmental limits, and providing guidance for decision making.
- Traditionally, the planning system has managed the impact of the built environment on the natural environment by command and control regulation. A more judicious mix of policy tools would achieve environmental goals more efficiently and effectively. In a future urban planning system government bodies responsible for environmental management should use a full range of policy tools, including market-based tools.
- Developing approaches to managing the cumulative effects of the built environment on the natural environment is a desirable feature of a future planning system. Such an approach will require institutions to be able to use adaptive management practices and strategies.
- Achieving reductions in greenhouse gases (GHG) through policies that change urban form takes a long time. Other policy measures are likely to be more effective and less costly in reducing emissions to meet New Zealand's emissions reduction targets. It will be important for government to consider the relative effectiveness (which can change with changes in technology) and the distributional impacts of policies to reduce GHG emissions in New Zealand.

This chapter is about urban planning and the natural environment.

Section 9.1 discusses different ways of conceptualising the relationship between the natural environment and the built environment and what that might mean for regulating the impact of the built environment on the natural environment.

Section 9.2 looks at some key issues with the Resource Management Act 1991 (RMA) in managing the effects of the built environment on the natural environment.

Section 9.3 outlines the desirable features of a regulatory regime for managing the impact of the built environment on the natural environment.

Section 9.4 looks at climate change and what that means for urban planning.

9.1 The relationship between and regulation of the natural and built environments

In developing a new planning system for New Zealand, how should the Commission think about the relationship between the built environment and the natural environment? This section presents two conceptions of the relationship between the natural and built environments. The two views have different implications for environmental law and regulation.

Regulation is about spillovers and sustainability and mitigation of effects

One conception of the relationship between the natural environment and the built environment focuses on the negative impacts of the built environment on the natural environment. These negative impacts on the natural environment are termed spillovers or negative externalities. For instance, run-off from roads and other impervious surfaces can impact the quality of water bodies. Emissions from cars, trucks and fireplaces can reduce air quality, and clearing land for development can place pressure on indigenous biodiversity.

Notions of sustainability

In this framing, the question of what is "sustainable" becomes very important.

Some aspects of nature are indispensable and the loss of these would lead to irreversible damage (Uno & Bartelmus, 2013). Ecological sustainability recognises that natural systems have ecological limits and does not pass the point where the environment is irreversibly damaged.

Another view of sustainability is about the need to maintain the natural environment so that it continues to contribute to the quality of the built environment. On this view the natural environment is conceived as providing *ecosystem services* to the built environment (Roberts et al., 2015). In this way:

- urban air quality is important for human health and the enjoyment of urban experiences;
- rivers and water bodies provide drinking water, act as natural pollution filters and provide recreational opportunities;
- forests and greenbelts serve as watersheds, habitats, carbon sinks, leisure amenities and tourist destinations;
- wetlands filter and process waste as well as providing breeding areas for fisheries and birds; and
- sand dunes and mangroves protect cities from storm surges and prevent erosion and siltation.

Sustaining ecosystem services requires maintaining the quality of the environment so that it can continue to provide services to the built environment.

Other notions of sustainability focus on intergenerational considerations. For example, Tietenberg and Lewis (2009) define a sustainability criterion where, at a minimum, future generations should be left no worse off than current generations. There is some debate about whether this criterion would allow gains in the built environment at the expense of the loss of some aspects of the natural environment, provided *the sum of*

physical and natural capital is maintained for future generations. Yet, some people believe that natural and physical capital is not substitutable. They think that the only sustainable built environment is one that does not reduce the existing stock of natural capital.

Conceptions of value

People value the natural environment in different ways. People can value the environment in an *instrumental* way, that is, for the value they get out of the ecosystems and species (eg, recreational value, medicinal value, cultural value or economic value).

But some people believe that ecosystems and species have value in and of themselves, no matter how people might value their use. On this view, the natural environment is something to be protected because it has *intrinsic* value.

As discussed in Chapter 7, Māori express their relationship with the environment in terms of the intergenerational obligation that arises by virtue of kinship (Box 7.1).

The RMA embodies many concepts

The current RMA is an environmental statute that embodies the concepts of ecosystem services, community wellbeing and negative externalities. The RMA accommodates different views about what "sustainable management" means, including maintaining resources for future generations, and there are different conceptions of value.

Box 9.1 **Resource Management Act (1991) Purpose Statement**

5 Purpose

(1) The purpose of this Act is to promote the sustainable management of natural and physical resources.

(2) In this Act, 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 well-being 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.

Thinking about the relationship between the natural and built environment in terms of spillovers and sustainability means that the regulator needs clarity about its role and the outcomes it is seeking. But it also places heavy reliance on the knowledge and information available to the regulator about the impacts of changes or growth in the built environment on the natural environment. This is to enable the regulator to "predict and control"– that is, accurately assess the impacts of the built environment and then apply policies and rules to mitigate the effects on the natural environment.

Regulation is at the intersection of two interlinked complex adaptive systems – the natural and built environments

Another way to view the relationship between the built environment and natural environment is as a relationship between two interlinked and interacting complex adaptive systems. This perspective leads to a different way of thinking about what is needed to effectively manage the impact of the built environment on the natural environment.

The origin of the idea that the natural environment is a complex adaptive system is often attributed to Charles Darwin (1861) who wrote in *The Origin of Species* that a "web of complex relations" binds living

things (p. 71). A hundred years later, Jane Jacobs (1961) had characterised cities as complex adaptive systems, describing them as "organized complexity" (Chapter 2).

Box 9.2 summarises the characteristics of complex adaptive systems.

Box 9.2 **The characteristics of complex adaptive systems**

1. Complex, large-scale behaviours emerge from the aggregate interactions of less complex agents. For example, macroeconomic trends emerge from the behaviour of many individual firms or investors.
2. The interactions of the system exhibit unpredictable, non-linear relationships where small-scale events can have large systemic effects ("butterfly effects") or where a minor shift in parameters can produce a sudden change of state ("tipping points"). Examples are the change in temperature that changes water into ice, or species extinction as a result of a small change in environmental conditions.
3. A complex, adaptive system can be described through the varied flows of its mediums – fluids, money, energy, information – for example, how clouds describe weather patterns.
4. Complex adaptive systems have diverse ingredients, such as the diverse range of species that make up an ecosystem.
5. All four of these properties combine into self-organising critical state behaviour through which change becomes a stabilising force rather than a disrupting force.

Sources: Holland, 1995; Ruhl, 1997; Colander & Kupers, 2014; Crawford, 2016.

Environmental law and regulation is determined within a complex adaptive system

At the same time that Jane Jacobs was writing about cities, Rachel Carson (1962) was writing about the impact of human actions on environmental dynamics. Her writings inspired a conservation movement and the development of a body of environmental law in the United States. But it was only in the late 1990s that writers like Levin (1998) described the complex adaptive properties of natural ecosystems and the impact of the loss of biodiversity on the ecosystem services on which people depend.

> Perhaps the fundamental theoretical and applied issues confronting ecologists today concern the stunning loss of biodiversity, and the implications for the loss of services on which humans depend…The biota not only provides direct benefits to humans, for example, as a source of food, fiber, and fuel; it also helps process nutrients essential to life, sequesters potentially harmful chemicals, and mediates regional and global climatic and atmospheric processes…. Ecosystems, and indeed the global biosphere, are prototypical examples of complex adaptive systems. (p. 431)

While Ruhl (1997) pointed out that

> [b]oth the target of environmental regulation, humans, and the purported beneficiary of regulation, the environment, display the discontinuities and synergies characteristic of complex adaptive systems (p. 968).

And Emison (1996) posited that environmental law itself is part of a complex system of human interaction with the natural environment (Box 9.3).

Box 9.3 **The changing nature of human agency and the impact on the natural environment**

- What comes under the purview of environmental law is subject to change as pollutants and the remedies available to mitigate them change. These changes are largely due to changing economic activity and technological change. Technological change, in particular, can be unpredictable and non-linear.

- People's behaviour and attitudes to the environment change over time. As scientific knowledge about the environment improves, the more people understand and the more they become concerned about the impact of human activity on the natural environment. As people became wealthier their expectations for environmental quality also increase, and they can influence business and government attitudes and behaviour toward environmental protection. These are the large-scale behaviours that can emerge from the behaviour of many individual agents.
- Values about the environment can change or become more prominent or recognised – for example the view that the environment should be protected because it has an intrinsic value rather than valued for the ecosystem services it provides. A shift in values can reach a tipping point, changing the purpose of regulation.
- The funding and the tools available to different levels of government responsible for environmental protection can change, along with the governance arrangements and the allocation of responsibilities. How money and information flow through the system is important for understanding how the system works, how it is constrained, or how it acts.

Source: Adapted from Emison, 1996.

While Emison argues that law and regulation are determined within a complex social environment, regulatory academics Robert Baldwin and Julia Black argue that so too are the activities of the regulator (Baldwin & Black, 2008; Black & Baldwin, 2010). Their theory of regulatory control departs from standard theories where the regulator is assumed to be able to assess the risk the regulated party poses to the objectives of the regulatory regime and then decide on the action it will take. In reality, the regulator may have very little influence over regulated parties who may be subject to other more powerful influences. For example, the regulated party is inevitably influenced by the culture of the industry it operates in (or for individuals, the social group they associate with), and may be subject to financial or other pressures that lead to risky behaviour or lack of compliance. The behaviour of the regulated party – both in respect of the risks it creates and its attitude to compliance – is also not blind to the behaviour and actions of the regulator. It is also recognised that regulators live with considerable uncertainty (NZPC, 2014). Williams and Brown (2012) outline four types of uncertainty that can impact on the regulator's management of the natural environment.

Box 9.4 **Types of uncertainty that can impact how the natural environment is managed**

- *Environmental variation* refers to fluctuations in the physical environment (such as precipitation patterns and temperature regimes) that directly and indirectly influence the ecological processes and the state of the natural environment.
- *Partial controllability* refers to the difference between the results intended by a given management decision and the results that actually occur. Unintended outcomes often result from management decisions.
- *Partial observability* refers to a regulator's inability to observe completely the resource system being managed; a nearly universal condition with renewable natural resources.
- *Structural uncertainty* is the lack of understanding (or lack of agreement) about the dynamic processes that control natural systems.

Source: Williams & Brown, 2012.

F9.1 An important purpose of environmental regulation is to manage the impact of the built environment on the natural environment. The challenge for environmental regulation is that the built environment and the natural environment display the characteristics of complex, adaptive systems.

F9.2 The characteristics of complex, adaptive systems mean that regulators can find it hard to accurately predict the impact of the built environment on the natural environment and take action to mitigate the impact.

F9.3 Environmental law is part of the complex system of human behaviour with respect to the natural environment. Regulators are only one influence and may have only partial oversight or control over regulated parties.

Understanding the RMA as the product of a complex social system

Seeing environmental law as the product of a complex, adaptive social system helps shed light on how law is developed, interpreted, implemented, challenged and changed, through the interaction of many agents.

Of the United States, Emison wrote,

> [t]he interactions of scientific knowledge, political interests, managerial competence, legal constraints, multiple levels of government, public interest groups, and private corporations combine to affect environmental quality…. Financial incentives, court orders, legal rights, and public opinion interact not only to produce today's environmental quality, but also to yield the unique approach that characterizes institutional responsibilities for environmental management in the United States today. (p. 182)

In New Zealand, the RMA had two main groups of supporters with contradictory agendas – economic reformers, who wanted less planning and regulation and greater freedom over land use, and environmentalists, who wanted stronger protection of the natural environment (Memon and Gleeson, 1995).

As Chapter 5 discusses, Parliament did not resolve these tensions when debating the Resource Management Bill. Major parties appear to have adopted a strategy of "constructive ambiguity".[79] That is, a strategy of maintaining vagueness around contested issues in the interest of progressing discussions, and in the hope that implementation would bring clarity. This approach is common in (international) environmental negotiations, and was understandable given that the dogged pursuit of clarity may have jeopardised progression of the Bill.

Further, the Act simply lists a range of "other matters" that persons exercising powers and functions in the Act should have particular regard to (section 7). These include Māori values with respect to the environment. Those values jostle in the list with the intrinsic value of the environment and instrumental matters such as the benefits to be derived from developing and using renewable energy.

Chapter 5's high-level assessment of New Zealand's planning system stressed that implementation of the Act has not brought clarity and the concept of sustainable management has failed to provide a philosophical foundation for planning under the RMA (Miller, 2016). The continuing debate around whether section 5 sets "bottom lines" or allows for an "overall broad judgement" provides evidence to support this point. While some commentators believe the "King Salmon case" settled this debate (sub. 60 and sub. DR122), many others (including the legal advice commissioned for this inquiry) have cast doubt over the wider application of the judgement (K. Palmer, 2016).

Recent governments have been loath to initiate a national conversation around what "sustainable development" means in the New Zealand context. One outcome is that while "sustainability" is a popular mantra in New Zealand policy, how the term is used or the philosophical lens through which is it applied, is unclear and inconsistent. This is not simply semantics. How sustainability is conceptualised has a significant impact on what the system is trying to "sustain" and, and consequently, on the design of institutions aimed at achieving "sustainable outcomes". Instead, "financial incentives, court orders, legal rights, and public

[79] The term "constructive ambiguity" is often credited to Henry Kissinger, who reportedly used ambiguity as a negotiating technique in international agreements (Shur-Ofry & Tur-Sinai, 2015).

opinion" interact and characterise New Zealand's approach to managing the impact of the built environment on the natural environment today.

F9.4 "Sustainability" and "sustainable development" are core concepts in the Resource Management Act. Yet ambiguity over the meaning of these concepts has led to difficulties in managing the impact of the built environment on the natural environment.

9.2 The built environment's effects on the natural environment: some specific issues

As described in section 9.1, environmental law and regulation must manage the impact of one complex adaptive system on another complex adaptive system. This section explores some issues about how, under the current RMA, cumulative effects are being managed, information for adaptive decision making is being generated and whether there is oversight of environmental outcomes.

The RMA has struggled to manage cumulative effects

Cumulative effects are a well-recognised characteristic of complex adaptive systems. As Crawford (2016) explains, complex systems display non-linearities, including "butterfly effects" where small-scale events can have large systemic effects, and tipping points where a minor shift in parameters can produce sudden changes of state.

In the natural environment, cumulative effects arise where individually innocuous impacts on the natural environment add up to cause significant damage. Assessed in isolation, these impacts are not large enough to trigger regulatory action. However, when many individually "minor" impacts accumulate independently, they can lead to substantial environmental degradation. Further, these individual impacts can interact in unpredictable ways – leading to unforeseen impacts on the natural environment (Becher, 2014).

The RMA specifically recognises the need to manage cumulative effects. Section 3(d) notes that "effects" include "[a]ny cumulative effect which arises over time or in combination with other effects – regardless of the scale, intensity, duration, or frequency of the effect". This includes any "potential effect of high probability" (section 3 (e)) and any "potential effect of low probability which has a high potential impact".

Yet, as in many other countries, New Zealand's planning system has struggled to adequately manage cumulative effects on the natural environment. The New Zealand Planning Institute describes the handling of cumulative effects as "[o]ne of the major failures with the RMA" (sub. 27, p. 11). Similarly, consulting firm Hill Young Cooper notes that "the basic problem planning has is dealing with cumulative effects – small effects one way or another that add up" (sub. 6, p. 9).

The management of cumulative effects is difficult because:

- time lags often occur between the spillover and the impact of the spillover becoming apparent (eg, nitrogen can take decades to leach into waterways);
- multiple, isolated incidents of spillovers can occur, making monitoring of individual impacts impractical; and
- the capacity of the natural environment to absorb a spillover – or society's ability to tolerate it – is often unknown or difficult to predict.

These difficulties reflect the complex nature of interactions between the built and natural environments, and the dispersed and incomplete nature of information about the effects of human actions on the natural environment. As Becher (2014) explains:

> Natural resources, like water and air, represent complex systems that form part of a larger and more complex bio-physical system. A characteristic of complex systems is that they have multiple stable states, and have the potential to change from one state to another ... However, many redundancies

> resulting from this complexity convey a certain degree of inertia to each system. This means there is a degree of resilience associated with each stable state, but a downside is that this resilience obscures a myriad of seemingly inconsequential changes that can result in a sudden change to a new state with unexpected properties. (p. 6)

Other issues identified as contributing to the difficulties include:

- a failure when designing the system to consider the cost, complexity and capability needed to manage cumulative effects;
- the limited availability of good science, data and biophysical modelling to support decision making and learning through time; and
- rigid institutional design that does not adequately deal with uncertain environmental impacts or the need to change management practices as more information becomes available.

The system does not generate information for adaptive decision making

Inquiry participants have suggested that the current system is not generating the level of information and analysis required for adaptive decision making. The Ministry for the Environment (MfE, 2014d) makes this point in its 2014 Briefing to the Incoming Minister:

> Our knowledge of the environment and how effectively we are managing it is insufficient in many areas. There has been a history of limited investment in environmental monitoring relative to growing pressures on the environment. Our evidence base is patchy at best. For too long, this has led to debate about data – whether it's robust, and whether it measures the right thing – overshadowing debate about environmental issues. (p. 13)

Similar comments were reflected in the submission from the Regional Public Health and New Zealand Centre for Sustainable Cities:

> A case can be made, however, that councils often work on the basis of limited information and understanding of the consequences of their actions, and/or they do not adapt their decisions in the light of changing circumstances, so that rules become maladaptive. Health and environmental consequences of council decisions are often not well understood, and shorter-term political considerations rather than longer-term consequences may be privileged. … This of course is not a criticism limited to local government – it applies at central government level also. (sub. 35, p. 4)

Until recently, developing nationally consistent environmental data has received little emphasis. Such data is critical for detecting longer-term changes in the natural environment and for understanding whether existing legislative frameworks are achieving their stated objectives.

Oversight of environmental outcomes is insufficient

Central government has too little understanding of whether the RMA is achieving good environmental outcomes or how efficient the current system is in achieving these outcomes.

For example, referring to its national surveys of local government, MfE notes:

> The survey did not measure the performance of the RMA in delivering better environmental outcomes. Nor did it measure how well individual local authorities delivered these outcomes: this occurs through state of the environment monitoring and reporting at both the national and local level. (MfE, 2016h)

The "state of the environment" reports of 1997 and 2007 were criticised for being inaccurate and having limited geographic coverage (PCE, 2010). It appears that for the first 20 years of the RMA, central government had little oversight of the health of New Zealand natural environment, let alone the impact the RMA was having on environmental outcomes.

The Environmental Defence Society (EDS, 2016) attributes this to the absence of an evaluative culture within government agencies:

> In the absence of a culture of evaluation and accountability, running blind is the only alternative. The underwhelming environmental outcomes of the RMA demonstrate the consequence of this absence. The poor attention paid to monitoring and enforcement, the poor evidentiary base for many of the past

> reforms,…the lack of data on policy effectiveness and the overall limited agency accountability all point to the same problem: the failure to rigorously evaluate outcomes and consequences and to respond accordingly. (p. 59)

Poor oversight has been found to be an issue across New Zealand's regulatory system. In its inquiry into *Regulatory Institutions and Practices* (2014b) the Commission found that oversight of regulators commonly involves extensive reporting against measures that give little indication of whether regulators are making good decisions or achieving the desired regulatory outcomes. Recent reviews of the RMA are a case in point.

> Previous reviews of the RMA have largely focused on processing issues such as time and cost of resource consents, rather than quality of decision making. There is very little monitoring at a local, regional or national level as to the quality of decisions made and whether the intentions of the RMA are being met. Available information suggests that many items identified as a matter of national importance under s6 of the Act are inadequately identified and protected through District Plan provisions. (Allison Tindale, sub. 8, p. 1)

Auckland Council makes a similar point:

> Ongoing changes to the planning framework have tended to focus on improving processes and reducing costs and delays in the consenting process. While this is important and helps to provide greater process certainty for those involved, it can result in undue focus on process and compliance, potentially losing sight of the overall outcomes sought. A good planning system must provide sufficient flexibility to keep the big picture in sight when making day to day decisions. (Auckland Council, sub. 47, p. 4)

In recent years, the government has taken steps to improve the monitoring of environmental health. The Environmental Reporting Act 2015 requires regular reporting on New Zealand's environment. Under the Act the Government Statistician and the Secretary for the Environment are jointly responsible for producing and publishing environmental reports independent of the government of the day. The Parliamentary Commissioner for the Environment may comment on environmental reports produced.

The Environmental Reporting Act 2015 is a step forward from the inconsistent reporting of the past two decades. Yet questions remain around how to link environmental data to the effectiveness of the planning system – at both the local and central government level. Data are valuable to the extent that they inform adaptive decision making and provide timely feedback on the effectiveness of previous decisions. As such, a clear "collection logic" is crucial when determining the type and form of environmental data collected.

In the context of monitoring the urban planning system, this means identifying environmental indicators directly impacted by the human behaviour regulated under the system. These indicators then become an indicator of environmental health, and the basis for reviewing current policies and regulations.

F9.5 The planning system has struggled to adequately manage cumulative effects on the natural environment. The system does not generate the level of information and analysis required for adaptive decision making, and oversight of environmental outcomes is insufficient.

9.3 A planning system to manage the impact of the built environment on the natural environment

Essential features

The interaction of two complex adaptive systems is inevitably uncertain. This makes it difficult to predict future outcomes. Yet, regulators and policymakers still play a role. Well-designed settings that encourage learning and adapting to new information, allow for flexibility and innovation, and the use of incentives, can lead to desirable outcomes for the natural environment. Box 9.5 outlines a list of design elements recommended by Emison (1996) to improve the management of the environment and improve environmental quality.

Box 9.5 **Applying complexity theory to environmental policy**

1. Collecting accurate detailed environmental data and making it widely available

   If we are in a continuous state of change and emergence, having some picture of that state is essential for us to respond and adapt…. Information, therefore, is key not only to get an accurate fix on the state of environmental affairs, but also to enlist all the players needed to improve the system. (p. 187)

2. Setting specific and measurable goals

   When goals are either vague or responsibility is not clearly assigned, the goal's chances of success are diminished… Because complex adaptive systems adjust, why not take advantage of this property when setting goals?... goals can be adjusted to provide for an ever-improving environment, based on our knowledge of where improvement is most beneficial. (p. 188)

3. Using all parts of the environmental management system

   Environmental quality management is more than writing regulations and enforcing them…. Tax policy, capital and operational spending, and information dissemination should accompany traditional regulation as candidates for action. (p. 188)

4. Using incentives to promote responsible behaviour

   The use of positive incentives can be a major strength of using complex adaptive systems to advance environmental quality. (p. 189)

5. Paying close attention to implementation

   Complex adaptive systems theory tells us that the best control of large systems comes from controlling the component systems. Therefore we can strengthen the effectiveness of environmental policy by focusing on state and local governments. Complex adaptive systems theory tells us that no design, no matter how well conceived, can possibly anticipate all the opportunities and problems likely to be encountered in implementing the policy. (p. 190)

6. Making innovation a priority

   …unmoderated control can be the enemy of innovation, and we desperately need innovation if we are to adapt to the emerging challenges of the future of environmental management. (p. 190)

7. Emphasising flexibility

   Complex adaptive systems theory indicates that we are unlikely to ever anticipate completely the consequences of the national environmental quality system. We will have unforeseen problems and unforeseen opportunities. Our policies should be built with adaptability and agility as two of their undergirding principles. (p. 192)

Source: Emison, 1996.

Drawing on these elements and the Commission's previous work on regulatory design, implementation and review (NZPC, 2013; 2014), this chapter proposes desirable features of a planning and regulatory regime to manage the impact of the built environment on the natural environment.

- A clear legislative purpose, alongside principles and objectives for managing the impact of the built environment on the natural environment, would inform decisions and help with priorities and trade-offs. Māori values about the environment would be recognised, respected and accommodated.
- The regulatory system would be outcomes-focused and have information flows so as to measure outcomes and make decisions.
- Insights about complex adaptive systems would inform the design of the system architecture for managing the impact of the built environment on the natural environment at all levels.

- The regulatory regime would make use of the full range of instruments that can influence human activity with respect to the natural environment, including providing information, command and control regulation, and market instruments.
- The planning and regulatory system would promote adaptive management (AM) so that the regulatory regime can respond flexibly to information flows about the state of the natural environment.

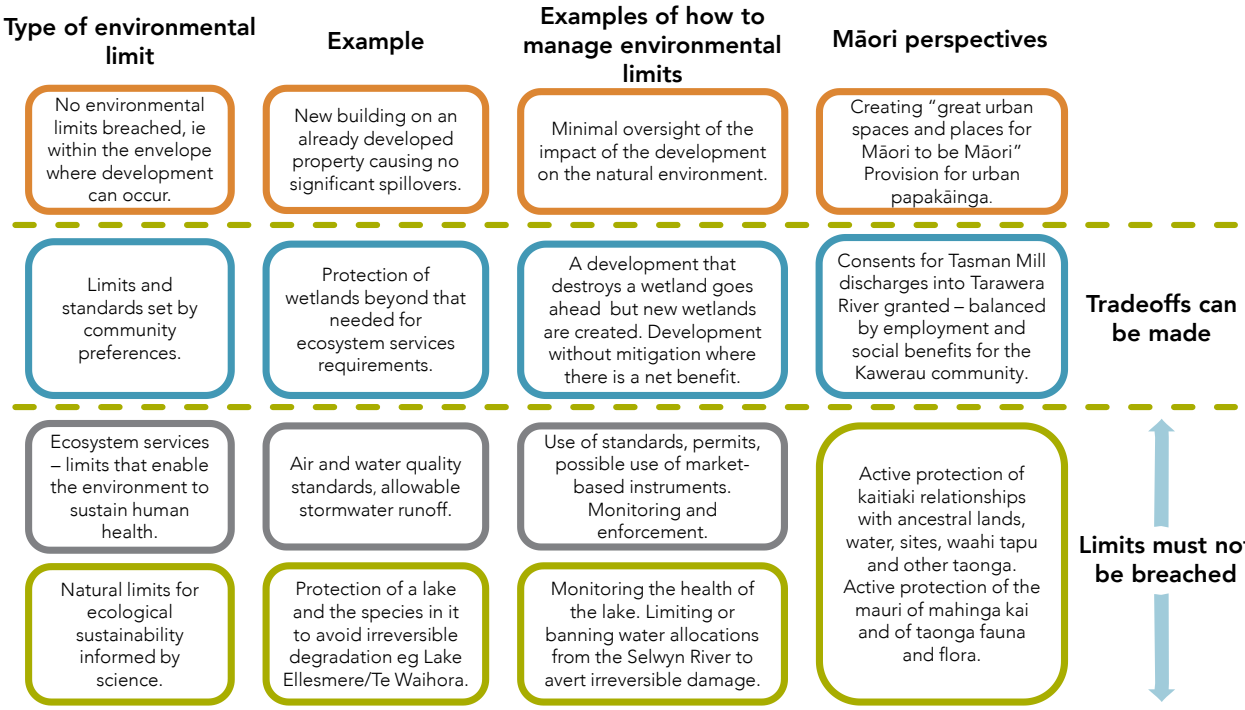
These desirable features are discussed in detail below.

Clear legislative purpose, objectives and principles

Future planning legislation should provide greater clarity and certainty for decision making than at present.

The Commission considers that the overarching purpose of planning legislation should reflect the positive benefits from the built environment that meet the social, cultural and economic needs of New Zealanders, while safeguarding the natural environment (Chapter 13). The concepts of sustainability, limits and standards can be invoked to help operationalise this purpose (Figure 9.1).

Figure 9.1 Limits and standards for regulation of the natural environment



In a complex and adaptive regulatory system, community preferences may change. People may increase their scientific understanding of the natural limits of ecosystems, and they may find new ways to mitigate the effects of the built environment on the natural environment.

This chapter distinguishes between the natural limits of ecological sustainability beyond which the environment would be irreversibly damaged, and the sustainability of ecosystem services necessary to maintain the liveability of the built environment.

These limits should not be breached. They also lie at the heart of the obligation that Māori have to protect the mauri of mahinga kai and the taonga fauna and flora. These two limits are shown in the last two rows of Figure 9.1, with examples and the regulatory control mechanisms that might be used to maintain levels of ecosystem services and protect ecological sustainability. The limits and the standards necessary for protecting these ecosystems, and the services they provide, rely on good science and good information about the state of the environment.

Above these limits are those limits and standards determined by community preferences[80] (shown in the second row in Figure 9.1). In many cases these will be well above the limits required to maintain ecosystem

[80] That is, they are determined in a complex social environment rather than being a product of a complex natural environment.

services for the built environment. For example, the community may have preferences for how to preserve wetlands or the quality of water in a river that exceeds what is needed to sustain the ecosystem. Where a proposed development will have a significant impact on the natural environment, a decision must be made about the social and economic value of the development compared to the loss to the natural environment.

Two examples illustrate the types of trade-offs.

- **Mitigation and enhancement:** NZTA mitigated the loss of wetland in the Kāpiti district as a result of the Mackays to Peka Peka expressway by creating new wetland areas – "with every hectare of wetland that is lost or moved due to construction, the MacKays to Peka Peka Alliance will regenerate it five times over" (NZTA, 2017).
- **Net benefit consideration:** The Environment Court renewed (time limited) consents for Tasman Mill discharges into the Tarawera River without remedy or mitigation of the adverse effects, because, on balance, the social and employment benefits to the community outweighed the loss to the environment (K Palmer, 2016).

A future planning system would be supported by objectives and principles aimed at setting and operationalising limits and standards for protecting the natural environment.[81]

And, where the natural environment is not significantly impacted, developments should be able to proceed with minimal oversight (top row of Figure 9.1). For example, kaupapa Māori urban developments and new building on an already developed property would have rights to proceed without undue restriction.

R9.1 The overarching purpose of planning legislation should reflect the positive benefits from the built environment that meet the social, cultural and economic needs of New Zealanders, while safeguarding the natural environment.

R9.2 Future planning regulation should set clear limits and standards within which development can occur, to ensure the integrity of natural systems (ecosystem sustainability), maintain standards of environmental quality (ecosystem services), and recognise community preferences (including Māori interests).

If developments breach community standards for the natural environment, then decision makers should balance the benefits of development against the impacts on the natural environment.

Where these limits and standards are not breached, and within the rules for the built environment, developments should be able to proceed with minimal oversight.

Legislation should provide clear objectives and principles to guide how limits and standards are determined.

A focus on environmental outcomes and information to support decision making

When dealing with a complex adaptive system, regulation (or other instruments that seek to maintain environmental standards) needs to be based on up-to-date information about outcomes. Monitored outcomes should correspond to specific and measurable goals that are linked to the overall performance of the system. Central government should work with local government to determine what environmental outcomes to measure.

[81]. Legislation should also provide corresponding objectives and principles for the built environment (Chapters 8 and 13).

This means identifying environmental outcomes that are impacted on by the built environment. These outcomes then become indicators of environmental health and the basis for reviewing current policies and regulations. Consistent and accurate information flows about the quality of the natural environment, especially at a regional level, are needed to measure these outcomes and make decisions. Also, information needs to be widely available, since the planning system is comprised of many dispersed regulators and regulated parties. Due to likely economies of scale and scope, central government is best placed to help regional regulators set up information systems that provide timely information about environmental outcomes.

Chapter 13 goes into further detail about central government's stewardship role in monitoring the outcomes of the planning system.

R9.3 Central government should work with local government to determine what key environmental outcomes are measured and work with regional regulators to set up information systems that provide timely information about outcomes.

The design of system architecture

The system architecture should allow for good information and societal preferences to inform the management of the impacts of the built environment on the natural environment. And the component parts should fit together, each with their own roles. Key players in the system (central government, local government, Independent Hearings Panels (IHPs) and the Environment Court) will each play a part in establishing and enforcing the ecological limits and standards designed to safeguard the natural environment. With reference to Figure 9.1, different players will set standards and limits, monitor outcomes, and make trade-offs and decisions. The will do so depending on the circumstances; so, these roles need to be clear.

Central government

Negative spillovers can extend beyond regional boundaries. Where the costs of spillovers are felt nationally, it is appropriate for central government to play a role in setting regulatory standards and policies and in providing guidance on how to apply those polices and standards. National standards, policies and guidance may also be needed where national consistency is important or where economies of scale and scope offer efficiency gains (Chapter 3).

A lack of central government guidance and the delay in establishing National Policy Statements (NPSs) and National Environmental Standards (NESs) has hindered the implementation of the current planning system (Chapters 4 and 8). Yet the Commission has received mixed views on the role central government should play in a future planning system.

Many inquiry participants believe more guidance and clearer standards from the central government would help councils make decisions (subs. 1, 2, 27, DR60, DR68, DR77, DR83, DR89). The Commission agrees with this view. However, submitters also warned that national requirements can limit the scope councils have to tailor land use regulations to local circumstances (subs. DR68, DR86, DR124).

Chapter 3 introduces a framework for allocating regulatory roles between central and local government (see Figure 3.1). See also the regulatory allocation framework set out in NZPC (2013) *Towards Better Local Regulation*.

R9.4 A future planning system would include a well-articulated and stable approach for deciding when to set environmental standards and policies nationally and when to leave standard setting to local decision makers.

In its draft report, the Commission raised the idea of a Government Policy Statement (GPS) on environmental sustainability. It was suggested that such a GPS could replace the existing NPSs and NESs with a view to creating a more congruent, transparent and clearer national direction.

While some submitters expressed general support for the intent of the GPS (subs. DR50, DR59, DR68, Dr108), many submitters expressed concerns (subs DR72, DR86, DR90, DR92, DR103, DR118). In particular, these concerns focused on:

- the practicality of balancing a wide range of competing interests within a single document;
- the risk that the GPS would become overly political and lose its required scientific focus;
- the risk that the GPS would be subject to ad hoc changes that would undermine certainty for both the environment and investors; and
- the belief that a GPS would need to be so high-level that it would not provide councils with the specificity needed for practical plan-making.

The Commission finds these arguments compelling. While there is value in central government clearly signaling its environmental priorities, a single document that attempts to do so could become unwieldy and would not be an appropriate model for setting environmental standards (K. Palmer, 2016). In addition, clearly defined objectives and principles in legislation should help to provide guidance around how best to resolve conflicting environmental objectives (Chapter 13).

In light of the arguments above, the Commission recommends the continued use of NPSs and NESs. Yet currently only one mandatory national statement sits under the RMA: the National Coastal Policy Statement. To ensure sufficient guidance is provided on a wider range of matters with respect to the natural environment, the Commission recommends that central government deliver a core suite of national instruments (Chapter 13).

Additionally, the Commission's recommendations around spatial planning provide an opportunity for central government to signal its priorities via a more practical and location-specific process. Chapters 10 and 13 discuss the Commission's suggested process for developing regional spatial strategies.

R9.5 A future planning system should retain the use of national instruments such as National Policy Statements and National Environmental Standards.

Importantly, national direction and guidance should not be restricted to formal legislative tools. A future planning system would see central government making more effective use of *informal* (ie, non-binding) guidance (Chapter 13).

Local government

Under the RMA, guidance at a regional level for managing the natural environment is currently provided through Regional Policy Statements (RPSs). Prepared by regional councils, RPSs outline strategies to address regional resource management issues such as maintaining air quality and managing natural hazards.

However, RPSs are also used to regulate the built environment. Regional councils include policies related to urban development that are often vague, too restrictive and aspirational, and based on insufficient evidence. Examples include:

- maintaining and enhancing the sense of identity and character of a region;
- setting explicit targets for intensification, and encouraging high-density and mixed development around designated centres to ensure a more compact urban form; and
- imposing urban limits.

McDermott (2016) argues for a shift in the focus of RPSs:

> While the setting of regional standards and provisions for protecting or restoring the quality of air and water, the integrity of soils, and biodiversity should be clearly set out and adhered to throughout region

> as far as practical, the tendency for Regional Policy Statements to promulgate land use prescriptions to control matters outside the immediate requirements of the natural environment intrudes on urban development options. (p. 23)

The Commission agrees. The purpose of RPSs should shift towards setting standards and limits to safeguard the natural environment. So, in a future planning system, regional councils should prepare a Regional Policy Statement for the Natural Environment (RPS-NE) to replace existing RPSs and regional plans (to the extent that they deal with standards and limits for the natural environment). The RPS-NE would stipulate the ecologically sustainable limits within which development in the region must occur. It would give effect to national policy instruments and would allow regional councils to set ecological limits and standards above national levels. For instance, a regional council may decide to set the minimum standard of water quality for local rivers at a higher level than specified in national instruments. The RPS-NE would give appropriate recognition to, and provide for, mana whenua kaitiaki relationships with the natural environment.

The role of regional councils in land-use planning is discussed in Chapter 10. Chapter 13 sets out the Commission's proposals for the hierarchy of Plans.

R9.6

In a future planning system, regional councils should prepare a Regional Policy Statement for the Natural Environment. That policy statement would:

- describe the ecologically sustainable limits that must not be breached;
- replace existing regional policy statements and regional plans to the extent that they deal with standards and limits for the natural environment;
- give appropriate recognition to, and provide for, mana whenua kaitiaki relationships with the natural environment; and
- give effect to national policy instruments and allow regional councils to set limits and standards above national levels in line with regional preferences.

Independent Hearings Panels and the Environment Court

Chapter 8 recommends establishing IHPs that would consider and review the suite of Plans within a region. Plans include an RSS (Chapters 10 and 13), RPS-NE and District Plans. Strengthening and streamlining the plan review process in this way ensures that plan rules adequately protect the natural environment, local environmental issues are addressed, and development is not unnecessarily constrained.

Even once IHPs are established, the Environment Court should continue to play an important, residual role in managing the effects of the built environment on the natural environment. The Environment Court should continue to be responsible for hearing appeals, on the merits of council consent decisions, and appeals, on points of law, from IHP decisions. As the decision maker on consent appeals, the Court will help to ensure that consent decisions comprehensively weigh up the social benefits of a development against its costs on the natural environment (Chapter 8).

Use of the full range of instruments

Traditionally, planning systems manage spillovers through regulation, monitoring and enforcement – so-called "command and control" measures. However, instances may likely arise when other policy approaches – or a more judicious mix of approaches – can achieve environmental goals more efficiently and effectively.

Firms and individuals make decisions that damage the environment partly because they do not bear the full cost of their actions – that is, costs spill over into the wider community (Chapter 3). "Market-based instruments" manage spillovers by internalising costs into the decisions of firms and individuals. When people face the full costs of their decision, they have an incentive to reduce environmental damage and use resources more efficiently. In this way, markets can act as the coordinating mechanism for multiple, independent players in a system. Box 9.6 outlines different types of market-based instruments.

Box 9.6 **Market-based instruments**

- *Price-based instruments* – instruments that attempt to influence environmental performance by pricing negative externalities or subsidising mitigation actions. Two examples are noted below.
  - Environmental charges – charges that link the amount paid to the level of spillover (eg, discharge fees for effluent). Alternative charges can be placed on inputs related to a spillover (eg, vehicle registration fees based on engine size as a proxy for GHG emissions).
  - Incentive payments – payments that subsidise the cost of mitigating actions. Competitive processes can be used to distribute incentive payments.
- *Quantity-based instruments* – instruments that involve setting quantity limits (eg, emissions) and that allow trade among those adding to the quantity and those mitigating the quantity (permitting individual underperformance if compensated by over-performance elsewhere). Tradeable permits and environmental offsets are two major variants.
  - Tradeable permits – permits that create and allocate a limited number of permits that produce an undesirable effect on the environment; then allow parties to trade the permits with each other. A person is then only allowed to exceed a given quantity if they buy permits from someone who has excess permits because they are under their permitted emissions level.
  - Environmental offsets - actions taken to meet a standard (reducing pollution or environmental impacts) at a site away from where the action causing an environmental externality occurs. The party causing the externality can either act, or pay for others to act on their behalf. For instance, to offset the loss of native vegetation from a development, a developer could improve the quality or quantity of native vegetation in a nearby area.

Source: Adapted from MacDonald, Conner & Morrison, 2004.

When market-based instruments are well-designed and implemented, they can lower the cost of achieving environmental objectives and create incentives to seek out innovative solutions to environmental problems. Yet relative to other countries within the Organisation for Economic Co-operation and Development (OECD), New Zealand does not use these instruments enough (OECD, 2007). The OECD has noted that, to meet its environmental challenges, New Zealand will need to "further integrate environmental concerns into economic and sectoral decisions, particularly by using economic instruments to internalise [the] environmental costs of economic activities" (p 1).

While New Zealand has other examples of market-based instruments (such as the Lake Taupō nitrogen cap and trade programme and the Quota Management System (QMS) for fish stocks), policy innovation in the use of market-based instruments has been minimal. [82] Command and control measures remain the policy instrument of choice in managing the impact of the built environment on the natural environment.

Councils have opportunities to make more use of the full range of environmental management tools. For example, Chapter 11 explores the use of congestion charges and water charges. That chapter highlights how technology now makes it possible to introduce sophisticated pricing structures that reflect the full costs of infrastructure use. It is possible that these pricing structures could internalise a broader set of external costs. However, taxes on fuel consumption are still likely to be a more efficient way to internalise the cost of some transport-related externalities such as air pollution from vehicle exhausts and GHG emissions.

Box 9.7 highlights examples of market-based approaches in France and Germany to manage stormwater run-off from the built environment on the natural environment, and raise revenue to pay for stormwater infrastructure.

[82] The Lake Taupō nitrogen cap and trade programme is one of the world's first non-point-source water quality cap and trade schemes (see Duhon, McDonald & Kerr, 2015).

Box 9.7 **Use of market-based instruments for stormwater run-off**

Many local authorities in France and Germany impose a stormwater tax on landowners to control stormwater run-off in urban areas. Unlike in rural areas where rainfall is absorbed into the ground, urban areas consist of expanses of impervious surfaces such as roads and car parks where water is unable to pass through. This causes stormwater to pick up pollutants such as chemicals and oils as it flows across these surfaces into the stormwater system, leading to in polluted rivers and streams. Taxes aim to incentivise improved management of urban stormwater and are based on the impervious land surface of a property.

The City of Dresden charges, on average, €1.04 per m^2 of impervious surface each year. Many French municipalities offer tax reductions between 20% and 100% if landowners create or improve their stormwater system to limit run-off. Additionally, the revenue collected in Germany helps to finance projects aimed at promoting re-use of stormwater for municipal use.

Source: OECD, 2010.

It is important that environmental regulators have access to a full range of policy tools. Yet ensuring that legislation provides access to tools is not enough. Central and local government need to work together to remove or mitigate obstacles to implementing market-based instruments. This includes removing or mitigating any misunderstanding and cultural resistance to the use of these instruments that stems from two common misconceptions (Review Group on the Resource Management Bill, 1991).

- The first misconception is that market-based instruments are simply a way for individuals to "buy their way out of" protecting the environment. The aim of market-based instruments is better environmental outcomes – the same as regulation. What differs is that market-based instruments use price mechanisms to create incentives for individuals to seek out efficient ways to achieve the desired outcome.
- The second misconception is that market-based instruments will not work because the government cannot precisely measure the level of spillovers generated. While it is true that a spillover is often difficult to measure, this is because of the nature of the spillover rather than the instrument selected to manage it. Nor does it follow that developing efficient market-based instruments requires more information than alternative policies (such as direct regulation). Indeed, market-based instruments can strengthen incentives to better understand the spillover in question.

Other obstacles that would need to be addressed include:

- the cost of collecting data on which to base taxes and charges;
- limited experience and capability in developing economic instruments;
- that market-based measures can be politically unpopular, given they can entail people paying to do things they previously enjoyed for free (or at a subsidised price); and
- potential distributional effects.

As steward of the planning system, central government has scope to do more to promote capability in the use of market mechanisms within the system. Chapter 13 looks at central government's stewardship role in more detail, while Chapter 14 addresses culture and capability within the planning system.

R9.7 When regulating urban spillovers affecting the natural environment, a future planning system should ensure regulators have access to the full range of instruments (including market-based tools).

Adaptive management practices

AM recognises that scientific understanding of complex natural systems is incomplete and that this uncertainty should not necessarily prevent projects from occurring (MfE, 2016l).

Under AM it is expected that management decisions will need adjusting as more information about the environmental impacts of a decision becomes available (ie, as the response becomes known).

AM can be contrasted to the "predict and control" approach typically used under the RMA. Under that Act, all applications for resource consent must include an assessment of the likely environmental effects of the proposal. Applicants must also include a description of how they will mitigate negative effects. Councils (or the Environment Court) then decide whether to grant the consent.

Difficulties applying a "predict and control" approach to complex environmental problems suggests that a future planning system should place greater emphasis on AM. This would require a recognition that planning decisions occur under uncertainty and that, in some instances, research, information gathering, and environmental management cannot be decoupled.

Cumulative effects are inherently unpredictable. Therefore, using AM can be a useful approach to managing these sorts of impacts on the natural environment. As Canter and Atkinson (2010) describe in their evaluation of AM for managing cumulative effects, a greater focus on learning by doing would see regulators regularly monitoring outcomes to determine if management actions are meeting outcomes. If outcomes are not met, regulators should facilitate management changes that will best ensure that outcomes are met or re-set the objectives.

AM is used for some other aspects of environmental regulation in New Zealand, including the regulation of the marine environment in New Zealand's exclusive economic zone (EEZ) and continental shelf (CS). Developers who seek a consent for an activity affecting the EER or CS can propose an AM approach to dealing with any uncertain impacts on the marine environment (Box 9.8).

Box 9.8 **Experience of adaptive management in regulating the marine environment**

The Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012 (EEZA) places an obligation on regulators to consider AM when assessing marine consent applications for activities in New Zealand's EEZ and CS. Under section 34(3) of the EEZA, where an activity is likely to be prohibited, "the Minister must first consider whether providing for an adaptive management approach would allow the activity to be classified as discretionary".

Yet the EEZA requires that the decision maker favours caution and environmental protection where the information available to the decision maker is uncertain or inadequate. In their consent application, an applicant can outline measures they will take to manage the uncertainty of the project. Such measures include monitoring, reviewing and varying the activity once the consent is granted. Decision makers then consider whether the measures are sufficient, whether further action is needed or the project should be refused consent.

Experience with the EEZA suggests there tension can emerge between the environmental benefits of AM and the investment uncertainty that may arise when AM is used. A common criticism from developers is that, in practice, AM has meant projects have been permitted to proceed in stages, and that this "staged approach" overlooks the fact that some projects require a minimum scale to be economically viable (MfE, 2016l).

For example, in 2014, proposals from Trans-Tasman Resources Ltd and Chatham Rock Phosphate Ltd to undertake seabed mining projects were declined. In both cases, the consent proposals included what the applicant considered to be AM provisions. However, the consents were refused on the basis that AM provisions did not adequately address the uncertainty surrounding the adverse effects of each project. Further, in both cases, the applicant rejected suggestions by the regulator to stage their projects, judging that a staged approach would make the project commercially unviable.

Source: MfE, 2016l.

The experience with the EEZA shows that staged approaches, with uncertainty about whether all stages can happen, may make a development unviable from the start. Additionally, the cost of analysing the potential

impact of proposed activities, and continually monitoring their effects along with the risk of having to adapt the project later, could mean that some acceptable projects become commercially unviable.

Wellington City Council raised this point in its submission:

> The Council sees the main obstacle to [an adaptive management] approach being the ongoing monitoring framework that will need to be implemented and the associated costs it brings. There is also the risk that, based on the level of sunk investment, changes to approved development to address issues of cumulative effects may simply be impractical or uneconomic. (sub. DR68, p. 15)

Even given the above, submissions to the inquiry indicate wide support for increasing the emphasis on AM (subs. DR68, DR73, DR86, DR111). For example, Water New Zealand submitted:

> Water NZ agrees that a greater emphasis on adaptive management may assist in managing cumulative effects. This is particularly the case, where as in Auckland, there have been numerous proposals for land use changes (including special housing areas) in a relatively short time frame, meaning there has not been enough time to develop accurate models to predict the effect of the changes.(sub. DR67, p. 8)

Similarly, the submission from Auckland Council notes:

> The council supports further investigation into the potential for using adaptive environmental management tools. Widening the environmental management toolkit and providing the discretion to use the best tool for each given situation or enabling a combination of approaches to be used would allow a more flexible and responsive approach, and enable the approach to be tailored to address complex local environmental issues (sub. DR86, p. 9)

When adaptive management is a possible mechanism

AM may be a better fit with market-based instruments for environmental management. For example, fishing quotas to regulate commercial fishing activities in New Zealand use a QMS that sets catch limits for different fish stock to prevent overfishing. Allocations of fish stock are split into quota shares that commercial fisheries can freely buy and sell. The Ministry of Primary Industries (MPI) regularly monitors and reviews the quota allocations – in other words, makes adaptive changes based on information about outcomes – to ensure the long-term sustainability of fish stocks. MPI (2016) reports that most of the stocks that were overfished before the introduction of the QMS now have sustainable catch limits in place.

AM can also help to manage discharges into rivers, with permits or licenses allocated, adjusted or revoked according to updated information about water quality.

Where information can be collected, outcomes monitored, and limits or standards adjusted, AM is a useful way to deal with cumulative or uncertain effects.

R9.8 A future planning system should encourage the use of adaptive management for dealing with cumulative or uncertain effects, where information can be collected and outcomes monitored, and where limits or standards can be adjusted.

Support for the use of adaptive management

To support the wider use of AM, Water New Zealand noted in its submission that "there should be clear guidance about what AM is, and what it is not, as well as when it is appropriate for it to be used" (sub. DR67, p. 9). The Commission agrees with this suggestion and considers that central government is well suited to provide this kind of guidance. As well as comprehensive guidance, central government should also help councils to build the scientific base and analytic capability necessary to support AM.

In addition, institutional resistance to acknowledging the presence of uncertainty will need to be overcome to implement AM effectively, as will the risk-averse cultures of government bodies. Williams and Brown (2012) note:

> Learning organizations are critical in implementing adaptive management. For adaptive decision making, many organizations must make a transition from a more traditional "top down" organization structure to one that is more inclusive, collaborative, risk tolerant, and flexible ... However, an adaptive management approach must comply with statutory and regulatory requirements. (p. v)

Chapter 14 explores the issues of culture and capability within the planning system.

R9.9 To support the use of adaptive management, central government should produce comprehensive guidance on when and how the approach should be used, and provide councils with technical support to help build capacity within the planning system.

The implications of an adaptive management approach for the use of natural resources

Figure 9.1 describes limits for protecting and preserving ecosystems (last row of the figure). When new information reveals these limits are close to being breached, then action is needed to avert irreversible damage. The example given in Figure 9.1 is of the health of a lake depending on the flows of water into the lake from a river.

Where market-based instruments are in place – such as tradeable permits for water allocations – then these can be "bought back" by the regulator and taken out of circulation. In this way, owners of tradeable permits are compensated for the loss of the property right to take water from the river. Where allocations of water have been made without a tradeable property right, and these are enduring, then these permits may need to be revoked, with a resulting loss (if uncompensated) to the holder of the permit. Of course, if permits are time-limited, then there should be no expectation of a roll-over of arrangements under AM as new information would be expected to inform and potentially revise regulatory settings.

Holders of property rights carry the risks associated with AM approaches. Losses incurred by holders of property rights are balanced against the losses that current and future generations would suffer as a result of the irreversible degradation of ecosystems.

9.4 Climate change and urban planning

Climate change is arguably the greatest challenge to the livability of New Zealand's urban environment. In its Fifth Assessment Report, the International Panel on Climate Change (2014) noted:

> Anthropogenic greenhouse gas emissions have increased since the pre-industrial era, driven largely by economic and population growth, and are now higher than ever … Their effects, together with those of other anthropogenic drivers, have been detected throughout the climate system and are extremely likely to have been the dominant cause of the observed warming since the mid-20th century. (p. 4)

Policy responses to climate change are commonly grouped into two broad areas – adaptation and mitigation. Adaptation policies aim to help communities and ecosystems cope with actual or expected changes in climate conditions. Mitigation polices aim to reduce GHG emissions and enhance carbon sinks.

Several inquiry participants raised questions around the role that a future urban planning system should play in adapting to and mitigating climate change (eg, sub. 3, sub. 7, sub. 9, sub. 20, sub. 21 and sub. 32).

A full discussion about adapting to and mitigating climate change is beyond the scope of this inquiry. The comments the Commission makes about the role that urban planning should play in addressing climate change in this section draws on the features of a desirable planning system discussed elsewhere in the chapter, and in other parts of the report. These include:

- the need for regular, accurate and detailed information flows;
- access to a full set of instruments, including market-based tools to manage spillovers;
- appropriate allocation of regulatory roles between central and local government (Chapter 3);
- use of adaptive approaches such as Real Options Analysis to deal with uncertainty (Chapter 10); and
- use of regulation where this is reasonably considered as the most efficient and effective way to achieve the purposes of the legislation (Chapter 13).

The challenge of adapting to and mitigating climate change provides an illustration of how the Commission's recommended planning system would manage the interrelationship between the built environment and the natural environment.

Adaptation – managing effects

In undertaking their responsibilities under the RMA, councils are required to have particular regard to the effects of climate change (s. 7). In addition, the New Zealand Coastal Policy Statement 2010 includes requirements for councils to manage the potential effects of climate change. For example:

- Policy 4 requires councils to provide for integrated management of natural and physical resources in the coastal environment, particularly where "development or land management practices may be affected by physical changes to the coastal environment…including as a result of climate change" (p. 13);
- when considering the form and design of reclamation, Policy 10 requires councils to have "particular regard" to "the potential effects on the site of climate change, including sea level rise, over no less than 100 years" (p. 15); and
- Policy 24 requires councils to "[i]dentify areas in the coastal environment that are potentially affected by coastal hazards..." having regard (among other issues) to the effects of climate change on coastal sediment dynamics and storm frequency, intensity and surges (Department of Conservation, 2010, p. 23).[83]

Generally speaking, communities are able to cope with climate variability within a given range. Outside this range they are vulnerable to loss and damage. For example, insufficient rain may cause water shortages; too much rain may cause harm from flooding.

The necessity to adapt to climate change arises after assessing what extreme (rather than average) events are likely in a region. In some respects, the strategies to adapt to climate change are well-known to councils. As Füssel (2007) notes:

> [M]ost activities considered in adaptation to climate change are not new... Adaptation includes well established practices from disaster risk management (e.g. early-warning systems), coastal management (e.g. structural protection), resource management (e.g. water rights allocation), spatial planning (e.g. flood zone protection), urban planning (e.g. building codes), public health (e.g. disease surveillance), and agricultural outreach (e.g. seasonal forecasts). (p. 268)

Yet several aspects of climate change adaptation are new. For example, climate change may result in new types of hazards that were previously absent or extremely rare (UNDP, 2010). Further, traditional assessment approaches for dealing with natural hazards and water-resource management are not well suited to a complex and dynamically evolving hazard such as climate change (Füssel, 2007).

The Parliamentary Commissioner for the Environment (PCE, 2015) has noted that, in coming years, rainfall, wind and storm patterns will alter in response to climate change. The PCE also noted that sea-level rise is projected to increase the frequency, duration and extent of coastal flooding (Box 9.9). Factors affecting the vulnerability of coastal areas to flooding include low land elevation, the presence or absence of natural and built defences (eg, sand dunes, built sea walls, and tidal barriers), and the design and capacity of stormwater pipes.

Box 9.9 **Projected impacts of climate change**

- **Rainfall:** The distribution and intensity of rainfall across New Zealand is predicted to change, with more rain expected in the west of both islands and in the south of the South Island. Northland and eastern regions are projected to get drier and downpours are projected to become more extreme – raising the risk of river flooding.

[83] See also Policy 3 (precautionary approach), Policy 3 (integration), Policy 18 (public open space) and Policy 27 (strategies for protecting significant existing development from coastal hazard risk).

- **Wind:** Changing circulation patterns in the atmosphere are projected to result in more intense and prolonged westerly winds – particularly in winter. This will increase the power of waves, leading to an increased risk of storm surges.[84]
- **Storms:** Warmer atmospheric temperatures are projected to alter storm patterns. Winter cyclones formed south of New Zealand will become more intense, resulting in stronger winds and larger waves hitting coastal areas exposed to the south. The intensity of cyclones elsewhere in New Zealand is projected to decrease.

Source: PCE, 2015.

In addition to flooding occurring more regularly, rising sea levels are projected to increase coastal erosion[85] and salt water intrusion into groundwater tables. The risk of these problems will depend on the characteristics of each local area and on the ability of that area to adapt to new climatic conditions (Scheraga & Grambsch,1998).

A future planning system will need to recognise the risk and impact of climate change. Yet, adapting to a changing climate will take more than simply strengthening planning legislation. Rather, action is required at different points in the planning system (Box 9.10).

Box 9.10 **Actions to adapt to climate change**

- **Disseminating the best-available science based on standardised data and assumptions.** Scientific analysis is crucial to understanding climate change risks, impacts and vulnerabilities. While local adaptation strategies will vary, the science underpinning the strategies should be developed from a common scientific base. This means, for example, developing nationally consistent approaches to collecting land elevation data and nationally consistent approaches to modelling sea-level projections.
- **Raising community awareness of the potential impacts of climate change and creating avenues through which the community can express their views on how risks are managed.** Climate change adaptation is a technical and complex subject. Central and local government need to focus on lifting community understanding of the science underpinning policy options, and the relative costs, benefits and risks of alternative courses of action.
- **Central and local government need to weigh up the cost and benefits of adaptation options alongside other social goals and priorities.** This includes assessing not only the fiscal cost of plans, but also the non-climate related side-effects of strategies (eg, the potential impact of sea walls on marine ecosystems).
- **Collaboration and coordination at the national, regional and local level.** While local areas will bear the brunt of some impacts of climate change (such as coastal erosion), other impacts may have national implications (such as changing rainfall patterns). Effective adaptation planning requires vertical collaboration between levels of government, and horizontal collaboration across government agencies and councils.
- **Monitoring the performance of adaptation actions and modifying them in response to new information or technology.** Climate change science and adaptation technologies are evolving rapidly. As a result, what constitutes best available science today is unlikely to be so in five years. Further, while much is known about how local ecological systems function, there is still much to learn; unexpected responses in the natural environment are likely. This points to the need for

[84] Storm surges occur when high winds and low air pressure combine to create a bulge in the sea that is driven onto the coast (PCE, 2015).

[85] Due to larger, more intense waves hitting the shoreline.

adaptation actions that respond responsive to new information and new technology as they become available.

- **Dealing with environmental uncertainty.** Uncertainty about the effects of climate change makes it very hard to decide how best to adapt now to future conditions. For instance, continuing rising sea levels may later mean investing in and building some form of sea wall. It is vital to consider this uncertainty and build flexibility into investment decision making when developing and analysing options for adaptation.

Sources: Scheraga & Grambsch, 1998; Füssel & Klein, 2004; UNDP, 2010; The United States Environmental Protection Agency, 2014; PCE, 2015.

All of these actions have been discussed as features of a desirable regulatory system for managing the impact of the built environment on the natural environment, in the course of this chapter.

It is also important to recognise that, in a complex social system, individuals will also adapt to climate change. People decide where they wish to buy property, and insurance companies decide what cover they will offer, and what premiums they will charge, for climate-related damage. Central and local government actions and policies to adapt to climate change will influence these decisions. For example, a council's decision to build a sea wall will influence the value of coastal properties, and individuals' decisions about whether to buy coastal property.

Mitigation – reducing greenhouse gas emissions

As part of the international response to climate change, central government has set an unconditional target of reducing New Zealand's emissions by 5% below 1990 levels by 2020.

The 2004 Amendments to the RMA introduced provisions prohibiting consent authorities from considering GHG emissions when making rules to control discharges in air, and when considering an application for discharge permits (sub. 7). Accordingly, responsibility for mitigation policies effectively rests with central government (Chapter 6).

Some submitters argue this decision should be reversed and councils given the mandate to control GHG emissions. For example, Sir Geoffrey Palmer and Dr Roger Blakeley submit:

> The Commission should be recommending amendment to the Resource Management Act 1991 to allow local government to properly deal with climate change factors when making environmental decisions. Cities and urban areas are estimated to account for 80% of New Zealand's greenhouse gases (sub. 122, p. 16).

However, there are strong arguments for formulating regulatory policy and standards for transboundary pollutants (such as GHG emissions) at the national level.

- The impacts of GHG emissions are felt on a global scale and over a long period of time. Because the beneficiaries of emissions reductions lie outside local boundaries, local authorities would face few incentives to set standards that reflected the national (or global) interest – particularly when doing so conflicted with the interests of their constituents.
- Local variability in emissions standards is unlikely to be efficient and may simply result in emissions-creating entities moving from local areas with strict emissions standards to areas with more lenient standards.
- As a general principle, policymaking responsibility should be allocated to the level of government where the electorate has the most interest (and ability) to hold politicians accountable for regulatory outcomes (Chapter 3). In the case of GHG emissions, effective accountability is more likely when policies and

> standards are set at the national level. This is because central government is accountable for New Zealand's compliance with its international climate-change obligations.[86]

The submission from the Property Council notes:

> [C]ontrolling GHG emission in one part of New Zealand will have no effect on climate change, if another part of New Zealand raises its GHG emissions by the same amount. The only fair and practical way to ensure national emissions go down is to manage it at a national level. (sub. DR118, p. 11)

Horticulture New Zealand submitted:

> There is clearly a link between urban planning and GHG emissions. However Horticulture New Zealand would not want to see GHG emissions targets be addressed through regional and district planning regimes. This is a national issue and therefore should be addressed at a national level as there is potential for inconsistencies in addressing the issue at a regional or district level. (sub. DR73, p. 11)

The Commission can see no strong rationale for giving local government primary responsibility for setting climate-change mitigation policies and standards. That said, local government may be an important conduit for mitigation action at a national level. This being the case, an NPS or NES would be the appropriate mechanism for promoting a nationally consistent approach to mitigation.

F9.6 The rationale for giving local government primary responsibility for setting climate change mitigation policies and standards is limited. Should central government decide a role for planning in climate change mitigation is needed, this role is best articulated through the use of a National Policy Statement and/or a National Environmental Standard.

Clearly, New Zealand needs to reduce its transport-related GHG emissions to meet its international commitments. The crucial question is: what is the most cost-effective combination of policies to achieve this objective? And, where does urban planning sit in this combination of policies?

Relevant considerations are:

- the potential magnitude of GHG reductions through urban planning policies;
- the cost of reducing emissions through urban planning policies relative to other policy measures; and
- how the costs of reducing emissions through planning policies are distributed throughout society.

The likelihood of urban planning being used to reduce emissions

The Commission's survey of councils suggests that most councils (60%) feel the planning system can have only a minor influence on reducing GHG emissions. A further 19% thought the planning system can have no influence on reducing emissions. Conversely, 19% also said that the planning system could be used to have a moderate (17%) or major (2%) impact on reducing emissions.

The main problem appears to be the degree of stasis in urban planning. Changes in urban form take decades to change the urban landscape (Chapter 2). Even so, the Sustainable Cities submission (sub. DR-82) believes that, based on available international and domestic evidence, urban form is "a useful planning domain through which urban emission reductions can be achieved over time" (p. 7).

However, as outlined in Chapter 4, policies that attempt to achieve a more compact urban form can also have unintended social costs. For instance, urban limits put in place to contain development within city limits create an artificial constraint on land supply, leading to less affordable house prices.

[86] A summary of the principles for allocating regulatory roles is provided in Figure 3.1.

The cost-effectiveness of different approaches for reducing emissions, and the role of technology

Studies on urban GHG emissions typically centre on the link between urban form and transportation – or more specifically, the relationship between urban density, vehicle miles (kilometres) travelled and GHG emissions per capita. Ewing et al. (2010) note:

> For decades, it has been known that compact areas have lower automobile use per capita and greater use of alternative modes of transport than do sprawling areas. They also tend to generate shorter trips. The combined effect is significantly less VMT [vehicle miles travelled]. (p. 20)

Numerous studies support this view. Ewing et al. (2015) assert close to 150 empirical studies ("conducted with rigour", p. 21) have investigated the relationship between urban development patterns and individual and household travel.

As for New Zealand research, Sir Geoffrey Palmer and Dr Roger Blakeley submit:

> The evidence from transport modelling for the Auckland Plan showed unequivocally that private vehicle use was significantly greater in more dispersed urban form options. Similarly, Australian studies have shown significantly greater transport costs and greenhouse gas emissions of dispersed urban form. (sub. DR122, p. 15)

Yet few of these studies indicate the relative cost-effectiveness of reducing emissions through promoting urban density as opposed to other policies that alter transport use. For example, market mechanisms – including taxes on petrol and subsidies for public transport – can be effective in reducing emissions from the use of private vehicles. It will be important for government to consider the relative effectiveness of policies to reduce GHG emissions in New Zealand.

Transport technology also influences the relationship between vehicle travel and GHG emissions. Infrastructure New Zealand submitted:

> The Commission identifies a list of "other factors" (including local demographics, income levels, land use mix and layout of streets) which impact carbon emissions, but the most significant – and not one which land use planners are necessarily in a strong position to understand – is transport technology.
>
> All available evidence today strongly indicates that electric vehicle prices are reducing, and will continue to reduce, as technology becomes cheaper. …With the decline of conventional engines, the basis for urban planning to manage down private vehicle use is greatly reduced, yet we have seen very little evidence that shifting energy trends are reflected in planning provisions. (sub. DR103, pp. 9–10)

Similarly, the Institute of Professional Engineers New Zealand submitted:

> Technology is constantly developing and changing the way we live. We believe technology may in some cases change the way in which we live, work and do business. For example, the uptake of autonomous or semi-autonomous vehicles could result in reduced congestion, reduced demand for parking spaces and lower noise and emissions levels, all of which will need to be considered in urban design. The rapid pace of change in ICT means that we are now more connected and working remotely, such as from homes, is a viable option for many industries. (sub. DR58, p. 3)

Distributional and equity considerations

Local demographics, the availability of public transport and income levels also have a significant impact on travel behaviour and GHG emissions. It will be important to also consider the distributional (equity) impacts of alternative ways to reduce GHG emissions in New Zealand.

F9.7 Achieving greenhouse-gas (GHG) reductions through policies that change urban form takes a long time. Other policy measures are likely to be more effective and less costly in reducing emissions to meet New Zealand's emissions reduction targets. It will be important for government to consider the relative effectiveness and the distributional (equity) impacts of alternative ways to reduce GHG emissions in New Zealand.

9.5 Conclusion

This chapter suggests the need for a new system for managing the impact of the built environment on the natural environment. Regulation that applies a traditional "predict and control" approach cannot deal with unpredictability and non-linearity of impacts and effects on the environment. Regulators are hampered – their view is partial and their influence over other agents may be weak. Other tools that provide incentives for polluters to change their behaviour, or to innovate to lessen effects on the environment, may be more effective in achieving environmental outcomes. Where regulation is warranted, AM practices (and structures that support AM) can allow regulators to make decisions in the face of incomplete information and they can make further decisions as more information comes to hand. In any event, much more can be done to gather information, and use it to monitor outcomes.

This chapter has also highlighted the need for a clear set of limits and standards within which development can occur, to ensure the integrity of natural systems, maintain standards of environmental quality for human health, and recognise community preferences (including Māori interests). Above these limits and standards, and within the rules for the built environment, developments should be able to proceed with minimal oversight. If developments breach community standards for the natural environment, then decision makers should balance the benefits of development against the impacts on the natural environment. Clear legislative objectives and principles for the natural and built environments will help to guide decision making. These objectives and principles form the basis for a new statutory framework outlined in Chapter 13.