Extract from Leila Chrystall's Thesis

3. Literature Review

3.1. Introduction

In this chapter the theory behind Integrated Catchment Management (ICM) is reviewed. Initially the definition is discussed and its association with sustainable development outlined. The literature review goes on to examine ICM in Australia, the United States of America, and the United Kingdom before the focus turns to ICM in New Zealand. Both the history of New Zealand's Environmental Legislation and the history of ICM in New Zealand are examined in some detail. Critical success factors of the ICM approach are then discussed and the chapter is completed with a section on the requirement of resource inventories in the ICM process.

3.2. Introduction to Integrated Catchment Management

Like all other environmental management approaches, literature on ICM is expansive and can sometimes be unclear to its meaning. Therefore, in order to gain a thorough appreciation of ICM it seems logical to single out the underlying definitions of the three issues given in the name 'integrated', 'catchment' and 'management' as was similarly done in a publication by the South African Department of Water Affairs and Forestry (1996).

3.2.1. Catchment

A catchment, or watershed, can be defined as a basin shaped area of land, bounded by elevated topographical features such as hills or mountain ranges from which all water, surface and sub-surface, flows into streams, rivers, wetlands and aquifers in the lower section of the basin.

It contains the processes and interactions that occur within the different components of the hydrological cycle including those of atmospheric, surface, and sub-surface water (Walmsley, 2002). In addition, a catchment also contains land where some of these hydrological processes are carried out, and land on which anthropogenic impacts occur,

affecting the quantity, quality or distribution of water in any one of the components featured in the hydrological cycle (Department of Water Affairs and Forestry, 1996).

3.2.2. Integrated

"A catchment is a complex living ecosystem which means that it is a large, interconnected web of land, water, vegetation, structural habitats, biota and the many physical, chemical and biological processes which link these" (Department of Water Affairs and Forestry, 1996, p. 3). Recognising that a disturbance occurring in one part of the system can affect or change other parts is the basis for an 'integrated' approach to the management of a catchment. Impacts to other parts of the system may be direct or indirect and the impact may increase or decrease in severity with time as it moves through the system.

3.2.3. Management

The aim of ICM is to maintain the whole system operating within the catchment at a pre-determined status, this is achieved with the creation and execution of management plans, which feature both the management of water and land-based impacts in the catchment (Department of Water Affairs and Forestry, 1996).

By bringing these three concepts together, the true value of ICM can be realised. ICM approaches treat the catchment and water resources within the catchment as one system; they appreciate that impacts or disturbances in one part may affect another part; they ensure any management actions carried out by a responsible body in one section of the catchment are not in conflict or in isolation from the actions of other authorities; and finally, ICM approaches ensure that any actions that may be carried out are done so after realising the needs and consequences of other stakeholders who may be affected by such actions (Department of Water Affairs and Forestry, 1996).

ICM has been described in various other ways throughout literature. Bowden (1999, p. 5) defines ICM as an "approach which recognises the catchment or river basin as the appropriate organising unit for research on ecosystem processes for the purpose of managing natural resources in a context that includes social, economic and political considerations". Basher (2003, p. 2), states that ICM is "a globally accepted approach to

managing our land, rivers and coasts in an interconnected holistic fashion which encompasses the principles of integration between communities, scientists, environmental managers, and management of natural resources with catchment or watershed boundaries", Robertson, Rolton, and Edgar (2005, p. 3) define it as "a holistic natural resource management system comprising interrelated elements of land and water in a river basin, managed on a triple bottom line basis", and Phillips (1998, p. 9) suggests that ICM is "the coordination of community activities, private initiatives and government programmes". He states that "managing the incremental and compounding impacts of disparate activities is both the greatest challenge for ICM and one of the main reasons for its existence".

For all the numerous definitions of ICM one can extract the same distinguishing components: catchment or watershed; holistic; triple bottom line (economic prosperity, environmental quality and social justice); and interrelations and coordination between involved groups, policy makers, land owners, and scientists. The combination of these components should ultimately lead to an achieved balance between interdependent roles of resource protection and resource use.

The final relevant detail of ICM is the fact that it is 'issue' driven. Bowden (1999) comments that it is the resource issues within the catchment (i.e. sediment generation, water quality etc.) that fuel the ICM process and prompt the different disciplines to interact with each other with the intention of solving the issues in a manner that suits every group.

3.3. Integrated Catchment Management and Sustainable Development

The term 'sustainable development' has become one of the most widely used expressions in the context of economy, environment, and development. It refers to an alternative method of development which allows for the needs of the environment and society as well as the economy. In essence it is about "improving the quality of life while living within the carrying capacity of supporting ecosystems" (Monro & Holdgate, 1991, p. 198). In other words it is the ability of the current generation to exist within the

assimilative capacity of the environment without compromising the needs of future generations.

ICM approaches are based on the principle of sustainability. They seek to manage the resources within the catchment in such a way that limits irreversible damage that would undoubtedly affect the resource for use by future generations. They endeavour to balance the needs of the environment, society and the economy by adopting a triple bottom line focus.

At the catchment level, ICM seeks to achieve sustainable development by recognising the health of an environmental component that occurs within the catchment. Most ICM projects use the water resource as the main environmental component and view it as the limiting factor to sustainability (Walmsley, 2002). Robertson, Rolton & Edgar (2005), show that the health of the water resource reflects the health and sustainability of the entire catchment. Poor water quality and limited water quantity for example, are two negative attributes of poor environmental health which can filter though to society impacting on lifestyles and wellbeing, thereby failing to achieve sustainability with respect to the environment, the economy and society.

3.4. International Integrated Catchment Management

As previously mentioned by Bowden (1999), ICM is globally established concept, operating in numerous countries around the world. Alternate names are used in different places: Total Catchment Management (Australia); Integrated Catchment Management (New Zealand); Integrated Watershed Management (USA); Integrated River Basin Management (UK); and Integrated Water Resource Management (UK) but they all share the same elements – “engaging stakeholders through a partnership approach, coordinating action across jurisdictions, systems thinking, and using a balanced approach to weigh concerns for sustainability against development” (Hooper, 1998, p. 1). The process, whatever the name, has had a different history in each country depending upon the statutory framework and associated environmental legislation put in place to manage and control the country’s natural resources.

What follows is a brief insight into ICM in Australia, the United States of America and the United Kingdom. The requirement to carry out ICM in some countries is more strict and regulated than in others and therefore assistance in generating ICM plans varies. Included in the section below are examples of agencies, both governmental and non-governmental, that have been formed to support local community groups and organisations in carrying out ICM.

3.4.1. Australia

The Australian Government System is split up into a number of tiers; federal, state and local government. The state governments have primary responsibility for environmental and natural resource management. The introduction of Total Catchment Management (TCM) into state legislation was staggered between states. Multi-objective management was first initiated at a watershed scale to focus on soil conservation in the 1930's, but it was not until the late 1980's when the terminology of TCM first reached policy directives or legislation in some of the states.

TCM began in New South Wales in 1984 and was formalised with the implementation of the *Catchment Management Act 1989* (NSW), which was to be enforced by the State Catchment Management Coordinating Committee, the Sydney Catchment Authority and eighteen catchment boards (Australian Catchment River and Estuary Assessment, 2002). The *Catchment and Land Protection Act 1994* (Vic) is the principle legislation that covers TCM in the state of Victoria, while in the other states the objectives of TCM are provided for under a combination of other acts and policies. The Tasmanian Government is currently in the process of developing a state policy on TCM by using most of the 95 Acts, administered by the Department of Primary Industries, Water and the Environment, to channel catchment management concepts (Australian Catchment River and Estuary Assessment, 2002).

In 1986, the River Basin Management Society was established in Australia with the aim to "establish a balanced approach to land, water & natural resource management on a catchment basis" (River Basin Management Society, 2005 para.1). It is a non-profit organisation which encourages membership by anyone involved in resource management

and in return provides conferences, workshops, and regular newsletters to promote River Basin Management in the hope that more informed and balanced decision making will bring sustainable environmental benefits to Australia.

An Australian Catchment, River and Estuary Assessment was carried out in 2002 by the National Land and Water Resources Audit, an initiative of the National Heritage Trust. This report was the first comprehensive assessment of Australia's catchments, rivers and estuaries. Upon completion it clearly identified the need to: "manage impact at the source; focus on improved practice in all land uses; and base targets for improvement in natural resource conditions on practice thus recognizing and reinforcing the role of TCM" (Australian Catchment River and Estuary Assessment, 2002 preface para.3).

3.4.2. United States of America

In the United States of America, environmental and natural resource management is dealt with by the federal government, but often delegated to the states by federal agencies under legislative authority. There currently is no national watershed management policy, except for the U.S. Environmental Protection Agency guidance that promotes the concept to the states (U.S. EPA 1992a as cited in Margerum (1995)). In light of this, many states and localities are pursuing their own watershed-based planning and management strategies.

The Wisconsin Department of Natural Resources (WDNR) implemented Integrated Watershed Management (IWM) with the introduction of the Wisconsin Priority Watershed Program. A proposal of creating Local Watershed Councils to manage and coordinate actions for watersheds of main concern was developed by the State of Oregon (Margerum, 1995), these councils encourage broad-based public support to help develop and implement Watershed Action Programs in conjunction with the Watershed Enhancement Board. In Washington State, the Basin Management Approach controlled by the Water Quality Program in the Department of Ecology and the Watershed Planning Act implemented by county and local governments comprise the main watershed approaches used (U.S. Environmental Protection Agency, 2002). These three states represent a few of many who have begun to implement their own IWM strategies.

Many states have produced publications and web-based information on developing Watershed Management Plans. Some of these include: 'Developing a Watershed Management Plan for Water Quality' conjointly produced by the Michigan Department of Environmental Quality and Michigan State University (MSU); 'A Guide to Developing Local Watershed Action Plans in Ohio' which was released by the State of Ohio Environmental Protection Agency; 'Oregon Watershed Assessment Manual' generated by Oregon Watershed Enhancement Board; 'Know your watershed' webpage created by the Conservation Technology Information Centre (CTIC) at Purdue University in Indiana; and finally 'Overview To Watershed Assessment: Tools For Local Stakeholders' produced by the U.S Environmental Protection Agency, Office of Water, which is applicable to all catchments and includes background information on Watershed Management Framework, Roles and Responsibilities of certain agencies, and an instructive section on Developing Watershed Assessment Plans.

These guides have assisted non-regulative agencies like watershed councils and other interest groups in compiling IWM plans in regions throughout the United States. Other non-profit corporations also exist in the United States who provide support to local governments, watershed councils, and local community groups when seeking to sustainably manage their local watersheds. Such corporations include The Centre for Watershed Protection[1] and The Watershed Management Council[2].

The US Environmental Protection Agency's (EPA) website holds extensive information on watersheds throughout the country, the EPA's 'Surf Your Watershed' Program[3] allows users to access information on a watershed level, including data such as: ambient water conditions; water column chemistry; biological integrity; bottom sediment characteristics; in-stream designated uses or impairments or special protection areas; in-stream flow data; point source discharge data (e.g., compliance monitoring data); and watershed land use

[1] http://www.cwp.org/mission.htm

[2] http://www.watershed.org/wmc

[3] http://www.epa.gov/surf

data. It also lists and provides detailed information about all of the watershed groups operating within each state.

3.4.3. United Kingdom

The implementation of Integrated River Basin Management (IRBM) in the European Union (EU) has been encapsulated within the Water Framework Directive (WFD), which came into force in December 2000. The WFD forms an agenda for the protection of surface waters and ground waters throughout the EU territory. It stipulates innovative ways of working and introduces a management framework based on river basins (Environment Agency, 2006).

The Secretary of State at the Department for the Environment, Food and Rural Affairs (DEFRA), the National Assembly for Wales, and the Environment Agency combine to perform the governmental roles required in the WFD in England and Wales (World Wildlife Foundation (WWF), 2006). The Environmental Agency replaced the previously operating National Rivers Authority (NRA) in 1996. Launched in 1989, the NRA managed water resources in ten of the former regional water authorities of England and Wales, the Authority was also responsible for pollution management, flood control and land drainage (Research Machines, 2006).

The WFD stipulates that each body of water is accompanied by a set of objectives and programmes of measures which are to be applied to achieve these objectives as well as River Basin Management Plans (RBMP) for each River Basin District (RBD) (Environment Agency, 2006).

'Water and Life for livelihoods: A Framework for River Basin Planning in England and Wales' is a thorough 111-page document provided by the Environmental Agency of England and Wales, which outlines the river basin planning process and the mechanisms used to engage and work with others to achieve co-ownership of the RBMP and the commitment of those responsible for undertaking its actions.

3.5. Integrated Catchment Management in New Zealand

The use of ICM as a tool to manage natural resources in New Zealand has not been constant; the change in environmental legislation over time has seen ICM approaches used for certain periods only to be lost in restructuring of governmental departments. The story of the rise and fall and the recent popularity of ICM is an interesting one, which is best understood with knowledge on the background of New Zealand's Environmental Legislation.

3.5.1. The history of New Zealand's Environmental Legislation

Since the 1940's regional government agencies defined by large catchment boundaries have been responsible for the management of land and water resources (Fenemor, 1992). Legislation prior to the 1940's included the River Boards Act of 1884 and the Land Drainage Act of 1893. Hydrological investigations began prior to the 1940's at various locations around the country. The Public Works Department imported the first known water level recorders in 1898, and by December 1912 a monthly chart recorder was installed in Northland on the Wairua River to investigate the possibility of a hydro-electric power scheme (Waugh, 1992).

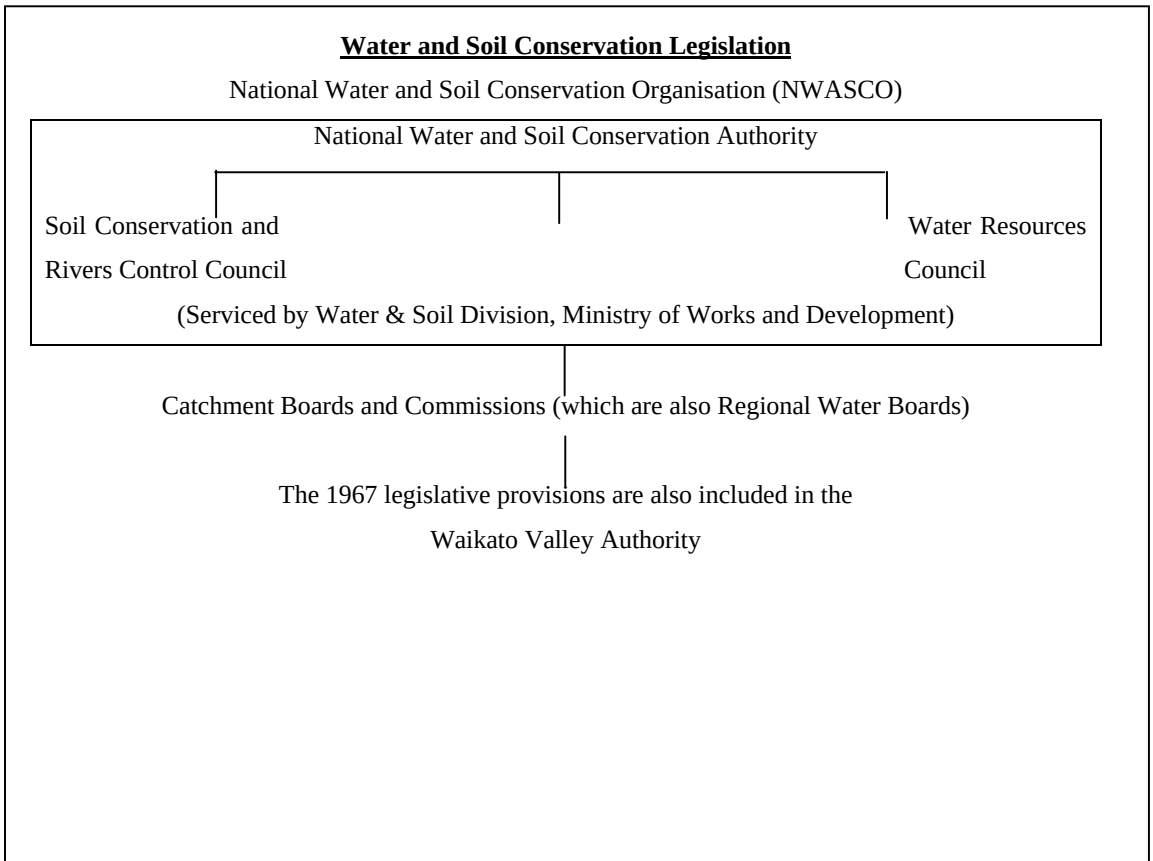
The Soil Conservation and Rivers Control Act was established in 1941 "… to make provision for the conservation of soil resources and for the prevention of damage by erosion, and to make better provision with respect to the protection of property from damage by floods" (Poole, 1983, p. 21). With this Act came the subsequent formation of catchment boards, supported by the Soil Conservation and Rivers Control Council at a national level. Hydrological work increased as a result of the establishment of the catchment boards (Waugh, 1992). Initially the focus of the catchment boards was on flood protection and soil conservation in response to the deforestation and the floodplain development for agriculture and urban growth occurring at the time.

The expanding agriculture, industry and urban sectors led to the increase in demand for water supplies and an increase in the need to discharge wastewater back to the surface or

sub-surface. The Waters Pollution Act came into force in 1953 in order to restrict pollution rather than reverse it.

The catchment boards' role was expanded in 1967 with the introduction of the Water and Soil Conservation Act. Regional Water Boards were established to manage water allocation and water pollution (Fenemor, 1992). It was at this stage when the National Water and Soil Conservation Authority (NWASCA) was created. This Authority was to guide the Rivers Control Council, who would deal with erosion, flooding and drainage, and the Water Resources Council who would deal primarily with the water resource, both of which operated though Catchment Authorities across the country (Poole, 1983).

The Water and Soil Conservation Act 1967 encouraged the 'multiple use' of water resources. However, it was stipulated that "any water use had to be 'beneficial' and no competing use had a legislated superiority over other uses" (Fenemor, 1992, p. 366). An amendment to the Act was provided in 1981, after the realisation that other water uses such as recreational, fisheries and aesthetic values also had to be taken into account.



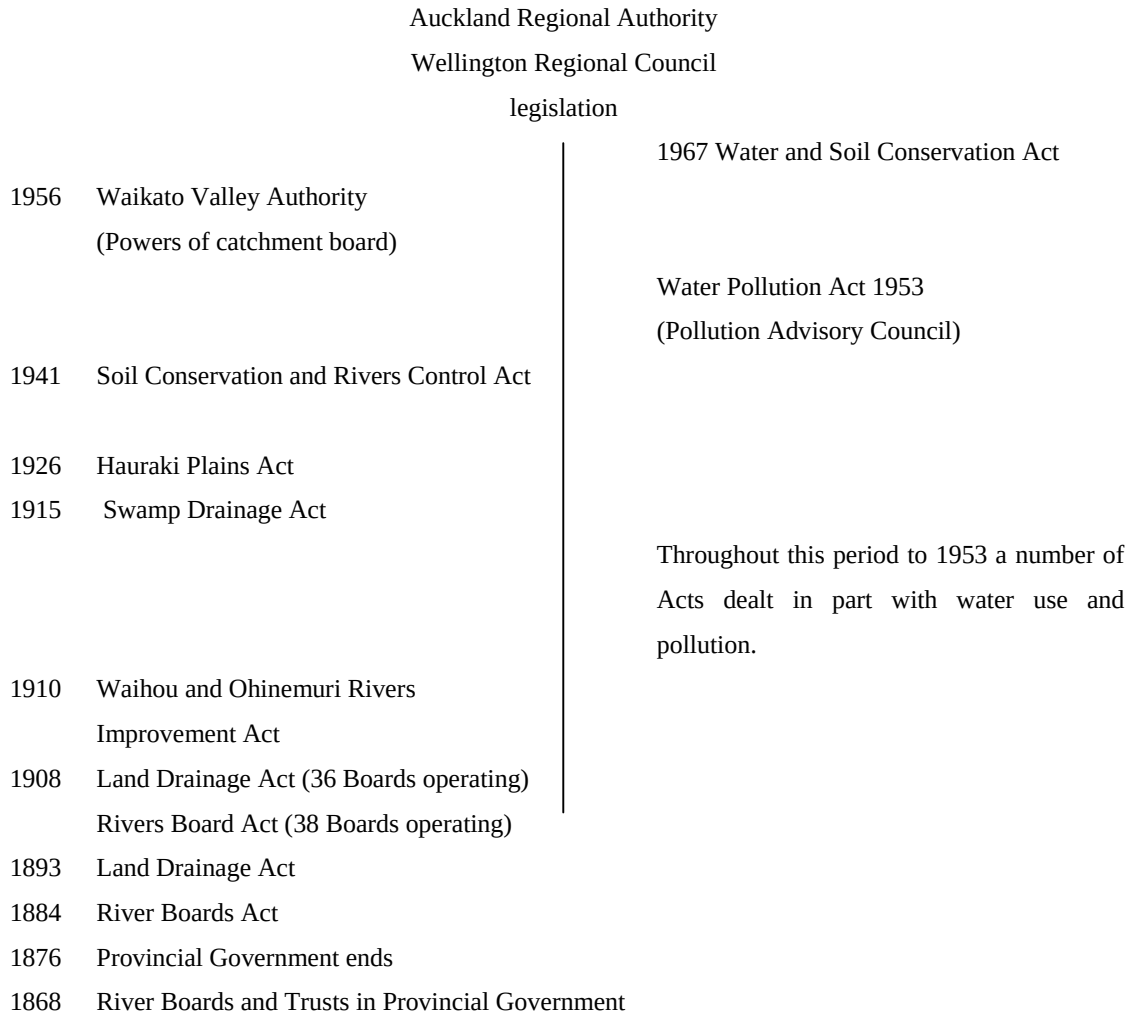


Figure 0-1: Water and Soil Conservation Legislation: Source (Poole 1983, p. 20)

The amendment was known as the 'Wild and Scenic Rivers' amendment, and it promoted protection and preservation of water bodies with outstanding natural features by implementing water conservation orders (Fenemor, 1992).

By this time, water management plans were only being created by the regional water boards for polluted catchments or catchments with water deficits (Fenemor, 1992). These plans were only informal and did not bind regional water boards to them. With the introduction of the Resource Management Act (RMA) in 1991, the concepts of resource management plans changed and were now compulsory documents that had to conform to national guidelines. A few years prior to the introduction of the RMA in New Zealand, regional councils replaced the existing catchment boards and regional water boards. They

also gained wider functions including regional planning, pest and weed control and civil defence responsibilities (Waugh, 1992).

Nearly 80 of New Zealand's previous acts and regulations were completely replaced by the RMA, and it included amendments to over 50 others (Waugh, 1992). In contrast to the Water and Soil Conservation Act, which supported a philosophy of multiple use, the RMA's purpose was sustainable management in respect of natural and physical resources (Fenemor, 1992).

Section 5(2) of the Resource Management Act defines sustainable management to mean: *'managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural wellbeing and for their health and safety while -*

(a) Sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and

(b) Safeguarding the life-supporting capacity of air, water, soil and ecosystems; and

(c) Avoiding, remedying or mitigating any adverse effects on the environment'

There are several assumptions that the Act is based on, including:

- *"The environment is a dynamic system comprised of interconnected elements -- air, land, water and ecosystems -- and should be treated as a whole;*
- *Those governing bodies closest to resources are the most appropriate to govern the use of resources; therefore, responsibility for implementing the RMA is decentralised to local and regional authorities;*
- *Efficiency comes from shifting attention and regulation away from 'activities' such as logging or grazing, and onto the 'effects' of activities such as sedimentation or eutrophication;*
- *The RMA recognises the Treaty of Waitangi and the partnership that exists between the Crown and the Maori. It was in 1840 that the Maori succeeded*

kawanatanga, governance, in exchange for rangatiritanga, absolute guardianship of resources by the Maori" (Frieder, 1997, p. 17).

The Resource Management Act 1991 is currently New Zealand's main piece of environmental legislation. "Section 30 of the Act requires our environmental management agencies (regional and unitary councils) to achieve integrated management of the natural and physical resources of the region" (Basher, 2003, p. 2) which is reflective of ICM. Although the RMA requires 'integration' some believe that the introduction of the RMA has hindered the rise of ICM. These arguments have been outlined in the section below which describes the history of ICM in New Zealand.

3.5.2. The history of Integrated Catchment Management in New Zealand

There seems to be a debate on the relative age of ICM in New Zealand, Robertson Rolton, & Edgar (2005, p. 3) claim that "ICM is relatively new to New Zealand but has gained credibility rapidly as an effective methodology for holistic management in a sustainable development framework", other researchers such as Bowden (1999) and Phillips (1998) claim that ICM has had more of an extensive history in New Zealand's management of land and water resources, but focus on the approach was lost in the post-Resource Management Act era.

From 1964 through to 1975, New Zealand participated in UNESCO's International Hydrological Decade (IHD). During this time New Zealand was split up into 90 distinct hydrological regions within which 76 representative basins were established (Bowden, 1999; Waugh, 1992). These representative basins are analogous to the catchment areas studied today. Studies within the catchments allowed an understanding of the physical hydrology of the landscape and provided information for planning, resource management, and environmental monitoring. Hence even through the IHD the need for studies on a whole catchment basis had already been realised in order to value natural and anthropogenic impacts on land and water resources (Bowden, 1999).

Studies that observed the impacts of land use conversions to uses such as cropping, dairy farming and forestry on water resources were carried out after the IHD programme

around 1975. Glendhu, Maimai, and Big Bush are three of the remaining catchment studies that are still in operation today. Initially there were around ten catchments that were established nationwide and ran for a period of about ten years from the mid-1970's to mid-1980's (Bowden, 1999).

According to Bowden (1999), these catchment studies along with those that were established later, failed to achieve true integrated management. The mid 1980's saw a combination of financial, political and institutional changes, and the subsequent reorganisation caused the loss of institutional motivations and individual efforts which were required to keep the studies going. Competition was created between science providers leading to an almost impossible situation for cooperative, long-term, national ICM.

The introduction of the Resource Management Act in 1991 worsened the situation according to Phillips (1998) and Bowden (1999). ICM became lost with the dissolution of the catchment boards and the framework of the new post-RMA organisations. There was no direct replacement of the catchment boards, and as functions became separated into different disciplines within these organisations, ICM was no longer practiced.

Bowden (1999, p. 7-8) believes that the practical application of the RMA 1991 has not generated the intended integrational approach to environmental management for two reasons; "the decentralization of environmental management responsibilities to regional and district councils" and "the RMA's focus on impact identification and mitigation rather than source area management".

The resources available to most regional and district councils are limited in New Zealand and the decentralization of environmental management and the requirements set by the RMA pushed councils beyond their resources. With the introduction of the RMA came the requirement of councils to produce a series of policy and planning documents. While the production of these documents had some benefits, they were time consuming and expensive consequently leaving inadequate resources to execute some form of integrated environmental management (Frieder, 1997). The decentralization of environmental

management also led to the formation of information exchange barriers, whereby councils have no incentive to share information and experiences among each other. The danger of this was that environmental management had become inefficient with councils working with limited knowledge and experiences.

The RMA has an inherent focus on impact identification and mitigation rather than regulation of activities that impose these impacts. It tries to identify and mitigate impacts such as sedimentation and eutrophication. Although this concept is good in theory, it becomes flawed when coupled with limited resources that force resource managers to make consent related decisions based on inadequate information and in short time frames (Bowden, 1999). In order to deal with these rushed decisions, councils try to remedy the effects by monitoring the approved activity so that any impacts will be seen as soon as they occur. This approach can be risky as by the time monitoring identifies a problem, it may be too late to mitigate, remedy or determine who is accountable (Bowden, 1999). In order to overcome this problem, resource managers should be looking to locate where the problems will come from prior to them eventuating, in a process of source area management.

Phillips (1998, p. 9) is in agreement with Bowden, and comments that “the last decade of research supporting ICM, tended to be less than well integrated”. Up until recently, environmental managers have “focused on individual threads of the puzzle only, concentrating on sediment supply, sediment budgeting, characteristics of individual ecosystem processes, and various hydrological studies”. He goes on to comment that “although many regional councils are trying to maintain cohesion across various functions, the integration of policy, planning and on-ground management has been less than coordinated”.

In a sense ICM in New Zealand has been recently reborn, researchers from numerous institutions; Landcare Research, NIWA, IGNS and universities in conjunction with regional and district councils and with the help of local communities, are working on carrying out ICM approaches which in the 21st century have been made easier with improved technology i.e. remote sensing and geographical information systems, from

which real environments can be modelled and predictions made on the effects of activities carried out within the environment. The need for ICM has once again been realised in a time where environmental sustainability is so topical.

Since the new millennium, numerous ICM projects have been instigated in New Zealand, these include the Tairei Trust (Otago), Motueka and Riwaka ICM (Tasman), Whatawhata Catchment Project (North Auckland), Whaingaroa Catchment Management Project (Raglan), Waipaoa Catchment Project (Gisborne) and Orari River Catchment Project (Canterbury). All of these projects recognise the need for a holistic, integrated, issue-driven, interdisciplinary approach to achieve sustainable management.

Like Australia, the United States and the United Kingdom, there are agencies in New Zealand that seek to support groups carrying out the ICM process. "The ICM Project"[4] is a Ministry for the Environment Sustainable Management Fund project aimed at sharing community level best practice in ICM nationally. The purpose of the ICM project is to create a network of people and institutions involved in ICM, and to provide opportunities for these people to share experiences, tools and approaches throughout New Zealand.

In addition to the ICM project, one individual ICM project has been established as a case study to develop framework for ICM research that can be applied anywhere. This ICM project is the Motueka and Riwaka ICM, it was chosen as a case study as its issues are common to many catchments in New Zealand, and thus solutions to these issues, involving the "science of integration" and the "integration of science and management" can be transferable through out New Zealand and the world (Basher, 2003, p. 2).

3.6. Critical success factors

The success of ICM in New Zealand and internationally has been made easier in the 21st century with the onset of new and more powerful technology and also the realisation that

[4] http://landcare.org.nz/icm/projects.asp

the approach must satisfy critical conditions in order for it to achieve the desired outcome.

In many of the relevant publications, critical success factors for ICM have been given, these include publications by (Bowden, 1999; Bowden, Fenemor, & Deans, 2004; Department of Water Affairs and Forestry, 1996; Fenemor, 2002; Walmsley, 2002). The following list of critical success factors to resolve environmental issues satisfactorily with an ICM approach has been summarized from (Bowden et al., 2004; Fenemor, 2002).

- Accountability.
    - A legal and institutional setting which facilitates resolution of the issues, so that both the process and its outcomes have accountability.
- Forward Planning.
    - Strategic planning to anticipate the issues, collect relevant information and initiate dialogue before the issue becomes a crisis.
- Vision, leadership and structure for the process.
    - At least one party to drive the process
- Involving all relevant stakeholder groups and engaging with stakeholder representatives who actually have decision-making power.
    - All interested parties need an opportunity to participate to maximize acceptance of the outcome.
    - Identifying and engaging the ‘reluctant’ participants can be critical to success.
- Adequate definition of the issue, including issue boundaries and spatial and time scales.
- Adequate information upon which to base the dialogue, and strong, accepted science.
- Accept local knowledge, including validated anecdotal knowledge, not just science.
    - Cultural insights, based on decades and even centuries of observation and experience can be extraordinarily valuable.

- Workable solutions expressed clearly and succinctly.
    - Communicating the process of reaching these solutions—e.g. how the catchment models work—and communicating the outcome itself in simple terms is vital.
    - Use of simple common sense tools and approaches to achieve critical communication and education including holding annual general meetings, forming community reference groups and a catchment website.
- Committed leaders willing to facilitate shared solutions.
    - Leadership is vital, especially from those who are respected in the community. They will provide the catalyst that makes the difference between success and failure.

The founders of the "Better River Basins" organisation in the UK (run under the World Wildlife Foundation (WWF), as part of the UK Natural Rivers programme) compiled a similar list for successful Integrated River Basin Management (IRBM) (World Wildlife Foundation (WWF), 2006):

- A long-term **vision** for the river basin, agreed to by all the major stakeholders.
- **Integration** of policies, decisions and costs across sectoral interests such as industry, agriculture, urban development, navigation, fisheries management and conservation, including through poverty reduction strategies.
- Strategic decision-making at the river basin **scale**, which guides actions at sub-basin or local levels.
- Effective **timing**, taking advantage of opportunities as they arise while working within a strategic framework.
- Active **participation** by all relevant stakeholders in well-informed and transparent planning and decision-making.
- Adequate investment by governments, the private sector, and civil society organisations in **capacity** for river basin planning and participation processes.
- A solid foundation of **knowledge** of the river basin and the natural and socio-economic forces that influence it.

'Adequate information' from the former list and a 'solid foundation of knowledge' from the second list are critical success factors that will be studied further. These factors support the premise of creating a resource inventory (also known as catchment assessments, technical reports, or information packages) as one of the first steps in the ICM process.

3.7. Resource Inventories and the ICM Process

Like any other management plan, an ICM plan starts with thorough research. Information on the various attributes and processes pertaining to the whole catchment is necessary so that effective plans to holistically manage the catchment can be drafted. The result of the gathering and compilation of such information is a resource inventory. As the name suggests, a resource inventory is an itemized listing of current assets within the geographical boundaries of the catchment which provides an understanding of these assets by outlining their quantity, quality, condition and location.

In addition to a stock take of the assets, the resource inventory also includes information on how the assets are currently being utilized in the catchment in the terms of urban use, agriculture, horticulture, industry, recreational, and aesthetic use. Statutory frameworks, current management practices, potential natural hazards, and land use change over time are also often included to strengthen the information database that will be invaluable to decision making bodies.

The resource inventory should be a 'living document', regularly being updated with new information and changes that mimic those occurring in the catchment. However, a copy of the initial resource inventory should be kept static to provide a baseline information source against which plans and programs can be evaluated.

The need for a resource inventory as the basis of an ICM plan is cited in most ICM and IWM publications, including the critical success factors outlined in Section 3.6. Rowland, 1995, cited in Walker & Ballamy (2003, p. 209), produced the following table outlining the key components of a catchment management strategy. The first key component listed

is ‘setting the scene’ giving the description of the biophysical resources in addition to their use and management.

Setting the Scene	Description of the physical, economic, biological and social attributes of the catchment and the use and management of natural resources in the catchment.
The Vision	A statement or series of statements describing a vision for the catchment or principles to guide use of resources that have broad stakeholder support.
Identifying Issues	Identification, analysis and ranking of the key natural resource management issues.
Outcomes	Statements of the proposed outcome resulting from the implementation of the strategy
Objectives	Specific, measurable, achievable, relevant and timely objectives to address each issue.
Strategies	Strategies to achieve the objectives. Major components of these strategies include: Activities to be carried out; Organisations, government departments or agencies, local authorities and other key stakeholders that need to be involved. Resources (time, money, manpower) needed to carry out activities.
Performance Indicators	Attributes that should be measured or determined to assess progress toward the objectives.
Outputs	For example: Policies for use by local or state government, industry groups and other agencies. Guidelines for the use and management of natural resources in the catchment. Operational plans to redress or prevent degradation of loss of value with natural resources in the catchment. Institutional arrangements necessary to achieve better use and management of natural resources.
Implementation	Mechanisms and structures to be used in implementing the strategy
Evaluation and Review	How the implementation of the strategy will be monitored so that appropriate changes can be made if necessary.

Table 0-1 Key components of a Catchment management strategy: Source Rowland (1995)

The Conservation Technology Information Centre at Purdue University in Indiana, USA, has designated a substantial section of their website to assisting local groups in effectively creating their own watershed plans. The following extract from their website is a simplistic outline of the Watershed Planning Process where the resource inventory has been listed as the first step.

The watershed planning process

1. Get to know your watershed
    - Determine size, boundaries, soils, terrain and other features
    - Understand the people, interests, and institutions
    - Determine how the watershed is used

2. Build local partnerships
    - Identify and contact partners/stakeholders
    - Divide work and responsibility
    - Identify and manage conflicts
    - Obtain local funding and other resources
3. Determine priorities for action
    - Assemble maps and data
    - Identify and document problems
    - Determine goals and objectives
    - Evaluate water quality
    - Assess land use
    - Select critical areas for attention
4. Conduct educational programs
    - Identify and understand target audiences
    - Develop specific messages
    - Combine communication approaches, channels and media
5. Provide landowners with assistance
    - Target technical assistance
    - Provide financial assistance
    - Build social support and recognition
6. Ensure implementation and follow-up
    - Continue with monitoring and evaluation
    - Provide continued local funding
    - Continue to inform and involve everyone

There are countless examples of step-by-step catchment (watershed) management guides which outline the need for resource inventories. Such examples include 'Developing a Watershed Management Plan for Water Quality: An Introductory Guide' (Brown, Peterson, Kline-Robach, Smith, & Wolfson, 2000) and 'A Guide to Developing Local Watershed Action Plans in Ohio' (Voinovich, Hollister, & Schregardus, 1997). A paper written by Shelton et al. (2001), demonstrates the need for an inventory approach to ecosystems in the Goulburn Broken Catchment in Australia. In this publication, only an inventory of the ecosystems goods and services operating within the catchment was recorded. This demonstrates that resource inventories can be tailored to suit the size and objectives of the eventual plan.

3.8. Conclusion

The main purpose of this literature review was to provide an understanding of the theory of ICM and ultimately to set the scene for the research. The final section of the chapter,

Section 3.7 outlined the requirement of a producing a resource inventory as the first stage in implementing an ICM plan.