Impact assessment and uncertainty: perceptions of New Zealand decision-makers

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Environmental and resource management decision-making can be extremely complex, controversial, ambiguous and difficult. Uncertainty, or the imperfect and inadequate understanding of a system, is an inherent part of decision-making. Impact assessment (IA) is an important tool that is used to evaluate, and inform decision makers of, the likely environmental effects of major proposals. There is widespread recognition of the importance of acknowledging, understanding and managing uncertainty that arises in resource management problems. Despite this, the recognition and treatment of uncertainty in the IA and subsequent decision-making process is often not well handled and in many cases not recognised, managed or taken into consideration. This research aimed to understand how decision-makers recognise the presence of uncertainty, particularly in the effects information, and how uncertainty is managed within the resource consent decision-making in New Zealand. In order to achieve this 104 experienced resource consent decision-makers, who act as internal or independent commissioners, were surveyed.

The results suggest that decision-makers’ have varied perceptions of the acceptability of uncertainty, the need for applicants to disclose uncertainty and decision makers to take it into account. The primary cause of uncertainty for decision-makers was poor quality effects information lacking important detail, although conflicting information, inherent uncertainty, and difficulty interpreting certain parts of the Resource Management Act 1991 were also emphasised as other notable sources of uncertainty. Decision-makers manage uncertainty in a variety of different ways, but predominantly used strategies to further understand and reduce uncertainty, rather than strategies to cope with the uncertainty once it has been accepted. Some recognised strategies were not used as frequently as they maybe could be (such as the precautionary principle and adaptive management), while others were used without properly considering the implications. Finally, it seems that the experience and professional background of decision-makers influences the way in which they understand and manage uncertainty. However, these characteristics do not fully explain the diversity in results, and it is likely that there are many other factors influencing decision-makers behaviour. The diversity in decision-makers responses suggests decision-makers are not being given substantive guidance about how to manage uncertainty and that the commissioner accreditation process is not moulding diverse individuals into decision-makers who are able to cope with uncertainty in a consistent manner. They still have a certain level of freedom to respond as they see fit, and are falling back to a large extent on personal perceptions, values, feelings and coping mechanisms, in deciding how to manage uncertainty.
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Chapter 1: Introduction

1.1 Introduction

The scale of environmental degradation caused by human exploitation of natural resources is at an all time high. It is widely accepted that the quality of life of current, and future generations, as well as that of other species, is being threatened by the manipulation and exploitation of natural resources (Dryzek, 2013). This has fuelled calls for more effective sustainable management of natural resources.

The sustainable management of the environment and its resources is heavily dependent on informed and balanced decision-making that considers natural, economic, social and cultural aspects of the environment. At the same time, it is widely recognised that resource management decision-making can be extremely complex, controversial, ambiguous and difficult (Balasubramaniam and Voulvoulis, 2005). Decisions are often made with high stakes and potentially long-term implications, and may involve many stakeholders with multiple and conflicting values. In addition, decision-makers are often under time pressure to make a decision on a proposed activity or development where all information may not be known or available (National Research Council of the National Academy, 2005).

Impact assessment (IA) is a process that has a primary aim of providing decision-makers with an indication of the likely consequences (both positive and negative) of a proposal on the natural and man-made environment (IAIA, 1999; Wood, 2003). IA is an anticipatory, systematic, integrative and participatory environmental management tool, which should
facilitate sound, integrated and informed decision-making (IAIA, 1999; Leknes, 2001; Sanderson, 2001; Wood, 2003; Jay et al., 2007; Jalava et al., 2013).

However, due to the complexity encountered in environmental and resource management and the incomplete and imperfect understanding of current and future natural and social systems, anticipating and understanding potential impacts of a proposal is often difficult (Mitchell, 2002; Balasubramaniam and Voulvoulis, 2005). It comes as no surprise that decision-makers are inherently more comfortable making decisions based on certain, uncontroversial, unambiguous evidence; however, this is rarely the case and uncertainty is often a central issue in resource management decision-making (Mitchell, 2002; Balasubramaniam and Voulvoulis, 2005; van Bree and van der Sluijs, 2014). It is, therefore, important that, instead of being thought of as a problem best ignored, uncertainty is recognised and managed, and that decision-makers determine how to function under the challenge of uncertainty (Mitchell, 2002; Geneletti et al., 2003). In practice, the recognition, treatment and handling of uncertainty in the IA and subsequent decision-making process is not well handled, and in many cases is not recognised, managed or taken into consideration (Reckhow, 1994; Geneletti et al., 2003; Lawrence, 2005). Therefore, this study is focused on decision-makers’ recognition and management of uncertainty in IA and resource management problems in New Zealand.

Environmental and resource management in New Zealand is administered under the Resource Management Act 1991. This Act governs the use and development of natural and physical resources, and certain activities require permission which comes in the form of resource consents. Impact assessment is integrated into this project approval process with impact statements (in the form of an Assessment of Environmental Effects or AEE) being required for all resource consent applications. Thus, thousands of impact assessments are generated in New Zealand each year with the primary purpose of informing decision-makers of the potential consequences of proposed activities. The purpose of this study is to evaluate the extent to which resource consent decision-makers operating under the RMA recognise and respond to uncertainty, especially in the impact assessment information.

This chapter explains the broad background to the study, the evolution, development and procedures of impact assessment and the role of uncertainty. The New Zealand context is
briefly introduced, followed by an explanation of the specific aims and objectives of the study.

1.2 Impact Assessment

1.2.1 Evolution of impact assessment
IA emerged in the late 1960s and coincided with increasing awareness of the implications of environmental change brought about by human actions, public demand and pressure that environmental factors be explicitly considered in development decisions (Noble, 2010; Morgan, 2012). The first formal incorporation of IA into legislation was in the National Environmental Policy Act 1969 (NEPA). This Act established an environmental policy that federal agencies proposing to undertake certain development projects that had the potential to affect people, communities and the natural environment in significant ways, had to demonstrate that the project would not adversely affect the environment (Noble, 2010; Morgan, 2012). Proponents were therefore required to produce an environmental impact statement describing the proposed development, the affected environment, the likely impacts and actions to mitigate or manage impacts, and to release it to the public, in order to demonstrate how these considerations had been recognised and addressed.

Since the initial inception, IA has been adopted, in some form, into formal procedures or legislation in more than a hundred countries (Wood, 2003; Morgan, 2012). While IA is used in policy, plan and programme development, it is most widely used at the project level.

1.2.2 The IA process
Figure 1.1 shows the key steps in the IA process as typically represented in the literature on IA. Although the steps are displayed in a linear fashion, IA should be an iterative process with feedback and interaction between the various steps (Wood, 2003; Glasson et al., 2013).

The first stage in the IA process is the design of the proposal which should be a thorough, systematic and documented process which considers other feasible approaches to establish the most environmentally sound option. Next is screening, or the determination of whether the action has significant enough environmental impacts (under the relevant regulations
and guidelines) that an IA is required and if so, what type or level of assessment is required. Following this is scoping, which identifies, from all the project’s possible impacts, the most crucial and significant issues associated with the proposal, thus determining the issues to be addressed in the IA report (IAIA, 1999; Wood, 2003; Noble, 2010; Glasson et al., 2013).

![Diagram of the impact assessment process]

*Figure 1.1: The main elements in the impact assessment process (Adapted from Wood, 2003; Wathern, 2013)*
The next step in the process is to identify the main impacts, their nature, magnitude, likelihood and significance. This information, along with the description, purpose and rationale of the project and a detailed explanation of the environmental baseline, makes up the IA report. Once complete the next step is report review, which involves a systematic appraisal of the quality of the IA report ensuring that it contains all the information required in the decision-making process (IAIA, 1999; Wood, 2003; Noble, 2010; Glasson et al., 2013).

Following this step is the decision-making, which is the consideration as to whether to approve or reject the proposal and to establish the terms and conditions for its implementation. If the proposal is approved, the next stage is post decision monitoring which involves recording the outcomes associated with the development to ensure that the terms and conditions of the approval are met and that mitigation measures are effective. Finally, auditing involves comparing actual outcomes with predicted outcomes and can be used to assess the quality of predictions and the effectiveness of mitigation (IAIA, 1999; Noble, 2010; Glasson et al., 2013).

There are two important components which should be take place in each stage of the process. First is public consultation and participation, which refers to the involvement of individuals or groups affected by the project to ensure that their views are adequately taken into consideration in the decision-making process. Second is the consideration of, and preparation for, mitigation and impact management, which is the introduction of measures to avoid, minimise, remedy or compensate for any significant adverse impacts (IAIA, 1999; Noble, 2010; Glasson et al., 2013). This is the idealised model of IA, and in each country that uses IA tends to design the process to suit the local institutional conditions, so may vary in some respects from this model.

1.3 Uncertainty in resource management

Uncertainty is not a simple or well-defined concept that is easy to describe (Kujala et al., 2013); it is a non-intuitive term that can be interpreted differently depending on the discipline and context in which it is applied (Ascough li et al., 2008). As a result, there are many different definitions, some of which are very complex. However, uncertainty can be defined as an incomplete understanding of a particular subject or system (Harwood and
Traditionally, uncertainty was considered to be a lack of scientific knowledge; however, current usage tends to be broader and more diverse, encompassing societal, political and cultural systems and can be caused or exacerbated by a lack of transparency and clarity in communication.

1.3.1 Current state of uncertainty literature and research rational

Uncertainty is a subject of interest in many fields of study, including ecology and conservation (Regan et al., 2002; Harwood and Stokes, 2003); climate change (Patt and Dessai, 2005; Kujala et al., 2013; Larsen et al., 2013); risk assessment (Morgan and Herion, 1990); and water management (Newig et al., 2005; Sigel et al., 2010; Raadgever et al., 2011). Across the different fields of research, there is little consistency in the approach taken to carrying out research into uncertainty; each field has its own tailored definition and context for understanding uncertainty.

Within the field of IA, since 2005 there has been an increase in the amount of literature addressing uncertainty. However, there appears to be no common, underlying conceptual framework used to guide analysis. Rather, the research approach is guided by the individual researcher’s interpretation, conceptualisation or understanding of uncertainty (Leung et al., 2015).

The majority of IA research addressing uncertainty focuses on the recognition and reduction of uncertainty present in the practice of IA (Leung et al., 2015). In a review of research into uncertainty in impact assessment, Leung et al. (2015) found that research specifically focused on matters such as: uncertainty in the prediction of impacts (Dipper, 1998; Peche and Rodriguez, 2011); better methods to quantify, model and cope with uncertainty (Geneletti et al., 2003; Bastola et al., 2011; Zhu et al., 2011; Jalava et al., 2013; Mesa-Frias et al., 2013); disclosure and communication of uncertainty (Tennøy et al., 2006) and post-decision follow-up and adaptive management strategies (Arts et al., 2001).

Despite the large proportion of literature focused on minimising uncertainty, it is widely accepted that uncertainty is an inherent part of the impact assessment process and more often uncertainty cannot be totally removed. There is, therefore, research aiming to understanding uncertainty in decision-making and its importance (Reckhow, 1994; Sigel et
al., 2010; van Bree and van der Sluijs, 2014) and the use of decision support tools to assist in the management of uncertainty (Walker et al., 2003; Ascough II et al., 2008). However there is little research into the way in which decision-makers perceive, manage and cope with uncertainty (Larsen et al., 2013).

1.4 Research aims and objectives
The aim of this research is to understand the role of uncertainty, particularly within the environmental effects information, in resource consent decision-making in New Zealand. To achieve this aim a number of specific objectives have been developed:

1. To understand what decision-makers recognise to be the main cause/source of uncertainty in resource consent applications;
2. To understand how decision-makers perceive uncertainty in resource consent applications;
3. To characterise and evaluate decision-maker’s responses and management strategies to uncertainty.

In order to achieve the aim and objectives a predominantly qualitative methodology was adopted. A theoretical framework was developed, which provided focus and direction for the study. Using this framework, a survey was developed with a purpose of understanding how decision-makers understand and manage uncertainty in resource consent decision-making. Open and closed questions were used to gain both qualitative and quantitative responses. In order to identify possible participants, consenting authorities throughout New Zealand were contacted and asked to provide the names of experienced resource consent decision-makers, who act as internal and independent commissioners.

1.5 Thesis Structure
Chapter 2 provides a theoretical framework exploring the theory of uncertainty in decision-making and focusing on uncertainty in IA information. It also explores the different management strategies used to cope with uncertainty in a resource management situation. In Chapter 3 New Zealand resource management, decision-making and IA context are examined in more detail, focusing specifically at the Resource Management Act 1991, the resource consent process and ways in which the process addresses uncertainty.
The research strategy used in the investigation is described in Chapter 4. It describes the specific research methods utilized in this study to address the research aims and objectives, specifically the sampling strategy, data collection and analysis. Chapter 5 details the results of the survey, including the decision-makers’ broad perceptions of uncertainty, the main sources and causes of uncertainty in the resource consent and impact assessment processes and the key ways in which decision-makers manage uncertainty in the decision-making process.

The results of the study are discussed in Chapter 6. The main reasons for uncertainty in resource consent decision-making are examined, decision-makers’ views regarding the acceptability and disclosure discussed and the approaches to the management of uncertainty evaluated. The wider implications of this research are considered and the study is reflected upon. Finally, Chapter 7 summarises the main findings of the study and provides the key recommendations and opportunities for future research.
Chapter 2: Uncertainty and decision-making: a theoretical framework

2.1 Introduction
The primary purpose of this chapter is to draw on the research literature to develop a conceptual understanding of uncertainty in resource management decision-making. In order to achieve this, this chapter outlines the main types of uncertainty that commonly occur in resource management at the project level, with a particular focus on the effects of information. It then goes on to examine the relationship between decision-makers and uncertainty, factors influencing differing perceptions of uncertainty, and the importance of acceptance, disclosure and communication of uncertainty. Finally, the main management strategies decision-makers commonly use to cope with uncertainty are considered.

2.2 Uncertainty in resource management – a conceptual understanding
Despite the fact that uncertainty has been acknowledged as an important consideration in resource management and environmental decision-making for decades, there is considerable variation in the way in which uncertainty is thought of. There is a lack of commonly shared terminology and no agreed generic typology of uncertainty or means of dealing with it. In addition there is a lack of information and agreement on the characteristics, relative magnitudes and importance of different types of uncertainty. As a consequence, within the fields of environmental management and decision support, many different typologies and classifications of uncertainty have been developed and adapted. As a result there are many different ways of conceptualising the dimensions of uncertainty (Regan et al., 2002; Walker et al., 2003; Ascough Ii et al., 2008; Brugnach et al., 2008;
Maier et al., 2008; Sigel et al., 2010; Raadgever et al., 2011; Kujala et al., 2013; van Bree and van der Sluijs, 2014).

The way in which individuals think about uncertainty affects the way in which uncertainty is considered in the decision-making process. Therefore this section provides a general outline of the dimensions of uncertainty in resource management at a project level. Some of the classifications of uncertainty are technically complex and multifaceted, and focus in detail on the specific mechanisms that cause uncertainty in the resource management process. As this research is predominantly focused on the ways in which decision-makers perceive and respond to uncertainty, such complex and technical classifications of uncertainty are less likely to be relevant or applicable. Accordingly, this chapter focuses on the broad types of uncertainty that may occur, the importance of recognising the level, or significance, of the uncertainty and the likely places within resource management in which uncertainty will manifest.

### 2.2.1 Reasons for uncertainty

Uncertainty occurring in resource management can be broadly categorised as either *inherent* uncertainty or *epistemic* uncertainty. Inherent uncertainty occurs because, while some natural environmental systems can be simple or only moderately complex, most are highly chaotic, turbulent, non-linear and unstable, resulting in a system that is inherently complex that will always have associated uncertainty, regardless of how much research is undertaken. This is compounded by the fact that in impact assessment, particularly in New Zealand, social, cultural and economic systems are also important components of the environment and they also have high levels of uncertainty. The highly variable, chaotic and constantly changing nature of these systems arises due to complex individual and group worldviews, attitudes, discourses and behaviours (Wilson and Bryant, 1997; Wood et al., 2000; Vanclay, 2003; Walker et al., 2003; Lawrence, 2004; Berkes, 2007; Dovers et al., 2008; Mesa-Frias et al., 2013; O'Riordan, 2014; van Bree and van der Sluijs, 2014).

More often than not, resource management involves considering all aspects of the environment; however, until recently, natural and social systems have often been examined in isolation of each other. Berkes (2007) and O'Riordan (2014) both argue that ways in which social systems change will depend on biophysical variables, and in turn, changes in the biophysical variables will depend on the extent, intensity, and type of
human activity. Understanding how the two types of system interact, though necessary, is difficult and complex and can further complicate existing uncertainties.

Epistemic uncertainty refers to the fact that resource management information is often uncertain simply because knowledge about the relevant system is frequently incomplete or imperfect. Although a lack of knowledge is the most common cause of epistemic uncertainty, uncertainty is also caused by conflicting evidence or information (Table 2.1). This is because there are a large number of sources of information available to decision-makers including impact statements, experts, other authorities (e.g. air pollution controllers), consultancy advice, information from previous projects, advice from planners and information from the public consultation. Decision-makers also frequently gain information, advice, and comment from more informal sources. While this may lead to very informed decision-making, having so many different forms of information can cause/increase uncertainty about the effects of a proposal, in which case a decision-maker must weigh large amounts of evidence. In some cases, there may simply be too much information for decision-makers to process (Zimmermann, 2000; Van Asselt and Rotmans, 2002; Wood, 2003; Ascough Ii et al., 2008).

<table>
<thead>
<tr>
<th>Type</th>
<th>Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of knowledge</td>
<td>Lack of observations/measurements, inexactness in measurement caused by imprecision or inaccuracy or because a system was practically immeasurable (in principle can be measured, but in practice too expensive, too lengthy, infeasible experiments)</td>
</tr>
<tr>
<td>Abundance of information causing complexity</td>
<td>The limited ability of human beings to simultaneously perceive and process large amounts of data. Usually occurs in situations in which more information is available than they can ‘digest’ or when dealing with phenomena which are defined or described by a large number of features or properties.</td>
</tr>
<tr>
<td>Conflicting evidence or information</td>
<td>Some of the information available is wrong (but not identifiable as wrong information by the system), information of non-relevant features of the system is being used, the model, which the observer has of the system, is wrong, etc.</td>
</tr>
</tbody>
</table>

It is crucial to determine the type of uncertainty present because, while epistemic uncertainty can be reduced through additional research, inherent uncertainty cannot. However, this is generally not recognised, often resulting in futile attempts to reduce
2.2.2 The level of uncertainty

The level of uncertainty can be classified on a spectrum of knowledge, ranging from certainty to total ignorance (Figure 2.1). Certainty can be defined as being when a person is confident about their knowledge relating to a specific question, while total ignorance occurs when a person has no knowledge relating to a specific question (to the extent that they are not aware that they do not know). Uncertainty refers to the middle of the spectrum between the two extremes of certainty and total ignorance (Walker et al., 2003; Sigel et al., 2010; van Bree and van der Sluijs, 2014).

In decision support literature, authors distinguish between different levels of uncertainty using categories: statistical uncertainty (where probabilities are known, but outcomes are not), scenario uncertainty (knowing outcomes but not likelihood), recognised ignorance (knowing very little but recognising such). However, environmental policy literature takes a more conceptual approach, arguing that on the spectrum of uncertainty the transition between certainty and total ignorance is continuous (Wynne, 1992; Walker et al., 2003; Sigel et al., 2010; Skinner et al., 2014).

![Figure 2.1: The progressive transition between certainty and total ignorance.](image)

Regardless, in resource management decision-making it is important to consider the level of uncertainty that is acceptable, allowing a permission to be granted, and when the level of uncertainty is unacceptable, resulting in a project being declined. Decision-makers do not have to treat all uncertainty equally. The importance of the uncertainty in the decision-making process should depend not only on the level of the uncertainty, but also on the significance attached to the uncertainty in the particular decision-making context (Peel, 2005). For example, when the uncertainties are low, but have a high degree of
significance, decision-makers should still place importance on them in the decision-making process (Figure 2.2).

![Figure 2.2: Matrix showing the level and significance, and thus importance of, uncertainty in decision-making.](image)

### 2.2.3 Location of uncertainty in resource management projects

Uncertainty can manifest itself within any part of a resource management problem. There are many different ways to conceptualise ‘location’ and there is little consistency in the way in which research has categorised this (often the classification is specific to the particular area of research). Therefore, the following section describes some of the broad areas of resource development applications in which uncertainty is likely to arise, and particular emphasis is placed on uncertainty within the effects information, and the way in which other parts of the resource management process influence, or are linked to, the assessment of effects process.

**Uncertainty within proposal**

Uncertainty in the project proposal can be a result of many factors such as the project being poorly defined, lacking specificity or having insufficient detail or technical information, or due to unanticipated changes to the project after the initial proposal was developed. In situations where there is uncertainty in the proposal, the IA process can be affected negatively. For example, there can be difficulties predicting and mitigating impacts, which can lead to decision-makers having doubts about the reliability of
information presented to them (De Jongh, 1988; Geneletti et al., 2003; Wood, 2003; Cashmore et al., 2004; Lawrence, 2004; Glasson et al., 2005; Tennøy et al., 2006; Wood, 2008; Glasson et al., 2013).

**Uncertainty due to public involvement and consultation**

Public involvement is critical to the success of IA for a number of reasons: to incorporate public views; to improve the environmental outcomes; to ensure that the process is transparent and open; to identify socially acceptable solutions and minimize conflict, legal challenges and costly delays; and to promote social learning and empower the community in the decision-making process (Morgan, 1998; Johnson, 2001; Noble, 2010; Glasson et al., 2013). However, the process can give rise to, or increase uncertainty in the decision-making process.

When involving the public in consultation it is difficult to gain a representative sample of the population. This is in part because citizens are not paid to engage in the consultation process, therefore the process can be highly dominated by interest groups (whose livelihoods or values might be strongly affected), or by those who live comfortably enough to allow them to participate (often affluent, middle class, articulate people). This can cause uncertainty as some interests may be missed or others over-represented and therefore the information presented to the decision-maker is not fully representative of the views of, and impacts on, the affected population (Harding, 1998; Irvin and Stansbury, 2004). In addition, uncertainty which otherwise would not be recognised or considered may be brought to the attention of decision-makers during the consultation process. For example, an issue that seemed clear might be reframed by public participation (Newig et al., 2005). Furthermore, public consultation can also add erroneous information, which can result in confusion over the issues and see the emphasis move away from important issues to frivolous ones (Johnson, 2001).

**Uncertainty in effects information**

The primary function of impact assessment is to provide decision-makers with sound information about the likely impacts of human actions on the environment. Often this information is presented in the form of an environmental impact statement. The quality of the impact statement has direct consequences for the decision-making process and is a key factor influencing the overall effectiveness of impact assessment. In order for IA to meet
the aim of informing decision-making, the information presented to decision-makers must be of a high standard, and must provide a full assessment of potential impacts. In practice, the quality of impact statements is highly variable and there is concern in many countries over the poor quality of impact assessment information. Not only can uncertainty that is not managed well contribute to poor quality effects information, poor quality effects information itself can cause uncertainty for decision-makers. Moreover, uncertainty is one of the main factors that influences the use of the effects information in decision-making.

Of particular concern is the uncertainty associated with baseline information, the prediction of impacts, the scoping of impacts, and in the use of expert judgement. (Glasson et al., 1997; Morgan, 1998; Barker and Wood, 1999; Schijf, 2003; Wood, 2003; Sandham and Pretorius, 2008; Jalava et al., 2010; Petersen et al., 2010; Pölönen et al., 2011; Chang et al., 2013; Glasson et al., 2013). Each of these is discussed below.

The collection of baseline information about the current and future state of the environment is an important step in the IA process. Baseline data can be collected from both existing information sources (e.g. census data, land use information) as well as gathered through data collection. Regardless of the source, all baseline data suffers from some level of uncertainty. There are a number of reasons for this, such as resource and time constraints limiting new data collection, or there may be ample resources, but they are devoted to collecting irrelevant information distracting attention from significant effects (Wood, 2003; Lawrence, 2004; Glasson et al., 2005; Noble, 2010; Glasson et al., 2013). There may also be error in measurement caused by sampling and other inaccuracies or imprecision (Walker et al., 2003). Not only that, the quality and credibility of impact assessments are strongly bound to the quality of the baseline information; all errors, assumptions, generalisations and inaccuracies in the baseline will propagate through the entire process causing further uncertainty. It is, therefore, important to devote sufficient effort to carefully and systematically describing the baseline conditions, as without doing so it is not possible to present an accurate and convincing picture of the likely effects that the development will have in the environment (Geneletti et al., 2003; Wood, 2003; Tennøy et al., 2006; Jalava et al., 2013).

IA should be explicit and objective in the prediction of impacts, including their nature, extent, magnitude and significance; however, in practice, predictions are one of the main causes of uncertainty. Not only are predictions often constructed to appear more robust and
certain than they actually are, they may be based purely on personal judgment/opinion with little to no reference to substantive evidence or direct observation of the environment (Morgan, 1998; Benson, 2003). Models (whether they be physical, mathematical or conceptual/mental) may also cause uncertainty, as they are imperfect simplifications of reality that do not take into account all the complexities of a system and therefore cannot precisely reproduce what happens in reality. Uncertainty may also occur due to a lack of sufficient understanding of the system (past, present, or future evolution), its behaviours and the interrelationships between the elements of the systems. Prediction also often involves assumptions which can contribute to uncertainty particularly when forming complex predictions that rest on each other. Regardless of the reason, even when an effort is made to reduce uncertainty, in most cases residual uncertainties will remain that require scientific (and community) interpretation. Predictions that are not acknowledged to have associated uncertainty may cause the unforeseen violation of environmental quality norms and standards, which can result in costly mitigation measures. It is, therefore, important that when communicating the results of predictions, the limitations, accuracy and/or confidence levels of predictions should be recognised and explained (De Jongh, 1988; Hellström, 1996; Sadler, 1996; Glasson et al., 1997; European Commission, 2001; Morris and Therivel, 2001; Geneletti et al., 2003; Walker et al., 2003; André et al., 2004; Tennøy et al., 2006; Jay et al., 2007; Jalava et al., 2010; Noble, 2010; Glasson et al., 2013; van Bree and van der Sluijs, 2014).

Scoping is an important part of impact identification and prediction, and if not carried out adequately, can cause uncertainty in the effects information. This is particularly true when consultation is not undertaken in the scoping process, as if they are not involved early enough, significant impacts on communities might not be identified. There is also the potential for uncertainty due to a divergence of opinion on the key impacts for investigation and their likelihood (Morgan, 1998; Wood, 2008).

Finally, uncertainty in effects information may be caused by expert judgment. The use of expert opinions to provide relevant effects information is indispensable: as there many factors that must be taken into account, some of which are qualitative in nature and can only be assessed on the basis of human judgements (Kontic, 2000; Noble, 2010). Uncertainty often arises when expert opinions are used, as the process is qualitative, subjective, interpretive and reflective in nature, and human beings have an inconsistent
ability to provide accurate judgment (Wang et al., 2006; van Bree and van der Sluijs, 2014). Furthermore, prediction involves subjective judgement and experts may exhibit systematic bias or be over-confident. There is also pressure on consultants and experts to ensure that the assessment of effects reflects well on the applicants and their proposal (Morgan, 1998). This is because, while there are often large investments at stake, the future employment of consultants is also determined by applicants opinions and perceptions of whether they are able to deliver what is required (Beder, 1993). Not only can there be a strong temptation to emphasise the benefits of the proposal (and to hide adverse effects), there is a certain level of inevitability that the collection, analysis, interpretation and presentation of the data in the effects information will be shaped by the values and goals of the individuals involved (Beder, 1993; Morgan, 1998). Therefore, although ideally experts are impartial, this is not always the case and should not be assumed without question. Moreover, it is important to acknowledge that the interpretation and assessment of expert opinion can vary widely – it is inevitable that individuals with different interests will interpret opinions and attribute levels of credibility differently (often no matter how it relates to the scientific correctness of the opinion) (Kontic, 2000).

Uncertainty in legislation
It may also be that legislation causes uncertainty. Environmental policy research has identified different reasons for uncertainty in legislation. One example is ‘linguistic uncertainty’ which is introduced when language and expressions are ambiguous, vague and context-dependent, or when terminology is used that does not have a widely accepted definition (and is not then defined) (Regan et al., 2002; Carey and Burgman, 2008; Kujala et al., 2013). A specific example of linguistic uncertainty is identified by Masden et al. (2010) who found that applicants in the UK are often uncertain about assessing cumulative effects, and decision-makers were uncertain about the adequacy of the assessment, because within the literature, and legislation, there is a lack of guidance about the requirements of assessing cumulative effects, and there is a the lack of a comprehensive definition.

2.2.4 Conclusion
While there is no commonly shared terminology and no agreed generic typology of uncertainty, there are a number of conclusions that can be drawn from the body of uncertainty literature. Understanding uncertainty is incredibly complicated, and has the potential to be very challenging. Resource management itself has the potential to be very
complex, and therefore there are many reasons for uncertainty. Although uncertainty can manifest itself almost anywhere within a resource management problem, it is important to recognise that not all uncertainty needs to be treated equally. The level of uncertainty present is an important consideration which should influence decision-makers attitudes towards, and management of, uncertainty.

2.3 Decision-making and uncertainty

Many factors have the potential to influence the way in which decision-makers understand, and inevitably respond to, uncertainty. The following sections describe different decision-making behaviours with reference to uncertainty, and then consider a number of factors that may affect an individual’s behaviour in the decision-making process.

2.3.1 Decision-making theories and uncertainty

Resource management decision-making is often a complex process (Iftekhar and Pannell, 2015). Because of this, understanding how decisions are made is difficult – decision-makers can explain their thinking and actions, but the way in which decision are actually made is very difficult to understand in a definitive sense (Schijf, 2003). Therefore, there are many different theories that attempt to explain different decision-making behaviours. One way in which these theories can be understood is on a continuum which places rational decision-making at one end and purely intuitive decision-making at the other. A large number of decision theories fall between the two, which can be broadly grouped together as incrementalism (Etzioni, 1967; Weston, 2000; Leknes, 2001).

It has been said that rational decision-making theory explains the way in which decision-making should take place, rather than how it takes place in practice (Weston, 2000). This is because it assumes decisions are made under specific conditions, which in reality are rarely met. For example, it assumes decision-makers have a well-defined problem with complete baseline information, a full array of alternatives to consider and adequate time, skill, professionalism and resources. In practice, decision-makers can be faced with: ambiguous and poorly defined problems; incomplete information about the baseline and the background of the problem, the alternatives and their consequences, the range and content of values, preferences and interests; and have limited time, skills and resources. Not only that, decision-making in the real world takes place in complex, unpredictable,
systems, that themselves are characterised by uncertainty (Forester, 1984; Weston, 2000; Nilsson and Dalkmann, 2001).

Intuitive decision-making assumes that individuals base decisions on professional judgement, habit, tradition, imitation of successful people, emotive reasoning, prior experiences, intuition, and/or political values (Kørnøv and Thissen, 2000; Weston, 2000; Nilsson and Dalkmann, 2001). Moreover, in complex and uncertain decision-making situations, rather than use decision tools, individuals will rely on intuitive techniques in an attempt to simplify the task and make the process more manageable (Plous, 1993; Kiker et al., 2005).

One way in which decision-makers can simplify decision-making is through the use of heuristics, which are general rules of thumb, mental shortcuts, common sense reasoning strategies and approaches that deviate from formal, logical and systematic choice. The benefit of using heuristics is that they can yield results that are very close approximations to the optimal answers. They are a ‘fast and frugal’ way to make virtue of limited time and knowledge as they reduce the time and effort that is required to make reasonably good judgements and decisions. However, the disadvantage is that the use of heuristics has the potential to lead to biases and inconsistencies (Plous, 1993; Gigerenzer, 2008; Iftekhar and Pannell, 2015; Burgess et al., 2016)

Decision-making needs to be robust, consistent, and defensible, and it is clear that not all of the decision approaches will produce such decisions. Although intuitive decision-making techniques are common when there is uncertainty, their use has the potential to result in inconsistent decision-making fraught with bias. While rational decision-making leaves less room for such inconsistences, in practice not all the assumptions of rational decision-making are likely to be met. A number of different decision models have been developed which attempt to combine the hard, top-down, rational comprehensive approach with the other approaches. These models are considered to be better able to manage uncertainty (Buchanan and O Connell, 2006).

One example is mixed scanning, which is based on the view that decisions are made through a rational process within restrictions imposed by political and societal realities. Therefore, while the decision-makers systematically assess evidence and weigh
alternatives (using rational techniques such as environmental assessment, cost-benefit analysis or goals-achievement matrices), the decision is also influenced by intuitive judgements and the political context. It is less demanding and detailed than rationalism but is more strategic, comprehensive and innovative than intuitive methods (Etzioni, 1986; Weston, 2000; Etzioni, 2001; Nilsson and Dalkmann, 2001). It is likely that when making decisions that involve uncertainty, decision-makers are using a mixed-scanning type approach, combining rational and intuitive techniques. It is therefore important to consider the ways in which different individuals will view uncertainty.

2.3.2 Uncertainty: perceptions, conceptualisations and attitudes
If sound environmental decisions are to be made, uncertainty must be considered. The way in which different individuals understand, perceive and conceptualise uncertainty varies. Attitudes differ, as does the degree to which individuals consider uncertainty to be acceptable, or not. The way in which an individual considers, and responds to, uncertainty depends on their values, attitudes and beliefs, which in turn are influenced by many things including: culture, religion, ideology, lifestyle, personal experiences, professional background, political affiliation, and relationships between individuals in society (Harding, 1998; Vlek, 2004; Dessai and van der Sluijs, 2007). When it comes to environmental decision-making, of particular relevance is how risk averse an individual is, their experience, and their proximity to the generation of knowledge. These are discussed below.

Some individuals have a risk averse attitude and therefore will often dislike any uncertainty in decision-making and will be conservative in their decision-making (Vlek, 2004; Dessai and van der Sluijs, 2007; Thissen and Agusdinata, 2008). For some such people, risk and uncertainty can invoke negative emotions of anxiety or fear and these feelings may restrict or suffocate their problem-solving and decision-making ability (Etzioni, 2001; Vlek, 2004). In addition, in the face of great uncertainty, individuals can be mentally short-sighted and insensitive to rational aspects of decision-making. In these situations, decision-makers act in predictable ways such as delaying decisions unduly (defensive avoidance), making decisions impulsively in order to escape the anxious state (overreaction) or obsessively collecting more information instead of making a decision (hypervigilance). In contrast, other individuals have a more risk-tolerant attitude, and are more comfortable with uncertainty and are less conservative in their decision-making.
Furthermore, some people find that risk and uncertainty invoke positive feelings: having successfully completed a risky task with an uncertain outcome may be a true learning experience that challenges an individual’s self-confidence and competence, and may enhance their self-esteem and social status. Without a certain amount of willingness to take risks, individuals would not be able to develop and learn new things or innovate the social, physical or economic environment (Janis, 1977; Etzioni, 2001; Vlek, 2004; Dessai and van der Sluijs, 2007; Thissen and Agusdinata, 2008).

An individual’s attitude towards uncertainty will also be affected by their experience. The extent of experience is often one of the most important factors influencing the effectiveness of resource management decisions. Attitudes towards uncertainty will inform decisions and guide behaviour – they will influence an individual’s interpretation, acceptance and response to uncertain information. Attitudes towards uncertainty form as a result of both direct experience or through second-hand information about it, and are by no means static – they are dynamic and ever changing, influenced by new experiences (Fazey et al., 2005; Upham et al., 2009). Both their personal experiences, as well as their level of professional experience therefore influence decision-makers’ attitudes towards uncertainty. They often come from a variety of different professional backgrounds (for example they may be democratically elected councillors or environmental, legal, or cultural experts), and therefore not only will experience in decision-making influence attitudes towards uncertainty, so too will other professional experience.

Finally, an individual’s perception of uncertainty is also influenced by their proximity to the generation of knowledge. This relationship can be explained by the concept of the ‘certainty trough’ (Figure 2.3) which suggests that there is a ‘distribution of certainty’ and that an individual’s proximity to the production of knowledge will influence their views of the credibility of, or their degree of confidence in, the knowledge (MacKenzie, 1993; Duncan, 2008). Knowledge producers, knowledge users and those opposed to the proposal will each view the level of uncertainty differently: knowledge producers tend to attribute a high level of uncertainty to their work, while those opposed to the project (often members of the public) will perceive an even higher amount of uncertainty than the producers. In contrast, knowledge users (such as project applicants and decision-makers) tend to attribute a comparatively low level of uncertainty. As knowledge changes hands, the perception of uncertainty changes – knowledge users lack an intimate connection with the
knowledge production and will attribute a relatively low level of uncertainty to the knowledge compared to those who produce the knowledge (MacKenzie, 1993; Duncan, 2008). Moreover, an individual’s perception of, or attitude towards, uncertainty is often shaped and influenced by the way in which the information is communicated by those who control the information flow, often the applicant. Not only that, the adequate disclosure of uncertainty should lead to the consideration of the decision and influence the decision-maker's determination about the acceptability of a project (Duncan, 2013). The following section considers the importance of disclosing and communicating uncertainty to decision-makers.

![Figure 2.3: The certainty trough adapted from (MacKenzie, 1993).](image)

### 2.3.3 Disclosure and communication of uncertainty to decision-makers

Although it is widely accepted that uncertainty occurs in the IA process, it is also acknowledged that impact statements often appear to be more certain than they should be, and therefore that decision-makers are often not made aware of the actual level of uncertainty (Tennøy et al., 2006). This poses a challenge because, in order for uncertainty to be acknowledged and managed in the decision-making process, the decision-makers must first be made aware of these uncertainties.

It is important that uncertainties are clearly expressed, and if necessary clarified, in all documents and communications with decision-makers. The benefits of informing decision-makers of uncertainty are that it leads to a greater level of scrutiny in proposals and also increases their awareness of the merits of the alternatives, allowing them to better orientate their management strategies. It also allows consideration of the risks of the project, assists in applicant and decision-maker accountability, and also encourages transparency and openness throughout the decision-making process. Furthermore, if uncertainties are not
appropriately disclosed and communicated, there is a risk that decisions made on the basis of erroneous information will result in unwanted environmental consequences (Geneletti et al., 2003; Tennøy et al., 2006; Wardekker et al., 2008; Duncan, 2013; Lees et al., 2016).

While in theory it is important for applicants to be transparent and acknowledge and disclose uncertainty, it is recognised that in practice communicating uncertainty is difficult. Often decision-makers are not made aware of the uncertainty present in resource management as it is not disclosed (and when it is, it is often inadequate and poorly communicated) (Dipper, 1998; Geneletti et al., 2003; Tennøy et al., 2006; Duncan, 2013; Larsen et al., 2013; Lees et al., 2016). For example, Tennøy et al. (2006) investigated disclosure and communication of uncertainty in IA in Norway and found that only a small minority of the impact assessment documents disclosed or thoroughly discussed uncertainty. Lees et al. (2016) found that decision-makers in Canada are rarely presented with detailed information about the nature and implications of uncertainty as impact information is often communicated in such a way that portrays a greater degree of confidence than may actually exist. Moreover, Leung et al. (2016) found that decision-makers generally believe that uncertainty disclosure and communication practices in Canada were poor.

The poor disclosure of uncertainty in impact assessments can be explained in a number of ways. Some scientists may feel that disclosing uncertainty could reflect badly on their professional competence and reduce the perceived value of the information in the IA (Reckhow, 1994). In addition, while applicants and their consultants need to disclose uncertainty, they do of course have a vested interest in making proposals and IA’s defensible, and may seek to minimize the public disclosure of uncertainty (Duncan, 2008). Another reason that uncertainty is often undisclosed is that any individuals who oppose the proposals can use uncertainty information to raise public opposition and manipulate the legitimacy of information (Leung et al., 2016). In saying this, it can be difficult to determine whether applicants deliberately hide uncertainty or if they just think it is too difficult or not worth the effort to disclose uncertainties to the public and to decision-makers (Lees, 2014).

While simply disclosing uncertainty is important, there is also a need for these uncertainties to be communicated in a style and language that, while matching scientific
practice, is able to be clearly understood by non-experts and lay people (Petersen, 2002; Tennøy et al., 2006). This is particularly difficult when dealing with scientific information because while there is a scientific need for the precise quantification of uncertainty, decision-makers (and the public) require a simplified analysis directed at those less familiar with the underlying science (Larsen et al., 2013; Leung et al., 2016). It has been argued that the influence of scientific evidence on decisions can be severely diminished when the uncertainty associated with impacts is not adequately explained (Reckhow, 1994; Dovers et al., 1996; Harwood and Stokes, 2003).

In addition, if attention is not paid to the way the effects information is communicated, there is the potential that more uncertainty can be introduced in the form of linguistic uncertainty, a source that is often over-looked as an important cause of uncertainty in the effects information (Regan et al., 2002; Carey and Burgman, 2008; Kujala et al., 2013).

Although there is a need for better communication of uncertainty, decision-makers also need to be less reliant upon, and accepting of, an applicant’s disclosure of uncertainty. Decision-makers need to undertake a deeper consideration of an applicant’s narrative and see through the smoke screen of the applicant’s certainty about what was actually uncertain (Duncan, 2008; Allen and Gunderson, 2011; Duncan, 2013; Leung et al., 2015).

### 2.3.4 Uncertainty and guidance

Despite the recognition of the importance of acknowledging and addressing uncertainty in IA and subsequent decision-making, there has been limited general guidance developed for consultants or decision-makers on how to interpret and manage uncertainty in resource management.

**Guidance for applicants**

Although there is a large body of academic literature addressing uncertainty in resource management, this does not seem to have been translated into guidance material for applicants and practitioners. In order for better informed decisions to be made, there is a need for applicants to adopt a more analytical, pragmatic, systematic and explicit approach to dealing with uncertainties (Isendahl et al., 2010). However, it is also recognised that there are some difficulties associated with developing, and using guidelines. Every resource management situation is unique: no two projects are identical, the specific
uncertainties will differ, the broader political and social context will be unique, and the decision-making legal framework may differ, etc. It is therefore not possible to provide specific guidance for every possible situation or scenario (Kloprogge et al., 2007). In saying this, the Netherland’s Environmental Assessment Agency has provided a large number of different guidance documents including guidance for applicants and impact assessors to better manage uncertainty in the assessment process and to improve the communication of uncertainty to decision-makers (Petersen et al., 2003; Kloprogge et al., 2007; Petersen et al., 2010; Petersen et al., 2013).

Guidance for decision-makers
In general, decision-makers are given little guidance on how best to interpret and manage uncertainty (Leung et al., 2015). As a result, decision-making under uncertainty is often based on intuition, heuristics and experience or on expert assessments which are often only of a limited use (Isendahl et al., 2010). It is understandable then that there are criticisms that decisions are made based on assessments with no consideration of the associated uncertainty (Reckhow, 1994). However, there are many ways to manage uncertainty (section 2.6) and before robust guidance can be produced, there is a need for more agreement about the most appropriate way to approach uncertainty.

2.4 Managing uncertainty in decision-making
Strategies that can be used to manage uncertainty with the impact assessment process are well documented. Many studies focus particularly on ways in which information in the impact assessment can be improved and tools which can be used to reduce uncertainty (such as sensitivity analysis, fuzzy logic, scenario analysis risk-based approaches, research, etc.) (Leung et al., 2015). However, most uncertainties cannot be eliminated, therefore decision-makers must accept, understand and manage them. Managing uncertainty requires a decision-maker first to recognise that uncertainty exists and then to determine whether it matters. Often the way in which decision-makers view uncertainty will determine the way in which they go about managing it (Benson, 2003; Walker and Marchau, 2003; Brugnach et al., 2007). For example, decision-makers who understand uncertainty as an inherent part of the resource management process will often accept the uncertainty and will often chose strategies which aim to manage the system with its irreducible uncertainties. On the other hand decision-makers who view uncertainty as a
lack of knowledge, will manage uncertainty by employing strategies aimed at remedying the deficiencies in the knowledge, such as by doing more research and gaining more information in the hope that the uncertainties are reduced. If a decision-maker views uncertainty as a manifestation of differing or conflicting views or knowledge frames, strategies that are employed to manage uncertainty are often those that aim to resolve conflicting views. Overall, those who are more risk-averse will have a more preventive management style, while those who are risk-tolerant tend to have an adaptive management style (Brugnach et al., 2008).

Similarly, the level of uncertainty that an individual is willing to accept is variable, and can be influenced by a number of factors including the extent of the benefits and the severity, likelihood, familiarity, spatial and temporal distribution of adverse impacts (Vlek, 2004). Given the complexity of impact assessment and subsequent decision-making, trade-offs (whereby gains in one area are made at the expense of losses in another) are an inherent aspect of the decision-making process (Morrison-Saunders and Pope, 2013). Trade-offs can be substantive (the actual win-loss outcomes of decisions which occur when gains in one area occur at the expense of losses in another area) or process orientated (when the ideal is compromised for the practical; e.g. trade-offs are made between the urgency of the decision and the need for further information or between certainty and uncertainty) (Wood, 2003; Morrison-Saunders and Pope, 2013).

A number of different approaches can be used to help to understand and manage uncertainty, and Larsen et al. (2013) have developed a conceptual model, which outlines the key approaches used to manage uncertainty in the decision-making process (Figure 2.4). This initial way of theorising uncertainty management strategies is useful as many of the more specific techniques fit well within the framework. Larsen et al. (2013) explain that the basic premise for understanding how decision-makers handle uncertainty is to know if they are aware of the uncertainty in question. This awareness, as previously discussed, is reliant upon either the adequate disclosure and communication of uncertainties by the applicant, or the decision-maker identifying the uncertainty themselves. If the decision-maker is aware of the uncertainty present, they can then make a choice to accept its presence and thus acknowledge the uncertainty or not. If the uncertainty is not acknowledged then it may reflect a strategy of denial by decision-makers, which can occur when decision-makers refuse to believe that the uncertainty
exists or, if it does exist, that it is relevant. Denial is “a refusal to believe something no matter what the evidence” (Larsen et al., 2013: 145).

When uncertainty is acknowledged there are two main types of strategies that can be used to ‘manage’ it – these are ‘handling’ strategies and ‘non-handling’ strategies. When a decision-maker chooses to ‘handle’ uncertainty, they can do one of two things, attempt to reduce the uncertainty or accept the presence of uncertainty and be resilient. The ‘non-handling’ strategies are to postpone decision-making or to ignore the uncertainty and proceed. The following sections explore these four main strategies (reduce, accept, postpone and ignore) in more detail.

![Conceptual model of different strategies of managing uncertainty in resource management problems.](image)

Ignoring uncertainty occurs when decision-makers purposefully choose to carry out the decision-making process without regard for the uncertainty (Raadgever et al., 2011; Larsen et al., 2013). Traditionally, this is the easiest and most common way to deal with uncertainty. However, overlooking uncertainty involves tolerating what could be a large amount of uncertainty, and therefore risk, associated with the outcomes of the decision, which could in turn lead to significant negative outcomes of the decision. This strategy does not solve the problem of uncertainty; it merely sweeps it under the rug and can have negative implications (Morgan and Herion, 1990; Walker and Marchau, 2003; Thissen and Agusdinata, 2008).
Postponing decision-making in the face of uncertainty is based on the belief that uncertainty will be dealt with when a larger and more robust body of scientific knowledge and information is available and thus the uncertainty will be reduced in the future (Larsen et al., 2013). However, there is also the risk that while some uncertainties will be reduced or disappear altogether, new ones might emerge, therefore the benefits of acting quickly are lost (Thissen and Agusdinata, 2008). In consent decision-making this strategy involves delaying the decision; however, in policy making there are examples of cases where whole areas have not been considered (e.g. climate change) because there is too much uncertainty for the issues to be meaningfully considered.

The first of the ‘handling’ strategies for managing uncertainty in a resource development proposal is to reduce the uncertainty by gaining more information (Thissen and Agusdinata, 2008; Raadgever et al., 2011; Larsen et al., 2013). Through the collection of more information and increasing the amount of knowledge about the proposal and its effects it is believed that any uncertainty that is present will be reduced and thus lead to improved decisions being made. This often involves pushing the management of uncertainty, and its costs, onto someone else; for example the applicant may have to ‘buy information’ through additional research or better integration of existing knowledge. Other ways of reducing uncertainty through knowledge generation are: data gathering and experimentation, quantitative simulation modelling, qualitative assessment, and the use of expert opinions. However, the reduction of uncertainty can only occur if the uncertainty occurs due to a lack of knowledge (epistemic uncertainty); the uncertainty caused by the inherent complexity of the environment will persist (Newig et al., 2005; Refsgaard et al., 2007; Ascough Ii et al., 2008; Brugnach et al., 2008; Hall and Solomatine, 2008; Thissen and Agusdinata, 2008; Raadgever et al., 2011).

There is also the possibility that by obtaining more information and doing further research, one may actually increase the level of uncertainty. While additional research may be undertaken in an attempt to better understand a system, it may reveal unforeseen complexities of the system, or uncover other uncertainties. Therefore, from the point of view of decision-makers, undertaking more research may not make their task easier in the short term (Dovers et al., 1996; Walker et al., 2003; Brugnach et al., 2008).
Another method for reducing uncertainty is uncertainty assessment. This is a strategy that can be used to better understand the uncertainty which is present in the resource management decisions. It increases the understanding of uncertainty and can therefore improve the use of more specific target-oriented uncertainty management strategies. Uncertainty assessment can involve the identification and classification of uncertainty, the quantification or determination of significance of the uncertainty, and the prioritisation of different uncertainties. Methods used to undertake this can involve stakeholders, public, experts, and by completing a peer review (Walker et al., 2003; Refsgaard et al., 2007; Ascough Li et al., 2008; Brugnach et al., 2008; Raadgever et al., 2011).

The second ‘handling’ strategy is to accept uncertainty, act consciously in its presence and be resilient (Larsen et al., 2013). This is an important strategy as often, in certain scenarios, uncertainty will be inherent in the problem and irreducible, and will therefore need to be thoroughly considered. A number of more specific management options that fall under this strategy include preparing for the worst, adopting robust and/or flexible solutions, and developing resilience (Brugnach et al., 2008; Thissen and Agusdinata, 2008; Raadgever et al., 2011; Larsen et al., 2013).

Preparing for the worst involves identifying the worse case scenario under uncertainty and developing contingencies to limit the potential negative consequences under that scenario (Brugnach et al., 2008; Raadgever et al., 2011). In contrast, developing resilience in the face of uncertainty would see the system affected by the project being changed to ensure it has the capacity to adsorb any disturbance or negative impacts (Berkes, 2007).

Robust and/or flexible solutions are those that will perform well under most possible scenarios, and are flexible enough that they can be adapted over time as conditions change or effects become better understood. This may involve employing different measures to ensure that the project will be effective under each of the possible scenarios (Thissen and Agusdinata, 2008; Raadgever et al., 2011). The two most recognised examples of robust and adaptive solutions that can be used in the face of uncertainty are the precautionary principle and adaptive management.
2.4.1 The Precautionary Principle

The precautionary principle originated from the recognition that the reactionary approach to resource management is ineffective and that there is a need to anticipate consequences of an action (Mitchell, 2002). There are a number of definitions for the precautionary principle. One of the earliest was developed at the United Nations Conference on Environment and Development in Rio de Janeiro in 1992, and stated that:

“where there are threats of serious irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation” (United Nations, 1992; White, 2015).

In other words, rather than waiting for a complete understanding or certainty, the precautionary principle advocates that managers and decision-makers should anticipate potentially serious and harmful environmental impacts from actions and take decisions to avoid such harm. This counters the notion that an activity should proceed until there is definitive evidence that it is harmful (Mitchell, 2002; André et al., 2004; Cooney, 2005; Lawrence, 2005).

It has been suggested that the precautionary principle is a framework to be used to manage the problem of uncertainty, and avoid the paralysis decision-makers may face when confronted with uncertainty. In its simplest form, the principle advocates that uncertainty should not be used as an excuse for inaction when potential consequences could be serious and damaging (Bodansky, 1991; Gullett, 1997; André et al., 2004; Tannert et al., 2007; Lawrence, 2015).

Since the United Nations conference in 1992, the precautionary principle has spread rapidly into many areas of international and domestic law and policy, from climate change to food safety (Peterson, 2006). However, despite its widespread use, the precautionary principle has been extensively criticised on a number of grounds, some of which will be briefly discussed.

Firstly, the definition of the precautionary principle is contested by some. The term is considered to be somewhat ambiguous, there is considerable confusion about what is meant by the concept, and there is no one-way of viewing precaution (Peterson, 2006; Gillespie, 2011). However, the real challenge is how to put this abstract definition into
practice. While the precautionary principle provides a general approach to environmental issues, there is a considerable lack of clarity about what it means to apply the principle or take precautionary measures, and there are no criteria to guide its implementation (Gullett, 1997; Cooney, 2005; Peterson, 2006; Allen and Gunderson, 2011; Gillespie, 2011). Furthermore, it is too vague to serve as a regulatory standard because it does not provide clear guidance for practice, does not provide guidance as to the appropriate point at which precautionary action should be triggered and applied, and does not specify to decision-makers how much caution should be taken (Bodansky, 1991; Gullett, 1997; Lawrence, 2005; Jalava et al., 2013). Moreover, there is an argument that, in situations where decisions makers are given ‘excessive discretion’ as to when and how to apply the principle, the regulatory framework may result in it being applied inconsistently, leading to unpredictable and inconsistent environmental management decisions. Conversely, it has been argued that, if there were excessive prescription of the principle, it would remove the flexibility needed to take into account the circumstances of each case (Cameron, 2006; Peterson, 2006).

This leads to an important distinction that has been made between the ‘precautionary principle’ and the ‘precautionary approach.’ While controversial, some believe that the precautionary principle is the stronger, more restrictive, hard line view while the precautionary approach is the weaker, less restrictive, more flexible version. The dividing points between strong and weak versions are the nature of the threat, the triggering point for the principle and the reversal of the burden of proof (Table 2.3) (Cooney, 2005; Peterson, 2006; Gillespie, 2011).

Finally, the precautionary principle might hinder the application of active adaptive management, which seeks to accelerate learning for better outcomes over the long-term. While adaptive management calls for risk-taking in order to learn, the precautionary principle is evoked to avoid risk. Thus, while managing in a precautionary way can minimise risk over the short term, there is potential for it to serve as an excuse for not taking the (perhaps risky) steps needed to learn. On the other hand, some authors promote adaptive management as an approach that can be used to implement precaution (Gullett, 1997; Jacobson, 2009).
Table 2.3: Comparison of the differences between the precautionary principle and precautionary approach (Cooney, 2005; Peterson, 2006; Gillespie, 2011).

<table>
<thead>
<tr>
<th>Nature of threat</th>
<th>Precautionary Principle</th>
<th>Precautionary Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Any harm may trigger its application</td>
<td>Harm must be ‘serious’, ‘significant’ or ‘irreversible’</td>
</tr>
<tr>
<td>Threshold of threat (What level of threat or potential for harm is sufficient to trigger application of the principle)</td>
<td>Application is triggered by any suspicion of a potential risk or reasonable grounds for concern (based upon reliable scientific data)</td>
<td>Application is only triggered is evidence relating to both likelihood of occurrence and severity of consequences is available (In this case scientific uncertainty alone or the possibility of environmental damage below the threshold level will not satisfy the threshold test for precautionary measures)</td>
</tr>
<tr>
<td>Burden of proof (Where does the burden of proof rest to show the existence/absence of risk of harm)</td>
<td>The burden of proof that no damage will occur is on those who wish to undertake an activity</td>
<td>The requirement to justify the need for action generally falls on those advocating precautionary action.</td>
</tr>
</tbody>
</table>

2.4.2 Adaptive Management

Adaptive management is a natural resource management tool for dealing with the challenge of the uncertain and unexpected, while allowing management and development to proceed despite the presence of uncertainty (Morgan, 1998; Mitchell, 2002; Allen and Gunderson, 2011). Rather than ignore uncertainty, or use it to prevent development, adaptive management is seen to be able to foster resilient and flexible management approaches that acknowledge inevitable changes and surprises (Allen and Gunderson, 2011).

Adaptive management is an iterative tool which involves rigorous research and planning of a project and its effects before implementation, and thorough monitoring and re-examination of impacts following implementation so that the management strategy can be altered to respond to emerging problems (Morgan, 1998; Lawrence, 2005). Holling (1978) saw that adaptive management was no more than common sense: it stems from the traditional way of dealing with the unknown – trial and error, where failures are accepted and form the basis of new experiments (learning by doing) (Stankey and Allan, 2009). However, one of the most important conditions of employing an adaptive approach to
resource management is that the ‘experiment’ should not create irreversible changes to the environment.

With increasing recognition of the complexity and uncertainty associated with managing natural resources, adaptive management has become an interesting and appealing solution. However, there is also a number of recognised challenges and risks associated with the approach - the implementation of adaptive management does not produce easy answers, it is only appropriate to use in some resource management problems and, as a result, some believe it has failed more often than not (Stankey and Allan, 2009; Allen and Gunderson, 2011).

Although Rogers (1998) outlines the success of the use of adaptive management in the management of large-scale problems, some suggest that it is most appropriate and successful with small and relatively simple applications (e.g. only a few regulatory bodies and interest groups involved, minimally severe impacts and low risk to any species) (Gregory et al., 2006). Mitchell (2002) goes one step further, warning against using adaptive management for large projects (such as a major dam) because the scale and implications make reversing the development or effects almost impossible. In addition, some systems are extremely sensitive (e.g. estuarine environments) and small changes can result in catastrophic collapses (Walters, 1997; Dovers et al., 2008).

In order to learn from and adapt the initial management strategy implemented, monitoring must be undertaken (Morgan, 1998). Well-designed monitoring can be costly (for example when multiple variables are measured at multiple sites and time scales), therefore there is a risk that, if there is inadequate funding or commitment, then monitoring, evaluating and reporting will not be done sufficiently (Walters, 1997; Rogers, 1998; Schreiber et al., 2004; Allen and Gunderson, 2011). For example, Walters (1997) is of the opinion that resource managers and decision-makers are generally conservative about such costs and risks, and are preferentially choosing to scale back experiments (e.g.limiting the variety of treatments, replication, duration, complexity of monitoring set, etc.) rather than invest in innovative monitoring approaches. There are also risks when there are additional costs and delays associated with gathering extra information or when there is a need for more monitoring than initially thought and extra funding is sought to successfully determine the outcomes of the monitoring. As a result it is fundamental that emphasis is placed on
designing firm, achievable and pragmatic goals and that their achievement is audited (Rogers, 1998; Allen and Gunderson, 2011).

Although adaptive management is predominantly about learning from mistakes, humans often have great difficulty in acknowledging failure or mistakes or in learning from such experiences. In addition, there is often a danger that, in clearly documenting failures, egos will be bruised or reputations tarnished (not to mention political risks) (Mitchell, 2002).

2.5 Conclusion

This chapter has presented a theoretical framework of uncertainty in resource management and decision-making. It has explained the reasons for uncertainty in the process, the different perceptions of uncertainty and the ways in which uncertainty can be managed in the process.

There are many causes of uncertainty there may be a lack of information, or conflicting information, too much information or the system of interest may just be too complex for a full understanding ever to be gained. The level of certainty about an issue can range from total certainty, to complete ignorance and it is important to consider the significance of the uncertainty that is present. Uncertainty can occur in many areas of the resource management process: in the project proposal, in the consultation, or in many different areas of the assessment of effects.

Most resource management situations will have a level of uncertainty, and it is therefore important that decision-makers are aware of this. Decision-makers’ perceptions of uncertainty, the way they understand it, whether or not they accept it, and how much importance they place on it can vary for many reasons, including the distance from the generation of knowledge and how risk averse an individual is. There is often little to no guidance to assist decision-makers in recognising and coping with uncertainty. The disclosure and communication of uncertainty is an important factor which affects decision-makers’ understanding and perceptions. In practice, uncertainty is often poorly disclosed and communicated by applicants, and there is a lack of guidance for applicants on how best to improve this.
There are number of different ways in which uncertainty can be managed in the decision-making process. Each of the strategies has benefits, but when implemented in a situation that is not appropriate, may have negative implications. Therefore it is important that decision-makers are well informed about these strategies before attempting to implement them.
Chapter 3: Resource management and decision-making in the New Zealand context

3.1 Introduction
This chapter first provide a brief overview of the Resource Management Act 1991, its key purpose and broad approach to resource management. Following this, the resource consent process is described, with a particular focus on the role of the impact information and the decision-making process. Finally the management of uncertainty under the Act in considered.

3.2 The Resource Management Act 1991
The Resource Management Act 1991 revolutionised resource management in New Zealand by streamlining and integrating previous legislation dealing with the management of air, water and soil. Today, it is the major statute governing resource management decision-making. Under the Act, much of the management of the environment is decentralised, placing considerable responsibility onto local government. This decentralisation is based on the principle that decision-making is best carried out at the level closest to the resources affected and also better enables public participation in resource management decision-making (Memon, 1993; Robertson, 1993; Peart, 2008; Local Government New Zealand, 2016).

3.2.1 Sustainable management
The overriding purpose of the RMA is ‘to promote the sustainable management of natural and physical resources’ where sustainable management is defined as (Section 5(1)):
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, remediating, or mitigating any adverse effects of activities on the environment.

It is important to note that sustainable management and sustainable development are not the same thing: sustainable management is an element of sustainable development and is less comprehensive, being focused on physical resources as opposed to social or economic. However, although the purpose of the RMA does not explicitly seek to achieve social or economic outcomes, decisions are to take into account the impact of the use of natural resources on social, cultural and economic matters (Ericksen et al., 2001; Peart, 2008).

3.2.2 Effects based approach

Rather than regulating specific activities, the Act takes an effects based approach whereby the focus is on managing the effects of activities rather than the activities per se and seeks to intervene only where activities are likely to result in unacceptable environmental impacts (Peart, 2008; Environment Foundation, 2016b). While it gives wider and stronger powers to manage environmental impacts, the Act adopts a more enabling approach than previous legislation. Although this approach has the advantage of providing room for innovative approaches, it can also result in environmental planning being reactive, in plans being complex and difficult to understand and in poor management of cumulative and diffuse impacts (Memon, 1993; Peart, 2008).

3.2.1 Hierarchy of government

The Resource Management Act acknowledges the importance of the different levels of government in environmental planning and management and as a result there is a hierarchical three-tier structure (Figure 3.1). Central government’s primary role is to oversee and monitor the Act, set national environmental standards and prepare national policy statements (Memon, 1993; Peart, 2008). Regional councils, of which there are 11, are primarily responsible for the management of natural resources such as water, air and land, and for producing regional policy statements and plans. There are 67 territorial
3.3 The Resource Consent Process

Under the Resource Management Act 1991, certain activities that affect natural or physical resources require permission in the form of resource consents. The Act provides the framework for the process by which consents are granted (Figure 3.2). The resource consent process allows authorities to determine the effects of an activity on the environment and to put measures in place that eliminate or mitigate potentially damaging effects of developments (Connell et al., 2009). Resource consents are obtained from regional councils or territorial authorities (and in some cases from central government), which act as consenting authorities.

Between 1997-2015 the average total number of resource consents processed in 12-month period by consenting authorities was 48,096, although since 2008 the number has decreased (Table 3.1). Between 1997-2015, almost all consents that were applied for were subsequently granted – an average of only 0.60% of consents were declined. Whilst territorial authorities processed an average of 62.9% of total consents, regional councils...
processed 20.9% and unitary authorities processed 16.5% (this number has increased since the formation of the Auckland Council which acts as unitary authority).

Figure 3.2: The resource consent procedure under the RMA 1991 in New Zealand (Wood, 2003).
Table 3.1: Summary of the characteristics and processing of resource consent application in New Zealand between 1999-2015.

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<tr>
<td>Total number of consents processed</td>
<td>58,060</td>
<td>49,152</td>
<td>48,045</td>
<td>49,012</td>
<td>54,658</td>
<td>51,768</td>
<td>51,960</td>
<td>36,154</td>
<td>34,055</td>
<td>40,363</td>
<td>34,055</td>
<td>36,154</td>
<td>34,055</td>
<td>40,363</td>
<td>36,154</td>
<td>34,055</td>
<td>40,363</td>
<td>48,096</td>
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<tr>
<td>Percentage of consents declined (%)</td>
<td>&lt;1</td>
<td>&lt;1</td>
<td>&lt;1</td>
<td>0.55</td>
<td>0.75</td>
<td>0.7</td>
<td>0.75</td>
<td>0.56</td>
<td>0.27</td>
<td>0.21</td>
<td>0.6</td>
<td>0.56</td>
<td>0.27</td>
<td>0.21</td>
<td>0.6</td>
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<tr>
<td>Percentage of total applications by consenting authority Regional council</td>
<td>16</td>
<td>18</td>
<td>17</td>
<td>24</td>
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<td>26</td>
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<td>18</td>
<td>20.9</td>
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<td>Territorial Authority</td>
<td>77</td>
<td>76</td>
<td>75</td>
<td>68</td>
<td>72</td>
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<td>69</td>
<td>39</td>
<td>41</td>
<td>43</td>
<td>62.9</td>
<td>77</td>
<td>76</td>
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<td>68</td>
<td>72</td>
<td>69</td>
<td>43</td>
<td></td>
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<tr>
<td>Unitary Authority</td>
<td>6</td>
<td>7</td>
<td>8</td>
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<td>8</td>
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<td>37</td>
<td>39</td>
<td>6</td>
<td>6</td>
<td>35</td>
<td>35</td>
<td>37</td>
<td>39</td>
<td>16.5</td>
<td></td>
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<tr>
<td>Percentage of total applications by type of activity Controlled</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>24</td>
<td>20</td>
<td>16</td>
<td>14</td>
<td>15</td>
<td>17.8</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>24</td>
<td>20</td>
<td>16</td>
<td>14</td>
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<tr>
<td>Restricted</td>
<td>-</td>
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<td>-</td>
<td>25</td>
<td>23</td>
<td>25</td>
<td>29</td>
<td>33</td>
<td>27.0</td>
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<td>29</td>
</tr>
<tr>
<td>Discretionary</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>49</td>
<td>50</td>
<td>45</td>
<td>42</td>
<td>39</td>
<td>45.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>49</td>
<td>50</td>
<td>45</td>
<td>42</td>
</tr>
<tr>
<td>Non-complying</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>9</td>
<td>11</td>
<td>8.8</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Other</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>6</td>
<td>6</td>
<td>-</td>
<td>6</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>6</td>
<td>6</td>
<td>-</td>
</tr>
<tr>
<td>Percentage of applications with further information requests (%)</td>
<td>22</td>
<td>28</td>
<td>33</td>
<td>35</td>
<td>35</td>
<td>32</td>
<td>43</td>
<td>35</td>
<td>32</td>
<td>28</td>
<td>32.8</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>22</td>
<td>28</td>
<td>33</td>
<td>35</td>
</tr>
<tr>
<td>Percentage of consents publicly notified (%) Fully</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>4.7</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Limited</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1.5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Total number of prehearing meetings held</td>
<td>679</td>
<td>508</td>
<td>432</td>
<td>546</td>
<td>647</td>
<td>518</td>
<td>379</td>
<td>239</td>
<td>150</td>
<td>528</td>
<td>455</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>679</td>
<td>508</td>
<td>432</td>
<td>546</td>
</tr>
<tr>
<td>Total number of hearings held</td>
<td>-</td>
<td>304</td>
<td>280</td>
<td>420</td>
<td>485</td>
<td>378</td>
<td>250</td>
<td>172</td>
<td>72</td>
<td>113</td>
<td>295</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>304</td>
<td>280</td>
<td>420</td>
</tr>
<tr>
<td>Percentage of applications granted by decision-makers (%) Local Authority Officer</td>
<td>90</td>
<td>84</td>
<td>83</td>
<td>84</td>
<td>87</td>
<td>87</td>
<td>85</td>
<td>91</td>
<td>89</td>
<td>96.5</td>
<td>86.7</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>90</td>
<td>84</td>
<td>83</td>
<td>84</td>
</tr>
<tr>
<td>Councillors (as part of a hearing panel)</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>&lt;0.5</td>
<td>4.2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Independent Commissioner</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>6</td>
<td>5</td>
<td>7</td>
<td>3.5</td>
<td>2.9</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Internal Commissioner</td>
<td>3</td>
<td>8</td>
<td>10</td>
<td>8</td>
<td>7</td>
<td>5</td>
<td>4</td>
<td>&lt;0.5</td>
<td>2</td>
<td>&lt;0.5</td>
<td>5.9</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>8</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>Other (mixed Panel) (%)</td>
<td>&lt;0.5</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>&lt;1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>1.1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>&lt;0.5</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Percentage of appeals to environment court (%)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1.8</td>
<td>1.2</td>
<td>1</td>
<td>1.4</td>
<td>1</td>
<td>0.7</td>
<td>&lt;0.5</td>
<td>0.7</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

40
3.3.1 Identifying the consent required

Initially, it needs to be determined whether a resource consent is required. This is achieved by establishing which of the six categories of activity (Table 3.2) the proposed activity will be classified as. Resource consent is required for controlled, restricted discretionary, discretionary and non-complying activities; permitted activities do not need consent and a consent cannot be granted for an activity classed as prohibited.

Between 2005-2013 an average of 17.8% of consents were for controlled activities, 27.0% for restricted discretionary, 45.0% for discretionary, 8.8% for non complying and 6% other activities (activities which require a resource consent but some district or regional plans do not have a classification for them) (Table 3.1).

Table 3.2: Consenting authorities in New Zealand classify activities into 6 groups and whether or not consent is required depends on this classification (Peart, 2008; Environment Foundation, 2016a).

<table>
<thead>
<tr>
<th>Type of activity</th>
<th>Description of activity</th>
<th>Consent required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permitted</td>
<td>The activity must comply with requirements, conditions or permissions specified within RMA and relevant plans</td>
<td>No</td>
</tr>
<tr>
<td>Controlled</td>
<td>The council can impose conditions (only on matters that it has reserved control in the plan)</td>
<td>Yes</td>
</tr>
<tr>
<td>Restricted</td>
<td>The council can exercise discretion as to whether or not to grant consent and what conditions to impose (only in respect to matters which is has restricted its discretion in the plan)</td>
<td>Yes</td>
</tr>
<tr>
<td>Discretionary</td>
<td>The council can exercise full discretion as to whether or not to grant consent and as to what conditions to impose</td>
<td>Yes</td>
</tr>
<tr>
<td>Non-complying</td>
<td>The applicant must establish that the adverse affects of the activity will be minor or that the activity will not be contrary to the objectives of the relevant plan</td>
<td>Yes</td>
</tr>
<tr>
<td>Prohibited</td>
<td>A prohibited activity may not be carried out. In addition, no resource consent can be sought or granted to authorise the activity</td>
<td>-</td>
</tr>
</tbody>
</table>

In addition to determining the classification of activity, it is also important to identify the type of consent that is required. There are five different types of resource consent that can be granted: land use, subdivision, coastal, water and discharge (Table 3.3). By establishing the type of activity and the type of resource consent needed, the applicant can then determine the level of detail needed in the consent application.
Table 3.3: Types of resource consents and the consent authorities responsible for issuing them (Ministry for the Environment, 2015).

<table>
<thead>
<tr>
<th>Type</th>
<th>Example of activity</th>
<th>Consent authority responsible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land use</td>
<td>Erect a building or convert garage into residential</td>
<td>Regional and/or territorial Authority</td>
</tr>
<tr>
<td></td>
<td>neighbourhood shop</td>
<td></td>
</tr>
<tr>
<td>Subdivision</td>
<td>Divide a property into two or more titles</td>
<td>Territorial</td>
</tr>
<tr>
<td>Coastal</td>
<td>Build a wharf below mean high water spring mark</td>
<td>Regional Council</td>
</tr>
<tr>
<td>Water</td>
<td>To take water from a stream for an irrigation scheme or</td>
<td>Regional Council</td>
</tr>
<tr>
<td></td>
<td>to build a dam</td>
<td></td>
</tr>
<tr>
<td>Discharge</td>
<td>To discharge storm water through a pipe into a lake or</td>
<td>Regional Council</td>
</tr>
<tr>
<td></td>
<td>to discharge exhaust fumes into the air</td>
<td></td>
</tr>
</tbody>
</table>

3.3.2 Application preparation

The resource consent application must then be prepared, including an assessment of environmental effects (AEE). Although not obligatory, applicants are encouraged to consult affected parties prior to submitting the application as it can avoid considerable costs later in the process and, in some cases, obtaining written consent from ‘affected parties’ will allow the consent to be assessed on a non-notified basis (Peart, 2008).

Assessment of Environmental Effects (AEE)

The Resource Management Act 1991 states that a resource consent application should contain an assessment of any actual or potential effects that the activity may have on the environment and the ways in which any adverse effects may be mitigated. This is the assessment of environmental effects (AEE). The Resource Management Act 1991 definition of environment (Section 2) is very broad and includes:

(a) ecosystems and their constituent parts, including people and communities; and  
(b) all natural and physical resources; and  
(c) amenity values; and  
(d) the social, economic, aesthetic, and cultural conditions which affect the matters stated in paragraphs (a) to (c) or which are affected by those matters

Similarly the definition of effect is also broad (Section 3):

(a) any positive or adverse effect; and  
(b) any temporary or permanent effect; and  
(c) any past, present, or future effect; and  
(d) any cumulative effect which arises over time or in combination with other effects—
regardless of the scale, intensity, duration, or frequency of the effect, and also includes
(e) any potential effect of high probability; and
(f) any potential effect of low probability which has a high potential impact.

Due to the breadth of the definitions, any decision taken about the use of natural resources must potentially take into account any impact on any part of the environment (Milne, 1993; Peart, 2008). However, in practice the detail required for the assessment will depend on the scale of significance of the potential impacts. The Act provides guidance on the contents of the AEE in the form of the Fourth Schedule (Box 1).

In the 2013 survey of consenting authorities it was found that 87% of consenting authorities produce their own written guidance material for applicants in preparing assessments of environmental effects (Ministry for the Environment, 2014); however, many are often still completed based on the broad frame of reference in the Fourth Schedule (Morgan, 2000).

In addition, in 1999 MfE published ‘A Guide to Preparing Basic Assessment of Environmental Effects’, but as the title indicates, the guide is not designed to be used for complex projects with complex effects. Revised in 2006, the guide has not been updated since the changes to the Fourth Schedule in 2013. Some councils have developed consent application forms which include checklists to assist with the AEE. While these assist people with no experience dealing with AEEs, there are risks associated with them if the council has not provided guidance on their use (Morgan, 2000).

Pre-application consultation with council
Before officially lodging an application for resource consent, an applicant can choose to consult the council about their application. This consultation can help in a number of ways, from confirming whether a resource consent is needed through to explaining the requirements of the AEE and advising on stakeholder consultation (Quality Planning, 2016d). Processing an application is generally simpler, quicker and less costly if the applicant has already sought the council's advice on the relevant plan provisions and information requirements before making an application (Quality Planning, 2016d).
Box 1: Extracted from the Fourth Schedule of the Resource Management Act

6 Information required in assessment of environmental effects
1) An assessment of the activity's effects on the environment must include the following information:
   (a) if it is likely that the activity will result in any significant adverse effect on the environment, a description of any possible alternative locations or methods for undertaking the activity:
   (b) an assessment of the actual or potential effect on the environment of the activity:
   (c) if the activity includes the use of hazardous substances and installations, an assessment of any risks to the environment that are likely to arise from such use:
   (d) if the activity includes the discharge of any contaminant, a description of—
      i. the nature of the discharge and the sensitivity of the receiving environment to adverse effects; and
      ii. any possible alternative methods of discharge, including discharge into any other receiving environment:
   (e) a description of the mitigation measures (including safeguards and contingency plans where relevant) to be undertaken to help prevent or reduce the actual or potential effect:
   (f) identification of the persons affected by the activity, any consultation undertaken, and any response to the views of any person consulted:
   (g) if the scale and significance of the activity's effects are such that monitoring is required, a description of how and by whom the effects will be monitored if the activity is approved:
   (h) if the activity will, or is likely to, have adverse effects that are more than minor on the exercise of a protected customary right, a description of possible alternative locations or methods for the exercise of the activity (unless written approval for the activity is given by the protected customary rights group).
2) A requirement to include information in the assessment of environmental effects is subject to the provisions of any policy statement or plan.
3) To avoid doubt, subclause (1)(f) obliges an applicant to report as to the persons identified as being affected by the proposal, but does not—
   (a) oblige the applicant to consult any person; or
   (b) create any ground for expecting that the applicant will consult any person.

7 Matters that must be addressed by assessment of environmental effects
1) An assessment of the activity's effects on the environment must address the following matters:
   (a) any effect on those in the neighbourhood and, where relevant, the wider community, including any social, economic, or cultural effects:
   (b) any physical effect on the locality, including any landscape and visual effects:
   (c) any effect on ecosystems, including effects on plants or animals and any physical disturbance of habitats in the vicinity:
   (d) any effect on natural and physical resources having aesthetic, recreational, scientific, historical, spiritual, or cultural value, or other special value, for present or future generations:
   (e) any discharge of contaminants into the environment, including any unreasonable emission of noise, and options for the treatment and disposal of contaminants:
      a) any risk to the neighbourhood, the wider community, or the environment through natural hazards or the use of hazardous substances or hazardous installations.
2) The requirement to address a matter in the assessment of environmental effects is subject to the provisions of any policy statement or plan.
3.3.3 Reviewing
Once the application is complete and lodged with the consent authority, it will be checked for completeness. This involves assessing the AEE to ensure that it is in the prescribed form and that it meets the requirements of Schedule 4 (Quality Planning, 2016a). In the 2013 survey of consenting authorities, it was found that 83% of consenting authorities followed set procedures to check that environmental effects were adequately identified and addressed in assessments of environmental effects (Ministry for the Environment, 2014).

There is a 10 working day timeframe for councils to determine whether an application is complete. In cases where an application is deemed incomplete, or the AEE is deemed not to contain all the relevant information, the consent authority can refuse to accept the application (Quality Planning, 2016a). Once the application has been accepted, councils have the right to request further information (s92). This occurs frequently; between 1997 and 2015 32.8% of all consent applications were deemed incomplete and more information was requested (Table 3.1). Once an application is deemed complete, a council officer will prepare an officer’s report on the application which usually contain recommendations about whether the consent should be granted and if so, what conditions should be placed on it (Peart, 2008).

3.3.4 Public notification
The next step in the process is for council staff to decide whether the application should be notified or non-notified. While notification allows public submissions, non-notification does not (Morgan, 2000). An application must be publically notified in cases where the activity will have or is likely to have adverse effects on the environment that are more than minor, or if the applicant requests it or when a rule, or national environmental standard requires public notification (Quality Planning, 2016f). An application can be fully notified (where anyone can make a submission) or given limited notification (where only those served with a notice of the application can submit). Between 1997-2015 an average of 4.7% of consent applications were fully notified each year and between 2005-2013 an average of 1.5% of applications were notified on a limited basis (Table 3.1). In cases where the consenting authority deems that the activity will have minor effects, and all the affected persons provide agreement, they can proceed without notifying the public. The next step is for the authority to then make a decision on the application (Fookes, 2000).
3.3.4 Hearings
Hearings are held, typically for notified applications, when the council considers it necessary when the applicant requests a hearing, or when a submitter wishes to be heard (Quality Planning, 2016c). A pre-hearing meeting may be held for the purpose of clarifying or facilitating the resolution of the matter or issue. Between 1997-2015 there was an average of 455 prehearing meetings held per year (Table 3.1). On average, 3% of pre-hearing meetings result in hearings not being necessary.

3.3.5 Decision-making for resource consents
The consenting authority then makes a decision on the application. Section 104 of the Act explains the way in which different activities must be treated in the decision-making process and the council’s rights or obligations to grant or deny the application. Section 104 states that the authority must have regard to:

(a) any actual and potential effects on the environment of allowing the activity; and
(b) any relevant provisions of—
   i. a national environmental standard:
   ii. other regulations:
   iii. a national policy statement:
   iv. a New Zealand coastal policy statement:
   v. a regional policy statement or proposed regional policy statement:
   vi. a plan or proposed plan; and
(c) another matter the consent authority considers relevant and reasonably necessary to determine the application.

The authority is obliged to grant consents on controlled activities but has the right to impose conditions (Section 104A). For both discretionary and non-complying activities the authority may choose to grant or refuse the application and may impose conditions (Section 104B). When dealing with restricted discretionary activities, the authority has the power to grant or refuse the consent but must only consider the activity based on the matters to which it has restricted the exercise of its discretion under its plan or proposed plan, and in national environmental standards or other regulations. If a council chooses to grant consent, then conditions can only be imposed in relation to those matters over which discretion has been restricted in the plan or proposed plan, national environmental standards or regulations (Section 104C). In order for consent to be granted for non-complying activities, the authority must be satisfied that either the adverse effects of the
activity on the environment will be minor or that the proposed activity will not be contrary to the objectives and policies of a proposed plan and/or plan (Section 104D) (Peart, 2008).

Conditions
The consenting authority has the right to impose conditions on the certain consents (see above). Conditions will often limit the activity in some way and can be, for example, financial (e.g. a bond), restrict the hours of operation, or the appearance or design, or require specific types of monitoring (Section 108).

Consenting authorities - Decision power
In most cases, decisions on whether to grant resource consents are made by councils. The exception is for nationally significant proposals, which are considered by the Environmental Protection Authority (section 42C(a) and 145(1a)). However, when applications are not considered nationally significant, more often than not the decision will be made a Local Authority Officer – between 1997-2015 local authorities made an average of 86.7% of the decisions (Table 3.1).

In some situations the council is able to delegate its functions and powers to a commissioner who will then carry out decision-making duties on its behalf (Quality Planning, 2016b). Commissioners may either be elected councillors or community board members (internal commissioners) or non-council members (independent commissioners) (Quality Planning, 2016g).

Councils use independent commissioners for a number of reasons; for example, an applicant or submitter may request the use of an independent commissioner, or the council itself may decide to use an independent commissioner. Or when there is a potential conflict of interest or when the case is particularly complex or technical and the specialist expertise not available within a council, independent commissioners may well be used (Quality Planning, 2016g). The use of independent commissioners has increased in recent years; between 1997-2004 they made 1% of decisions on resource consents, however this number has steadily increased and in the 2012-2015 financial year they were used 7% of the time (Table 3.1).
A councillor acting as an internal commissioner may be used in situations such as joint hearings. Between 1997-2015, internal commissioners made an average of 5.9% of decisions, although in the two most recent financial periods, this has fallen (Table 3.1). A combination of both independent and internal commissioners may be used and the council has the discretion to decide on the number of commissioners appointed. Combinations of this kind are less common than any other decision-making scenario, occurring an average of 1.1% of the time between 1997 and 2015 (Table 3.1).

Commissioner accreditation

In order to become an internal or independent commissioner, an individual must be accredited. The main way to gain accreditation is to hold a ‘Making Good Decisions’ Certificate (Quality Planning, 2016e). The Ministry for the Environment introduced the ‘Making Good Decisions’ Programme in 2004 with the aim of improving the implementation of the RMA and making decision-making standards and practices more consistent across councils (Hobbs, 2004). There are three courses that are available in the programme: the foundation course, the panel recertification and the chair recertification courses (Table 3.4). The foundation course provides the initial certification, and anyone who passes this must recertify with either of the recertification courses after three years and every 5 years after that (Quality Planning, 2016e).

Table 3.4: Different courses available in the ‘Making Good Decisions’ programme (Opus, 2016b, 2016c, 2016a).

<table>
<thead>
<tr>
<th>Course</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundation course (Opus, 2016b)</td>
<td>Provide the skills and knowledge needed to guide decision-makers through the ethical, legal and practical requirements of decision-making under Resource Management Act 1991 (RMA). Covers:</td>
</tr>
<tr>
<td></td>
<td>• Natural justice and ethics</td>
</tr>
<tr>
<td></td>
<td>• Principles of decision-making</td>
</tr>
<tr>
<td></td>
<td>• Considerations Relating to Māori</td>
</tr>
<tr>
<td></td>
<td>• Planning framework</td>
</tr>
<tr>
<td></td>
<td>• Consent Hearings</td>
</tr>
<tr>
<td></td>
<td>• Roles of participants in hearings</td>
</tr>
<tr>
<td></td>
<td>• Hearings procedures</td>
</tr>
<tr>
<td></td>
<td>• Managing Hearings</td>
</tr>
<tr>
<td></td>
<td>• Considering/testing/weighing evidence</td>
</tr>
<tr>
<td></td>
<td>• Deliberation/preparing decisions</td>
</tr>
<tr>
<td>Panel Recertification (Opus, 2016c)</td>
<td>The purpose is to share knowledge and experiences gained, ensure that knowledge is up to date with legislative changes and case law decisions and further develop the range of complex skills required</td>
</tr>
<tr>
<td>Chair recertification (Opus, 2016a)</td>
<td>The purpose is to enable chairs to gain recertification and new chairs to gain endorsement as well as develop skills and behaviours required of a Chair and share experiences and gain knowledge from other Chairs</td>
</tr>
</tbody>
</table>
3.3.6 Appeal
The applicant or any person who has made a submission is able to appeal the consenting authority’s decision. The appeal is lodged with the Environment Court, which has the power to review and overturn decisions made by consent authorities. Very few consent decisions are appealed in the Environment Court; between 1997-2015 an average of 0.7% of applications were appealed each year. The decision made by the Environment Court can only be contested in the High Court on points of law (Peart, 2008).

3.3.7 Monitoring
Consenting authorities are obligated to monitor whether or not the conditions of consents are being met. The AEE should contain information on monitoring if the likely effects are of a scale or significance to warrant monitoring, and the consent holder may be required to undertake that monitoring as a consent condition. Authorities are also required to take appropriate action where necessary, for example where significant adverse effects occur that were not anticipated; the authority can review or modify conditions or revoke the consent.

3.4 Uncertainty in the resource consent process under the RMA 1991
The term ‘uncertain’ (or any variation of) is not explicitly used in the Act. As previously stated in Chapter 2, there are three main ways in which uncertainty in resource management can be actively managed: request more information, implement adaptive management, or take a precautionary approach. As the first of these is explicitly dealt with in the Act, as noted above, this section focuses on the other two approaches.

3.4.1 Precautionary approach in New Zealand
While the precautionary principle is explicitly incorporated into some domestic legislation (Fisheries Act 1996 and Hazardous Substances and New Organisms Act 1996), the Resource Management Act 1991 is less progressive and only implicitly applies the precautionary approach (Christensen and Jennings, 2013; Magallanes and Severinsen, 2015). The lack of explicit reference may simply be due to the age of the Act, and that precaution was in its infancy when the Act was conceived (Gillespie, 2011; Magallanes and Severinsen, 2015). In saying that, the Act as a whole was clearly designed to be
protective and pre-emptive, with a precautionary flavour (Magallanes and Severinsen, 2015).

Despite the omission of the explicit principle from the Act, the courts have been eager to read in an element of precaution into the application of legislation (Magallanes and Severinsen, 2015; Warnock and Baker-Galloway, 2015). They have consistently ruled that precaution is inherent in the Act (it is said to be reflected in ss3(f), 104(l)(a) and 105) and "not extraneous to the legislation", which is already weighted towards being risk averse (Cameron, 2006; Gillespie, 2011). While it has been argued that it is implicit, it was determined in McIntyre v Christchurch City Council (1996) that:

'[t]he weight to be given to the precautionary principle depends on the circumstances, including: the extent of scientific knowledge and the impact on otherwise permitted activities, the gravity of the effects and the statutory purpose of promoting sustainable management.'

The reading in of the precautionary principle by the courts has been done in three key ways within the consenting context. Firstly, the courts have considered that, when proving or disproving the existence of future effects, the ordinary civil standard of proof is not sufficiently precautionary. It is therefore untenable. The RMA expressly requires the consideration and weighing not only of those effects that are more likely than not to occur, but also those that may be unlikely but of potentially high magnitude. Case law resolving this point has followed two divergent paths; the tradition expressed in McIntyre v Christchurch City Council (1996) has seen greater value in recognising a flexible standard of proof varying according to the severity of the potential impact, while the line of cases beginning with Shirley Primary School v Christchurch City Council (1999) has dispensed with the idea of “proof” entirely in favour of an expert exercise of discretion when identifying potential effects. Academic scholarship has not reconciled the two traditions. Yet the key point is that precaution has been seen as central in establishing the existence of future effects (Magallanes and Severinsen, 2015).

Secondly, in some cases, the courts have recognized the existence of a precautionary burden of proof. The act ultimately does not contain a strong form of the principle as it does not place the evidential burden on the applicant to demonstrate their activity would not cause unacceptable environmental harm (Warnock and Baker-Galloway, 2015). Instead there is a greater inclination to recognise an evidential or tactical burden on every
party involved to make the existence of potential effects ‘a live issue’. Because it applies not only to an applicant, this approach is not overly precautionous (Magallanes and Severinsen, 2015).

Finally, in some cases, the courts have also accepted that the international law principle of precaution is a valid matter than can be considered under s 104(1)(c) of the RMA which states that:

(1) When considering an application for a resource consent and any submissions received, the consent authority must, subject to Part 2, have regard to—
   (a) any actual and potential effects on the environment of allowing the activity; and
   (b) any relevant provisions of—
      (i) a national environmental standard:
      (ii) other regulations:
      (iii) a national policy statement:
      (iv) a New Zealand coastal policy statement:
      (v) a regional policy statement or proposed regional policy statement:
      (vi) a plan or proposed plan; and
   (c) any other matter the consent authority considers relevant and reasonably necessary to determine the application.

While other cases have rejected this view, they have nevertheless accepted that greater weight can be given to potential effects according to their likelihood and magnitude (this is particularly the case it subsidiary policy instruments; e.g. the New Zealand Coastal Policy Statement references the need for precaution specifically). It has recently been confirmed in Sustain Our Sounds v New Zealand King Salmon Company Ltd (2014) that the precautionary obligation can, in some circumstances, be discharged through the imposition of adaptive management conditions (Magallanes and Severinsen, 2015).

As well as being considered under the RMA, the precautionary principle is also included in a number of other plans and policies. The Coastal Policy Statement includes the precautionary approach in its 3rd policy.

   Policy 3 Precautionary approach
   (1) Adopt a precautionary approach towards proposed activities whose effects on the coastal environment are uncertain, unknown, or little understood, but potentially significantly adverse.
   (2) In particular, adopt a precautionary approach to use and management of coastal resources potentially vulnerable to effects from climate change, so that:
       (a) avoidable social and economic loss and harm to communities does not occur;
(b) natural adjustments for coastal processes, natural defences, ecosystems, habitat and species are allowed to occur; and
(c) the natural character, public access, amenity and other values of the coastal environment meet the needs of future generations.

In addition, some regional and district plans also include the precautionary approach as a principle. For example the Marlborough Regional Policy Statement incorporates the approach into its principles:

3.6.1 Principle
Where insufficient information about actual or potential adverse effects is available resource management policies and plans will take a precautionary approach to the use and development of resources to ensure there are no adverse effects on the environment.

3.4.2 Adaptive management in New Zealand

Despite not being mentioned in the Act, the use of adaptive management has been accepted under the Resource Management Act 1991 (examples include the development of marine farms, a run-of-river hydro scheme, and a tidal energy project. Where decision-makers are uncertain of the consequences of a proposed project, rather than forgo the proposal altogether, they may use adaptive management as a framework to assist with the development of conditions which are implemented, to deal with some of the future uncertainties that arise. Adaptive management is particularly useful when the effects of a project are uncertain, and the outcomes of the proposed methods used to avoid, remedy, or mitigate the effects are also uncertain (Warren et al., 2006; Parliamentary Commissioner for the Environment, 2011; Christensen and Jennings, 2013).

The use of adaptive management has been restricted to proposals whereby effects are not likely to be serious and are able to be reversed over time. It has also been acknowledged that there is a need for strict threshold levels to trigger responses to monitoring results (Parliamentary Commissioner for the Environment, 2011). It is seen to be important that, if adaptive management is to be utilised, the decision-maker must be careful to ensure that its objectives are reasonably certain and enforceable. In order to achieve this, a decision-maker may call for further detail in draft management plans so as to be reasonably confident of their success (Christensen and Jennings, 2013).

The applicant must persuade the decision-maker, with enough evidence, to grant consent on the basis of allowing the adaptive management processes to be embarked upon. While
this does not mean that an applicant must try and anticipate all hypotheses that may occur, they must satisfy the decision-maker that the adaptive management plan can operate in a way that will serve the purpose of the RMA to promote sustainable management (Christensen and Jennings, 2013).

Some see the precautionary principle and adaptive management having conflicting aims and therefore cannot be successfully used in conjunction (Jacobson, 2009). In contrast to this, the Parliamentary Commissioner for the Environment (2011) believes that the two can work together and are interdependent, because not only does adaptive management encourage caution and prudence (if negative effects occur, the activity will only be allowed to continue if they are addressed), it is focused on environmental effects so the applicant can decide how best to manage these effects. Furthermore it also stimulates technological innovation, which is particularly important in situations where knowledge about an environment, and the effects of potential activities, is so limited. Adaptive management is a ‘learn as you go’ way of applying the precautionary approach. As the effects become clearer, management techniques are adapted to protect the environment. It may be that the effects are sufficiently serious that adaptive management is not appropriate and therefore the consent should be revoked (Parliamentary Commissioner for the Environment, 2011). While such approaches have been advocated for environmental management for some time, adaptive management has only recently been employed more widely to support the management of natural resources (Warren et al., 2006).
Chapter 4: Research Strategy

4.1 Introduction and experimental design
The research methodology adopted for this study was to survey consent decision-makers to elicit their understandings of uncertainty in the consent process (especially AEE information) and their responses to uncertainty in New Zealand under the Resource Management Act 1991. This chapter explains the research strategy employed in this investigation and the specific research methods used to collect and analyse data. It begins by justifying the use of a questionnaire to collect data, followed by an explanation of the sampling strategy and questionnaire design and pretesting, and the way in which the survey was administered. The methods of data analysis are then described followed by an explanation of ethical and methodological considerations, specifically subjectivity and bias.

4.2 Questionnaires as a method of data collection
Given that there has been little to no research on the issue of uncertainty in resource consent decision-making in New Zealand, it was decided that the most valuable way to approach the research would be to aim to understand the broad approach to uncertainty, rather than focus on a specific case study. Although interviews are capable of yielding more in-depth understanding of an issue, they can be time-consuming to undertake and analyse, thus limiting the number of participants involved in the study. In contrast, questionnaires are capable of gathering information from a larger sample of a broader population that may be geographically dispersed. Questionnaires can be used to gain both qualitative and quantitative information about behaviours, experiences, attitudes, values, interpretations and opinions (McGuirk and O'Neill, 2010; Halperin and Heath, 2012).
Therefore, given the time and resources available, as well as the aim of the research, it was deemed that the most appropriate form of data collection was to use a questionnaire. It was considered to be the most efficient and effective way to obtain broad information about the way in which a large number of decision-makers across the country understand and manage uncertainty.

4.3 Sampling strategy

In order to determine the most appropriate participants to take part in the questionnaire, a number of steps were taken. Firstly, a list of decision-makers who hold a ‘Making Good Decisions’ certificate (both non-local body elected (independent commissioners) and local body elected members (internal commissioners)) was obtained from the MfE website (Ministry for the Environment, 2014). This was used as the sampling frame, or the target population that had the potential to be selected in the sample surveyed (Figure 4.1) (Halperin and Heath, 2012). As there are >1000 individuals who have obtained the certificate (>300 internal commissioners and >700 independent commissioners) it was decided that only a subsample of these would need to be sampled. Rather than take a random sample of this large population (some individuals may not have acted as a decision-maker or may have very little experience), it was decided that a purposive sampling strategy be employed, whereby the sample is selected based on a specific characteristic of a population (Figure 4.1) (McGuirk and O'Neill, 2010). In this case that characteristic was experience.

Figure 4.1: Sampling strategy used to gain a short-list of participants from the population

<table>
<thead>
<tr>
<th>‘Making Good Decisions’ Certificate holders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Independent commissioner deemed ‘frequently used’ by Authority</td>
</tr>
<tr>
<td>Email address available</td>
</tr>
<tr>
<td>Internal commissioner deemed ‘frequently used’ by Authority</td>
</tr>
</tbody>
</table>
While the list of certificate holders has basic information about the individual (for example organisations/council body, field of expertise, geographic location of practice and certificate information) there is no information about the decision-making experience of the individual. Therefore, in order to establish which commissioners were used most frequently and have the most experience, each consenting authority (all city, district, unitary and regional councils) was contacted by email (Appendix X). Of the 78 local authorities contacted, ~60 replied. Authorities that replied to the initial email were then asked whether they were willing to provide contact details (email addresses) for the independent commissioners identified (internal commissioner contact information can be found on local authority websites). While most authorities provided the names of the commissioners most frequently used, not all authorities were able to provide the requested information.

From the information gained, a list of regularly used independent and internal commissioners with contact details was created. A total of 153 independent commissioners and 152 internal commissioners were shortlisted as participants of the study.

While this number could have been reduced further, by refining the sampling frame or undertaking random sampling, it was decided that all 305 of these potential participants be included in the study. This is an important decision as determining the appropriate sample size means also deciding how much error one is willing to tolerate – a large sample is likely to increase precision, but it is also likely to be more costly (Bryman, 2012). Therefore a number of different factors were taken into consideration when making this decision, the first of which is that most surveys are subject to non-response. Although hard to predict and highly variable, there are a number of ways to maximise response rates. Two examples include purposive sampling, because interest in the topic might be strong, and the use of follow-up emails to non-respondents (McGuirk and O'Neill, 2010; Bryman, 2012).

Another important consideration is also the cost of the sample size. Although online questionnaires are relatively financially inexpensive, the larger the sample, the larger the cost in the researcher’s time (emailing and processing data) (Bryman, 2012). In this case, as there was both quantitative and qualitative information being gathered, a balance
between the amount of time needed to process large amounts of qualitative information and the number of samples needed to undertake statistics was taken into account.

Finally, the number of participants required in the sample is dependent on the nature of the population the sample is drawn from. When a population is homogenous (and all have similar characteristics that are of interest rather than heterogeneous where the population is broad and varied) it is less important to have a very large sample, as there is less likely to be a large amount of variation in response (Bryman, 2012).

4.4 Questionnaire design

The questionnaire was developed using literature on uncertainty in IA, resource management, and decision-making (e.g., Geneletti et al., 2003; Tennøy et al., 2006; Brugnach et al., 2007; Jacobson, 2009; Sigel et al., 2010; Duncan, 2013; Larsen et al., 2013). The questionnaire consisted of three parts, the first of which concentrated on participant’s background and decision-making experience. The second part focused on understanding decision-makers’ perceptions of the acceptability of uncertainty as well as the main reasons for uncertainty in the resource consent process. Finally, the third section of the survey aimed to understand the strategies decision-makers used to manage uncertainty in the resource consent.

The questionnaire contained a mixture of both open and closed questions, as both have associated advantages and disadvantages. Closed questions are quick and easy to answer, easy for researchers to process and analyse and easy to compare respondents answers. However, there is the danger when using closed questions, in which respondents are asked to rank items, select categories, or select a point on a scale, that they can lead ‘satisficing behaviour’: that is, they keep reading and ticking until they feel that they have provided a satisfactory answer and then stop. They also rest on the assumption that the words, categories and concepts included carry the same meaning for all respondents and require a deep understanding of all the possible answers (McGuirk and O’Neill, 2010; Bryman, 2012; Halperin and Heath, 2012). A large number of questions were structured using the Likert scale, which measures the intensity of feeling about a statement. It is beneficial, as it does not discriminate against less talkative or articulate participants. Multi-choice questions, ranking questions and yes/no questions were also employed.
Open questions were also utilised, and while they offer less structure than closed questions, they generally have the potential to elicit more in-depth information. Using open questions makes it possible to pose complex questions, and allow respondents to recount understandings, experiences or opinions in their own terms rather than restricting responses. They are capable of yielding valuable, unanticipated insights into people’s experiences, understandings and interpretations as well as their reactions to social processes and circumstances. Open questions also lead to unprompted, detailed and reasoned responses that can reveal logic and rationale behind answers (Halperin and Heath, 2012). However, open questions, while easy to ask, can be difficult to answer and even more difficult, and time consuming, to analyse. There is the tendency for answers to open questions to lack consistency and therefore be difficult to compare (McGuirk and O'Neill, 2010; Bryman, 2012; Halperin and Heath, 2012).

4.5 Pretesting the questionnaire

It is acknowledged that pre-testing a questionnaire with a subsample of the target population can be beneficial. This is not only because pretesting a questionnaire can allow the researcher to assess the merits of questionnaire design, its appropriateness to the audience and whether it does in fact achieve the research aims, but also because any confusion over question wording can be mitigated. This is particularly important when using self-completed surveys, as the researcher is not at hand to clarify the intent of the questions (McGuirk and O'Neill, 2010; Curtis and Curtis, 2011; Halperin and Heath, 2012; Neuman, 2013). Therefore, the questionnaire was pretested with a number of council/consultancy employees, as well as individuals who have worked as a Commissioner on a hearings panel. This was done to fine-tune the questionnaire, ensure that the questions were valid (content and phasing) and reliable.

4.6 Administering the questionnaire

It was decided that the most appropriate method of administering the questionnaire was via the Internet using the survey provider Survey Monkey as not only are the results obtained more quickly than a postal questionnaire (often within the first 24 hours), there is less of a cost involved as no printing or postage costs are included (Lewis-Beck et al., 2003; Halperin and Heath, 2012). Most importantly, it is easier and less time consuming for participants to complete, as they do not have to post it back.
In order to administer the questionnaire, each potential participant was individually contacted via email. The email provided a brief outline of the project and asked whether they were willing to participate in the study (Appendix X). Should they be willing, a link to the online survey was also included in the email. The email was sent on the 25th November 2015 and participants were given until the 20th December 2015 to complete the questionnaire. As recommended by McGuirk and O'Neill (2010) a second email was sent on the 15th December to remind potential participants that if they wished to participate the survey was only open for a few more days.

4.7 Data analysis

The questionnaire received a 34% response rate and in total 103 individuals participated. Following the completion of the questionnaire data analysis was undertaken. In order to analyse the data, Microsoft Excel was used to create a spreadsheet of participants and their responses to the questionnaire.

Quantitative data analysis

The questions in the survey that were quantitative in nature (the closed questions) were analysed by applying pre-established categories to the data. This then allowed frequency counts to be determined for each category. In some cases information was graphed to help identify key trends in the data.

Qualitative data analysis

The open-ended questions were analysed by coding the answers provided. This involved analysing the participant responses and assigning them to different categories. A three-step process was employed to code the information. The first was to employ grounded, or open, coding whereby presumptions and previous knowledge of the subject area are put aside and the researcher concentrates instead on finding themes in the data. This allows codes to emerge from the data as the researcher reads it (Halperin and Heath, 2012). Grounded coding involves constant comparison, every time a researcher selects a passage of text and codes it is compared with all the passages of text that have already been coded. Then, a list of codes and definitions is drawn up to form a coding frame (Halperin and Heath, 2012).
Following this, axial coding was undertaken whereby codes are organised, reviewed and examined. In this process codes can be sorted, broadened, grouped together or deleted, and codes checked and rechecked to ensure that they are applied properly. Axial coding also involves understanding any linkages between themes, concepts and codes, as well as causes and consequences of these linkages. This can also raise new questions, suggest dropping some themes or examining others in more depth. Finally, selective coding was employed. Selective coding occurred after key themes were identified, and involved examining previous codes to identify and select data that supported these themes. While the coding process was used to compare and contrast answers and to detect themes, the original statements in completed questionnaires were constantly referred to in order to retain the subtlety of information (Halperin and Heath, 2012; Neuman, 2013).

Statistical analysis
The use of inferential statistical analysis was not appropriate as there was no basis for assuming that the sample of participants was representative of the overall population of decision makers. Therefore the analysis was largely interpretive, using tables and graphs. In order to further analysis the information gathered cluster analysis was used (Wards method, using squared Euclidean distance on the similarity measure).

4.8 Ethical considerations and approval
Ethics are an important consideration of any social research. The most important ethical principles that need to be considered in survey research are a) participants’ right to privacy b) participants’ voluntary participation c) ensuring no harm is done to participants and d) ensuring that there is no deception or exploitation of participants (Bryman, 2012; Neuman, 2013).

In order to ensure the ethical conduct of this research, before fieldwork and the collection of data began, ethics approval was gained from the University of Otago Geography Department, through the Head of Department (Appendix). An ethics B application, rather than an ethics A, was completed as the investigation did not seek any personal information from the participants, involve any physical or psychological stress and did not involve the participation of minors or vulnerable individuals or put participants under any risk. Participants were asked to provide an email address if they were willing to participate in
key informant interviews or would like a copy of summary results – with no obligation to do so. Personal anonymity and confidentiality was guaranteed to all participants involved in the research meaning that their names would not be attributed to the information obtained (Bryman, 2012; Neuman, 2013). Thus, questionnaire answers were not attributed to any individuals. Furthermore, it was ensured that participants were provided with enough information about the project, its aims and the value of it, before they chose to participate, and all participants involved in the study participated voluntarily of their own accord.

4.9 Methodological considerations

4.5.1 Subjectivity

The data collection and analysis components of this research contained an unavoidable degree of subjectivity. Despite most social research containing this inherent degree of subjectivity, it is still important to acknowledge it. The subjectivity in this research specifically relates to participants’ interpretation of the questionnaire survey and the researcher’s interpretations of their answers. As previously stated, using a survey as the mode of data collection means that the design and wording must be thoroughly considered as the researcher is not present to clarify any of the questions or prompt the participants.

Subjectivity is an important consideration in the design of surveys as both open and closed questions can cause problems if not considered well. Open questions, if poorly worded, can yield highly inconsistent answers, and closed questions rest on the assumption that the words, categories and concepts included, carry the same meaning for all respondents (McGuirk and O’Neill, 2010; Halperin and Heath, 2012). The subjective nature of the interpretation of the questions in the survey was therefore an important consideration of this research. As previously mentioned the survey was pretested, which allowed for some issue to be resolved, however, it is likely that some of the participant’s interpretations of questions differed slightly.

In addition to this, there is considerable subjectivity involved in analysing the responses to the survey. There were a number of ambiguous responses from participants such as “by asking myself what is the reasonable position on the evidence”. The use of the term ‘reasonable’ highlights some of the vagueness of the language that posed problems when analysing data. While each question was initially analysed and coded separately, in
situations where responses the questions were ambiguous, previous responses were examined and often the ambiguity was reduced.

Another consideration that may have increased subjectivity in answers was the participant’s ability to recall details from decisions. Some of the participants have been acting as a decision-maker for a considerable length of time (>20 years) and therefore their ability to recall details from decisions may be hindered, reducing the level of detail or accuracy. Despite the importance of acknowledging the subjectivity present, this does not reduce the credibility or value of research.

4.5.2 Positionality and bias

Some researchers argue that scientific research is not based on values, beliefs, opinions or attitudes or influenced by personal or political views (Neuman, 2013). However, it is acknowledged that the values and personal interests of a researcher can influence a number of different aspects of the research process, for example the choice of research area, and the analysis and interpretation of data (Holliiday, 2007; Bryman, 2012).

Natural resource development can be highly political and controversial. While it is concerned with the natural environment, resource development is also entwined with social, political and cultural values. This research came about due to the researcher’s interest in the EEZ and the two highly political marine consents, which were declined due to the considerable uncertainty in the applications and effects information (Chatham Rock Phosphate Ltd’s application to mine phosphorite nodules on the Chatham Rise and Trans Tasman Resources Ltd’s application to mine iron sand in the South Taranaki Bight). As the current research is not focused on a single case study, the positionality of the researcher is less of a direct issue. Nevertheless it is essential for the researcher to recognise that research cannot be value-free, and for them to act in a self-reflective manner. Rather than burying or denying assumptions, view points, values and preconceptions, this researcher acknowledged them and became highly sensitive to them so that they could be seen past and be put aside (Neuman, 2013).

Therefore, in order to avoid bias, this research was approached in an objective way, and data collection was conducted with an open mind and all viewpoints were considered valid and acceptable. This was done with the intention of separating the researcher’s values from
the findings, as recommended by Neuman (2013). Furthermore, the theoretical framework was developed as a neutral analytical tool through which the results could be evaluated while minimizing bias or conflict of interest and the researcher also maintained a constant self-critical awareness regarding assumptions and values.

4.6 Conclusion
This chapter has established the broad research strategy employed to undertake this research. It explained the use of research methods to collect, process and analyse data. In summary, the research involved a predominantly qualitative approach, and a survey was used to evaluate decision-maker’s perceptions of uncertainty in resource consents in New Zealand. In light of the information presented in this chapter, the following chapters outline and discuss the results that have been obtained from the survey.
Chapter 5: Results

5.1 Introduction
This chapter presents the results of the primary data collection, namely the questionnaire. It first characterises the participant’s experience and professional background, then examines their opinions about sources/causes of uncertainty, their perceptions of uncertainty generally and then considers management strategies used to cope with uncertainty. Finally, the results are analysed further using cluster analysis, as well as broken down based on experience and background of decision-makers.

5.2 General characteristics of decision-makers
This section briefly characterises the participants of the study based upon their decision-making experience, professional background and education. Participants were selected for this study based on the fact that they had been identified by consenting authorities as having experience as a decision-making commissioner. Of the 103 respondents, the vast majority had gained most of their decision-making experience as an independent commissioner (57.1%), while a third had acted mostly as an internal (council) commissioner and only 8.6% had acted in both roles in equal capacities (Table 5.1).

When asked about the number of decision processes individuals had participated in, results showed that respondent’s level of experience was varied: while more than 50% of respondents had made less than 20 decisions and were relatively inexperienced, a small number of participants (16.8%) were very experienced having made more than 100 decisions.
Table 5.1: Participants experience making resource consent decisions under the Resource Management Act 1991, and their qualifications and professional background/occupations.

<table>
<thead>
<tr>
<th>Measure of experience/education and profession (n)</th>
<th>Categories</th>
<th>Percentage of participants (%)</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Role in which most experience was gained (103)</td>
<td>Independent commissioner</td>
<td>57.1</td>
<td>59</td>
</tr>
<tr>
<td></td>
<td>Internal commissioner</td>
<td>34.3</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>Both in equal capacities</td>
<td>8.6</td>
<td>9</td>
</tr>
<tr>
<td>Number of decision processes participated in as a decision-maker (102)</td>
<td>&lt;5</td>
<td>20.8</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>5-10</td>
<td>11.9</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>10-20</td>
<td>16.8</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>20-100</td>
<td>33.7</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>100-500</td>
<td>16.8</td>
<td>18</td>
</tr>
<tr>
<td>Length of time acting as a decision-maker (103)</td>
<td>&lt;5 years</td>
<td>31.4</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>5-10 years</td>
<td>33.0</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>10-20 years</td>
<td>27.2</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>&gt;20 years</td>
<td>8.7</td>
<td>9</td>
</tr>
<tr>
<td>Proportion of decision-makers that have made decisions for each type of consenting authority (103)*</td>
<td>Territorial Authorities</td>
<td>69.9</td>
<td>72</td>
</tr>
<tr>
<td></td>
<td>Regional Councils</td>
<td>40.8</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>Unitary Authorities</td>
<td>19.4</td>
<td>20</td>
</tr>
<tr>
<td>Types of activities most frequently dealt with by decision-makers (103)</td>
<td>Controlled</td>
<td>2.9</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Restricted Discretionary</td>
<td>7.8</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Discretionary</td>
<td>47.6</td>
<td>49</td>
</tr>
<tr>
<td></td>
<td>Non-complying</td>
<td>30.1</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>Do not know</td>
<td>11.7</td>
<td>12</td>
</tr>
<tr>
<td>Proportion of decision-makers that have participated in each types of consent (102)*</td>
<td>Non-notified</td>
<td>42.2</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>Limited Notified</td>
<td>72.5</td>
<td>74</td>
</tr>
<tr>
<td></td>
<td>Fully Notified</td>
<td>88.2</td>
<td>90</td>
</tr>
<tr>
<td>Types of activities most frequently dealt with by decision-makers (103)</td>
<td>A mixture</td>
<td>29.4</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>Subdivision</td>
<td>18.4</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>Land use</td>
<td>17.5</td>
<td>18</td>
</tr>
<tr>
<td>Occupation/main area of professional specialisation (103)</td>
<td>Land use and subdivision</td>
<td>5.8</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Water</td>
<td>14.6</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Traffic and roading</td>
<td>2.9</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Energy</td>
<td>5.8</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Coastal</td>
<td>2.9</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>2.9</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Planner</td>
<td>28.2</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>Councillor/commissioner</td>
<td>24.3</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>RMA lawyer</td>
<td>11.7</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Farmer</td>
<td>6.8</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Environmental scientist</td>
<td>6.8</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Engineer</td>
<td>5.8</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>RMA consultant</td>
<td>4.9</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Landscape architect</td>
<td>2.9</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Police force</td>
<td>2.9</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Cultural expert</td>
<td>1.9</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>3.9</td>
<td>4</td>
</tr>
<tr>
<td>Decision-makers who have completed the ‘Making Good Decisions’ programmes (103)*</td>
<td>Foundation course</td>
<td>97.1</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Recertification for panel members</td>
<td>62.9</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>Recertification for chairs</td>
<td>47.6</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>None</td>
<td>2.9</td>
<td>3</td>
</tr>
<tr>
<td>Highest level of education (102)</td>
<td>Doctor of Philosophy (PhD)</td>
<td>4.9</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Masters Degree</td>
<td>21.6</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>Honours Degree</td>
<td>7.8</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Other Postgraduate Qualification</td>
<td>7.8</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Bachelors Degree</td>
<td>32.4</td>
<td>33</td>
</tr>
<tr>
<td></td>
<td>Certificate/Diploma</td>
<td>10.8</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>11.8</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>None</td>
<td>2.9</td>
<td>3</td>
</tr>
</tbody>
</table>

* Percentages not add to 100 as participants were able to select multiple options
The 78 consenting authorities in New Zealand were quite well represented; participants had made decisions for a total of 67 different councils including every regional council and unitary authority except Chatham Islands Council. Of the 103 participants, 69.9% had made decisions for territorial authorities, 40.8% for regional councils and 19.4% for unitary authorities. Given the proportion of consenting authorities that are unitary authorities and regional councils, the results suggest that these are overrepresented by participants.

The vast majority had made decisions on fully notified consents, and limited notified consents (88.2% and 72.5% respectively), while less than half had dealt with non-notified consents. This suggests that most decisions in which commissioners are used are for consents with some level of notification. In addition, almost a third dealt with a large range of different types of activities (29.4%) while the rest of respondents make decisions on more specific types of activities such as subdivision, land use, energy projects and decisions concerning water (Table 5.1).

While the respondents were dominated by planners (28.2%) and career councillors/commissioners (24.3%), the rest of the participants were from very diverse backgrounds such as environmental science, landscape architecture, farming, the police force, etc. (Table 5.2). Participants were well educated, with three quarters holding a Bachelor Degree or postgraduate qualification.

The vast majority (97.1%) have been accredited through the ‘Making Good Decisions’ programmes, particularly the foundation course. More than half have completed the recertification, while just under half hold the chair certification (62.9% and 47.6% respectively).

5.3 Sources and causes of uncertainty in resource consents

In order to cope with and manage uncertainty, it is first important that decision-makers understand where the uncertainty within a resource consent is coming from, what is causing it, whether it is reducible, and where it is located. Therefore participants were asked a series of questions to understand the types and locations of uncertainty that they believe are present in the resource consent applications.
5.3.1 Types of uncertainty

When asked whether they agree that uncertainty is inherent in resource management, there was a general trend of agreement: almost 72% either agreed or strongly agreed, with only 17% holding the opposite views (Figure 5.1). In contrast there was a more varied response when participants were asked whether they thought that the process itself manufactured uncertainty, with less than 25% agreeing or strongly agreeing, but almost half disagreeing or strongly disagreeing. However, over 25% were also neutral to the question (Figure 5.1).

![Figure 5.1: Degree to which decision-makers agree that uncertainty is inherent in resource management and that uncertainty in resource management applications is manufactured by the process (n).](image)

Results show that the most commonly identified main causes of uncertainty were the inherent complexity of a system (43.6% of participants ranked it first and 28.2% second), and a lack of information (33.0% and 31.3% ranked it first and second respectively). Both conflicting information and too much information were identified as lesser causes of uncertainty, with very little emphasis being placed on too much information as primary cause of uncertainty.

![Figure 5.2: Decision-maker views of the main causes of uncertainty (inherent complexity of a system, lack of information, too much information and conflicting information) in resource management applications under the RMA 1991 (n = 94).](image)
5.3.2 Location of uncertainty

Not only is it important that decision-makers understand the cause of uncertainty, it is also important that they are aware of the location of the uncertainty within the resource management problem. When asked about types of information present in resource consents, which have the most potential for uncertainty to arise, participants identified information in the AEE to be the main area where uncertainty is likely to occur (56% of participants ranked it first) (Figure 5.3).

Uncertainty in the proposal was also believed to be important with 14.3% and 38.8% ranking it first and second respectively. While information in the consultation was also an important cause for uncertainty being ranked first by 22.0%, it was only ranked second by 14.3%. While 7.7% of participants ranked information generated by the hearing as having the most potential for uncertainty, no participants believed that other information was the most likely to have uncertainty arise.

When asked in an open question to identify the most common sources of uncertainty in the resource consent process, Table 5.2 shows that the main source identified was the AEE (39.1%), which supports the findings of the previous question (Figure 5.3). Furthermore, other more specific types of effects information were also identified (such as cumulative effects, amenity/heritage/aesthetic effects), suggesting that almost 60% of participants identified information associated with the AEE as a main source of uncertainty.
Table 5.2: The most common sources of uncertainty in the resource consent process identified by decision-makers (n = 87).

<table>
<thead>
<tr>
<th>Most common source of uncertainty in resource consent process</th>
<th>Percentage of participants (%)</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>The AEE (e.g. prediction of actual effects)</td>
<td>39.1</td>
<td>34</td>
</tr>
<tr>
<td>Lack of robust information/evidence/knowledge (e.g. technical</td>
<td>17.2</td>
<td>15</td>
</tr>
<tr>
<td>Interpretation of the RMA</td>
<td>16.1</td>
<td>14</td>
</tr>
<tr>
<td>Cumulative effects</td>
<td>10.3</td>
<td>7</td>
</tr>
<tr>
<td>Notification process/effects on submitters</td>
<td>9.2</td>
<td>9</td>
</tr>
<tr>
<td>Conflicting evidence presented by different parties</td>
<td>8.0</td>
<td>7</td>
</tr>
<tr>
<td>Uncertainty in outcome of resource consent application</td>
<td>6.9</td>
<td>6</td>
</tr>
<tr>
<td>Poor preparation/deliberate omission of info/bias</td>
<td>8.0</td>
<td>7</td>
</tr>
<tr>
<td>Lack of quantitative effects information</td>
<td>4.6</td>
<td>4</td>
</tr>
<tr>
<td>Amenity/heritage/aesthetic values and effects</td>
<td>3.4</td>
<td>3</td>
</tr>
<tr>
<td>Lack of resources available to applicants (e.g. time/costs to</td>
<td>3.4</td>
<td>3</td>
</tr>
<tr>
<td>Other</td>
<td>4.6</td>
<td>4</td>
</tr>
</tbody>
</table>

*Numbers do not add to 100 as participants provided multiple answers

The lack of robust information/evidence or knowledge, as well as conflicting evidence presented by different parties, were also major causes of uncertainty (identified by 17.2% and 8.0% respectively). Again, this is consistent with a previous question in which a lack of information was identified as a common source of uncertainty in resource consents (Figure 5.2).

A number of specific reasons were identified for the lack of information being presented to the decision panels, including a lack of resources available to applicants/the time and costs associated with a large application (3.4%). One participant elaborated, asserting that:

“Applicants do not want to commit to detailed designs until they are certain an application will be approved and they can obtain funding. Lack of detailed design at the consent application stage makes it difficult to determine the level of effects and often leads to project modifications further down the line.”

The way applicants and consultants behave can also contribute to uncertainty. An example is the poor preparation of applications/applicants deliberately hiding (or being vague about) information and bias (8.0%). One respondent explained that the reasoning for this was that applicants do not want affected parties to know what is going to be applied for:

“Having presented evidence (rather than been a decision-maker) at several hearings uncertainty can be introduced by the applicants team as a way to hide facts that go against their case. Decisions are also made on preconceived ideas held by the decision-makers so by having an understanding of the make-up of the hearing panel, the applicants team can tailor their presentation to sway things their way”

While there were many uncertainties related to the resource consent process identified, there were also a number of legislative uncertainties that a small number of decision-
makers were concerned about. For example, uncertainty in the resource consent process because of the RMA was identified by 16.1% of respondents, in particular the issue of the subjective wording of the RMA, and the different interpretations of parts of the legislation. While participants explained that the broad definition of ‘environment’ causes them problems, the purpose of the RMA and the interpretation and implementation of ‘sustainable management’ was more commonly reported. While it was argued that “the objective is too broad and often subjective”, another participant held a contrasting view that “a more prescriptive approach would remove uncertainty, but reduce the flexibility available to decision-makers to tailor decisions to suit the circumstances of individual applications”.

Finally, 4.6% of applicants identified various other source of uncertainty, such as “the difference between Matauranga (the knowledge, comprehension, or understanding of everything visible and invisible existing in the universe) versus western science” and the interpretation of data presented by expert consultants. One participant explained a number of very interesting sources of uncertainty:

“Inexperience of planners and other professionals, mainly those advising the Council, resulting in poor overall judgment and advice; lack of certainty that consent conditions will be adhered to and that adequate enforcement action will be taken; ability of applicants to obtain incremental consents (the ‘foot in the door’ strategy); multiple layers of consents (e.g. subdivision, land use, regional consents, Special Housing Area overlays); public notification decisions constrained by s95 of the RMA”

These ‘other’ sources of uncertainty that were identified indicate that uncertainty is being caused by a large number of different aspects of the process and occurring in a large number of different areas of resource consents. However, the AEE was seen as the main source of uncertainty.

Uncertainty in effects information

More than 70% agreed or strongly agreed that the process of assessing effects is complex and difficult and therefore effects information often has associated uncertainty (Figure 5.4). However the respondents differed over which aspect of the AEE was most responsible for the uncertainty (Table 5.3).
Participants were particularly focused on having sufficient and reliable information presented in the AEE. The main sources of uncertainty identified by respondents were conflicting information from experts or submitters and inadequate AEEs produced by applicants (lack of robust information, poor research, limited data, etc.) (19.1% and 18.0% respectively). One participant stressed that:

“Applicants do not want to commit to detailed designed until they are certain an application will be approved and they can obtain funding. Lack of detailed design at the consent application stage makes it difficult to determine the level of effects and often leads to project modifications further down the line.”

The subjectivity of effects information (and the difficulty interpreting it) was identified by 9.0% (examples include the analysis of acoustic, visual, social or air quality effects).

Table 5.3: The most common sources of uncertainty in AEE’s as identified by decision-makers (n = 89).

<table>
<thead>
<tr>
<th>Responses</th>
<th>Percentage of participants (%)</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulty in predicting impacts</td>
<td>21.4</td>
<td>19</td>
</tr>
<tr>
<td>Conflicting information from experts or submitters</td>
<td>19.1</td>
<td>17</td>
</tr>
<tr>
<td>Inadequate assessment of effects</td>
<td>18.0</td>
<td>16</td>
</tr>
<tr>
<td>Determining level/significance of effect</td>
<td>12.4</td>
<td>11</td>
</tr>
<tr>
<td>Social/cultural/qualitative effects</td>
<td>12.4</td>
<td>11</td>
</tr>
<tr>
<td>Subjectivity of effects information</td>
<td>9.0</td>
<td>8</td>
</tr>
<tr>
<td>Deliberate omission (or exaggeration) of information / bias</td>
<td>9.0</td>
<td>8</td>
</tr>
<tr>
<td>Impacts relating to aesthetic/amenity/heritage values</td>
<td>6.7</td>
<td>6</td>
</tr>
<tr>
<td>Lack of robust baseline information</td>
<td>5.6</td>
<td>5</td>
</tr>
<tr>
<td>Cumulative effects</td>
<td>4.5</td>
<td>4</td>
</tr>
<tr>
<td>Complexity of the systems being affected</td>
<td>4.5</td>
<td>4</td>
</tr>
<tr>
<td>Assumptions</td>
<td>3.4</td>
<td>3</td>
</tr>
<tr>
<td>Mitigation</td>
<td>2.2</td>
<td>2</td>
</tr>
<tr>
<td>Consultation</td>
<td>2.2</td>
<td>2</td>
</tr>
<tr>
<td>Other</td>
<td>13.5</td>
<td>12</td>
</tr>
</tbody>
</table>

* Numbers do not add to 100 as participants provided multiple answers

Furthermore, 9.0% mentioned the deliberate omission (or exaggeration) of information or bias, including “the deliberately stilted information presented by the applicants”, “the deliberate underestimation of the level of adverse effects so that conditions imposed are
acceptable”, and “submitters deliberately exaggerating adverse effects in an attempt to sabotage the application”. Unidentified, erroneous, unreliable or invalid assumptions were also identified (3.4%).

Participants also mentioned a number of specific elements of the AEE process which cause uncertainty, predominantly the prediction of impacts (21.4%), which is often not completed to a high enough standard (particularly when inconsistent/crude modelling techniques are used and the quality of input data is poor). Similarly, a lack of robust baseline information was also cited as a cause for uncertainty (5.6%). One respondent felt that uncertainty would be reduced if there were a requirement for: “more detailed baseline info and modelling predictions instead of reluctance to invest in the required information”. Furthermore, 12.4% of participants identified that determining the level or significance of effects is the most common source of uncertainty (which is a particular concern when determining whether the effects are more than minor). In saying this, one participant stated that there is “too much of a preoccupation with determining whether effects are minor as opposed to acceptable”. Two individuals (2.2%) felt that uncertainty was mainly caused by proposed mitigation measures to deal with adverse effects; one of them saying:

“The ability to adequately mitigate or manage adverse effects to the satisfaction of affected parties, also an inherent assumption that it is ok to mitigate or manage adverse effects rather than accept that environmental adverse effects are a no-go area (so a pro-development bias within the consenting system)”

Specific types of impacts were also mentioned as key sources for uncertainty. Social/cultural/qualitative effects were identified by 12.4%, while 6.7% of individuals believed that the most common source of uncertainty was assessing the impacts on aesthetic/amenity/heritage values. Cumulative effects were also mentioned (4.5%), particularly the difficulty predicting long term/future impacts of proposal, in particular the impacts on future generations under global change. Finally, 13.5% of respondents believe that the main source of uncertainty came from somewhere else; such examples include:

“The weighing of effects - getting the appropriate balance”

“Lack of experience in recognising an effect and lack of confidence by professional planners in asserting their evaluative (and therefore holistic) expertise against a more readily evidenced technical assessment”

“Also, different levels of ‘risk’ appetite from some different bodies - e.g. regional versus local council on level to which things like possible liquefaction/historic
alluvial fans should be totally avoided (Regional Council perspective often) versus can be adequately mitigated (more often Local Council perspective). Without a crystal ball, difficult to know where the right balance lays between these two.”

5.4 Perceptions of the acceptability and disclosure of uncertainty

Participants were asked a series of questions that aimed to understand how they perceive uncertainty in resource consents, particularly how acceptable it is and the importance of disclosing it (Figure 5.5). While there was variation in the answers provided, more than 50% of participants agreed or strongly agreed that it was acceptable for resource consent applications to be uncertain. On the other hand, a surprisingly large number do not believe it acceptable (just over 30% disagreed or strongly disagreed).

Figure 5.5: Decision-maker perceptions of the presence, acceptability and disclosure of uncertainty in resource consents under the RMA 1991 (n).

Results suggest that when it comes to the level of uncertainty present in resource consents, participants are generally believe the current level of uncertainty is acceptable, and only
30% held the view that the level is too great (Figure 5.5). Overall, most think that uncertainty is acceptable and a large number are comfortable with the existing levels of uncertainty in the consent process.

More than 70% agreed/strongly agreed that applicants should disclose any uncertainty present in the resource consent application, and a similar proportion are happy with, or neutral on the existing levels of disclosure in consent documents. Only one third felt there were some grounds for improvement.

There was broad agreement that decision-makers must accept that uncertainty is present in resource consents and should take it into account and disclose how it was managed. Overall, it seems that there is greater agreement among the respondents about the need for the process to acknowledge and deal with uncertainty, but less agreement on the inevitability and current levels of uncertainty in resource consent processes.

### 5.5 Management of uncertainty in decision-making process

While it is important that decision-makers recognise the presence of uncertainty in resource consents, it is equally important that they manage, and cope with, uncertainty with which they are faced. Participants were therefore asked a series of questions about different management strategies. When asked whether they take steps to manage uncertainty, almost 95% of participants believe that they do (Figure 5.6).

![Graph showing percentage of participants who consider they take steps to manage uncertainty in the resource consent process](image)

*Figure 5.6: Proportion of participants who consider that they take steps to manage uncertainty in the resource consent process (n = 84).*

### 5.5.1 Level of uncertainty

An important facet of managing uncertainty is determining when the level of uncertainty is large/significant enough for it to warrant serious consideration. Therefore participants were asked to explain how they determine whether the level of uncertainty in a consent application is significant enough to affect the final outcome of the decision (Table 5.4).
Overall, there was quite a range of answers, and broadly decision-makers did not have robust strategies, techniques, or methods of analysing evidence, to make the determination.

Table 5.4: The ways in which decision-makers determine whether the level of uncertainty present in a consent is significant enough to affect the final outcome of the decision (n = 79).

<table>
<thead>
<tr>
<th>Responses</th>
<th>Percentage of participants (%)</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>It depends on the robustness of the evidence</td>
<td>16.5</td>
<td>13</td>
</tr>
<tr>
<td>It depends in the significance and/or magnitude of the adverse effect</td>
<td>13.9</td>
<td>11</td>
</tr>
<tr>
<td>Use judgement to decide</td>
<td>13.9</td>
<td>11</td>
</tr>
<tr>
<td>Use experience to decide</td>
<td>11.4</td>
<td>9</td>
</tr>
<tr>
<td>By examining the evidence and questioning at the hearing</td>
<td>8.6</td>
<td>7</td>
</tr>
<tr>
<td>Request more information /adjourn hearing</td>
<td>8.6</td>
<td>7</td>
</tr>
<tr>
<td>Discuss with other decision-makers on decision panel</td>
<td>7.6</td>
<td>6</td>
</tr>
<tr>
<td>By weighing evidence</td>
<td>7.6</td>
<td>6</td>
</tr>
<tr>
<td>By looking at case law and/or if the proposal meets aim of RMA</td>
<td>6.3</td>
<td>5</td>
</tr>
<tr>
<td>Use morals and gut feelings</td>
<td>3.8</td>
<td>3</td>
</tr>
<tr>
<td>Seek other advice</td>
<td>3.8</td>
<td>3</td>
</tr>
<tr>
<td>Other</td>
<td>16.5</td>
<td>13</td>
</tr>
</tbody>
</table>

* Numbers do not add to 100% as participants provided multiple answers

Many of the answers that were provided were simply explaining the process and intuition by which decision-makers made the determination: for example, using judgement or experience (13.9% and 11.4% respectively) or morals and gut feelings (3.8%). Others were influenced solely by the quality, and completeness, of information presented to the decision-maker; for example, 16.5% of participants stated that determining whether or not the level of uncertainty is significant enough to affect the final outcome depends on the robustness of the evidence. Other participants described approaches which sought to reduce uncertainty or better understand it, such as examine the evidence and asking questions at hearing (8.6%) or request more information/adjourn hearing (8.6%).

5.5.2 Strategies used to manage uncertainty

When asked to identify up to six strategies they use to manage uncertainty in the consenting process, respondents provided a very broad range (Table 5.5). There were, however, a number of strategies that are identified by a large proportion of participants. The most commonly reported strategy was to ask questions at the hearing (68.9%). For example, participants explained the need to identify issues of concern early on and ask direct/open questions at hearing to clarify issues until satisfied. In addition, some decision-makers identify the areas that are uncertain and formally request more information from applicant (55.4%). Despite the large number of decision-makers relying on this strategy,
and that it is “the most useful tool available to narrow uncertainty”; one participant stated “the legislation is intent on minimising the options for requesting additional information”.

Furthermore, 31.1% of respondents also mentioned consideration of management options/consent conditions. Specific examples included designing robust monitoring and reporting conditions which address the adverse effects, granting consents for a shorter period if there are significant risks, and utilizing review provisions of the RMA (section 128). Another commonly identified strategy that was identified was to clarify evidence before making a decision (29.7%), a specific example of which was to ensure that information is robust, based on sound research and not biased.

**Table 5.5: Strategies decision-makers identified that are used to manage uncertainty in the consent process (n = 74).**

<table>
<thead>
<tr>
<th>Strategy to manage uncertainty</th>
<th>Percentage of participants (%)</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ask questions of experts at hearing</td>
<td>68.9</td>
<td>51</td>
</tr>
<tr>
<td>Formally request further information</td>
<td>55.4</td>
<td>41</td>
</tr>
<tr>
<td>Consider management options/consent conditions</td>
<td>31.1</td>
<td>23</td>
</tr>
<tr>
<td>Clarify evidence</td>
<td>29.7</td>
<td>22</td>
</tr>
<tr>
<td>Read information and do best to understand (before hearing)</td>
<td>20.3</td>
<td>15</td>
</tr>
<tr>
<td>Look at case law/ seek legal advice/ consider RMA</td>
<td>17.6</td>
<td>13</td>
</tr>
<tr>
<td>Discuss with others decision-makers (and use their experience)</td>
<td>17.6</td>
<td>13</td>
</tr>
<tr>
<td>Talk to planner/ author of planners report</td>
<td>12.2</td>
<td>9</td>
</tr>
<tr>
<td>Adjourn hearing</td>
<td>12.2</td>
<td>9</td>
</tr>
<tr>
<td>Caucusing</td>
<td>10.8</td>
<td>8</td>
</tr>
<tr>
<td>Determine significance of impacts</td>
<td>8.1</td>
<td>6</td>
</tr>
<tr>
<td>Conduct a site visit</td>
<td>8.1</td>
<td>6</td>
</tr>
<tr>
<td>Conduct own research</td>
<td>8.1</td>
<td>6</td>
</tr>
<tr>
<td>Undertake more consultation</td>
<td>8.1</td>
<td>6</td>
</tr>
<tr>
<td>Consider experience/credibility of experts</td>
<td>6.8</td>
<td>5</td>
</tr>
<tr>
<td>Hot tubbing experts - reduces areas of difference</td>
<td>6.8</td>
<td>5</td>
</tr>
<tr>
<td>Ranking/prioritising issues</td>
<td>6.8</td>
<td>5</td>
</tr>
<tr>
<td>Decline consent</td>
<td>6.8</td>
<td>5</td>
</tr>
<tr>
<td>Look at method used in AEE</td>
<td>5.4</td>
<td>4</td>
</tr>
<tr>
<td>Use past experience</td>
<td>5.4</td>
<td>4</td>
</tr>
<tr>
<td>Be open minded</td>
<td>2.7</td>
<td>2</td>
</tr>
<tr>
<td>Other</td>
<td>36.5</td>
<td>27</td>
</tr>
</tbody>
</table>

Numbers do not add to 100 as participants provided multiple answers

Lesser-used strategies included hot-tubbing witnesses (where multiple witnesses are questioned at the same time to reduce areas of difference); ranking/prioritising issues of contention and uncertainty to establish their importance (both 6.8%), and conducting their own research to further understand the issues (8.1%). Furthermore, 8.1% also mentioned the importance of ensuring that the consultation was undertaken properly and in some cases undertaking more, to gain local knowledge of the issues. One participant explains, often submitters will uncover important issues not included in the AEE. Another
participant said “I assume that for many people who submit, there are others that do not because the submission system is unapproachable for many people”. Moreover, 6.8% of participants saw that, when contradictory evidence was being presented, it was important to consider the credibility, validity, qualifications and experience. Finally, 36.5% of respondents mentioned ‘other’ strategies which they use to manage uncertainty; some examples include: using rules of natural justice, focusing on issues and not emotive baggage, imagining what the decision will look like in years to come, being as fair as possible, having a logical structure for decision-making, attempting to resolve issues at prehearing and getting parties to present evidence as well as possible.

While some strategies, such as formally requesting information, conducting one’s own research, undertaking more consultation, caucusing and hot tubbing, were used to reduce uncertainty, other approaches seem to be used to help decision-makers to better understand uncertainty (such as discussing with other decision-makers, talking to the author of the planning report and being open minded). Very few strategies that were identified by decision-makers were strategies used in the face of uncertainty once the presence of uncertainty has been accepted. Considering management options/consent conditions, declining the consent, looking at case law and considering how/whether the proposal meets the aim of the RMA are all strategies which broadly accept uncertainty and are used to help make a decision in the face of it.

Surprisingly, participants mentioned neither the precautionary principle nor adaptive management. While considering management options/consent conditions and declining the consent are strategies that are broadly adaptive and precautionary respectively, it would be presumptuous to suggest that decision-makers were actually using adaptive management and the precautionary principle to manage uncertainty.

5.5.3 Decision-maker perspectives on recognised management strategies
Participants were asked about their views on a number of recognised strategies that can be used to cope with uncertainty in resource consent decision-making.

Reducing uncertainty
There was a general trend of agreement that the most effective way to manage uncertainty is to have more information (~80% agreed/strongly agreed) (Figure 5.7). The large number
of specific strategies that were identified were strategies to gain more information and reduce uncertainty supports this. Participants were also asked about the methods they most frequently used to reduce uncertainty (Figure 5.8). The strategies that were most commonly used to gain more information and reduce uncertainty were to formally request information and consult experts (ranked first or second by ~50% of participants). Talking to applicants or council staff or relying on the documentation provided was moderately used; the least use strategies were to conduct one’s own research and ‘other’.

![Figure 5.7: Degree to which participants agree that the most effective way to manage uncertainty is to have more information about the proposed project (n)](image)

**Figure 5.7: Degree to which participants agree that the most effective way to manage uncertainty is to have more information about the proposed project (n)**

![Figure 5.8: Strategies which decision-makers most commonly used to help to reduce uncertainty in resource consent applications under the RMA 1991 (n=78)](image)

**Figure 5.8: Strategies which decision-makers most commonly used to help to reduce uncertainty in resource consent applications under the RMA 1991 (n=78)**

**Precautionary principle**

When participants were asked what they understood by the term precautionary principle, 55.3% of participants gave answers that could be grouped together as “err on the side of caution” (Table 5.6). For those respondents who believed that caution should be exercised, many reasons were given to justify caution, including: uncertainty or lack of scientific consensus, or potential for significantly adverse (or irreversible) effects.
Although only 5.3% of individuals openly admitted that they did not know what the precautionary principle was (or had never heard of it), a number of definitions provided suggest that a larger proportion of participants lacked an understanding of the principle. For example, a small number provided definitions that were more linked to adaptive management than the precautionary principle, mentioning the need for projects to be adjustable and strictly monitored and if adverse effects arise the project must be altered. Moreover, 7.9% of participants gave definitions that were clearly taken from the Internet (predominantly Wikipedia). For example:

> “if an action or policy has a suspected risk of causing harm to the public or to the environment, in the absence of scientific consensus that the action or policy is not harmful, the burden of proof that it is not harmful falls on those taking an action”.

**Table 5.6: Definitions of the precautionary principle as provided by participants (n = 75).**

<table>
<thead>
<tr>
<th>Definition</th>
<th>Percentage of participants (%)</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Err on the side of caution</td>
<td>55.3</td>
<td>43</td>
</tr>
<tr>
<td>Burden of proof</td>
<td>7.9</td>
<td>6</td>
</tr>
<tr>
<td>If unsure make an effort to understand/do not prejudge the application</td>
<td>6.6</td>
<td>5</td>
</tr>
<tr>
<td>An approach to be used when there is uncertainty or a lack of info</td>
<td>5.3</td>
<td>4</td>
</tr>
<tr>
<td>Adaptive management</td>
<td>3.9</td>
<td>2</td>
</tr>
<tr>
<td>Other</td>
<td>15.8</td>
<td>12</td>
</tr>
<tr>
<td>Do not know/have not heard of it</td>
<td>5.3</td>
<td>4</td>
</tr>
</tbody>
</table>

Percentages may not add to 100% due to rounding

Finally, 15.8% of respondents provided another definition, for example “academic term for common sense” and “precautionary principle is based on anticipating effects on a worst case on their possible spectrum, and considering it or devising conditions accordingly.” Two participants touched on the fact that, while the precautionary principle is inherent in the RMA, it is not defined, meaning that it can be interpreted in a large number of ways.

> “…The absence of, or any uncertainty in, any information should not be used as a reason for postponing or failing to take any measure to achieve the purpose of this Act. It is implicit in the application of the Resource Management Act 1991 however application of the precautionary principle is therefore open to wide interpretation, with similar risks being treated differently by decision-makers…Importantly there was no consensus on the meaning of the term. The meaning of precaution often rests on the values of the individual.”

> “The RMA leaves society’s risk tolerance and risk aversion to the decision-makers to decide. Application of the precautionary principle is open to wide interpretation and can result in similar risks being treated differently with different litigation consequences. Although the RMA does not actually prefer precaution, it is implicit in the way the Act is implemented and defined by case law…Application of a general precautionary principle is within the decision-maker's discretion…”
Given the range of understandings of the precautionary principle, it is no surprise that there was a variety of circumstances in which participants believed that it is an appropriate decision-making option (Table 5.7). The two most commonly mentioned situations were when there are significantly adverse effects associated with a proposal and when there are high levels of uncertainty/little confidence in the evidence (31.4% and 17.1% respectively). Furthermore, 17.1% of individuals provided a specific example of situations in which the use of the precautionary principle is appropriate. Examples include consents relating to climate change, sea-level rise, coastal processes, areas of new technology, the introduction of species, minimum flows on rivers where the data frame is not long, elite soils, natural hazards, salmon farming in Marlborough, the CRL link in Auckland, wastewater management and the first consent under a new plan.

Table 5.7: Situations where use of the precautionary principle is appropriate/not appropriate as identified by decision-makers.

<table>
<thead>
<tr>
<th>Situation (n)</th>
<th>Category</th>
<th>Percentage of participants (%)</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>use is appropriate (70)</td>
<td>Significantly adverse effects</td>
<td>31.4</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>High uncertainty/little confidence in evidence</td>
<td>17.1</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Provided a specific example</td>
<td>17.1</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Only as a last resort</td>
<td>5.7</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Where effects can be managed</td>
<td>5.7</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>In all situations</td>
<td>2.9</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Do not know</td>
<td>11.4</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Other (e.g. poorly prepared application / public concerns)</td>
<td>8.6</td>
<td>6</td>
</tr>
<tr>
<td>use is not appropriate (62)</td>
<td>Where adverse impacts are insignificant or can be easily mitigated</td>
<td>33.3</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>When applications are very detailed and have little uncertainty</td>
<td>23.0</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>When benefits are significant</td>
<td>4.6</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Use is very rarely/never justified</td>
<td>4.6</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>When applications are very poor</td>
<td>3.1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>When effects cannot be mitigated</td>
<td>3.1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Similar previous consents</td>
<td>3.1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Do not know</td>
<td>9.2</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Other (e.g. economic uncertainty/ plan changes)</td>
<td>16.9</td>
<td>11</td>
</tr>
</tbody>
</table>

Percentages may not add to 100% due to rounding

Participants were also asked to identify situations in which they saw the use of the precautionary principle not appropriate. A third of participants believed that it was not appropriate when adverse impacts are insignificant or can be easily mitigated. Many participants also believed its use should be linked to the quality of the application: a large number of individuals thought it not appropriate when applications are very detailed and there is little uncertainty (23.0%).
Adaptive management

When asked to explain what adaptive management meant, again the results were highly variable (Table 5.8). While 19.4% of participants explained that adaptive management meant allowing an activity to proceed but imposing conditions and strict monitoring and adaptation, some saw adaptive management to mean that a project has a flexible management plan or that it was a strategy that involved baseline information, monitoring and review (7.5% and 3.0% respectively) (Table 5.8). Some admitted that they did not know what it meant or had not heard of it (14.9%), and 7.5% of participants chose to provide the Wikipedia definition of adaptive management:

“Adaptive management (AM), also known as adaptive resource management (ARM), is a structured, iterative process of robust decision-making in the face of uncertainty, with an aim to reducing uncertainty over time via system monitoring.”

<table>
<thead>
<tr>
<th>Definition</th>
<th>Percentage of participants (%)</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allowing an activity to proceed but imposing conditions and strict</td>
<td>19.4</td>
<td>13</td>
</tr>
<tr>
<td>monitoring and adaptation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adapting an activity to reduce adverse effects</td>
<td>16.4</td>
<td>11</td>
</tr>
<tr>
<td>Staged project that is only able to move on if affects are acceptable</td>
<td>10.4</td>
<td>7</td>
</tr>
<tr>
<td>Provided the ‘Wikipedia’ definition</td>
<td>7.5</td>
<td>5</td>
</tr>
<tr>
<td>Flexible management plan</td>
<td>7.5</td>
<td>5</td>
</tr>
<tr>
<td>Learning by doing</td>
<td>3.0</td>
<td>2</td>
</tr>
<tr>
<td>Baseline information, monitoring and review</td>
<td>3.0</td>
<td>2</td>
</tr>
<tr>
<td>Be very careful using it</td>
<td>3.0</td>
<td>2</td>
</tr>
<tr>
<td>Do not know/have not heard of it</td>
<td>14.9</td>
<td>10</td>
</tr>
<tr>
<td>Other (e.g. “change when change is required”)</td>
<td>14.9</td>
<td>10</td>
</tr>
</tbody>
</table>

Percentages may not add to 100% due to rounding

Participants were asked to indicate situations in which the use of adaptive management would be appropriate (Table 5.9). The most common response to the question was that they were unsure and did not know when it was appropriate (16.1%). Although participants did consider uncertainty when determining when the use of adaptive management is appropriate, their opinions were not consistent: 12.9% of participants stated that they thought that it was appropriate when there is uncertainty, however some participants were more specific, stating that they thought that it was only appropriate when risks and uncertainty are low (11.3%).

A number of participants (11.3%) gave a specific example of a situation suited to adaptive management including Marlborough Salmon farming and geothermal energy extraction.
Finally, 14.5% of participant’s responses were categorised as ‘Other’. Examples include situations where submitters are nervous and are appearing on a ‘once only’ basis on an issue which is vital to them, and projects involving ecological enhancement.

Table 5.9: Situations where use of adaptive management is appropriate/not appropriate as identified by decision-makers.

<table>
<thead>
<tr>
<th>Situation (n)</th>
<th>Category</th>
<th>Percentage of participants</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>When there is uncertainty (or when effects are unknown or there is a lack</td>
<td>When there is uncertainty (or when effects are unknown or there is a lack</td>
<td>12.9</td>
<td>8</td>
</tr>
<tr>
<td>of robust information)</td>
<td>of robust information)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>When risks/uncertainty is low</td>
<td>When risks/uncertainty is low</td>
<td>11.3</td>
<td>7</td>
</tr>
<tr>
<td>Specific example</td>
<td>Specific example</td>
<td>11.3</td>
<td>7</td>
</tr>
<tr>
<td>Where there is a robust monitoring programme</td>
<td>Where there is a robust monitoring programme</td>
<td>8.1</td>
<td>5</td>
</tr>
<tr>
<td>All situations</td>
<td>All situations</td>
<td>6.5</td>
<td>4</td>
</tr>
<tr>
<td>Where it will achieve its goals and achieve a positive outcome</td>
<td>Where it will achieve its goals and achieve a positive outcome</td>
<td>6.5</td>
<td>4</td>
</tr>
<tr>
<td>When project is staged and effects can be reduced</td>
<td>When project is staged and effects can be reduced</td>
<td>6.5</td>
<td>4</td>
</tr>
<tr>
<td>Technological advancement</td>
<td>Technological advancement</td>
<td>3.2</td>
<td>2</td>
</tr>
<tr>
<td>When effects will change over time</td>
<td>When effects will change over time</td>
<td>3.2</td>
<td>2</td>
</tr>
<tr>
<td>Do not know</td>
<td>Do not know</td>
<td>16.1</td>
<td>10</td>
</tr>
<tr>
<td>Other</td>
<td>Other</td>
<td>14.5</td>
<td>9</td>
</tr>
<tr>
<td>Use is appropriate (62)</td>
<td>Use is inappropriate (58)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Significant adverse impacts</td>
<td>Significant adverse impacts</td>
<td>31.0</td>
<td>18</td>
</tr>
<tr>
<td>High levels of certainty</td>
<td>High levels of certainty</td>
<td>22.4</td>
<td>13</td>
</tr>
<tr>
<td>Should be used in all situations</td>
<td>Should be used in all situations</td>
<td>5.2</td>
<td>3</td>
</tr>
<tr>
<td>Do not know</td>
<td>Do not know</td>
<td>17.2</td>
<td>10</td>
</tr>
<tr>
<td>Other</td>
<td>Other</td>
<td>24.1</td>
<td>14</td>
</tr>
</tbody>
</table>

Percentages may not add to 100% due to rounding

Participants were also asked when the use of adaptive management would not be appropriate. A third of participants stated that adaptive management was not appropriate when adverse effects are significant, while just under a quarter believed it inappropriate that when there are high levels of certainty about the project and its impacts. There were many other suggestions, but these two categories accounted for half of the total responses.

5.5.4 Guidance and support for decision-makers managing uncertainty

Just under two thirds of respondents held the view that they were given no guidance about how to manage uncertainty arising in the consent process (Figure 5.9). Of those who believe that they had been given guidance, most said it mainly came from the Making Good Decisions course, and as advice from planners or the planning report (42.3% and 34.6% respectively) (Table 5.10). While case law was mentioned, decision-makers indicated that they relied on more informal guidance (such as discussions with other decision-makers and information on the Quality Planning website).
Figure 5.9: Proportion of participants who consider that they are provided with guidance (formal or informal) on how to manage uncertainty (n = 84).

Table 5.10: Explanation of the specific guidance that participants believe that they are given (n = 30).

<table>
<thead>
<tr>
<th>Type of guidance</th>
<th>Percentage of participants (%)</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Making good decision course</td>
<td>36.7</td>
<td>11</td>
</tr>
<tr>
<td>Advice from planners/planning report</td>
<td>30.0</td>
<td>9</td>
</tr>
<tr>
<td>Case law</td>
<td>13.3</td>
<td>4</td>
</tr>
<tr>
<td>Other</td>
<td>16.7</td>
<td>5</td>
</tr>
<tr>
<td>Not specified</td>
<td>3.3</td>
<td>1</td>
</tr>
</tbody>
</table>

Percentages may not add to 100% due to rounding.

Those who felt that they were not provided with guidance were asked whether they thought there was a need for more guidance (Table 5.11). A large proportion believed it would be useful (40.0%), and felt that MfE needed to provide better guidance through the ‘Making Good Decisions’ programme and that decision-makers should be provided with guidelines, checklists or ongoing updates. One individual asserted that “Yes, there is a need for guidance because uncertainty does not need to be a cause for paralysis”.

Table 5.11: Views of participants who believe that they are not given guidance, on whether guidance is needed (n = 44).

<table>
<thead>
<tr>
<th>Is guidance needed?</th>
<th>Percentage of participants (%)</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>40.0</td>
<td>22</td>
</tr>
<tr>
<td>No</td>
<td>18.2</td>
<td>10</td>
</tr>
<tr>
<td>Not specified</td>
<td>41.8</td>
<td>23</td>
</tr>
</tbody>
</table>

Percentages may not add to 100% due to rounding.

Those who did not believe that guidance was necessary (18.2%) explained that as every case is different, it is difficult/risky to provide guidance or that the management of uncertainty was the responsibility of the decision-maker and required their judgement. Despite that, overall participants were open to the idea of having guidance with more than 50% of participants either believing that they are given guidance, or stating that they would
find guidance useful. Another theme that emerged was the importance of experience. 16.5% of respondents either relied on their own experience, or thought that experience was vital in order to be able to manage uncertainty well.

Participants were asked to rank factors that have helped decision-makers to cope with uncertainty (Figure 5.10). Background/area of expertise and personal experience in decision-making were the most influential factors in helping decision-makers understand and manage uncertainty (both ranked either first or second by ~60% of participants). While an individual’s qualifications and advice from council staff were less relied on, the ‘Making Good Decisions’ programme as well as advice from other decision-makers were reported as an important secondary sources of assistance, especially the latter.

![Figure 5.10: Factors that have helped decision-makers to be able to understand and manage uncertainty in the decision-making process (with 1 being the most and 7 least) (n = 80).](image_url)

**5.6 Further analysis of results**

In order to understand better how decision-makers perceive, understand, and manage uncertainty further analysis of the results was undertaken. Cluster analysis was used to explore whether there were observable groupings among respondents based on their answers to certain indicator questions. Second, the link between attitudes to uncertainty and professional background was examined more closely.
5.6.1 Perceptions of uncertainty

It is acknowledged within the literature that different individuals will have different perceptions about the acceptability and importance of uncertainty, and that there are many different factors that can influence one’s perceptions. Therefore, rather than analyse decision-makers’ perceptions based upon the broad characteristics of participants, a cluster analysis was undertaken with the aim of understanding whether there were in fact clear differences in the decision-makers perceptions about the acceptability and importance of disclosure of uncertainty. The questions used are shown in Table 5.12. The cluster analysis (Ward’s method, using squared Euclidean distance for the similarity measure) produced six groups, each of which had a distinct perception of uncertainty (Figure 5.11 and Table 5.12). Characteristics of the groups (such as education, background, decision-making expertise) were examined, to explore possible reasons for shared attitudes.

The cluster analysis suggests that decision-makers are far from unanimous in their views of uncertainty; in fact there are some fundamental differences in the perceptions of uncertainty. As the dendrogram shows (Figure 5.11) groups one to four are distinct from groups five and six. Groups one through four are distinguished by their general acceptance of uncertainty, its level and the way in which it is communicated; groups 5 and 6 are less accepting of uncertainty. Looking more closely at groups one to four, group one is the largest grouping in the analysis so represents a more widespread set of views; groups two and three are considerably smaller, representing sub-groups of respondents with subtly different perspectives. All three groups are accepting of uncertainty in resource consents, but have varied attitudes about the level of uncertainty, applicant disclosure and the role of the decision-maker. Group four is rather distinct in a number of ways. As a group they are relatively dismissive of uncertainty. For example, although they do not believe the presence of uncertainty is acceptable, they believe the level of uncertainty is fine, which may indicate that the do not believe that there is uncertainty in the consents process. Furthermore, for the most part they do not agree that decision-makers need to accept and take into account uncertainty. Interestingly, the group is quite experienced with all participants having more than 20 decisions experience (with all but one individuals having more than 100). Also, of the five group members, three hold no qualifications other than the ‘Making Good Decisions’ certificate. They also consider that the majority of the uncertainty in the resource consent process comes from the interpretation of the RMA and whether or not the consent application will be granted.
Table 5.12: Summary statistics for cluster analysis, showing the most common response to questions about the presence and disclosure of uncertainty (mode) and the percentage of respondents in each group who answered with the mode (%) for each cluster group

<table>
<thead>
<tr>
<th>Cluster</th>
<th>Descriptive stats</th>
<th>Mode answer</th>
<th>Agree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>It is acceptable for resource consent applications to be uncertain.</td>
<td>%</td>
<td>73.0</td>
<td>70.3</td>
<td>70.3</td>
<td>51.4</td>
<td>75.7</td>
<td>75.7</td>
</tr>
<tr>
<td>2</td>
<td>The level of uncertainty present in resource consent applications is too great and it needs to be reduced.</td>
<td>%</td>
<td>100.0</td>
<td>80.0</td>
<td>60.0</td>
<td>40.0</td>
<td>40.0</td>
<td>80.0</td>
</tr>
<tr>
<td>3</td>
<td>It is essential that applicants disclose any uncertainty present in the resource consent application.</td>
<td>%</td>
<td>63.6</td>
<td>54.5</td>
<td>36.4</td>
<td>45.5</td>
<td>81.8</td>
<td>45.5</td>
</tr>
<tr>
<td>4</td>
<td>Uncertainty within resource consent applications is inadequately disclosed, poorly communicated and difficult to understand.</td>
<td>%</td>
<td>80.0</td>
<td>60.0</td>
<td>40.0</td>
<td>40.0</td>
<td>80.0</td>
<td>40.0</td>
</tr>
<tr>
<td>5</td>
<td>Decision-makers must accept that uncertainty is present in resource consents and it must be taken into account in the decision-making process.</td>
<td>%</td>
<td>80.0</td>
<td>66.7</td>
<td>60.0</td>
<td>73.3</td>
<td>73.3</td>
<td>53.3</td>
</tr>
<tr>
<td>6</td>
<td>It is vitally important that decision documents disclose this uncertainty and how it has been addressed.</td>
<td>%</td>
<td>76.2</td>
<td>52.4</td>
<td>57.1</td>
<td>47.6</td>
<td>57.1</td>
<td>71.4</td>
</tr>
</tbody>
</table>

Interesting and noteworthy characteristics of each group:

- **Cluster 1**: Mixture of experience, >50% with more than 20 decisions. Nearly 60% hold MGD chair certificate.
- **Cluster 2**: 70% Independent Commissioners. Mixture of experience, >50% with more than 20 decisions. Nearly 60% hold MGD chair certificate.
- **Cluster 3**: 70% Independent Commissioner. Mixture of experience, >50% with more than 20 decisions. Nearly 60% hold MGD chair certificate.
- **Cluster 4**: 45% hold MGD chair certificate. 60% with > 20 decisions. >50% planners.
- **Cluster 5**: 45% hold MGD chair certificate. 60% with > 20 decisions. >50% planners.
- **Cluster 6**: 50% Independent Commissioner without any qualifications other than the MGD (2 Police Officers & a farmer). All made > 20 decisions (most >100). Mostly believe that uncertainty comes from RMA and outcome of consent.
Figure 5.11: Dendogram showing the clustering of decision-makers based on their responses to questions relating to the acceptability, communication and disclosure of uncertainty.
Groups five and six, together making up a third of the total number of participants, are the more concerned about uncertainty. While group five are accepting of uncertainty, group six can be characterised as the most apprehensive/averse to uncertainty: they do not agree that it is acceptable for applications to be uncertain. Both groups agree that the current level of uncertainty needs to be reduced and that applicants must disclose uncertainty. Group five agree that applicants are not adequately communicating uncertainty, however group six are neutral. Both groups place a high importance on decision-makers accepting uncertainty, taking it into account and disclosing it in the decision documents. In both groups, more than 50% of the decision-makers had made less than 20 decisions with only one individual in each group having more than 100 decision experiences.

Overall, the analysis shows some fundamental differences amongst the decision-makers, not clear unanimity. There are a number of factors which may play a part in these differences. For example, groups five and six, being the two groups which are most concerned about uncertainty, appear to be the two least experienced groups. Not only that, they are also made up of a larger proportion of decision-makers who predominantly gained their experience as internal commissioners. In contrast, groups two and four, which seem broadly to be least concerned with uncertainty (almost dismissive of it) seem to be more predominantly made up of experienced decision-makers and independent commissioners.

5.6.2 Understanding and managing uncertainty
Decision-makers believed that the most important factors that helped them to understand and manage uncertainty were background/area of expertise and experience as decision-makers (Figure 5.10). To investigate this further, decision-makers’ understanding of uncertainty and management strategies used to cope with uncertainty were analysed on the basis of background and experience. The participants were divided according to their experience (one group with >20 decisions and one with <20 decisions), their commissioner status (internal and independent commissioners) and their professional background (Councillors/career commissioners, environmental scientists/ engineers, planners/RMA consultants, RMA lawyers and other). Responses to different questions were analysed based upon the different groups. The use of chi-square tests on the frequency tables was considered, however there were too many categories and not enough responses to make the test viable, especially for the analysis of background/discipline, so the following interpretation is qualitative.
Although the behaviour of the groups is similar in many ways, there are subtle differences in the way in which the different groups understand and manage uncertainty, and certain groups have tendencies to behave in certain ways.

*Understanding sources and causes of uncertainty*

The results suggest that those with less experience placed more emphasis on uncertainty in information generated by the consultation and submissions process, and less on information in the AEE, than those with more experience. Internal commissioners were also more concerned with public involvement and less with the AEE than independent commissioners. Both Environmental Scientists/Engineers and RMA Lawyers placed more emphasis on uncertainty arising in the AEE than the other groups and those decision-makers with a background that was classified as ‘other’ presented quite unique opinions, believing uncertainty was more likely to arise in the hearing and proposal than other groups.

![Bar chart showing decision-maker views of the types of information with the greatest potential for uncertainty to arise in resource management applications (ranked 1st), by experience (number of decisions made and type of commissioner) and background/professional specialisation (n).]

*Figure 5.12: Decision-maker views of the types of information with the greatest potential for uncertainty to arise in resource management applications (ranked 1st), by experience (number of decisions made and type of commissioner) and background/professional specialisation (n).*

Decision-makers’ views about the main causes of uncertainty were also broken down based on the same professional groups and experience attributes (Figure 5.13). When classified according to experience, the responses show little difference; however, on the basis of commissioner type, the independent commissioners seem to place less emphasis
on the inherent complexity of a system and more on a lack of information than internal commissioners, although the differences are subtle. However, there is considerably more variation in the results when looking at the decisions-makers in terms of their background. Planners/consultants and Environmental Scientists/Engineers hold broadly similar views, while Lawyers (and to a lesser extent Councillors/career commissioners) consider that too much information is a greater cause of uncertainty than other groups. Again, the participants with ‘other’ backgrounds (e.g. cultural experts, farmers and police officers) presented quite distinct results, considering uncertainty to be predominantly caused by the inherent complexity of a system and conflicting information. Many of the individuals who make up this group are also represented the cluster analysis group four, which was also a very distinct group with unique views (Section 5.6.1).

The responses to questions about the specific reason for, and location of, uncertainty in resource consents and AEEs were analysed in the same way (Table 5.13). Decision-makers with >20 decisions experience gave a wider range of reasons for uncertainty in the resource consent and the AEE than those with less experience. Independent commissioners placed more emphasis on the AEE and the difficulty in predicting impacts as sources of uncertainty than internal commissioners, who strongly highlighted bias and the deliberate omission of information in both the consent process broadly, as well as the AEE.
When looking at the decisions-makers background there is also considerable variation in the sources of uncertainty that were identified. Councillors/career commissioner identified uncertainty caused by conflicting information and the inadequate assessment by applicants, and being fairly ambivalent to specific source of uncertainty related to the AEE.

**Table 5.13: Decision-makers views about the most common sources of uncertainty in the resource consent process and AEE, by experience (number of decisions made and type of commissioner) as well as background/ professional specialisation.**

<table>
<thead>
<tr>
<th>Locations or/ reason for uncertainty</th>
<th>All decision-makers</th>
<th>Number of decisions made</th>
<th>Role in which decisions were made</th>
<th>Occupation/ main area of profession/specialisation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Individuals with &gt;20</td>
<td>Dependents</td>
<td>&quot;Councillor/ Environmental Scientist/Engineer&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>decisions made</td>
<td>decisions experience</td>
<td>&quot;Commissioner/ Environmental Engineer&quot;</td>
</tr>
<tr>
<td>The AEE (e.g. prediction of actual</td>
<td>39.1</td>
<td>35.6</td>
<td>46.4</td>
<td>&quot;Planner/ RMA consultant&quot;</td>
</tr>
<tr>
<td>effects)</td>
<td></td>
<td>48.1</td>
<td>22.2</td>
<td>&quot;RMA Lawyer&quot;</td>
</tr>
<tr>
<td>Lack of robust information/evidence</td>
<td>17.2</td>
<td>11.9</td>
<td>28.6</td>
<td>&quot;Other&quot;</td>
</tr>
<tr>
<td>Interpretation of the RMA</td>
<td>16.1</td>
<td>11.9</td>
<td>25.0</td>
<td></td>
</tr>
<tr>
<td>Cumulative effects</td>
<td>10.3</td>
<td>6.8</td>
<td>17.9</td>
<td></td>
</tr>
<tr>
<td>Notification process/effects on</td>
<td>9.2</td>
<td>10.2</td>
<td>7.1</td>
<td></td>
</tr>
<tr>
<td>submitters</td>
<td></td>
<td>9.3</td>
<td>11.1</td>
<td></td>
</tr>
<tr>
<td>Conflicting evidence</td>
<td>8.0</td>
<td>6.8</td>
<td>10.7</td>
<td></td>
</tr>
<tr>
<td>Uncertainty in outcome of</td>
<td>6.9</td>
<td>8.5</td>
<td>3.6</td>
<td></td>
</tr>
<tr>
<td>application</td>
<td></td>
<td>7.4</td>
<td>8.5</td>
<td></td>
</tr>
<tr>
<td>Poor preparation/deliberately hiding</td>
<td>8.0</td>
<td>8.5</td>
<td>7.1</td>
<td></td>
</tr>
<tr>
<td>info/bias</td>
<td></td>
<td>5.6</td>
<td>14.8</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>4.6</td>
<td>6.8</td>
<td>1.9</td>
<td></td>
</tr>
<tr>
<td>Lack of quantitative effects</td>
<td>4.6</td>
<td>3.4</td>
<td>7.1</td>
<td></td>
</tr>
<tr>
<td>information</td>
<td></td>
<td>7.4</td>
<td>9.3</td>
<td></td>
</tr>
<tr>
<td>Amenity/heritage/aesthetic values</td>
<td>3.4</td>
<td>5.1</td>
<td>3.7</td>
<td></td>
</tr>
<tr>
<td>and effects</td>
<td></td>
<td></td>
<td>3.7</td>
<td></td>
</tr>
<tr>
<td>Lack of resources available to</td>
<td>3.4</td>
<td>5.1</td>
<td>3.7</td>
<td></td>
</tr>
<tr>
<td>applicants</td>
<td></td>
<td></td>
<td>3.7</td>
<td></td>
</tr>
<tr>
<td>n</td>
<td>89</td>
<td>59</td>
<td>28</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source of uncertainty in the AEE</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulty in predicting impacts</td>
<td>21.4</td>
<td>22.6</td>
<td>20.7</td>
<td>30.4</td>
</tr>
<tr>
<td>Conflicting information</td>
<td>19.1</td>
<td>12.9</td>
<td>22.4</td>
<td>16.1</td>
</tr>
<tr>
<td>Inadequate assessment by applicants</td>
<td>18.0</td>
<td>29.0</td>
<td>12.1</td>
<td>19.6</td>
</tr>
<tr>
<td>Other</td>
<td>13.5</td>
<td>12.9</td>
<td>13.8</td>
<td>10.7</td>
</tr>
<tr>
<td>Determining level/significance of</td>
<td>12.4</td>
<td>6.5</td>
<td>15.5</td>
<td>10.7</td>
</tr>
<tr>
<td>effect</td>
<td></td>
<td></td>
<td>11.5</td>
<td>5.0</td>
</tr>
<tr>
<td>Social/cultural/qualitative effects</td>
<td>12.4</td>
<td>16.1</td>
<td>10.3</td>
<td>16.1</td>
</tr>
<tr>
<td>Subjectivity of effects information</td>
<td>9.0</td>
<td>9.7</td>
<td>8.6</td>
<td>12.5</td>
</tr>
<tr>
<td>Aesthetic/amenity/heritage values/</td>
<td>6.7</td>
<td>9.7</td>
<td>5.2</td>
<td>8.9</td>
</tr>
<tr>
<td>impacts</td>
<td></td>
<td></td>
<td>3.8</td>
<td>10.0</td>
</tr>
<tr>
<td>Lack of robust baseline information</td>
<td>5.6</td>
<td>3.6</td>
<td>6.9</td>
<td>8.9</td>
</tr>
<tr>
<td>Deliberate omission of information</td>
<td>5.6</td>
<td>6.5</td>
<td>5.2</td>
<td>7.1</td>
</tr>
<tr>
<td>Cumulative effects</td>
<td>4.5</td>
<td>12.9</td>
<td>5.4</td>
<td>5.4</td>
</tr>
<tr>
<td>Complexity of the systems being</td>
<td>4.5</td>
<td>6.5</td>
<td>3.4</td>
<td>5.4</td>
</tr>
<tr>
<td>affected</td>
<td></td>
<td></td>
<td>3.8</td>
<td>5.0</td>
</tr>
<tr>
<td>Assumptions</td>
<td>3.4</td>
<td>9.7</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Expert bias</td>
<td>3.4</td>
<td>6.5</td>
<td>1.7</td>
<td>-</td>
</tr>
<tr>
<td>Mitigation</td>
<td>2.2</td>
<td>3.2</td>
<td>1.7</td>
<td>-</td>
</tr>
<tr>
<td>n</td>
<td>89</td>
<td>58</td>
<td>31</td>
<td>56</td>
</tr>
</tbody>
</table>

*Numbers do not add to 100 as participants provided multiple answers*

Environmental scientists/ Engineers placed a lot of importance on the difficulty in predicting impacts and the complexity of the system being affected, and interestingly the
deliberate omission of information and bias. Planners and RMA consultants described a large range of different reasons for uncertainty. They highlight the uncertainty around the notification and consultation, as well as in the social/cultural/qualitative effects information and the difficulty interpreting subjective effects information.

Not surprisingly, Lawyers emphasised the uncertainty that comes from the subjectivity of interpreting the RMA. More interestingly they also highlighted the importance in determining level/significance of effect, however this may be that an important part of the decision-making process is to determine whether the effects are more/less than minor. The group of lawyers also expressed concern for the uncertainty caused by not having enough quantitative effects information and the subjectivity of interpreting effects information suggesting that they prefer the evidence to be certain.

Again, the group of decision-makers with ‘other’ backgrounds presents a unique set of results. Not only did the group not present a very wider range of results, they also identified determining level/significance of effect and social/cultural/qualitative effects as the main reasons for uncertainty (which no other group did).

Management of uncertainty

When looking at the strategies that were used by decision-makers to manage uncertainty, a number of interesting patterns that emerge (Table 5.14). Regardless of group, two strategies that were more commonly relied on to cope with uncertainty were asking questions of experts at hearings and formally request further information. The use of ‘other’ strategies was also common, with the exception of Planners/RMA consultants.

While the most commonly used strategies for both groups were to ask questions of experts at hearing and to formally request further information, when compared to those with less experience, those with more experience used a slightly wider range of strategies to cope with uncertainty. Not only that, they also relied on more direct procedural strategies: considering management options/consent conditions; adjourning the hearing; talk to planner/author of planners report; caucusing; undertaking more consultation; hot tubbing experts; declining consents.
Table 5.14: Strategies decision-makers identified that are used to manage uncertainty in the consent process by experience (number of decisions made and type of commissioner) as well as background/ professional specialisation.

<table>
<thead>
<tr>
<th>Management strategy</th>
<th>All decision-makers</th>
<th>Number of decisions made</th>
<th>Commissioner role</th>
<th>Occupation/ main area of professional specialisation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Environmental Engineer/ Scientist</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Individuals with &gt;20</td>
<td>Independent</td>
<td>Planner/RMA Consultant</td>
</tr>
<tr>
<td></td>
<td></td>
<td>decisions experience</td>
<td>Commissioners</td>
<td>RMA Lawyer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Individuals with &lt;20</td>
<td>Internal</td>
<td>Other</td>
</tr>
<tr>
<td></td>
<td></td>
<td>decisions experience</td>
<td>Commissioner</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ask questions of</td>
<td>68.9</td>
<td>74.3</td>
<td>65.8</td>
<td>97.3</td>
</tr>
<tr>
<td>experts at hearing</td>
<td></td>
<td></td>
<td>66.7</td>
<td>46.7</td>
</tr>
<tr>
<td>Formally request</td>
<td>55.4</td>
<td>54.3</td>
<td>57.9</td>
<td>75.7</td>
</tr>
<tr>
<td>further information</td>
<td></td>
<td></td>
<td>40.0</td>
<td>50.0</td>
</tr>
<tr>
<td>Other</td>
<td>36.5</td>
<td>37.1</td>
<td>36.8</td>
<td>40.5</td>
</tr>
<tr>
<td>Consider management</td>
<td>31.1</td>
<td>42.9</td>
<td>21.1</td>
<td>56.8</td>
</tr>
<tr>
<td>options/conditions</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clarify evidence</td>
<td>29.7</td>
<td>20.0</td>
<td>39.5</td>
<td>37.8</td>
</tr>
<tr>
<td>Read information &amp;</td>
<td>20.3</td>
<td>17.1</td>
<td>23.7</td>
<td>29.7</td>
</tr>
<tr>
<td>do best to</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>understand</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case law/ seek</td>
<td>17.6</td>
<td>20.0</td>
<td>15.8</td>
<td>5.4</td>
</tr>
<tr>
<td>legal advice/</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>consider RMA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discuss with</td>
<td>17.6</td>
<td>17.1</td>
<td>18.4</td>
<td>21.6</td>
</tr>
<tr>
<td>others decision-</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>makers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Talk to planner/</td>
<td>12.2</td>
<td>17.1</td>
<td>7.9</td>
<td>16.2</td>
</tr>
<tr>
<td>author of planners</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>report</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjourn hearing</td>
<td>12.2</td>
<td>17.1</td>
<td>7.9</td>
<td>10.8</td>
</tr>
<tr>
<td>Cauising</td>
<td>10.8</td>
<td>20.0</td>
<td>2.6</td>
<td>18.9</td>
</tr>
<tr>
<td>Determine</td>
<td>8.1</td>
<td>11.4</td>
<td>5.3</td>
<td>16.2</td>
</tr>
<tr>
<td>significance of</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>impacts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conduct a site</td>
<td>8.1</td>
<td>8.6</td>
<td>7.9</td>
<td>2.7</td>
</tr>
<tr>
<td>visit</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conduct own</td>
<td>8.1</td>
<td>8.6</td>
<td>10.5</td>
<td>10.8</td>
</tr>
<tr>
<td>research</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Undertake more</td>
<td>8.1</td>
<td>11.4</td>
<td>5.3</td>
<td>5.4</td>
</tr>
<tr>
<td>consultation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consider experience</td>
<td>6.8</td>
<td>8.6</td>
<td>2.6</td>
<td>5.4</td>
</tr>
<tr>
<td>credibility of</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>experts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hot tubbing</td>
<td>6.8</td>
<td>8.6</td>
<td>2.6</td>
<td>10.8</td>
</tr>
<tr>
<td>experts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ranking/prioritising</td>
<td>6.8</td>
<td>8.6</td>
<td>5.3</td>
<td>5.4</td>
</tr>
<tr>
<td>issues</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decline</td>
<td>6.8</td>
<td>8.6</td>
<td>2.6</td>
<td>8.1</td>
</tr>
<tr>
<td>consent</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Look at method</td>
<td>5.4</td>
<td>-</td>
<td>5.3</td>
<td>5.4</td>
</tr>
<tr>
<td>used in AEE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use past experience</td>
<td>5.4</td>
<td>2.9</td>
<td>7.9</td>
<td>10.8</td>
</tr>
<tr>
<td>Be open minded</td>
<td>2.7</td>
<td>-</td>
<td>5.3</td>
<td>2.7</td>
</tr>
<tr>
<td>n</td>
<td>74</td>
<td>48</td>
<td>21</td>
<td>36</td>
</tr>
</tbody>
</table>

*Numbers do not add to 100 as participants provided multiple answers

In addition, there seems to be a difference in the strategies used, based on whether or not a decision-maker has primarily acted as an internal or independent commissioner. A large proportion of independent commissioners reported that they ask questions at the hearing and formally request information. When compared to independent commissioners, very few internal commissioners mentioned considering consent conditions, determining the significance of impacts, caucusing or declining consent.

When looking at the occupation/ main area of specialisation of participants, there are a number of interesting findings. Councillors/career commissioners placed emphasis on the determination of the significance of impacts and conducting their own research, but did not mention using consent conditions or declining the consent. Scientists predominantly used
strategies that reduce uncertainty or allow them to better understand uncertainty (asking questions of experts at hearing, formally requesting further information, clarifying evidence and reading information and doing their to best to understand).

Planners and RMA consultants predominantly ask questions of experts at hearings and formally request further information, and were the least reliant on ‘other’ strategies. They also placed considerable emphasis on the use of consent conditions and management options. Lawyers relied more on the consideration of management options/consent conditions, looking at case law/ seek legal advice/ considering whether the proposal meets the purpose of the RMA, caucusing, declining consents and ‘other’ strategies than other groups. They were also the group that provided the fewest number of strategies, not mentioning many strategies that were identified by other groups.

*Recognised management strategies*

It is clear from the results that decision-makers are primarily using strategies to understand and reduce uncertainty, rather than approaches which are used once the level of uncertainty is accepted. Therefore, the decision-makers’ understanding of the precautionary principle and adaptive management were not analysed further.

*Support for understanding and managing uncertainty*

It comes as no surprise that those with >20 decisions experience considered that their experience was the most helpful factor, while those with less experience relied more on their background and area of expertise (Figure 5.14). Those who had primarily gained their experience as internal commissioners relied less on their background/ area of expertise, and more on the ‘Making Good Decisions’ programme and advice from council staff compared to independent commissioners. Environmental scientists and lawyers relied primarily on their background and area of specialisation compared to other professional groups, lawyers and planners relied the least on the ‘Making Good Decisions’ programme.
5.7 Overview of findings

The results of this investigation show that decision-makers perceive there to be a wide range of reasons for uncertainty in the resource consent process. The most widely reported reasons for uncertainty were the lack of effects information, conflicting information and the inherent uncertainties associated with particular types of information. In addition, there was variability in participant’s views about acceptability of uncertainty, as well as whether or not the current level of uncertainty is too large. In saying this, the majority agree that applicants and decision-makers have a responsibility to acknowledge and communicate uncertainty.

When it comes to the management of uncertainty, the approaches used are many, and highly variable. However the majority of strategies are used with the aim of better understanding or reducing uncertainty. No participants mentioned that they use the precautionary principle or adaptive management to manage uncertainty. When asked about the two strategies specifically, there was substantial variation in definitions and situations.
deemed appropriate for their use. In saying this, although some participants were unsure of the strategies or their use, many made links to uncertainty. Despite decision-makers being divided when it came to whether or not they were given guidance, they were predominantly relying on their experience in decision-making and professional background to assist them in understanding and managing uncertainty. The majority of participants were open to the idea of being provided guidance to manage uncertainty.

The analysis of the link between a decision-maker’s background and experience and their views of, and approaches, to uncertainty suggest that indeed different groups do tend to behave differently. Those with more experience provided a larger range of reasons for uncertainty, but predominantly were concerned with uncertainty related to the AEE, while those with less experience were also concerned with the interpretation of the RMA and of terms such as cumulative effects. Those with more experience also relied more heavily on direct procedural strategies. Independent commissioners placed more emphasis on effects information, and provided a wider range of management strategies, but relied most heavily on asking questions at the hearing, formally requesting information, and considering consent conditions than internal commissioners. The groups with different professional specialisations also seem to behave differently. Lawyers were one of the most distinct groups, particularly when it came to the management of uncertainty, identifying the use of consent conditions as the primary way to manage uncertainty, an approach that other groups placed considerably less importance on. Planners and RMA consultants relied more heavily on specific steps in the consent process to manage uncertainty, while scientists mostly used strategies to reduce and understand uncertainty.
Chapter 6: Discussion

6.1 Introduction
The primary aim of this research is to understand the role of uncertainty in resource consent decision-making in New Zealand, particularly within the effects information. This chapter discusses the key findings outlined in chapter five in relation to the theoretical concepts in chapter two. Decision-makers’ views of uncertainty are addressed first, then the uncertainty that occurs in the resource consent process is characterised. Following this, the management strategies employed by decision-makers are considered and evaluated, and the wider implications of findings are considered. The chapter closes with some reflections on the study as a whole.

6.2 Decision-makers’ views of uncertainty in resource consents
Participants in this investigation provided a wide range of different reasons for uncertainty arising in the resource consent process. While this may suggest that uncertainty is widespread, the participants largely agreed that it is acceptable for resource consent applications to contain uncertainty, and that it is important that decision-makers take that into consideration and where necessary disclose it in decision documentation. This suggests that they recognise that there will be situations in which they have to make decisions based on uncertain evidence. This is an important finding, because if decision-makers are not accepting of uncertainty, they can end up acting in a short-sighted manner, denying that the uncertainty exists and proceeding without caution, or, in contrast, they may be defensive and hypervigilant, delay decisions unduly, or obsessively collect more
information in an attempt to reduce the uncertainty (Janis, 1977; Etzioni, 2001; Vlek, 2004; Larsen et al., 2013).

There was considerably more variation in decision-maker views about whether the level of uncertainty present in resource consent applications is too great and needs to be reduced. The literature suggests a number of possible reasons for this. For example, their attitude towards risk: while some decision-makers feel uncomfortable and anxious about uncertainty, which limits their ability to problem solve, others may be more relaxed about uncertainty and are able to function as usual. The level of uncertainty individuals are willing to accept also depends on the magnitude of damage that is likely to occur. Uncertainty is often more easily accepted if the benefits of the proposal are large, the effects are not severe, and the consequences are familiar and to some extent controllable (Vlek, 2004).

The decision-makers who participated in this study have different experiences of the process, in terms of numbers of decisions made, differing degrees of complexity and controversy, and different levels of uncertainty in the applications. Therefore, it is likely that those experiences will have shaped how they view the need to reduce uncertainty. Finally, as explained in section 2.3.2, decision-makers’ perceptions of uncertainty can be affected by their experience with the generation of effects information: those with more experience may perceive higher levels of uncertainty than those who have not been involved (MacKenzie, 1993; Duncan, 2008, 2013)(Figure 6.1).

Figure 6.1: Individuals possible perceptions of uncertainty based upon their experience and involvement in the production of effects information.
Decision-makers in this investigation mostly agreed that it is essential for applicants to communicate uncertainty but had varied views about the adequacy of current practices. This may be because some individuals are happy to read between the lines, while others may need it explicitly explained. On the other hand it may simply be due to the variable quality of the applications (Arts et al., 2001; Geneletti et al., 2003; Tenøy et al., 2006; Duncan, 2008; Wardekker et al., 2008; Leung et al., 2015; Lees et al., 2016; Leung et al., 2016). This is discussed further in section 6.3.1.

**6.3 Causes of uncertainty in the resource consent process**

The results suggest that there are many possible causes of uncertainty in the resource consent process, a finding that is supported by the research literature. However, the causes can be grouped into four broad categories (Figure 6.2): uncertainty caused by the quality of the effects information; inherent uncertainty; uncertainty caused by conflicting information; and uncertainty caused by the consent process itself. Each of these categories is by no means discrete; many of the uncertainties explained could be characterised in different ways, and fit into multiple categories. Despite this, the four categories are a convenient way of simplifying a complex and interconnected characteristic of resource management. The following sections discuss each of these broad categories of uncertainty in more detail, with particular emphasis on the quality of effects information.

![Figure 6.2: Four broad classifications of uncertainty identified by decision-makers.](image)

**6.3.1 Quality of effects information**

Poor quality effects information can cause uncertainty in a number of ways. Firstly, a large number of decision-makers identified the lack of effects information as a main cause uncertainty, which is not surprising as a lack of knowledge is one of the most common causes of uncertainty in environmental decision-making (Zimmermann, 2000; Van Asselt
and Rotmans, 2002; Ascough Ii et al., 2008). Specific reasons reported by participants for the lack of information include lack of robust information or technical information, poor research methods, lack of proper analysis, insufficient use of experts, insufficient attention given to contentious issues and limited data collection, etc.

Applicants not dedicating enough resources to the applications also caused uncertainty for participants. The quality of the effects information can be directly affected by the proponent’s commitment to the project (Morgan, 2012). More specifically, Morrison-Saunders et al. (2001) found that one of the main reasons for poor quality of effects information was insufficient financial resources and time dedicated to the application (particularly to baseline data collection, prediction of impacts and EIS preparation).

The deliberate omission (or exaggeration) of information by biased applicants or experts also created uncertainty for decision-makers in this study. While the use of expert opinions is indispensable in resource management, they cannot be viewed unquestioningly as objective and unbiased (Beder, 1993; Morgan, 1998; Kontic, 2000; Wang et al., 2006; Noble, 2010; van Bree and van der Sluijs, 2014). Tennøy et al. (2006) found that one of the reasons for uncertainty in effects information was due to bias. Schijf (2003) suggested that while some consent applications in her study were very objective, others were far from it - applications were slanted, advocating for the proposed development, or contained specific problems that reduced the objectivity of the information such as suggestive language or lack of support for predictions. Although a number decision-makers in this investigation recognised that experts may exhibit bias that view may not be shared by all decision-makers, and it is interesting that Fougère (2013) found that the decision-makers for the Escarpment Mine on the Denniston Plateau application in Westland, New Zealand, treated the experts as unquestionably objective.

**Improving the quality of effects information**

The quality of effects information, and the uncertainty it causes, is an important factor that has the potential to influence the quality of decision-making. Although many sources of uncertainty in resource management are inherent, or very difficult to reduce, there are several ways in which the quality of effects information can be improved. First, applicants could be provided with guidance about the importance of disclosing and communicating uncertainty, and ways in which to do that (Arts et al., 2001; Geneletti et al., 2003; Tennøy
et al., 2006; Duncan, 2008; Wardekker et al., 2008; Leung et al., 2015; Lees et al., 2016; Leung et al., 2016). While there are difficulties with the development of guidance, there are examples of guidance material which could be drawn on, particularly from the Netherland’s Environmental Assessment Agency (Janssen et al., 2003; Petersen et al., 2003; van der Sluijs et al., 2003; Dessai and van der Sluijs, 2007; Kloprogge et al., 2007; Petersen et al., 2010; Petersen et al., 2013).

It is worth mentioning that although there are many techniques which can be used to reduce uncertainty in effects information (including, but by no means limited to, sensitivity analysis, scenario analysis, fuzzy logic and increased data collection), if applicants can reduce it, or even remove it, then there is less need to disclose and communicate it. However, it is still important that applicants understand the importance of disclosing and communicating uncertainty (Phillips, 2005; Stenton, 2006; Cardenas and Halman, 2016). It is also important that decision-makers are aware that applicants often have a vested interest in making proposals and effects information defensible, and therefore some may systematically seek to minimize uncertainty disclosure (Duncan, 2008; Allen and Gunderson, 2011; Leung et al., 2015). Therefore, even in situations where uncertainty is disclosed, decision-makers should not solely rely upon what is disclosed, they should undertake a deeper consideration of an applicant’s narrative and see through the smokescreen of applicants’ certainty about what was actually uncertain (Duncan, 2008; Allen and Gunderson, 2011; Duncan, 2013; Leung et al., 2015).

Another option that could be considered to reduce expert bias and improve the quality of effects information is to use independent consultants to produce the AEE. Rather than have proponents hire and pay impact assessors, applicants would be charged for the IA and the relevant authority (or an independent body) would contract out the work to independent consultants (Beder, 1993; Morgan, 2000; Wood et al., 2000). However, Morgan (1998) believes that it is unlikely that there would be a shift away from the status quo in New Zealand as it would require significant changes to institutional arrangements. Therefore, a more practical and reasonable suggestion is to introduce a formal accreditation process for consultants, as it would help lift the quality of the effects information by ensuring that it is undertaken by appropriately qualified and experienced practitioners (Fuller, 1999; Wood, 2003). Although there is no government led initiative for an accreditation process in New Zealand, the Environmental Institute of Australia and New Zealand (EIANZ) has
established a number of endorsements and certifications which aim to ensure that practitioners meet high standards of professional and ethical conduct, as well as acknowledge highly qualified, specialised and experienced individuals (Environmental Institute of Australia and New Zealand, 2012; Certified Environmental Practitioner Scheme, 2016a, 2016c, 2016b).

Finally, the quality of effects information is likely to improve if the expectations are raised. The reviewing procedure in the New Zealand resource consent process is intended to assess the ‘completeness’ of applications prior to them being considered by decision-makers. There are a number of issues with this process. Although there have been observations of inconsistent reviewing practices (Barnes, 2000; Morgan, 2000; Ministry for the Environment, 2014), it is more important that the system recognises that the reviewing process is not just a matter of simply checking that effects information has all the required and relevant content. According to impact assessment theory, a review should also consider the quality and success of the whole IA process, the experience of practitioners, the project type, the communication of information and public participation (Barker and Wood, 1999; Weston, 2000; Morrison-Saunders et al., 2001; Jalava et al., 2010). The reviewing process in New Zealand is not as rigorous as this: while there are provisions for specialists to audit the consent (RMA Section 41C(4) and 92(2)), there is no mention of an assessment of the quality of information, or of the process by which it was gained.

**6.3.2 Inherent uncertainty**

Inherent uncertainties were mentioned by a number of the decision-makers in the questionnaire. The literature suggests that no matter the issue, there will always be uncertainty due to natural variability and complexity of systems (Walker et al., 2003; Lawrence, 2004; Mesa-Frias et al., 2013). Decision-makers in this study identified a number of inherent uncertainties, one of which was the prediction of impacts (and the determination of their level/significance). Leung et al. (2016) found similar results in her study of decision-makers in Canada. Although there is usually considerable room for the improvement of prediction (especially when it comes to determining the significance of impacts), there is often also considerable and unavoidable inherent uncertainty associated with the prediction and determination of the significance of impacts, as the process is very subjective (De Jongh, 1988; Morris and Therivel, 2001; Benson, 2003; Tennøy et al.,...
2006; Jay et al., 2007; Noble, 2010). For example, Noble (2010) argues that the process of determining significance is highly subjective and is essentially making an informed judgement about the importance of effects. Furthermore, while there are often thresholds for effects on the biophysical environment, there are no recognised standards for socio-economic impacts; therefore, often the line between being significant or not extends over a range of values that are built on perceptions, as much as facts (Glasson et al., 2013).

Cumulative effects (the impacts of a project that interact with past, present, and reasonably foreseeable actions that collectively generate significant environmental change) are important considerations in IA, and are required to be considered in the resource consent process. In practice they are often not addressed or handled adequately, and can be a major cause for uncertainty (Morgan, 1998; Duinker and Greig, 2006; Noble, 2010). Leung et al. (2016) found that the identification and assessment of cumulative impacts was the most commonly reported sources of uncertainty in IA; in contrast, this study found that they were only identified by a small number of decision-makers. Since the inception of the Canadian Environmental Assessment Act 1995, cumulative effects have been a major focus in both theory and practice, and Canadian decision-makers may be more sensitised to the way in which cumulative effects are assessed and communicated, meaning that they very aware when assessments are insufficient and uncertainty is present. In addition the scope of the Canadian IA system differs to that of NZ meaning that only large projects require an EIA, which may be more likely to have complex cumulative impacts (Wood, 2003; Duinker and Greig, 2006).

Another source of uncertainty that was identified by decision-makers was the qualitative and subjective effects information (such as social or cultural effects and amenity values). Because of the broad definition of ‘environment’ in the RMA, there are many different components of the environment that need to be considered in the IA process, meaning that the way in which impacts are measured, and the type of information gained, can vary. Therefore, decision-makers will often be presented with both qualitative and quantitative information. There has been a long running debate in the literature concerning whether decision-makers’ needs are met most efficiently and effectively by quantitative or qualitative impact predictions (Cashmore et al., 2004). Some argue that where possible, all impact predictions should be quantified. However, in practice, decision-makers will be confronted with qualitative information about societal systems, their values and the
possible impacts on them; it is an intrinsic aspect of resource management. Societal systems are ever changing and variable, extremely complex, driven by differing attitudes and behaviours, and thus inherently uncertain (Wilson and Bryant, 1997; Vanclay, 2003; Walker et al., 2003; Brugnach et al., 2007; Ascough Ii et al., 2008). Although participants in this study feel that qualitative impact information can cause uncertainty in consent process, the decision-making process does involve weighing facts and values and making trade offs (Wood, 2003; Morrison-Saunders and Pope, 2013). Uncertainty associated with qualitative information is one component that decision-makers have to learn to manage; it is not likely to go away.

Implications of inherent uncertainty

It is important to acknowledge that, of course, the prediction, determination of significance, and the assessment of qualitative and cumulative effects can be poorly completed, resulting in poor quality effects information. However, decision-makers should be aware of the inherently complex and difficult nature of these processes, and that there will always be some uncertainty associated with them. If one attempts to reduce inherent uncertainty, financial resources and time will usually be wasted; therefore, decision-makers must consider the nature, cause and reducibility of uncertainty before making a judgement as to whether there is a need to reduce that uncertainty (Walker et al., 2003; Berkes, 2007; Ascough Ii et al., 2008; Mesa-Frias et al., 2013; van Bree and van der Sluijs, 2014). Decision-makers in this investigation placed more emphasis on uncertainty associated with the quality of effects information than the inherent nature of other factors causing uncertainty. While they may believe that the effects information they are provided with is insufficient in amount and quality, it may also be possible that they are not distinguishing between inherent uncertainty, and an applicant’s failure to provide adequate information. This is an important consideration, as it will directly affect the choice of management strategy.

6.3.3 Conflicting information

Another source of uncertainty that was mentioned many times throughout the questionnaire was the presence of conflicting information and the associated uncertainty. Resource management often involves differing interests, and decision-makers are frequently presented with evidence and effects information from parties with conflicting values or opinions. Participants commented that conflicting evidence came about due to
differing opinions of applicants, opponents, experts, and submitters, and often came to light in the preparation for the hearing and at the hearing itself.

In a study of a New Zealand wind farm development (Phillips, 2005), there was little agreement between experts about the visual impacts of the proposal, and the decision-makers reported that it was not possible to determine which expert was right or wrong, making the decision particularly difficult considering that there was little way of remedying or mitigating the impacts. Similarly, Schijf (2003), studying effects information in New Zealand consent processes, found that disagreement between experts often resulted in conflicting information. When working through this, decision-makers were more likely to place increased importance on the source of the information, relying on the reputation of an expert, rather than thoroughly scrutinising the information provided.

6.3.4 Uncertainty about resource consent decision-making
Some decision-makers expressed concern about uncertainty caused by the resource consent process, and in particular the subjectivity and interpretation of the term ‘sustainable management’ in the RMA, which has long been recognised as fraught with difficulties (Harris, 1993; Dormer, 1994). The major cause for uncertainty lies with the interpretation of the word ‘while’ as it determines the weight given to the substantive part of section 5(2) and the latter half (section 5(2)(a-c)).

**Box: Section 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

Although it was intended that ‘while’ should be read as ‘at the same time as’ and that matters in 5(a-c) are non-negotiable bottom lines that must be met in all cases (Armstrong, 2014; Environment Foundation, 2016), the judiciary very quickly began to interpret it differently. Decision-makers have tended to treat Section 5(2) as the superior clause and therefore ecological, economic, social and cultural matters are given equal consideration (consistent with the ‘overall broad judgement’ approach, which renders the purpose of the
RMA very flexible). Despite the outcome of Environmental Defence Society Inc. v New Zealand King Salmon Company Limited case, in which ‘while’ was determined to mean ‘at the same time as’, it is still too early to assess whether this will influence future practice and decisions (Armstrong, 2014; Environment Foundation, 2016).

The results of this study show that, despite the King Salmon decision, decision-makers still see a lack of clarity in the way in which the purpose should be interpreted, causing them uncertainty in the resource consent decision-making process. The ‘Making Good Decisions’ documentation has not clarified this for decision-makers, but does urge more of a ‘broad judgement approach’ (Ministry for the Environment, 2015). On the purpose of the Act, the guidance states that (page 33):

“An overall judgement based on the weighing of the relevant RMA factors (particularly those in part two) is required: applying the RMA in practice involves a broad judgment of whether a proposal would promote the sustainable management of natural and physical resources. The act has a single purpose in this regard. Making a decision often involves weighing up the significance of different factors and considerations, some of which maybe conflicting. Having said this, because of the RMA is not simply about achieving a balance between benefits in adverse effects preparing from the committee is about considering overall impact of a proposal”

This is an issue which needs clarification and it will take time for the implications of King Salmon to become clear.

6.3.5 Conclusion

Decision-makers in this investigation have identified many sources of uncertainty that have the potential to emerge from almost all areas of the resource management process. Some uncertainties are reducible, or avoidable, while others are inherent and need to be accepted. Some of these sources may be important enough that decision-makers take them into account in the final decision while others may be easy to over come and have no impact on the final decision. The following section discusses the ways in which decision-makers manage uncertainty in resource management.

6.4 Management of uncertainty

6.4.1 Broad characterisation of uncertainty management

Simply acknowledging uncertainty in resource management is not sufficient; uncertainty needs to be actively managed in the decision-making process. Therefore, this study aimed
to understand and evaluate the management strategies used by decision-makers to cope with uncertainty in the resource consent process. Just over 90% of decision-makers surveyed actively take steps to manage uncertainty they are confronted with, but the approaches taken are anything but consistent.

Although the strategies used are diverse and large in number, figure 6.3 simplifies this by considering them with respect to the broader context of the resource consent process. Some strategies are used in specific parts of the decision-making process, while others are used throughout. Another way to consider the management strategies is to consider the approach to uncertainty. Some strategies used by the decision-makers in this study can be broadly characterised as passive responses to uncertainty, such as being open minded and using past experience. However, the majority were mechanisms or techniques by which uncertainty could be either better understood or reduced, so adopting a more active approach in responding to the uncertainty. In contrast, very few were strategies that could be used to cope in the face of uncertainties were mentioned.

Figure 6.3: Strategies used by decision-makers to cope with uncertainty in the context of the resource consent and decision-making process. Blue = passive responses to uncertainty; Orange = active strategies used to understand / reduce uncertainty; and green = accepting strategies that are used in the face of uncertainty.

6.4.2 Strategies used to understand and reduce uncertainty
Decision-makers in this study placed considerable emphasis on reducing uncertainty, the specific strategies for which are usually implemented early in the decision-making process.
The hearings, and preparation for the hearing, appear to be an opportunity for decision-makers to clarify and manage uncertainty.

The two most commonly reported strategies used to understand and reduce uncertainty were formally requesting more information (under Section 92 (1 and 2)) and asking questions at the hearing. More than half the participants in this study rely on requesting more information, which is consistent with the fact that, on average, a third of all consent applications have further information requests (Ministry for the Environment, 2014). Despite the reliance on gaining further information, there are a number of issues associated with the process. One participant stated, “the legislation is intent on minimising the options for requesting additional information”. While streamlining and shortening the consent process and sharpening the processing of consents, the Resource Management Amendment Act 2009 (simplifying and streamlining), has placed time limits on consent processing times, and reduced the number of times councils can ‘stop the clock’ after information requests to twice (Section 88C). This means that if further information is requested more than twice, the council has to continue to process the application whilst waiting for the information. Moreover, if the applicant refuses, a council must still make a decision on the application under section 104 (Ministry for the Environment, 2009). Therefore, although formally requesting further information is heavily relied upon, decision-makers will not always be given the information they need to understand and reduce the uncertainty. The result of this pressure on councils to reduce the time and costs associated with the consent processing is that the decision-making process can be inhibited (Ericksen et al., 2001; Schijf, 2003).

In addition, the reduction of uncertainty by gaining more information is seen to be a more traditional approach, which as previously mentioned, may not always make the uncertainty more manageable (Walker et al., 2003; Ascough Ii et al., 2008; Kaspersen, 2008; Isendahl et al., 2010a; Mesa-Frias et al., 2013; van Bree and van der Sluijs, 2014). Before dedicating resources to reducing uncertainty, the nature, reducibility, level and relative importance/significance should be considered, otherwise efforts may be futile and resources wasted. Only those uncertainties which are critical for decisions to be made should be targeted with further analysis, to understand to what extent they can be reduced by further research and assessment (Peel, 2005; Kaspersen, 2008). Results suggest that only a small proportion of decision-makers are considering the importance of uncertainty
before attempting to reduce it: less than 20% of participants mentioned strategies which
took into account the level of uncertainty (ranking/prioritising issues of contention to
establish their importance and determining the significance of impacts); and when asked
about how they determine whether the level of uncertainty present in an application is
significant enough to affect the final outcome of the decision, only a small proportion of
participants made the connection between uncertainty and its significance or relevance to
the decision outcome.

The results suggest that, rather than causing uncertainty, the hearings process is a gateway
for decision-makers to understand, reduce and manage uncertainty. The most commonly
reported strategy was to identify issues of concern early on and ask direct/open questions at
hearing to clarify issues. Moreover, one fifth of decision-makers explained that they read
information thoroughly and do their best to understand all of the information in order to be
prepared for the hearing. The ‘Making Good Decisions’ documentation places substantial
emphasis on ensuring that decision-makers are equipped and prepared for resource consent
hearings and provides considerable guidance on how to approach asking questions in
hearings (Ministry for the Environment, 2015)

A strategy that a small number of decision-makers used to reduce uncertainty associated
with conflicting information was to consider the experience/credibility of expert witnesses.
As noted earlier, this is not without problems. Isendahl et al. (2010b) advocates that a more
useful strategy is to further understand the reasoning and judgement behind an expert’s
recommendations or opinions, rather than solely relying on their credentials or experience.
The ‘Making Good Decisions’ guidance supports this, suggesting that decision-makers
consider the grounds on which an experts opinion is based, whether the opinions expressed
are based on correct facts and valid assumptions as well as their experience and
qualifications, objectivity, credibility and integrity (Ministry for the Environment, 2015: 194).

One strategy that is useful in managing and reducing uncertainty, but was only mentioned
by a small number of participants, is undertaking public consultation. This is surprising
considering a large proportion of decision-makers mentioned uncertainty associated with
social systems. Public consultation is a vital, and beneficial, step in both the IA process and
the resource management process (when determined necessary under the RMA). By
undertaking robust, or additional, public consultation, decision-makers can gain insights into the ‘social system’ that is likely to be affected by the activity in question, gain valuable local knowledge and reduce uncertainty (Dougherty and Hall, 1995; Newig et al., 2005).

6.4.3 Passive responses to uncertainty

There were a number of strategies which can be broadly described as passive strategies, that were used to cope with uncertainty including using past experience and discussing with other decision-makers. As there is little to no guidance provided to decision-makers about uncertainty, it comes as no surprise that decision-makers are falling back on such intuitive coping strategies. Communication is an important approach to managing uncertainty; it can be used to understand uncertainty, or others’ perspectives about uncertainty, to alleviate uncertainty, or to negotiate the most appropriate way forward (Isendahl et al., 2009; Raadgever et al., 2011). Discussing uncertainty with other decision-makers is likely to occur when a group of decision-makers are appointed, but is a less viable option when an individual is making decisions alone. Individuals may gain valuable insights by discussing uncertainty with other decision-makers, but it may also mean that the responsibility is pushed onto those who are more experienced.

While a small number of participants identified the use of past experience as a management strategy, the majority of participants felt that their professional background and experience in decision-making were the two factors which assist them most in understanding and managing uncertainty. As previously discussed, experience is an important factor which influences an individual’s attitude towards uncertainty (Fazey et al., 2005; Upham et al., 2009). The results of this investigation suggest that commissioners have varied levels of experience (both in number of decisions made, years active, types of consent applications, and types of activity. Etc.). This may mean that if decision makers are relying heavily on experience, it could introduce inconsistency into the approaches to uncertainty. Moreover, if decision-makers are drawing on professional background, there is the possibility that this allows even more variation into the process, as the participants of this study came from many areas of specialisation. This is discussed in more detail in section 6.5.
6.4.4 Strategies used in the face of uncertainty

The last group of strategies is used by decision-makers acting consciously in the presence of uncertainty (Larsen et al., 2013). This is an important group of strategies as often in certain scenarios uncertainty will be inherent or irreducible and will therefore need to be thoroughly considered. Decision-makers described three strategies that could be used once uncertainty was ‘accepted’: considering case law and how/whether the proposal meets the purpose of the RMA; considering management options and consent conditions; and declining the consent.

Decision-makers’ use of case law to guide decisions made in light of uncertainty is in line with the findings of Schijf (2003) who stated that decision-makers place considerable weight on the importance of legal precedence. Partly this is because they may be vulnerable to legal challenges if they ignore it. But it also provides solid examples to compare current consent applications to, and it is easier to rely on practical examples than guidance and generally worded policies or ambiguous plan rules.

As explained in Chapter 3, under Section 108 of the RMA decision-makers can impose conditions on a consent. The ‘Making Good Decisions’ documentation stresses that “conditions are an important part of the resource consent because they are the main way of ensuring that any adverse environmental effects of an activity are avoided, remedied or mitigated and that good information gathering occurs” (Ministry for the Environment, 2015: 227). Guidance is also provided to assist in producing fair, practical and enforceable conditions. However, very little information is provided about specific types of conditions, and there is no reference to uncertainty in this context. In contrast, Quality Planning (2016) explains that, in situations where there is uncertainty about some adverse effects, a range of consent conditions can be implemented, such as:

- monitoring/investigating and reporting conditions, which can be useful when there is uncertainty about adverse effects;
- ‘trigger and response’ conditions, which can be used so that if a certain situation occurs, there is a restriction on the exercise (for example, when the flow in a river drops below a specified level, the amount of the discharge into the river must reduce);
- a ‘review condition’, which allows councils to review the conditions of a consent in the future – it gives them flexibility to address specific significant adverse effects that might arise.
If consent conditions are to be used to manage uncertainty successfully, they must be adhered to, monitored, and enforceable. The Ministry for the Environment (2014) survey of consent authorities, suggests that monitoring and enforcement practices are variable. For example, about 5% only undertake ‘reactive monitoring’ in response to complaints while 84% undertake ‘proactive monitoring’ of resource consents. However, ‘proactive monitoring’ is also variable: some councils monitor all consents, some others only monitor land-use consents, and others adopt a risk-based approach by balancing the need for continuous and consistent compliance with keeping monitoring costs reasonable for the consent holder (dependent on history of compliance and the number and complexity of consent conditions). Moreover, Bachurst et al. (2002) raised concerns about the quality of self-reporting by councils, suggesting that there are discrepancies between the Ministry for the Environment (2000) annual survey information, which stated that 96% of councils were undertaking monitoring, and their investigation of a subset of council practices which suggested very little monitoring was taking place.

Finally, declining the consent application was also mentioned as a potential strategy, although only a very small proportion of decision-makers mentioned it. This is consistent with the Ministry for the Environment (2016) figures that on average only 0.6% of consents are declined each year. This could be because decision-makers ‘remedy’ the uncertainty in other ways (e.g. it is reduced/understood to the point that it is not large enough to result in the application being declined), or possibly because decision-makers do not consider that uncertainty is cause for not granting consent, except as a last resort in certain situations.

The precautionary principle and adaptive management
The precautionary principle and adaptive management are the two most widely recognised strategies for coping with uncertainty, according to the international literature. None of the study participants volunteered either as a strategy they employ. There are a number of possible reasons for this. Firstly, it is clear that a number of individuals were not aware of the strategies, or when their use is appropriate. Secondly, decision-makers may be aware of both strategies, but are not aware of their use in situations with uncertainty; however, this is unlikely as many individuals mentioned uncertainty when explaining situations in which the use of these strategies is appropriate. Thirdly, it may be that decision-makers place
more emphasis on understanding and reducing uncertainty, and that it rarely affects the outcome of the decision.

Although the Act does not specifically mention the precautionary principle it is argued by many that it is inherent in the RMA, reflected in the fact that it specifically instructs decision-makers to consider ‘any potential effect of low probability which has a high potential impact’ (S3(f)) and implied through ‘avoiding, remediying or mitigation’ of any adverse effects from any proposed activity on the environment (S5(2c)) (Cameron, 2006; Rennie, 2006; Gillespie, 2011). Thus, under this interpretation, the precautionary principle is utilised as part of the overall broad judgement instead of expressly incorporated, and therefore as it is inherent, to apply the principle separately would lead to double-counting of the need for caution (Shirley Primary School v Christchurch City Council). Despite this, Schijf (2003) commented that it is disconcerting that the philosophy of the precautionary principle has not yet left its impression on resource management decision-making in New Zealand system. This may be because leaving it as part of the overall broad judgement approach relies on the decision-maker’s discretion (Olsen, 2015); alternatively, it may be that it has not yet seeped through to the resource consent decision-making level, or decision-makers do not feel that the precautionary principle gives adequate legal security to base decisions upon (Schijf, 2003).

Because decision-makers have a high level of discretion as to when and how to apply the precautionary principle, it it will inevitably result in the regulatory framework being applied inconsistently, leading to unpredictable and inconsistent environmental management decisions (Fisher and Harding, 1999; Cameron, 2006; Peterson, 2006). Fougère (2013) observed this flexibility when decision-makers for the application Escarpment Mine on the Denniston Plateau were dismissive of precaution, in favour of the economic benefits of the proposal:

“it would have been easy to reject this application had we been inclined to take a more precautionary approach. We are greatly influenced however by the significant economic gains that the district and region and the country as a whole will enjoy if the mine proceeds”

It maybe understandable that decision-makers do not consider the precautionary principle to be a viable strategy when managing uncertainty. However, it is worrying to find considerable variation in the understandings of the principle in this study. Overall, it is
likely that few decision-makers are knowingly using the precautionary principle in their consent decisions.

Adaptive management on the other hand, while not written into legislation, is written into case law, and the ‘Making Good Decisions’ documentation explains that it is a tool that can be used in consent decision-making (Ministry for the Environment, 2015: 231):

“the process for reviewing consent conditions is quite involved and can sometimes factor in decisions to grant relatively short term consents. It is good practise to include one or more different types of ‘trigger and response’ or ‘adaptive management’ conditions in complex consent to provide more flexibility for consent holder and greater certainty for councils.”

Its use in the resource consent process has become increasingly popular in the last decade so it is therefore somewhat concerning that there was such a wide spectrum of understandings of the tool in this study. While some decision-makers have a comprehensive understanding, others admitted that they had no idea what it was, or they provided the Wikipedia definition. Decision-makers’ opinions of situations in which the use of adaptive management is appropriate, or not, were again highly varied, and in many cases conflicting. Ironically, it may be that when decision-makers implement consent conditions, they are often using adaptive management strategies to manage uncertainty without realising that they are doing so.

6.5 Professional background and experience and responses to uncertainty

When analysed based upon background and experience, decision-makers’ understanding of uncertainty and their choice of management strategies used to cope with uncertainty showed that, although there were many similarities in behaviours, there were also distinct differences and certain groups had tendencies to behave in certain ways. This diversity in the way in which decision-makers respond to uncertainty, and that there are often differences in attitude towards uncertainty based upon professional training as well as experience, is consistent with previous research overseas (Fazey et al., 2005; Morss et al., 2005; Upham et al., 2009).

Those with more experience provided a wider range of reasons for uncertainty in resource consents, but focused more on the AEE, whereas those with less experience, while still concerned with the effect information, were also concerned with the interpretation of the
RMA and of terms such as cumulative effects. Those with more experience also relied more on direct procedural strategies (e.g. considering management options/consent conditions, hot tubbing experts, declining consents, etc.). A person’s attitude as well as their interpretation, acceptance and response to uncertainty, is influenced by new experiences and is dynamic and ever changing. It seems reasonable to conclude that decision-makers with more experience have had more opportunity to gain knowledge, skills and confidence with certain types of uncertainty and have a more robust understanding of the specific mechanisms available to them to manage uncertainty in the consents process.

The type of experience also produced some diversity in results. Independent commissioners placed more emphasis on effects information (and specific types of effects information) as a source of uncertainty than internal commissioners. Not only that, independent commissioners provided a wider range of management strategies but relied heavily on asking questions at the hearing, formally requesting information, and considering consent conditions. It may be that independent commissioners (who are used by councils when there is a need for specialist expertise) have more experience in IA and/or the use of technical information and are therefore more aware of the different sources of uncertainty that may arise.

When it came to the background of commissioners, one of the groups with the most distinct views were the RMA lawyers. For example, they placed more emphasis on effects information and having too much information as the main causes of uncertainty than any other group and identified the use of consent conditions as the primary way to manage uncertainty, an approach that other groups placed considerably less importance on. It may be that the decision-makers with an RMA law background have less experience with effects information than the other groups, and are therefore less confident with it, causing them to be hypervigilant about uncertainty. Moreover, lawyers will be more aware of the possibility of legal repercussions of decisions, and therefore use consent conditions more frequently as a safety net.

In terms of the management of uncertainty, planners and RMA consultants used a range of approaches but relied more heavily on specific steps in the consent process (such as caucusing, hot tubbing and asking questions at hearings) than other groups. This suggests
that they have a strong sense of the procedural tools available to them. On the other hand, scientists relied more heavily than some other groups on asking questions at hearings and requesting more information. Morss et al. (2005) found that those with a scientific background dealt with uncertainty by attempting to quantify, analyse and reduce it by obtaining additional data or conducting additional research, while other decision-makers viewed uncertainty as an unavoidable factor, and dealt with it by finding the best information that was quickly and easily obtainable, making a decision and moving on.

It is very likely other factors are influencing the differences in opinion. For example, the system of resource management in New Zealand means that many different types of resource consent applications, for many different activities, are dealt with by commissioners. So the type of experience one decision-maker has had may be very different to that of another individual with the same number of decisions; this will be particularly so for commissioners who tend to specialise in a certain types of projects.

### 6.5 Wider implications of findings

Across the resource management literature, there is an agreement that decision-makers need to be provided with pragmatic uncertainty guidance material that allows decisions to be made in a systematic, informed and consistent manner (Isendahl et al., 2010a). Decision-makers surveyed in this investigation had differing views about whether or not they were given guidance, but the majority did not believe that they were. Schijf (2003) also found that there is an absence of strong central guidance on dealing with uncertainty in the consent process in New Zealand, resulting in decision-makers not utilising expertise in uncertainty management that has been developed elsewhere. In the international context this is probably not unusual. For example, Leung et al. (2015) observed that decision-makers in Canada are given little guidance on how best to interpret and manage uncertainty. In such an environment, decision-making under uncertainty is often based on intuition, heuristics and experience (Isendahl et al., 2010a).

This research has highlighted the lack of transfer of knowledge between uncertainty theory and practice. Indeed, decision-makers are predominantly relying on their background/area of expertise and personal experience in decision-making, as well as advice from other decision-makers. Therefore, although decision-making is guided by policy and planning
frameworks, and decision-makers are expected to evaluate the effects of decisions against these, when it comes to uncertainty, the individual decision-makers have great influence on the decision process (Schijf, 2003).

With this in mind, it is not surprising that this research shows that decision-makers’ understandings of uncertainty, and approaches to management, are diverse. This diversity is by no means explained just by the experience and professional backgrounds of decision-makers, and it is highly likely that there are other factors that influence decision-makers (such as their attitudes towards nature, complexity, and the unknown, and their values, beliefs and culture).

The diversity in results may suggest that the accreditation process, which individuals must complete in order to become a decision-maker, is not moulding diverse individuals into a tightly defined group of decision-makers or providing them with advice about how to approach uncertainty. As a result, decision-makers have a certain level of freedom to respond as they see fit, and are falling back to a large extent on personal perceptions, values, feelings and coping mechanisms, in deciding how to manage uncertainty. It is important then to consider the ways in which this diversity will affect the resource consent process, and the outcome of consent decision-making. This is particularly important because, although commissioners are only involved in a very small proportion of resource consents, they are often the most controversial or technical decisions. In order to do this, the conceptual model, which described the key approaches used to manage uncertainty in the decision-making process in section 2.6, has been adapted (Figure 6.4).

The model shows that decisions made under uncertainty can be approached in a number of different ways. First, some decision-makers may be more aware of uncertainty than others, possibly because of varied disclosure practices of applicants, or because decision-makers are more vigilant in their recognition of uncertainty. Following this, those who are aware, may or may not acknowledge it. While those who do not acknowledge it are likely to proceed to decision-making ignorant of, or just ignoring, the uncertainty, those who acknowledge it may choose to spend time understanding uncertainty and/or reducing it.
As explained previously, decision-makers in this study seem to place considerable emphasis on reducing and understanding uncertainty. This may be because the effects of information that decision-makers are provided with is of poor quality, or is subjective and/or technical and therefore it requires considerable effort to understand the information and uncertainty. It may be that gaining more information in a complex and uncertain situation is an automatic and instinctive reaction for some individuals. For those who do not believe it is unacceptable for resource consent applications to be uncertain, the reduction/removal of uncertainty may be an important step in the decision-making process. Decision-makers may find that understanding uncertainty is more of a challenge than deciding a course of action once they are aware of the uncertainty, or that while these uncertainties are not significant enough to affect the outcome of the decision, they are substantial enough that decision-makers use approaches that allow them better understand the uncertainties and their implications, or reduce/remove the uncertainty. This is supported by Schijf (2003), who found that in some cases decision-makers carefully considered uncertainty, and methodologically discussed it, sought additional information and then made the judgment that the uncertainty was not large enough to effect the decision. However, decision-makers in this investigation did not place emphasis on determining the significance of uncertainty, before making an effort to reduce it. It may
then be that resources are wasted on reducing uncertainty that holds no bearing on the outcome of the decision.

It is important to also consider the implications and contributions of this research on the wider body of literature. Despite the more than 40 year history of IA, the interest in uncertainty in impact information has really only grown in the last decade. Broadly speaking, the research addressing uncertainty in resource management decision-making and impact assessment is scarce. Most studies investigate a small number of case studies in detail and there is very little research into the ways a large group of individuals understand and manage uncertainty. By gaining a better understanding of this complex subject and the way in which a large group of decision-makers understand uncertainty, this research has made an important and unique contribution to the body of literature.

Furthermore, while there are broad frameworks explaining the management of uncertainty, there is a lack of literature addressing the specific ways in which decision-makers actually manage uncertainty. This study has provided valuable information about the practical methods decision-makers use to cope with uncertainty. Not only that, it has also shed light on the treatment of uncertainty in the resource consent process in New Zealand. As previously discussed, it has also highlighted that there is a need for decision-makers to be provided with more guidance about the many different reasons for uncertainty, as well as the ways in which uncertainty can be successfully managed.

Moreover, as chapter 2 explained, uncertainty is a complex and difficult concept for individuals to grapple with. Within the literature there is little consistency in the way in which uncertainty is thought about: there is no shared terminology or typology or agreed ways of managing uncertainty. This research shows that resource management decision-makers in New Zealand also demonstrate diversity in their understandings and management of uncertainty.

6.6 Uncertainty guidance – where to from here?
As already discussed, this research has highlighted the lack of transfer of knowledge between uncertainty theory and practice. There is a need for decision-makers to be provided with guidance to assist them understand and manage uncertainty, a notion that the
majority of participants were open to. As every resource management situation is unique, there are some difficulties associated with developing and using guidance (Kloprogge et al., 2007; Isendahl et al., 2010b; Petersen et al., 2010). This is particularly true of the New Zealand situation: as a large range of activities, of varying types and scales are regulated under the RMA, it would be unrealistic to recommend that decision-makers be provided with prescriptive guidance. Instead, a more informative and educational approach to guidance should be taken, so that if faced with uncertainty, decision-makers are better equipped to cope with it (and their views of it will be more consistent).

A number of approaches could be incorporated into the process to improve decision-makers’ understanding and treatment of uncertainty. First, decision-makers could be encouraged to ‘revalue’ uncertainty. Within resource management, uncertainty is often perceived as a disadvantage, but decision-makers could be more open-minded and positive, viewing uncertainty as a challenge and an opportunity to learn something new and make more considered decisions (Isendahl et al., 2010a). Decision-makers should be more willing to abandon the idea that uncertainties are a wholly negative aspect that must be removed, and accept that there are limits to what can be done to reduce uncertainty and that uncertainties will remain in spite of the scientific effort to overcome them (Grunwald, 2007; Isendahl et al., 2010b).

A research institute in the Netherlands has released a number of guidance documents to be used by policy makers in the management of uncertainty (Van der Sluijs et al., 2003; Janssen et al., 2005). They include broad checklist-style documents as well as in-depth detailed guidance documents. One specific approach from those documents that could be adopted by decision-makers is the mapping and assessment of uncertainty, which can be done by using review questions to extract information about uncertainty (such as those in Table 6.1), or by using a matrix approach involving identifying and classifying the most relevant uncertainties and characterising their nature, cause, location and consequences (Table 6.2). It seems that a particular area of focus for this guidance should be the level/significance/implications of uncertainty present in applications. An important step in the management of uncertainty, that needs to occur before determining a course of action, is determining whether the uncertainty is critical enough that it warrants further attention. For example decision-makers should be considering the implications of the uncertainty and
whether or not it is likely to have a bearing on the outcome of the application before requesting costly further information.

Brugnach \textit{et al.} (2007) conceptualized uncertainty in a broader sense than other authors, arguing that solutions to uncertainty are more easily identified if decision-makers understand uncertainty in a more relational context. They defined three types of uncertainty and the effect each has on knowledge (inherent uncertainty causing unpredictability, and lack of knowledge, and different knowledge frames, both causing conflicting information), and then developed management approaches based on the uncertainties. This approach has been developed further by Isendahl \textit{et al.} (2010b) who asked decision-makers to characterize uncertainty that they experienced and develop strategies that could be used to manage the specific uncertainties.

\textit{Table 6.1: Review questions that could be used by decision-makers to further understand uncertainty in resource consent applications (Janssen et al., 2003; Petersen et al., 2003; van der Sluijs et al., 2003; Lees, 2014; Lees et al., 2016).}

\begin{itemize}
    \item Does the EIS directly disclose/address uncertainty?
        \begin{itemize}
            \item What is the uncertainty about? (e.g., predictions, mitigation, project design, etc.)
            \item What is the cause of the uncertainty? (e.g. lack of information, inherent uncertainty conflicting information)
        \end{itemize}
    \item Is uncertainty used as a criterion when addressing the significance of residual impacts?
    \item When identified, how is uncertainty addressed/are any measures proposed to address
        \begin{itemize}
            \item Is uncertainty justified or ignored?
            \item Is uncertainty addressed by more research?
            \item Is uncertainty explored through risk-based scenarios, worst-case scenarios, or probabilities?
        \end{itemize}
    \item In the uncertainty significant to the outcome of the decision?
        \begin{itemize}
            \item Which aspects of uncertainty require additional attention and why (e.g. decision stakes are high, various assumptions are critical, a small change in an indicator estimate may have a significant influence on impacts)
            \item What are the implications of the uncertainty?
            \item Is the uncertainty reducible?
            \item Can the uncertainty be mitigated?
        \end{itemize}
\end{itemize}

\textit{Table 6.2: Example of an uncertainty assessment matrix that could be used to further understand uncertainty (adapted from van der Sluijs et al. (2003), Walker et al. (2003) and Janssen et al. (2005).}

\begin{table}[h]
\centering
\begin{tabular}{|l|l|l|l|l|l|}
\hline
Level of uncertainty & Nature of uncertainty & Qualification of knowledge base & Value-ladenness of choices & Qualification of knowledge base & Significance of uncertainty & Reducibility of uncertainty \\
\hline
Proposal & & & & & & \\
Effects & & & & & & \\
Consultation & & & & & & \\
Hearing & & & & & & \\
\hline
\end{tabular}
\end{table}
From the examples discussed, it is clear that there are a number of accessible and practical methods which have the potential to assist decision-makers work through uncertainty in resource management. There is an opportunity for these to be incorporated into the ‘Making Good Decisions’ programme.

6.7 Research reflections

The limitations and shortcomings of social research methods are well documented. An important part of the research process is to reflect on challenges that arose and the ways in which the research could be improved. As discussed in the chapter 4, although there are many advantages to the use of questionnaires in social research, there are also a number of disadvantages. A few specific issues that were encountered will now be discussed, followed by a reflection upon the overall research strategy used.

The identification and sampling of participants was not without problems. The use of councils to identify potential participants relied on them providing information, and because not all were able or willing, to assist, there may be potential participants that were not identified. While this was not unavoidable, the use of chain sampling, which was used by Leung et al. (2016) in a similar study, could be used to minimise the number of unidentified individuals. Chain sampling involves the initially identified potential participants being asked to further identify any other individuals who would be appropriate candidates to participate in the research (Hay, 2010). Due to the interconnected nature of the commissioner community it is likely that individuals have worked with a number of other commissioners and therefore have knowledge about potential participants. In fact, three individuals actually emailed the researcher with suggestions of other individuals to include in the study.

Although it was stressed to potential participants that if they chose to participate, their responses to the questionnaire would be anonymous and confidential, a number of individuals still expressed concerns about their anonymity and did not wish to participate in the study as it could jeopardize their career. They explained that the business of acting as a commissioner was difficult to get into and if their anonymity was not totally preserved it would be very easy to identify them, as New Zealand is such a small place. Despite these issues, almost all questionnaires are subject to non-response (McGuirk and O'Neill, 2010;
Bryman, 2012), and it was never expected that all potential participants would choose to be involved in the research.

The design of the questionnaire raised some issues. Upon reflection, there were too many questions in the questionnaire. Not only was there a large amount of information to process, the longer the questionnaire the higher the rate of response drop off (Neuman, 2013). As well as making the questionnaire shorter, the number of open-ended questions could be reduced to one or two and the others be replaced with closed questions. For example, similar studies which published since the sampling took place predominantly used closed questions. Leung et al. (2016) used a larger variety of types of questions, some of which could be employed in this type of research to reduce the time taken to complete and process the questionnaire. Examples include questions that ask participants to allocate points among categories and questions that use category scales where participants are asked to specify where their opinion sits.

In addition, a small number of participants suggested that some questions were too difficult to answer, as they were too subjective. As explained in chapter 4 there is an unavoidable degree of subjectivity involved in social research, particularly when it comes to the interpretation of survey questions (McGuirk and O'Neill, 2010; Halperin and Heath, 2012). Others commented that they would have liked uncertainty to be defined (a definition of uncertainty was actually provided in the introduction of the questionnaire, but as not all participants read this, it could have been emphasised, or moved to the start of the questionnaire rather than the introduction).

Having said this, because there has been little or no research on the issue of uncertainty in resource consent decision-making in New Zealand, the use of a questionnaire was the most appropriate and effective way to gain a general understanding of the broad situation. The questionnaire yielded both qualitative and quantitative information about the way in which a large number of decision-makers across the country think about and manage uncertainty. This study has therefore set the foundation for future research to be undertaken on more specific areas of uncertainty in resource consents, impact assessment and decision-making both in New Zealand and internationally.
Chapter 7: Conclusion

7.1 Main findings

This investigation aimed to understand the role of uncertainty, particularly within the environmental effects information, in resource consent decision-making in New Zealand. The specific objectives were to understand what decision-makers recognise to be the main cause/source of uncertainty in resource consent applications, how they perceive uncertainty, and to characterise and evaluate the strategies they use to manage the uncertainty. The results suggest that, for decision-makers uncertainty within the resource consent process in New Zealand is anything but simple.

Decision-makers identified many facets of the resource consent process which cause uncertainty, but the primary cause was applicants providing poor quality effects information lacking important detail. Other sources of uncertainty included conflicting information, inherent uncertainty, and difficulty interpreting certain parts of the RMA. While some of these uncertainties can be reduced or removed, others are implicit in environmental management, and need to be accepted as that.

Decision-makers’ have varied perceptions of the acceptability of uncertainty, the need for the level of uncertainty to be reduced, applicants to communicate it and decision makers to take it into account. These perceptions could be influenced by a large range of different factors, but the diversity in the results suggests that the commissioner accreditation is not moulding diverse individuals into decision-makers who are able to cope with uncertainty in a consistent manner – they still have a certain level of freedom to respond as they see fit, and are falling back to a large extent on personal perceptions, values, feelings and
coping mechanisms, in deciding how to manage uncertainty. It is unsurprising, then, that
decision-makers identified such a large number of different approaches for managing
uncertainty. These strategies can be grouped into three main categories: strategies used to
further understand and reduce uncertainty; passive strategies; and strategies used in the
face of uncertainty once it has been accepted. Some strategies which have been identified
within the literature were not used as frequently as they maybe could be, while others were
used without properly considering the implications. Neither the precautionary principle nor
adaptive management were mentioned as management options, despite the emphasis in the
literature on the value of their use.

Decision-makers appear to be given little to no substantive guidance about how to manage
uncertainty. This needs to be remedied, as current practices inevitably lead to inconsistent
treatment of uncertainty. Almost all participants were open to the idea of being provided
with some form of guidance, and there are many examples within the literature that could
be adopted in the New Zealand context.

Finally, it seems that the background and experience of decision-makers influences the
way in which they perceive and manage uncertainty, with the more experienced
responding differently to the less experienced, internal commissioners differently to the
independent ones, and lawyers, planners, scientists, councillors and other professional
groups tending to respond in ways that reflect their particular backgrounds. However,
these characteristics do not fully explain the diversity in results, and it is likely that there
are many other factors influencing decision-makers and their understanding and
management of uncertainty.

7.2 Recommendations
This study has highlighted that there is an opportunity to improve the treatment of
uncertainty in the resource consent process. As decision-makers identified that the main
cause for uncertainty is poor quality of effects information, the Ministry for the
Environment may need to consider whether there is a need for the quality of effects
information to be improved. There are many ways in which this could be achieved
including changing the legislation so that independent consultants must produce effects
information for certain applications, or the introduction of a mandatory professional
accreditation for practitioners. The simplest way to improve the quality effects information is to raise the expectations of effects information through more rigorous reviewing of applications, checking for both completeness and adequacy.

It is also worth considering the need for the institutional framework to recognise uncertainty. The uncertainty, the precautionary principle and adaptive management should be more explicitly incorporated into the RMA. It has been argued that the precautionary principle is inherent in the RMA, and adaptive management is written into case law and is mentioned in the ‘Making Good Decisions’ documentation, however, there is little consistency in the way in which decision-makers think about the two approaches to uncertainty management. In fact, decision-makers did not even make direct links between the two strategies and the management of uncertainty. However it is likely that some decision-makers are invoking the strategies (either knowingly or unknowingly). Accordingly, the RMA could be amended so that it explicitly refers to uncertainty, the precautionary principle and adaptive management. If not, there is still a need for the ‘Making Good Decisions’ programme to consider incorporating the two strategies into the documentation and training (or in the case of adaptive management clarifying and emphasising the existing information). Furthermore, applicants should be required to disclose uncertainty to decision-makers; this could be incorporated into Schedule 4.

Whether or not uncertainty is explicitly addressed in the legislation, it is an issue that decision-makers are faced with, and accordingly they need to be provided with guidance about it. As explained, within the literature there are existing frameworks that can be used to assist decision-makers understanding and treatment of uncertainty including revaluing uncertainty and uncertainty assessment. It is likely that providing guidance to decision-makers make them feel more comfortable when faced with uncertainty, possibly reduce costs for applicants, and in the end it is likely to lead to decisions that are more robust, defensible and consistent.

7.3 Future research opportunities
The findings of this study identified a number of areas in which further research could be undertaken. Overall there was a very positive response to the research: more than 40 individuals expressed an interest in being interviewed. A number of individuals also stated that they would like to have been interviewed and make more meaningful reflections on
their past decisions in order to provide more detailed and helpful answers. This investigation has shed enough light on decision-makers’ broad treatment of uncertainty that there is an opportunity to undertake a more in-depth enquiry to investigate individual decision-makers’ views in more depth and detail, possibly involving a number of case studies (e.g. a number of nationally significant applications).

In addition, a number of international studies have been undertaken investigating how applicants understand, communicate and manage uncertainty in the IA (Stenton, 2006; Allen and Gunderson, 2011; Lees, 2014). These studies have been undertaken using document analysis, predominantly looking at impact statements. There is the opportunity to undertake research combining key informant interviews with document analysis to allow for a deeper analysis of the role of uncertainty in resource consents.

Similarly, a number of overseas researchers have found that the way in which different parties involved in resource management (applicants, consultants, decision-makers and submitters, etc.) view uncertainty differs significantly (Leung et al., 2016). It would be interesting to investigate this in the New Zealand setting, possibly combining interviews with observational methods. For example, the researcher could attend hearings of current applications to better understand the way in which applicants and decision-makers approach, communicate and manage uncertainty.

Although the RMA does not specifically refer to uncertainty, the precautionary principle and adaptive management, the Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act requires those making decisions on marine consent applications to take into account any uncertainty or inadequacy in the information available (S61(1)). The way in which decision-makers perceive and manage uncertainty under this legislation could be investigated, or a comparative study could be undertaken to understand whether there are any difference in decision-makers responses under the two pieces of legislation.

7.4 Conclusion

Overall this research has identified that there is a large range of different uncertainties in resource consents in New Zealand, and that effects information is the primary cause of
uncertainty for decision-makers. There is a need for decision-makers to be provided with guidance on how to manage this uncertainty, as currently they are relying on their professional and decision-making experience. New Zealand has an opportunity to be a leader in the management of uncertainty in resource management, rather than a follower, but does need to start taking action as soon as possible.
References


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Sustain Our Sounds v New Zealand King Salmon Company Ltd (2014) NZSC 40, Supreme Court, New Zealand


Appendices

A  Ethics application
B  Emails sent to councils and potential participants
C  Questionnaire
Appendix A: Ethics Application

1. University of Otago staff member responsible for project: *Prof Richard Morgan*
2. Department/School: Geography
3. Contact details of staff member responsible: rkm@geography.otago.ac.nz
5. Indicate type of project and names of other investigators and students:

<table>
<thead>
<tr>
<th>Type of Research</th>
<th>Names</th>
<th>Level of Study</th>
<th>External Research/</th>
<th>Names</th>
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<td></td>
<td>Masters of Science</td>
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<tr>
<td>Student Research</td>
<td></td>
<td>Jessica Gerry</td>
<td></td>
<td></td>
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</tbody>
</table>

**Form Updated: May 2015**
6. When will recruitment and data collection commence? 25th November

7. When will data collection be completed? 1 month after commencing

8. Brief description in lay terms of the aim of the project, and outline of the research questions that will be answered:

Environmental and resource management decision-making is often complex and challenging and an important factor is information uncertainty. Impact assessment (IA) is a key tool used to inform decision makers of the likely environmental impacts of major proposals on the environment and local communities. An important part of this process is also to recognise and manage uncertainty about impact information and its implications for decision makers. However evidence suggests that the recognition and treatment of uncertainty in the IA, and in the subsequent decision-making process, is often not well handled and in many cases not recognised, managed or taken into consideration. The aim of this research is to understand the role of uncertainty, particularly the effects information, in resource consent decision-making. To achieve this aim a number of specific objectives have been developed:

- To understand whether decision-makers recognise the presence of uncertainty in resource consent applications
- To understand what decision-makers perceive to be the main cause/source of uncertainty in resource consent applications
- To characterise and evaluate decision-maker’s responses and management strategies to uncertainty

9. Brief description of the method. Include a description of who the participants are, how the participants will be recruited, and what they will be asked to do:

The intended participants of this study are commissioners making resource consent decisions under the Resource Management Act 1991. A list of individuals who hold the relevant qualifications to act as a commissioner (those who have completed the ‘Making Good Decisions’ Certificate) has been provided by the Ministry for the Environment. These individuals will be emailed and provided with details of the study and asked if they are willing to participate (see attached). If they agree, they will be asked to complete an online survey hosted by Survey Monkey, which will take them ~20-25mins to complete (see attached). The survey contains ~35 questions, which are a mixture of closed and open questions.

10. Disclose and discuss any potential problems:

None identified. Potential participants will have the clear option of not taking part in the survey. If they do take the survey all questions address their professional activities. No personal information will be collected. All information will be treated as anonymous and will be aggregated for analysis.

*Applicant's Signature: .................................................................
Name (please print): .................................................................
Date: ..........................

*The signatory should be the staff member detailed at Question 1.

ACTION TAKEN

☐ Approved by HOD  ☐ Referred to UO Human Ethics Committee

☐ Approved by Departmental Ethics Committee

Signature of **Head of Department: .................................................................

Name of HOD (please print): .................................................................

Date:

................................................................

**Where the Head of Department is also the Applicant, then an appropriate senior staff member must sign on behalf of the Department or School.

Departmental approval: I have read this application and believe it to be valid research and ethically sound. I approve the research design. The research proposed in this application is compatible with the University of Otago policies and I give my approval and consent for the application to be forwarded to the University of Otago Human Ethics Committee (to be reported to the next meeting).

IMPORTANT NOTE: As soon as this proposal has been considered and approved at departmental level, the completed form, together with copies of any Information Sheet, Consent Form, recruitment advertisement for participants, and survey or questionnaire should be forwarded to the Manager, Academic Committees or the Academic Committees Administrator, Academic Committees, Rooms G22, G23 or G24, Ground Floor, Clocktower Building, or scanned and emailed to either gary.witte@otago.ac.nz or jane.hinkley@otago.ac.nz.
Appendix B: Sampling Strategy

Table B1: Emails sent to consenting authorities when gathering the names of frequently used internal and independent commissioners

<table>
<thead>
<tr>
<th>Email to consenting authorities</th>
<th>Email to potential participants (1st email)</th>
</tr>
</thead>
</table>
| Subject: University of Otago Masters Research  
To whom it may concern,  
My name is Jessica Gerry and I am a Master’s research student at the University of Otago. As part of my research I am planning to undertake a survey of independent and internal commissioners to find out about their role in the RMA consenting process. Are you able to provide me with list of the independent commissioners and elected councillors or community board members that are most frequently used by the (name of council)?  
If you would like any more information please email me at jessica.gerry@otago.ac.nz  
Yours sincerely,  
Jessica Gerry | Subject: University of Otago Masters Research  
Dear (name),  
My name is Jessica Gerry and I am a Master’s research student in the Department of Geography at the University of Otago. I am undertaking research investigating how experienced decision makers perceive and respond to uncertainty in the resource consent process under the Resource Management Act 1991.  
I am looking for ~150 individuals who have acted as decision makers (for example as Commissioners or elected representatives on a hearing panel) to participate in this study. As an experienced resource consent decision maker, I would like to invite you to participate in this research.  
The information will be presented in a Masters thesis and may also be published in a research paper. In either event it will not be possible to identify participants, directly or indirectly.  
If you are willing to participate in this project, please follow this link and complete the online survey. It should take no more than 20 minutes. If you are able to complete the survey before the 11th of December it would be greatly appreciated.  
If you would like any more information please email me at jessica.gerry@otago.ac.nz or contact my supervisor Professor Richard Morgan at rkm@otago.ac.nz or on (03) 479 8782.  
If you do not want to receive any further correspondence, please reply to this email and let me know.  
Thank you for your time; your input is greatly appreciated.  
Yours sincerely,  
Jessica Gerry |
Subject: University of Otago Masters Research
Dear (name),
I am following up on my recent email in which you were invited to participate in my Masters research investigating how experienced decision makers perceive and respond to uncertainty in the resource consent process under the Resource Management Act 1991. So far I have received very positive and constructive feedback, which has produced a wide range of information. If you have already completed the survey, I would like to thank you for the time you have taken to respond and I appreciate your invaluable input.
If you have not yet competed the survey but are willing to do so, your participation would be most welcome. I do really appreciate the time you take out of your busy working day but would require the survey to be completed by this Friday, 11th December. Thank you again for your time and please don't hesitate to contact me if you have any further questions regarding the survey.
Yours sincerely,
Jessica Gerry
Appendix C: Questionnaire

Resource Consents and Uncertainty
A survey to be completed by resource consent decision-makers

Research by:
Jessica Gerry
Department of Geography
University of Otago
jessica.gerry@otago.ac.nz

Supervisor: Professor Richard Morgan, Department of Geography, University of Otago,
email rkm@geography.otago.ac.nz phone (03) 479 8782

Thank you for participating in this research. The project is being undertaken as a part of
the requirements for Jessica Gerry’s Masters of Science and aims to understand how
experienced decision-makers perceive and respond to uncertainty in the resource consent

Environmental and resource management decision-making is often complex and
challenging and an important factor is information uncertainty. Uncertainty can be defined
as the imperfect and inadequate understanding of a system. Traditionally, uncertainty was
considered to be a lack of scientific knowledge; however, it is more broad and diverse, encompassing societal, political and cultural systems.

The following is a survey that contains ~35 questions about your experience as a resource consent decision maker and your perceptions of, and responses to, uncertainty. It should take no more than 20 mins to complete. No personal information is being sought.

This intention of the research is to use the raw data to make observations and draw conclusions based on the analysis of this data in an aggregated way. The researcher will be the only person that will have access to this information in its raw form; it will be stored securely and will be destroyed at the end of research. It is not the intention that attribution or identification of any participant can be derived from the final thesis. The results of the project may be published and will be available in the University of Otago Library (Dunedin, New Zealand) but you anonymity will be preserved.

If you have any questions about our project, either now or in the future, please feel free to contact either Jessica Gerry or Professor Richard Morgan.

Please read the following and click accept if you agree to participate in this research.
I have read the previous information concerning this project and understand what it is about. All my questions have been answered to my satisfaction. I understand that I am free to request further information at any stage.
I know that:-
1. My participation in the project is entirely voluntary;
2. I am free to withdraw from the project at any time without any disadvantage;
3. The information provided by the participants will be used only for the purposes of research and possibly academic publications arising from this research.
4. The results of the project may be published and will be available in the University of Otago Library (Dunedin, New Zealand) but every attempt will be made to preserve my anonymity.

☐ I agree to take part in this project.

This study has been approved by the Department stated above. However, if you have any concerns about the ethical conduct of the research you may contact the University of Otago Human Ethics Committee through the Human Ethics Committee Administrator (ph 03 479-8256). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.
The following section is concerned with your decision-making background and experience.

1) What do you consider your main area of specialisation, professional experience or occupation (e.g. surveyor, resource management lawyer, social scientist, farmer etc.)?


2) What qualifications have you obtained (e.g. BA(Sociology), MSc(Ecology), Dip(Agriculture))?


3) Please indicate if you have completed any of the following ‘Making Good Decisions Programmes’:
   - Foundation Course
   - Recertification for Panel members
   - Recertification for Panel Chairs
   - None of the above (please indicate the way in which decision-making accreditation was gained ________________________________)

4) Please indicate the capacity through which most of your experience as a decision maker has been obtained: internal Commissioner (elected member of consenting authority)
   - Independent Commissioner (non-elected member of the public)
   - I have served in both capacities equally
   - I am a councillor and I have never acted as a Commissioner
   - Other (please specify ________________________________)

5) How many decision processes have you participated in as a decision maker?
   - <5
   - 5-10
   - 10-20
   - >20
   If more that 20 please give approximate number ______

6) For what length of time have you acted as a decision maker?
   - <5 years
   - 5-10 years
   - 10-20 years
   - >20 years
7) For which of the following consenting authorities have you acted as a decision maker most frequently? If you have acted in equal capacities for two or more types of consenting authority please select multiple options

- Regional councils
- Territorial authorities
- Unitary authorities

8) Please indicate the council/s that you have acted as a decision maker for (if you have acted as a decision maker for ‘call ins’ please indicate here):


9) When acting as a decision maker for consenting authorities, which of the following types of activities have you most frequently dealt with?

- Controlled
- Restricted discretionary
- Discretionary
- Non-complying
- I do not know

When acting as a decision maker for consenting authorities, which of the following types of consent applications have you most frequently dealt with?

- Non-notified
- Limited notified
- Fully notified

10) In your experience as a decision maker, are there certain types of proposed activities that you deal with more frequently than others (eg roading projects, subdivisions, water takes for irrigation)?


The following section is concerned with uncertainty in the resource consent process and subsequent decision-making under the Resource Management Act 1991. Please rate how strongly you agree or disagree with the following statements by clicking on the appropriate box:

11) Uncertainty is inherent in resource management.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree
12) The uncertainty in resource management problems is manufactured by the process (eg measurement error).

☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

13) It is acceptable for resource management applications to be uncertain.

☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

14) The level of uncertainty present in resource consent applications is too great and it needs to be reduced.

☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

15) It is essential that applicants disclose any uncertainty that is present in the resource consent application.

☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

16) Uncertainty within resource consent applications is inadequately disclosed, poorly communicated and difficult to understand.

☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

17) Decision makers must accept that uncertainty is present in resource consents and it must be taken into account in the decision-making process.

☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

18) It is vitally important that decision documents disclose this uncertainty and how it has been addressed.

☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

19) In your experience, what do you consider to be the most common sources of uncertainty in the consenting process?
20) Please rank the following types of information in order of which has the greatest potential for uncertainty to arise in (with 1 being the greatest potential and 5 being the least potential)

- Information in the proposal
- Information about the environmental effects
- Information generated by the consultation and public submissions (where relevant)
- Information generated by the hearing (where relevant)
- Other information (please specify if applicable ________________)

21) Research suggests that uncertainty can be caused by imperfect knowledge about a system (natural or social), or due to the inherent complexity of a system. Please rank the following in order of which you consider to be the main cause of uncertainty in the resource management applications you have dealt with (with 1 being the main cause and 4 being a lesser cause)?

- Lack of information
- Conflicting information
- Too much information
- Inherent complexity of a system

22) To what extent do you agree that the process of assessing effects is complex and difficult and therefore effects information often has associated uncertainty?

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

23) In your experience, what do you consider to be the main source of uncertainty in the environmental effects information?

24) Do you associate uncertainty more with:

- Natural systems (eg biophysical environment)
- Social systems (eg social, cultural and economic systems)
- Both natural and social systems are of equal uncertainty

25) In which of the following systems can associated uncertainty be more easily reduced

- Natural systems (eg biophysical environment)
- Social systems (eg social, cultural and economic systems)
- Both natural and social systems are equally able to have uncertainty reduced
The following section of this survey is concerned with strategies used to manage uncertainty in the resource consent process under the Resource Management Act 1991.

26) Are you provided with any general guidance (formal or informal) as to how to manage uncertainty in the resource consent process? If yes, what is the guidance and have you found it beneficial? If no, do you think there is a need for guidance?

27) How do you determine whether the level of uncertainty in a consent application is significant enough to affect the final outcome of the decision?

28) In the decision-making process, do you take steps to manage uncertainty?
   - Yes
   - No

29) Research suggests that people manage uncertainty in a number of different ways. Please list up to 6 strategies you used to manage uncertainty in the resource consent process (with 1 being most frequently used strategy and 6 being least frequently).

   1
   2
   3
   4
   5
   6

30) For the strategies you have listed please choose the two main ones and explain why you use them

31) Do you agree that the most effective way to manage uncertainty is to have more information about the proposed project?

   - Strongly Agree
   - Agree
   - Neutral
   - Disagree
   - Strongly Disagree
32) In a situation where there is significant uncertainty about a resource consent application, which of the following methods do you use to help reduce the uncertainty? Please rank them in order of most frequently used (with 1 being most frequently used and 7 being least frequently)

- Rely on documentation provided
- Consult experts
- Talk to council staff
- Talk to applicant
- Formally request more information
- Conduct your own research (eg use the internet or ask someone informally)
- Other - please specify ____________________________

33) Research suggests that the ‘precautionary principle’ and ‘adaptive management’ are often raised as potential responses to uncertainty. What do you understand by the term precautionary principle?

____________________________________________________________________________

____________________________________________________________________________

34) If you agree that the precautionary principle is a potential response to uncertainty, please outline:

a) Situations in which you consider the use of the precautionary principle is appropriate

____________________________________________________________________________

____________________________________________________________________________

b) Situations in which you consider the use of the precautionary principle is not appropriate

____________________________________________________________________________

____________________________________________________________________________

35) What do you understand by the term ‘adaptive management’?

____________________________________________________________________________

____________________________________________________________________________

36) If you agree that adaptive management is a potential response to uncertainty, please outline:

a) Situations in which you consider the use of adaptive management is appropriate

____________________________________________________________________________

____________________________________________________________________________
b) Situations in which you consider the use of adaptive management is not appropriate

37) Please rank the following in order of which best prepared you to be able to understand and manage uncertainty in the decision-making process (with 1 being the most and 7 least).

- Qualification (eg tertiary education)
- Background/area of expertise
- ‘Making good decisions’ program
- Personal experience in decision making
- Advice from other decision makers (eg when working on a panel)
- Advice from council staff
- Other - please specify __________________

38) Keeping in mind the questions that have been asked and your responses, do you have anything you would like to add?

I appreciate the time and effort that you have taken to answer these questions. From this survey a number of key informant interviews may take place. If you are willing to participate in an interview please tick the box below and provide your details. A summary of the research findings from this study will be produced. If you like to receive a copy please tick the box below and provide your details.

Name: ____________________________
Email: ____________________________

☐ I am willing to participate in a key informant interview
☐ I would like to receive summary results of this study

Thank you for your time