INTEGRATED CATCHMENT MANAGEMENT PLANNING FOR THE NEXT GENERATION

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ABSTRACT

Integrated Catchment Management Planning (ICMP) is a process for developing a framework to guide development and land use activities with respect to water resources within a catchment. In general, it is a tool for establishing the demands and effects of existing and proposed land uses at a catchment scale, and developing high-level management strategies to manage these demands and effects.

As the name suggests, ICMPs are intended to integrate the various strategies that can be used to achieve positive environmental, social and economic outcomes through effective management of water resources within a catchment. That is, by looking at the water cycle and associated functions within catchment as a whole (including cultural context, biodiversity, hydrogeological conditions, and the catchment's relationship to other catchments) and weaving these together to develop overlapping strategies that will improve the catchment for existing and future generations.

However, valuable opportunities are often missed during the ICMP process when various components are developed in silos or in a linear process rather than collaboratively and holistically. Frequently the interrelationships between different elements are not fully taken into account as the plan evolves, resulting in conceptual frameworks which are not always practical to implement. Furthermore, the potential cross benefits of available management techniques are often missed.

Firstly, this paper will explore the existing ICMP framework and how or why its current implementation may be inadvertently resulting in outcomes that are counter to the overarching philosophy. The paper will then look at opportunities to improve the interconnectivity between baseline data, catchment activities, values and outcomes, and the available management tools based on best practice. Finally, the paper will conclude with high-level recommendations for how the next generation of ICMPs can build on the current framework to continually improve how we plan for and manage our water resources.

KEYWORDS

Integrated Catchment Management, Water Sensitive Design, Framework, Water Resources

PRESENTER PROFILE

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1 INTRODUCTION

1.1 THE CHALLENGE AHEAD

Integrated Catchment Management Planning (ICMP) has the potential to significantly improve the way we allocate, develop and manage land and water use in New Zealand. However, the complex regulatory frameworks, regional/local boundaries and growth pressures often result in sub-optimal application of the of best practice ICMP processes. This can result in ad-hoc solutions which do not fully consider the context, limitations or interdependent nature of water resources, land use and development within catchments. To maximise the benefits of ICMP we need to ask ourselves the following questions;

- What does the ideal ICMP process look like;
    - What are the key features required to optimise social, environmental and economic outcomes;
- How is the ICMP process currently being used
    - What (if any) key features are missing that prevent us from realising the full potential of ICMP;
- What are the implications of how we are currently using ICMP;
- What are the root causes which lead to sub-optimal use of ICMP; and
    - How can we overcome the existing barriers to achieve improved and consistent outcomes from the ICMP process?

The following sections attempt to answer each of these questions at a high level to stimulate further discussion within the industry. A lot of the discussions and suggestions that are presented in this paper are not necessarily new. In fact, the topic has been discussed for many years from several different angles and perspectives. Resulting in minimal change to the way we currently undertake ICMP in New Zealand. This is the very reason we need to examine the issue again, summarise some of the key findings from previous research, and attempt to provide a fresh perspective. It is envisaged that by doing so, the reader is challenged to question the limitations and constraints of the current model, and consider ways to improve the model in order to realise the potential of a fully integrated approach.

There are some examples of an emerging integrated approach to catchment management planning. However, even these are limited in their effectiveness due to the constraints and limitations of the current regulatory framework and processes which are discussed later. This paper is intended to restart the discussion as to why these limitations exist and what can be undertaken by industry professionals to remove or overcome these limitations. Through this process a new, consistent framework can be developed to enable the next generation of ICMPs to be undertaken in a manner that truly integrates all aspects of anthropogenic development (both urban and rural) within catchments and leaves a positive legacy for the future.

1.2 WHAT IS IN A NAME?

Different terminology is often used when discussing aspects of catchment management. The terminology tends to be used somewhat interchangeably to refer to, what are in fact, quite different activities with different focusses, goals and objectives. A good discussion of the differences between the various terms used and why it is important to define what is meant by these terms before embarking on any discourse has previously been presented to the industry (Hunter & Scrafton, 2012). While the need for consistent and appropriate terminology is discussed later, to avoid confusion, the following definitions will be used (as consistently as possible) throughout this paper to refer to the different types of catchment based initiatives;

Integrated Catchment Management [Plans] (ICM[P])

A holistic plan for how development/redevelopment within a hydrologic catchment should be managed to achieve optimised social, environmental and economic outcomes. These plans identify the key constraints and opportunities within a catchment that need to be taken into account during development/redevelopment or changes in land-use. The ICMP should be undertaken in parallel with, or ideally as part of, the structure/spatial planning.

Catchment Management [Plans] (CM[P])

A plan outlining how **stormwater** within a catchment is to be managed to meet the objectives and constraints identified in an ICMP. These plans relate specifically to stormwater management and occur after the structure plan/spatial planning processes. This allows the details of stormwater management to be better defined, implemented and budgeted.

Stormwater Management [Plans] (SWM[P])

Detailed and site-specific with defined development typologies/footprints intended to demonstrate how the options outlined in a CMP are implemented.

It may seem somewhat trivial to focus on semantics, but experience shows that it is necessary to have a consistent understanding of the breadth and scope of the activities to ensure the right outcomes. Particularly as the lack of consistent terminology or well defined scope may in fact be a contributing factor to sub-optimal outcomes from the ICMP process (Hunter & Scrafton, 2012). We cannot adequately define our goals and objectives if we are talking at cross purposes or the subject of discussion is commonly understood and agreed upon. As Charles F Glassman said;

> *"It's very important to choose our words carefully because miscommunication leads to misunderstanding, which rarely leads to anything good"* (Glassman, 2009)

2 IDEALISED APPROACH

ICM can be viewed as a subset of land use management using the catchment as a defining management unit. (Bowden, 1999) 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"*

This requires wide ranging support and partnership between different branches of government and those in the private sector. All stakeholders need to agree on the key principles, overarching regulatory framework and process dynamics. This is difficult to achieve in an often adversarial climate where each party's desired outcomes are not always aligned or backed by reliable data. To achieve truly integrated management of land use and natural resources we need;

- An agreed set of guiding principles
- A process methodology which allows all elements within the system to be adequately considered at the early stages
- access to consistent, high quality data

The following is an attempt to summarise these in the hopes of promoting further discussion.

2.1 KEY PRINCIPLES

There are five key principles required for effective Integrated Catchment Management (Ashton, 1999). These are paraphrased below;

- a **systems** approach, which recognises and addresses the needs of individual components and interrelationships (including human and natural systems);
- an **integrated** approach, where key issues or areas of focus are identified by the various stakeholders and addressed collectively;
- a **stakeholder** approach which engages individuals, landowners, and government agencies in a participatory process to define the desired outcomes;
- a **partnership** approach which seeks to reach agreement on common objectives, and defines the roles, responsibilities and accountabilities of each agency and individual who participates in the process of decision-making; and
- a **balanced** approach which seeks to achieve a sustainable blend of positive social outcomes, economic development and protection of natural resources.

These principles are considered to be fundamental to the success of a truly integrated approach to land-use and water management. The overarching theme is one of collaborative and holistic thinking, whereby the needs of all stakeholders (including the environment) are taken into consideration when defining the objectives, and desired outcomes, for activities within a catchment.

2.2 PROCESS METHODOLOGY

The ICMP process should ideally be initiated prior to the Structure Plan process (or equivalent spatial planning) to enable the hydrogeological, ecological, hydraulic and other water resource related characteristics of a catchment to be identified and fed into strategic growth and land-use planning (ARC, 2005). Figure 1 below, while somewhat outdated, shows the general alignment and linkages between ICM and other aspects of the planning process in Auckland with some of the missing links/feedback loops required to improve outcomes.

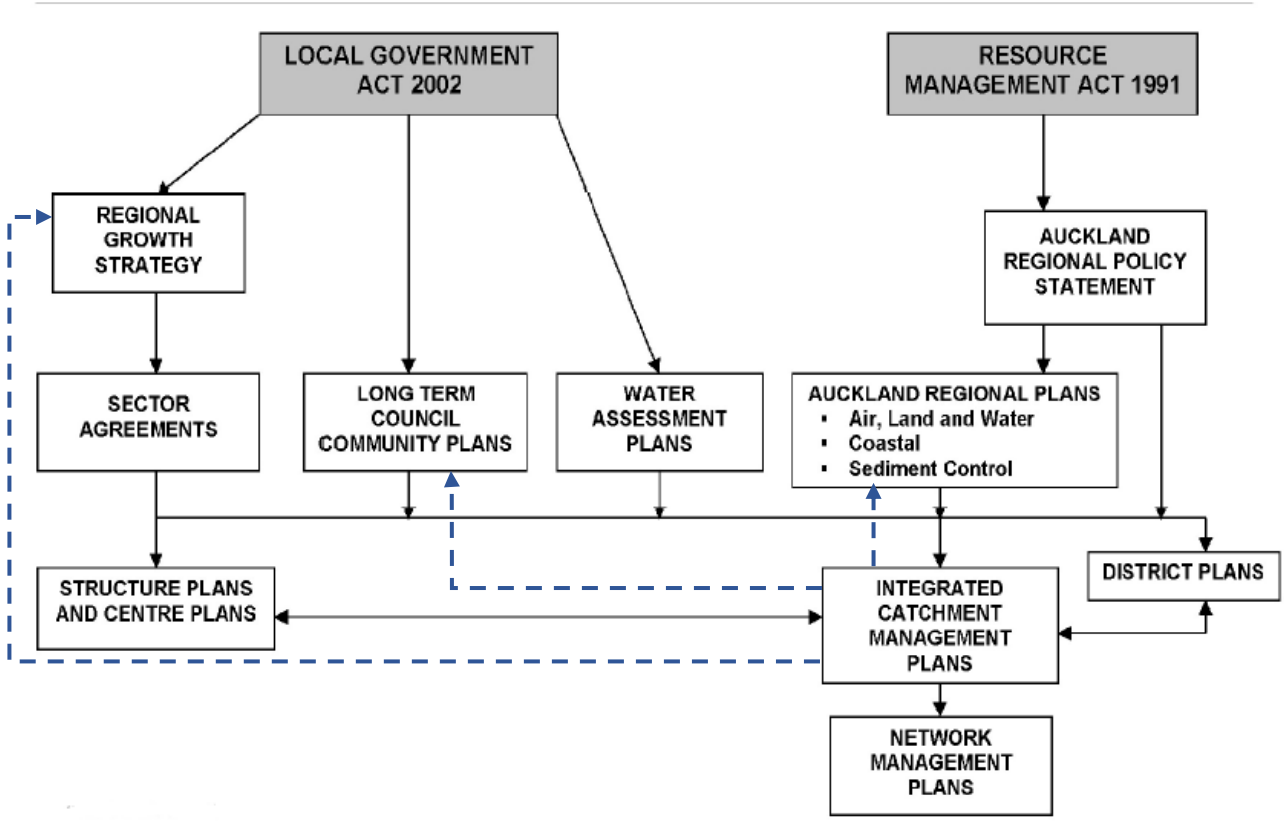

Figure 1: Relationship between ICM and other planning documents adapted from (Reed & Utting, 2011) to show proposed linkages and feedback mechanisms (dashed).

While management of water resources is not the only aspect that needs to be considered when planning for development and growth, it is (or should be) one of the key early considerations. This is because water resource related issues fundamentally impact on the ability to use and develop land and getting the management of this resource wrong can have significant consequences. A somewhat obvious example is zoning land that is subject to serious and frequent flooding for high-density residential development. This inherently would present a significant risk to future owners/users of the land and/or severely constrain the typology of development (e.g. dwellings may need to be constructed on stilts to lift floor levels above the flood waters). Due to growth pressures this cannot always be avoided, but without the information relating to flood depth and extents being feed back into the strategic planning process, opportunities to avoid or adequately address these risks can be missed. As such, growth planning needs to incorporate environmental, socioeconomic, geophysical and infrastructural constraints in order to be effective (Hunter & Scrafton, 2012)

Additionally, when the constraints are not well understood, growth can be planned in such a way that existing issues are exacerbated, resulting in adverse outcomes downstream. The carrying capacity and constraints within a catchment need to be identified and understood early. These can then feed into structure planning and growth strategies and identify areas where development should be limited and/or areas where the best opportunities for intensification exist. This can be overlaid with the other planning considerations (e.g. transportation links, population growth and land use needs) to determine where compromises may be required and inform the ultimate outcomes.

The general approach to integrated land use and catchment management needs to be collaborative, adaptive and iterative. There needs to be constant monitoring of outcomes and feedback loops that allow improvements to be made over time. (Feeney, et al., 2010) provides an excellent summary of the bigger picture processes underlying ICM using the ISO Plan-Do-Check-Review cyclical model. However, in order to implement ICM we need to examine the subroutines within this framework – in particular the 'doing'. Figure 2 gives suggested considerations when developing an ICMP along with a suggested simplified framework based on the same ISO model;

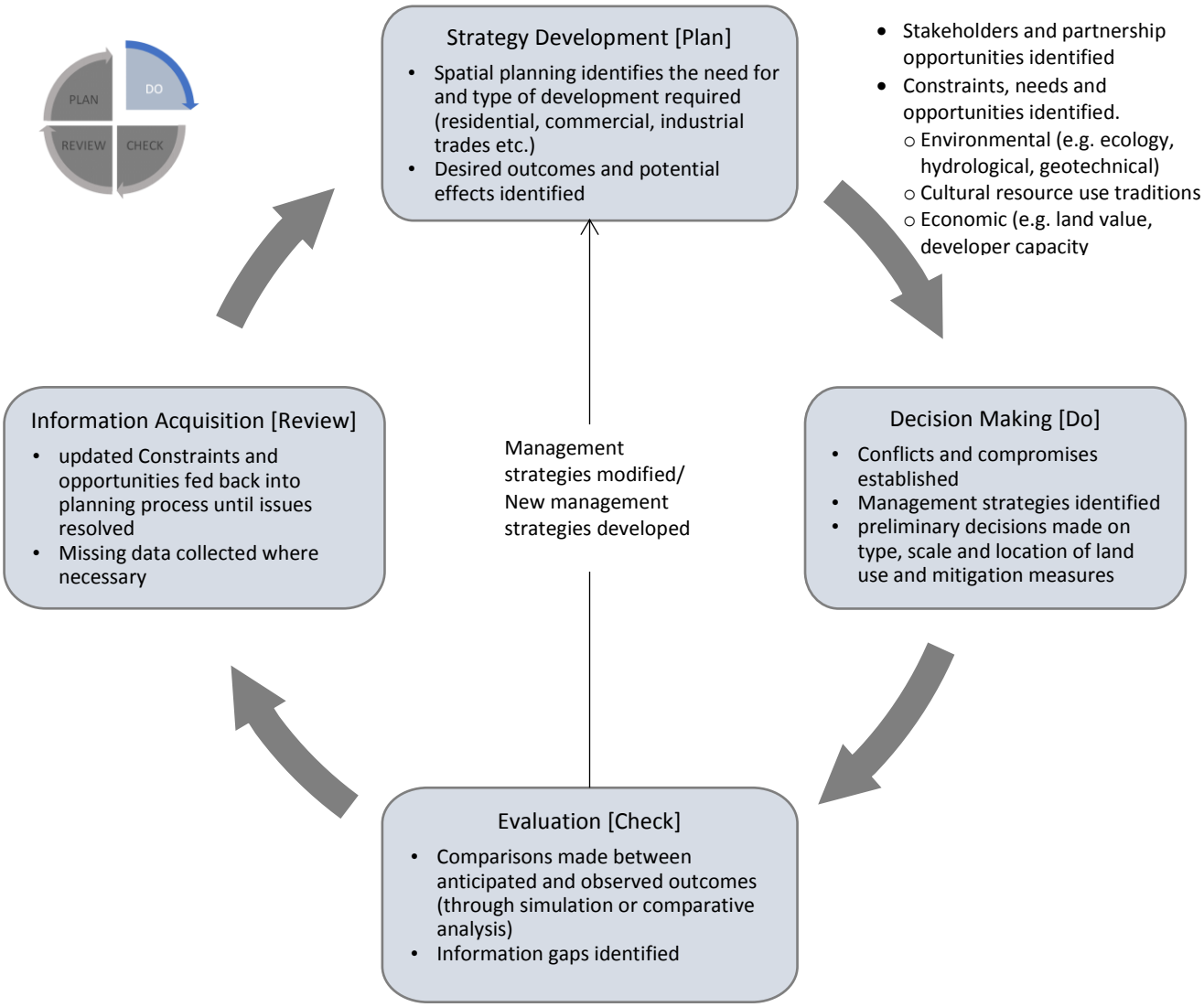

Figure 2: Conceptual ICM development framework adapted from (Hooper, 2005)

2.3 SCALE AND BOUNDARIES

To realise the full benefits of ICMP it is important to set the scale and extents appropriately. (Hooper, 2006) discusses the importance of scale with respect to ICM but leaves the question open as to which scale is the most appropriate as this depends predominantly on the context. Table 1 below shows these scales in relation to the management of water resources in New Zealand and the associated regulatory framework.

Table 1: ICM planning scale, adapted from (Hooper, 2005) and (Feeney & Gustafson, 2010) to reflect the New Zealand catchment planning context

	Macro level	**Meso level**	**Micro level**
Natural system and resources	Part of a geographical zone such as a river basin or different ecological zones	Regional or local ecological resource system	Areas with relatively uniform ecological conditions
Mapping scale	>1:500,000	1:100,000–1:500,000	1:10,000 - 1:1,000
Mapping unit	Connected rivers, aquifer, estuarine and coastal systems ('harbour catchments')	River and coastal catchments, Aquifers	Subcatchments; specific estuary, wetland or ecological assets
Level of decision-making	National level/Inter-regional	Regional level	Local level and individual
Lead organisation examples (NZ Context)	Central Government	Regional Councils	Territorial Authorities and/or private sector
Relevant Documents (NZ Context)	National Environmental Standards National Policy Statements	Regional Policy Statements River Management Plans Integrated Catchment Management Plans	Catchment Management Plans SW Management Plans Structure Plans
Mechanisms (NZ Context)	Resource Management Act	Regional Plans	Resource Consents District Plans

In order to provide for effective *integrated* catchment management, planning requires consideration of all of these scales. This 'multi scalar' perspective is required to ensure that central government policies enable and support regional councils in fulfilling their mandate for sustainable management of natural resources in the context of regionally specific issues (Memon, et al., 2009). Regional Councils, in turn need to support and facilitate the development of ICMPs and incorporate local knowledge of specific catchment scale issues.

Additionally, scale needs to be considered both spatially and temporally. Small spatial and temporal scales make the development of ICMPs simpler and easier to manage. However, without understanding the larger spatial and temporal context activities within a catchment, the external influences on, and cumulative impacts of individual management decisions are not taken into account (Bowden, 1999). In essence, the selected scale needs to be not too big and not too small. Local scale issues need to be understood and incorporated into the process with cognisance of the bigger picture issues where direction is needed at the regional and national level. It is therefore suggested that the Meso Catchment Scale is the most appropriate to achieve the best balance between individual and local interests, and national policies and objectives in New Zealand. That being said, this requires the support of all parties to be effectively implemented. Firstly, at a national (macro) level, policy needs to first recognise the interrelationships between the complex systems and reflect this. Secondly, individuals and stakeholders (at the micro level) need to be willing to make decisions that reflect the common, catchment wide good. This approach would then result in the 'top down' meeting the 'bottom up' (Hooper, 2005).

On a more practical level, the selection of scale for any specific catchment management initiative depends on the context and geographical limits of elements which may influence, or be affected by, activities within a catchment. Sometimes micro scale analysis is required to support the meso and macro scale activities and vice versa. The key is to ensure that all scales are examined, at least at a high level before selecting the scale of effort and investment required to facilitate land use and spatial planning.

Ideally, when linking to any strategic growth planning initiative, the catchment boundaries of the ICMP need to encompass all of the potential growth, or redevelopment area within a geographical or hydrological catchment. However, it also needs to be small enough that the collection of necessary baseline data and the setting of objectives is logistically feasible. Similarly, when dealing with brownfield development or developed catchments, the boundaries of the ICMP need to capture all land uses and interactions which may affect the catchment (e.g. where there may be significant transportation routes which cross the hydrological boundaries of a catchment). Often, potential development or growth areas cross geographical/hydrological boundaries. In these cases, the characteristics of all catchments that the development affects (and the interaction at the catchment boundaries) must be understood to make for an effective scale approach for ICM.

3 COMMON ISSUES WITH THE CURRENT ICM APPROACH

In order to improve and refine ICM it is first necessary to examine some of the common factors that resulting in sub-optimal implementation. Only then can we begin to adequately address the issues. The following discussion outlines two broad areas where the need for improvement has been observed, if well-integrated outcomes are to be achieved .

3.1 ALIGNMENT AND TIMING

The way in which the growth planning is implemented in New Zealand tends to lead to ICM being deferred until late in the process. This reduces the effectiveness of ICM and leads to solutions which can be difficult to practicably implement. The current approach is, in general, hierarchical and sequential. To be effective, ICM needs to be run in parallel to, and fully integrated with, land use planning and spatially based strategic growth initiatives. ICM needs to be seen as not just a tool for sustainable management of water resources but as part of a suite of tools for integrating the management of land use and natural resources at a catchment scale.

The land use planning process in New Zealand generally follows a very linear, silo-based approach. Often, strategic growth and structure planning is well under way (if not a fait-accompli) before the ICMP process begins. Land use, strategic transport links and other critical aspects become fixed and rigid before the ecological and stormwater constraints are properly (and adequately) understood. These aspects can even be given statutory status through district plan changes and land designations prior to the catchment management process getting underway. While such plan changes may come with associated conditions requiring and ICMP to be completed prior to undertaking development, it means that there is limited, if any, opportunity to inform or influence the shape of development and activities within a catchment. The end result is an ICMP that is far from being integrated and becomes a de-facto implementation plan, rather than a management plan that encompasses the interrelated nature of activities within the catchment. Stormwater practitioners and other professionals involved in preparing the ICMPs can find themselves in no-win situations trying to manage the effects of potentially inappropriate land uses within a catchment.

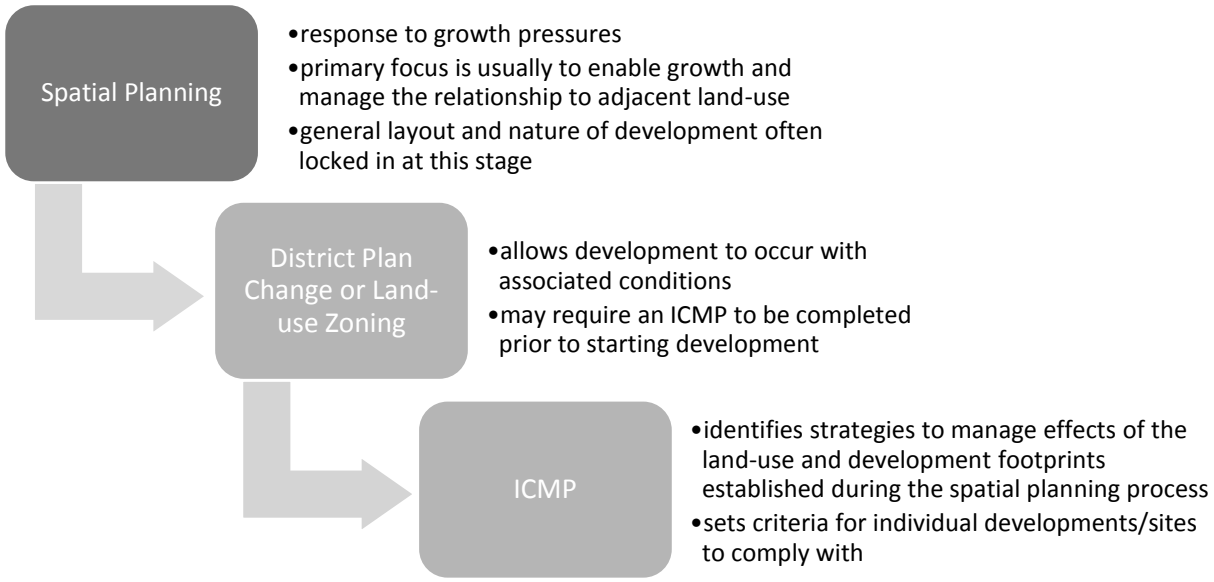

Figure 3: Simplified schematic of how ICMP is currently implemented in New Zealand

The linear approach described above also removes, or limits, the ability to effectively collaborate across disciplines (water resources, ecology, transportation, social amenity etc.). The necessary feedback loops are removed from the process and the interdependent aspects often end up being ignored. For example, the spatial planning process may identify the need for a critical transport link based on an assumed land use configuration. Without a clear understanding of the stormwater and ecological constraints, the critical transport link could end up being located in an area at high risk of flooding or within an area of high ecological value. By the time the ICMP process is initiated, the ability to manage the effects of the transport link may be limited, resulting in adverse effects that could have been avoided if the constraints had been known early in the process. Similarly, opportunities to find innovative solutions may have been lost due to a lack of understanding of the impacts of one element of the system on another.

3.2 SCALE AND EXTENTS

As will be discussed later, it is important to recognise that while the enabling mechanisms for effective ICM need to be considered at a macro scale (top-down), the implementation of ICM needs to be viewed at the meso and micro scales (bottom-up). The level of effort and detail required needs to ensure that locally specific (sub-catchment) constraints and issues can be identified and examined through the lens of regional objectives. ICM in New Zealand tends to be either too high level, missing critical local detail or; too detailed, missing regionally relevant issues.

The boundary extents of many ICMPs undertaken in New Zealand in recent years are either too small to fully encompass external factors and linkages (both upstream and downstream) or artificially constrained by a given growth area or territorial authority's boundaries. Equally important is the need to accurately define the hydrological boundaries of the catchment(s) of interest. This is not always an easy task with limited access to high quality data or accurate historical information of changes and modifications to drainage systems. Even when the hydrological boundaries can be well defined, growth is not necessarily well aligned with hydrological catchment boundaries. Therefore, the ICMP boundaries required to inform and support the spatial planning processes with respect to the management of ecological and water resources may span multiple hydrological boundaries.

4 BARRIERS TO EFFECTIVE INTEGRATED CATCHMENT MANAGEMENT IN NEW ZEALAND

There are a number of factors which make it difficult to implement ICM, leading to the sub-optimal outcomes discussed above. These common barriers arise from the way in which the spatial planning and regulatory frameworks in New Zealand are implemented, and a lack of emphasis by regulators on a truly integrated approach. The following is not intended to be an exhaustive list, but to highlight some of the key barriers to implementing well integrated land-use and water resource management.

4.1 SEMANTICS

It is important to examine what is (or should be) intended by the 'Integrated' in Integrated Catchment Management. As touched on earlier, the terminology and semantics play an important, and underappreciated, role in determining how ICMPs are developed. Integrated Catchment Management is an approach and framework that enables evidence based decisions on land use, water and the environment to be made which consider the effect of the interrelationship between land use, the environment, and all stakeholders within the catchment (Hooper, 2005). The 'Integrated' aspect of an ICMP, therefore refers to the integration of the different activities and functions relating that affect, or are effected by, anthropogenic land use and development. Land use decisions should be made based on balancing the environmental, social and economic outcomes within the catchment and surrounding areas.

Unfortunately, due to the liner process (see above) which is often followed, the land use and structure planning process may already have determined the type and extent of development before the ICMP process begins. There is then little (if anything) that can be accomplished during the development of the ICMP to fundamentally shape the way development occurs. This means that the ICMP essentially becomes purely a Catchment Management Plan or water infrastructure plan with some attempts to 'integrate' the three water related activities within the catchment (stormwater, wastewater and water supply).

Perhaps consideration of adopting terminology that encompasses the collaborative, holistic and long term approach required to achieve truly integrated land use and natural resource management planning at a catchment level needs to occur.

4.2 GROWTH PRESSURES AND TIME FRAMES

The rapid population growth in New Zealand over recent years has put significant pressure on local authorities to free up land for development. The need to provide housing, and space for commerce and industry can result in land being earmarked for urban intensification before the natural context of the catchment(s) is properly understood. While attempts can be made to account for this, by the inclusion of resource consent conditions or similar mechanisms, it can often be difficult to implement the necessary mitigation once the effects are subsequently understood. Additionally, opportunities for avoiding effects all together or enhancing already degraded waterways can be missed. ICMP then becomes an implementation tool rather than a planning tool.

4.3 REGULATORY FRAMEWORK

The current regulatory framework in New Zealand (Resource Management Act) is intended to facilitate a sustainable and integrated approach to the management of natural resources. However, in practice the way in which catchment management planning has been undertaken by Regional Councils has generally lacked integration with other planning processes for spatial and natural resources (Memon, et al., 2009). The introduction of the National Policy Statement for Fresh Water Management NPS-FM provides an encouraging

platform, and logical framework for enabling ICM. Yet, the words 'integrated' and 'catchment' only appear 7 and 4 times respectively in the current version (MfE, 2017). Objective C1 (Integrated Management) of the NPS-FM is given as;

> *"To improve integrated management of fresh water and the use and development of land in whole catchments, including the interactions between fresh water, land, associated ecosystems and the coastal environment"* (MfE, 2017).

However, Policies C1 and C2 under this objective are little more than statements. There is no real direction given as to what 'integrated' means, nor clear guidance on how Regional Councils are to achieve integrated management of fresh water and land use and development. This results in ad-hoc and inconsistent application of ICM and inefficiencies from Regional Councils needing to essentially "make it up as they go" with limited resources and guidance relating to best practice.

4.4 INSTITUTIONAL CAPACITY

Regional and territorial authorities have finite institutional capacity and often have to work with limited data relating to the potential long term effects or constraints within a potential growth area. This results in the regulatory authorities needing to make decisions relating to land use changes based primarily on what potential effects are identified and the mitigations presented within tight statutory timeframes (Bowden, 1999). The sheer magnitude of the task of implementing a well-integrated approach to land use and water resource management is daunting, even with adequate resources, tools and information.

The implementation of the ICMP process must be balanced with the other statutory obligations and competing demands of the councils. As a result, developing and implementing an ICM process, while attempts are made, is regularly put in the too-hard basket, and as such given very little funds and resources to provide robust outcomes.

4.5 SHARING OF KNOWLEDGE AND AVAILABILITY OF DATA

An unintended consequence of the devolution of environmental management to regional authorities, as a result of the RMA, is a lack of incentive to share information between local, regional and private institutions (Bowden, 1999). This has resulted in inefficiencies and the repetition of past mistakes as well as unnecessarily tying up resources and funding. Similarly, there is no particular incentive for the private sector to collaborate or share knowledge for the sake of improving and refining the ICM approach.

Professional industry bodies are often called upon to bridge the knowledge gap on a mostly voluntary basis. However, without the direct support of central, regional and local government these groups of individuals struggle to make significant headway at collating, cataloguing and disseminating knowledge fast enough.

The lack of access to, and sharing of, quality data means that catchment management planning is constrained and delayed. The collection and analysis of new data is both time and resource hungry. This can result in only the bare minimum being collected when undertaking ICM initiatives. We need data about the characteristics of a catchment, the existing systems, and how these interact. We also need tools which allow us to assess the potential effects of certain activities within catchments and how these effects may accumulate over time (Bowden, 1999).

5 ENABLING EFFECTIVE INTEGRATED CATCHMENT MANAGEMENT

From an examination of the collective knowledge on the subject, and contemplation of the various opinions through the lens of experience, the following are identified as areas where we can make change in order to realise the potential of ICM as a tool in sustainable management of the environment. Some are wide reaching and systemic, while others are a matter of changing our perspective or making better use of elements already available;

5.1 ELEVATE THE STATUS OF ICM

We need to re-frame ICM as an integral part of the resource management decision-making process. This does not necessarily require legislative change but needs policy direction and buy-in at a national and regional level. In fact, the key principles and objectives of the ICM approach align almost perfectly with the intent of the Resource Management Act. Water policy set by central government needs to recognise the value of ICM as a means to achieve the sustainable development and resource management. Together this will support the role of regional councils in implementing, through joint funding models, and support ICM practices (Memon, et al., 2009). ICM outputs also need to be given statutory status by incorporation into district and regional plans as applicable under objectives and policies (Hunter & Scrafton, 2012).

5.2 DEFINE AND AGREE ON A PROCESS

Once ICM is elevated to its rightful place within the resource management framework we then need to agree on the immutable elements of the ICM approach. Much like the ICM process itself, this will require consensus between regulators, practitioners and individual interest. Agreement needs to be reached as to, not only, where ICM fits in the planning framework but also what the bare minimum components of an ICMP are.

5.3 IMPROVED DATA MANAGEMENT

There are a huge number of data sets in existence that, if combined centrally, would reduce the amount of upfront effort required when undertaking catchment based studies. Data such as;

- hydrogeological and rainfall information;
- environmental baselines and natural resource mapping
- land use and coverage data; and
- topographical information (LiDAR, utility asset data),

If these data sets were centralised and shared on an accessible platform, redundant and unnecessary collection of data could be avoided. Similarly, examples of useful (and not so useful) methodological successes, if pooled and shared effectively can help us to avoid re-inventing the wheel or repeating the same mistakes as others. Allowing research funding and resources to be deployed more effectively.

The centralisation and sharing of data would also help to establish gaps and inconsistencies. This would enable central, regional and local government to (more) effectively target research programmes to fill the gaps. Some of these ‘big data’ sets are already being collated and curated, although this is a big and expensive undertaking. We need to find a simple way to share data effectively while still having confidence in the quality of the data.

5.4 MONITORING AND FEEDBACK

Not only do we need to collectively manage and disseminate knowledge, we need also to have consistent and formalised monitoring processes to facilitate the collection of new data relating to the long term outcomes and effectiveness of ICM. This requires all stakeholders to be empowered and supported to participate in collecting and reporting on performance against objectives in a collaborative and no-adversarial process.

Consent conditions relating to ICMPs or structure plans need to acknowledge that we are unlikely to get it right first time, and provide built in mechanisms for adapting ICMPs and related documents. This is an effective way of implementing a feedback loop for the ICMP, which can also be monitored by the consenting authority.

Additionally, nationally and regionally consistent objectives need to be established that are aspirational (forward looking), yet still SMARTER (Specific, Measurable, Achievable, Realistic, Time-based, Endorsed and Relevant). Measurement against these objectives needs to reflect this dichotomy and focus on trends rather than absolutes. Milestones and targets need to accommodate continuous improvement towards the ultimate end goal.

6 CONCLUSIONS

ICM is a complex and wide reaching process requiring diverse inputs and built-in feedback loops. It needs to account for competing pressures and objectives in both a spatial and temporal context. To achieve integrated, sustainable land use and resource management it needs a collaborative approach that considers;

- Scale: National, regional and project level objectives both now and in the future
- System capacities: (environmental, socioeconomic and infrastructural constraints)
- System interactions: both inter and intra catchment
- Stakeholders: cultural relationships with water and other natural resources, human needs, economic development requirements etc.

The current implementation structure presents several barriers to developing a holistic, integrated approach. It tends to be 'top down' and hierarchical rather than collaborative and adaptive. ICM needs to be able to incorporate and respond to known and anticipated needs to ensure it is not just reactive, but proactive and forward looking. Stakeholder input mechanisms need to be put in place that allow 'bottom up' considerations to be taken into account. These need to be complimented with effective objective setting, monitoring and feed mechanism which are non-adversarial in their approach. Mechanisms need to be developed and put in place to facilitate the collection, curation and sharing of data and knowledge attained through the development and monitoring phases of ICM.

The lack of consistent and accepted guidance, and limited institutional capacity for change, results in confusion and disillusionment with the process. ICM should be viewed as an integral part of growth planning and sustainable resource management, rather than as an "add on" which is required to meet statutory obligations. Central government needs to guide and support the development of ICMPs to allow local and regional government to access the required resources. The development of partnerships and co-funding models may help, by removing the artificial barriers between different stakeholders.

By changing the way in which we view and use ICM, to a multi-discipline and multi-scaled approach, we can respond to growth in a way that allows for short term needs while allowing the long term and wider considerations to be taken into account. A framework for integrated land use and environmental management is required that is flexible and adaptive to allow it to reflect the changing needs and requirements of future generations. We need to re-ignite this conversation to continue to improve the way we plan and manage growth to protect and enhance the natural and anthropogenic resource responses for our catchments.

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