Moving Towards Sustainability:

The ecological Reserve and its role in implementation of South Africa's water policy.

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Author's note:
Though much of the text contained herein has already been published in various other Department documents, this particular document has no official status, and should not be considered as necessarily representing official policy of the Department of Water Affairs and Forestry, South Africa.

CONTENTS

1 INTRODUCTION

New water policy and legislation
The Water Law Principles of 1996 clearly set the direction for the future of water resources management. The twin threads of sustainability and equity run through the Principles, the National Water Policy of 1997 and the National Water Act (Act 36 of 1998). The key to balancing sustainability and equity lies in the provisions for the Reserve, and in our ability to quantify a Reserve for a water resource, as well as to manage water uses so as to meet the Reserve.

The move to integrated management of water resources, on an ecosystem basis, requires the introduction of a new set of tools for resource management, tools that are flexible, protective and can take account of extreme differences within South Africa, both in socio-economic conditions, and in natural variability of aquatic ecosystems.

From resource development to resource management
The move to resource management has been a gradual one over the last ten years, driven by need, as South Africa approached the limits of new development of water resources and was forced to begin a shift to careful management of existing available resources. To support this change, new tools and new ways of making decisions have been under development within the Department and within other agencies responsible for natural resource management.

The gradual introduction of some new tools in recent years was not driven entirely by existing legislation - rather their development was in response to a changing economic, social, institutional and environmental climate, which had its roots in changes in South Africa as well as global changes. The Water Act of 1956 was no longer an adequate tool with which to face the future. In many respects, new water policy and legislation are a reflection of medium-term changes in our overall environment, and the need to adapt resource management to address these changes.

2 POLICY AND LEGAL CONTEXT FOR THE RESERVE

2.1 Historical pressures for change

The introduction of a concept such as the ecological Reserve, with its very significant implications for water allocation and water rights in South Africa, did not emerge from a policy vacuum. Over the years, it had become clear that the 1956 Water Act, with its emphasis on development of water resources and its entrenchment of riparian rights, was no longer able to meet the needs of the changing political, social, economic and ecological environments. Water resource managers, faced with the challenges of limited water resources, the need for economic development and provision of basic water supplies, required policy instruments which were more flexible, more integrative and more dynamic.

The far-reaching political and social changes in South Africa in the early and mid-1990's only added to the tension caused by the gap between the outdated policy tools and the new realities of resource management. As well, during the late 1980's and early 1990's, data began to become available from South Africa's national monitoring networks which clearly demonstrated the long term trend towards degradation of the quality and ecological health of many of our most important water resources. Yet another source of pressure for change was the global trend towards recognition and incorporation of environmental concerns and values into resource management.

On a technical level, the Department responded with several significant policy shifts during the 1980's and early 1990's, which were to lay some of the foundations for the introduction of the ecological Reserve and all it represents. Notably, these policy shifts included:

- the development of the so-called "receiving water quality objectives (RWQO) approach to water quality management[12], and
- the incorporation of ecological flow requirements (Instream Flow Requirements or IFR) into the planning and design of major developments such as large dams and inter-basin transfers, in response to the introduction of Integrated Environmental Management requirements by the Department of Environment Affairs and Tourism.[3]

- The development of water quality guidelines for aquatic ecosystems which were derived on the explicit basis that ecosystems should be protected as the resource base which provides water and water-related services for people.[4]

However, with the 1956 Water Act still in force, the implementation on the ground of these policy changes was hampered, although definite progress was made.

2.2 Water law and policy reform in South Africa

Almost immediately after the country's first democratic elections in 1994, the Minister of Water Affairs and Forestry, Professor Kader Asmal, announced that the country's water law would be substantially reformed, as part of the overall review of legislation in the country.[5] A process of reform was introduced which began with the establishment of a national Panel which was tasked with drawing up a set of principles upon which water law reform should be based. It was at this stage that the issue of protection of aquatic ecosystems entered the national debate, along with the equally important and complex issues of equity, water rights, promotion of economic development and provision of basic water services. The debate was marked by significant energy and interest, and input from many sectors, including previously disadvantaged communities, business and commerce and environmental interests.

The new Constitution of South Africa provided the overall framework, since any new water policy and legislation had to be consistent with the spirit of the Constitution, which gave all people the right to access to water and the benefits derived from water, and the right to a clean and healthy environment.

After a lengthy process of public consultation and debate, the Panel came up with the principles which would be used to guide the drafting of a new water policy and new water legislation.[6,7] These are summarized in Table 1 below (as they are stated in the White Paper on National Water Policy).[8] The principles which are highlighted in italics in Table 1 are those which have been most significant in development of the concept of the ecological Reserve and processes for its implementation.

The essence of the new Principles can be summed up in the remarkably concise but encompassing slogan which was adopted at the time by the Department: "Some for all forever". This provided the context and motivation for the protection of water resources, and was the starting point for subsequent development of the protection policy:[9]

Table 1: Water Law Principles

- The status of the nation's water resources as an indivisible national asset will be confirmed and formalised.
- ***National Government will act as the custodian of the nation's water resources and its powers in this regard will be exercised as a public trust.***
- ***All water in the water cycle whether on land, underground or in surface channels, falling on, flowing through or infiltrating between such systems, will be treated as part of the common resource and to the extent required to meet the broad objectives of water resource management, will be subject to common approaches.***
- ***Only that water required to meet basic human needs and maintain environmental sustainability will be guaranteed as a right. This will be known as the Reserve.***
- In shared river basins, Government will be empowered to give priority over other uses to ensure that the legitimate requirements of neighbouring countries can be met.
- All other water uses will be recognised only if they are beneficial in the public interest.
- These other water uses will be subject to a system of allocation that promotes use which is optimal for the achievement of equitable and sustainable economic and social development.
- The new system of allocation will take into consideration the investments made by the user in infrastructure for water use.
- ***The new system of allocation will be implemented in a phased manner, beginning in water management areas which are already under stress. This system of allocation will use water pricing, limited term allocations and other administrative mechanisms to bring supply and demand into balance in a manner which is beneficial in the public interest.***
- The riparian system of allocation, in which the right to use water is tied to the ownership of land along rivers, will effectively be abolished. Transitional arrangements will, over time, ensure an orderly, efficient and gradual shift in water use allocations as and when necessary.
- Water use allocations will no longer be permanent, but will be given for a reasonable period, and provision will be made to enable the transfer or trade of these rights between users, with Ministerial consent.
- To promote the efficient use of water, the policy will be to charge users for the full financial costs of providing access to water, including infrastructure development and catchment management activities. This will be done on an equitable basis and according to the realistic reasonable programme which has already been begun.
- All water use, wherever in the water cycle it occurs, will be subject to a catchment management charge which will cover actual costs incurred.
- All water use, wherever in the water cycle it occurs, will be subject to a resource conservation charge where there are competing beneficial uses or where such use significantly affects other users.
- The use of rivers and other water resources to dispose of wastes will also be made subject to a catchment management charge which will cover actual costs, and a resource conservation charge where there are competing beneficial uses for such use and/or such use significantly affects other users.
- To promote equitable access to water for disadvantaged groups for productive purposes such as agriculture, some or all of these charges may be waived for a determined period where this is necessary for them to be able to begin to use the resource.
- To promote equitable access to water for basic human needs, provision will also be made for some or all of these charges to be waived.
- All major water user sectors must develop a water use, conservation and protection policy, and regulations will be introduced to ensure compliance with the policy in key areas.
- In the long-term, since water does not recognise political boundaries whether national or international, its management will be carried out in regional or catchment water management areas (which will coincide either with natural river catchments, groups of catchments, sub-catchments or areas with linked supply systems with common socio-economic interests) recognising that conflicting interests will intensify the need for national management and supervision and that the policy of subsidiarity does not interfere with the need for a national and international perspective on water use.
- Provision will be made for the phased establishment of catchment management agencies, subject to national authority, to undertake water resource management in these water management areas.
- Provision may be made to allow for the functions of the development and operation of the national water infrastructure which links regional catchments and systems, to be transferred to a public utility established for that purpose.

2.3 A new national water policy

The water law principles were ratified by the South African cabinet in 1996, and almost immediately a process of drafting of new national water policy began. At this time, eleven task teams were formed to address the various areas of policy reform required by the new Principles, and to investigate possible implementation

options. There was significant technical input into these task teams, balanced by economic, social and political interests. Many Department officials participated in or led the task teams, but the team composition also included members of various external interest groups and contracted experts from within South Africa and from other countries with recent experience in water law reform.

A White Paper on Water Supply and Sanitation was published fairly early in the process, and drafting of the Water Services Act commenced, to run in parallel with but slightly ahead of drafting of national water policy and a National Water Act. The Water Services Act is not discussed further in this paper, except to mention that although it preceded the National Water Act, it is in fact subservient to the National Water Act, and deals only with the provision of water services, while the National Water Act deals with broader issues of management of water resources.

The structure of the task teams and the scope of their work evolved and shifted as all groups gained more understanding of the nature of their task and the issues involved. Integration between the teams tended to happen on a fairly natural basis, as the team members got to grips with the real challenge of drafting a technically sound policy which was faithful to the twin themes of sustainability and equity that ran through all of the Water Law Principles.

Initially, a Water Quality Task Team was established under the leadership of Dr Henk van Vliet, then Director of the Institute for Water Quality Studies in the Department. It was quickly recognized that in order to take account of the need for integrated management of water resources and the need for management across the hydrological cycle, the team would need to address not only water quality, but rather "resource quality", a concept which embraced management of water resources as whole ecosystems and explicitly introduced an integrated ecosystems approach into the policy development. This is captured in a statement from an early policy document produced by this team:[10]

> "The fact that water is a renewable natural resource means that we need to change the way in which we perceive and value our water resources. This new perspective has two major implications for water resource management. First, we need to see a water resource not just as the commodity water, but as the whole ecosystem, of which water is one component. The ecological integrity which gives a water resource its resilience is an essential component of the value of the resource. In order to reflect a new and broader perspective on water resources, the term "water resource quality" is used, rather than simply "water quality." This is a reminder that all components of aquatic ecosystems - the water environment - must function properly if we are to reach the goal of *some for all, forever*."

The Water Quality Task Team gradually evolved into the Resource Protection and Assessment Policy Implementation Task Team (PAPITT), and fell to their task of preparing a detailed submission to the Water Policy Drafting Team. Various policy options were investigated to ascertain their suitability for implementation of the principles of sustainability and equity. While the earlier policy development of the 1980's and 1990's had laid some of the groundwork, there was still a need for more: more tools, more detail, more understanding of how the policy tools could be applied. Extensive review was undertaken of policy approaches used in other countries, and many workshops were held with groups around the country, including water resource managers, aquatic scientists, economists. The development of the policy options, and the reasons for selection of the options that were finally included in the National Water Policy, are set out in some detail in the discussion documents produced by the PAPITT.[11,12] These discussion papers included recommendations for implementation of the key Water Law Principles the ecological Reserve and protection of water resources.

The submissions from all the policy task teams were integrated by the Water Policy Drafting Team, and the White Paper on National Water Policy was published in April 1997. This landmark document set out the policy positions for protection, use, development, management and control of South Africa's water resources into the future, and explained how the policy would be implemented.

2.4 Drafting of the new National Water Act

Almost immediately after the White Paper was produced, a Water Law Drafting Team was established in May 1997. The team composition included both legal and technical experts, including Department officials. Debates during the drafting process were, as with debates on the Principles, marked by their energy, breadth and depth. As legal tools were developed, they were tested for their suitability to the South African situation, their ability to

support integrated management of water resources, and their ability to meet the challenges of sustainable resource management in South Africa's new and rapidly changing social and political context. Various drafts of the National Water Bill were released for public comment and consultation, and all major interest sectors in the country took part in the process.

The National Water Bill was submitted to Parliament early in 1998, and the Act came into force, with the exception of Chapter 4 (the provisions for water use licensing), on 1 October 1998. (Chapter 4 was enacted on 1 October 1999.) A feature of the National Water Act is that the twin themes of sustainability and equity are echoed throughout – this represented one of the first attempts in the world to "legislate for sustainability" at the national level. Another important aspect of the new legislation is that it was recognized that these ambitious new provisions could not be implemented all at once. There needed to be a smooth, phased transition, in order to prevent negative short-term impacts on the economy and in order to take account of the capacity constraints, both human resources and financial constraints. The Act makes several mentions of the need to implement "in a phased and progressive manner", "as soon as is reasonably practical", on the basis of clear priorities.

The National Water Act is framework legislation, i.e. it does not prescribe in great detail the regulatory procedures, standards and tools which will be used in the protection, use, development, conservation, management and control of water resources. Much of that detail will be provided in regulations, some of which have already been published, while many others are now in development. A strength of this approach is that it allows flexibility at the technical level. Regulatory tools can be modified as understanding develops. A well-structured process exists at national level to ensure that regulations are submitted to parliamentary review, and are checked for consistency with the spirit and intention of the National Water Act. Draft regulations are submitted to a Parliamentary Portfolio Committee and subjected to intense scrutiny before being gazetted.

3 DEVELOPMENT OF THE POLICY FOR PROTECTION OF WATER RESOURCES

The goal for water resource management and service provision in South Africa is captured in the succinct statement "Some, for all, forever". This provides the context and motivation for the protection of water resources:

- **Some:** This indicates a recognition that water is a finite, though regenerating resource; that we must limit our demands on water resources; and that we must ensure careful and efficient utilisation of water resources.
- **For all:** This indicates a fundamental commitment to equitable utilisation. It is accepted that water resources will be utilised, for domestic consumption, for industrial and agricultural development and production, and for recreation, in ways which will benefit all the people of South Africa.
- **Forever:** This acknowledges the commitment to sustainable management: the willingness to balance the needs for long term access to the resource, against the needs for short term development and utilisation. From this commitment comes the responsibility to protect the ability of water resources to sustain long term utilisation. This requires protection of the structure, integrity and function of aquatic ecosystems.

If water, and the services provided by water resources, are to be available to people on an equitable basis in the long term (forever), then water resources require protection.[13]

3.1 Water as a Renewable Natural Resource

We have been used to thinking about water as a commodity, something which is contained in rivers, lakes and groundwater, stored in dams and reservoirs, transported in pipes and canals, and purchased for various uses and services, such as drinking water, irrigation or industrial processes. We need to broaden our view, and see that in fact, the water itself is only one part of a large and complex ecosystem. It is this larger ecosystem which provides us, not only with the water which we see as a commodity, but also with many other services and benefits.

Some of the services provided by water resources, which are encompassed in our definition of utilisation, are:

- water for drinking and basic human needs;
- water for economic development (for example industry, agriculture, power generation);
- transport and/or purification of some waste products;
- subsistence or commercial supplies of fish and plants;

- opportunities for recreation;
- maintenance of habitats for conservation of particular plants, animals, landscapes and environments, for conservation of biodiversity, and for utilisation such as ecotourism;
- retention and storage of water;
- transport of flood waters.

Almost all of the services provided by utilisation of water resources rely on natural hydrological, biological and ecological processes, and require at least some degree of maintenance of the natural structure and character of aquatic ecosystems. As "renewable natural resources", water resources have a certain amount of resilience to the pressures and demands of utilisation. This resilience allows water resources to be utilised on a continuous basis, as long as the demands are not too great.

If a water resource is over-utilised or allowed to degrade too far, (i.e. too much water is taken out, too much waste is put in, natural shape and structure are modified too greatly by erosion, sedimentation or habitat degradation), then the water ecosystem loses resilience and begins to break down. The ecological integrity of the resource can be damaged: once this happens, the capability of the resource to meet people's demands for utilisation can be reduced, or possibly even lost altogether. If the utilisation of water resources remains at a level within the limits which can protect ecological resilience, then that level of utilisation can be sustained indefinitely.

In many cases in South Africa, our water resources have already been modified by utilisation and development, and no longer remain in their natural ecological state. A water resource does not have to be in a pristine or untouched state to have ecological integrity; even modified aquatic ecosystems can have the resilience which makes them renewable resources, so long as we manage them in such a way that we either maintain or rehabilitate a certain level of ecological function and integrity.

3.2 A New Perspective on Water Resources

The fact that water is a renewable natural resource means that we need to change the way in which we perceive and value our water resources. This new perspective has two major implications for water resource management. First, we need to see a water resource not just as the commodity water, but as the whole ecosystem, of which water is one component. The ecological integrity which gives a water resource its resilience is an essential component of the value of the resource. This leads us to a new and broader definition of a water resource:

> *A water resource is an ecosystem which includes the physical or structural aquatic habitats (both instream and riparian), the water, the aquatic biota, and the physical, chemical and ecological processes which link habitats, water and biota.*

Second, we need to recognise and respect the limits to the degree of utilisation which can be sustained by a water resource before resilience is lost. Resilience in turn depends on maintaining a certain base level of ecological integrity and function. This level, which we call the Resource Base, is critical to the capability of water resources to sustain utilisation, and must be protected.

In recognition of the importance of the Resource Base, the Water Law Principles identify a "Reserve", which will give effect to the policy for protection. The Reserve is intended to protect the resilience of water resources, in order that basic human needs can be met (e.g. human health and safety and domestic water supply,) and ecological functions and processes can be sustained.

> *The Reserve is defined in terms of:*
>
> - *the quality of water,*
> - *the quantity and assurance of water,*
>
> *which are needed to protect basic human needs, and the structure and function of ecosystems so as to secure ecologically sustainable development and utilisation.*

3.3 Policy implementation

3.3.1 Finding the Balance

The responsibility for management of water resources includes a responsibility to protect the users of water resources, which in turn requires protection of water resources from over-utilisation or impacts which cause degradation.

Hence the concept of protection encompasses

- protection to ensure sufficient water quantity and water quality (especially in relation to human health), to meet basic human needs;
- protection of ecosystem structure and function, in order to ensure that utilisation of water resources can be sustained in the long term;
- meeting the water quality requirements of other water users (agriculture, industry, recreation) as far as possible, within the constraints of requirements for protection of basic human needs and protection of the resources.

Sustainable utilisation requires achievement of a balance between an acceptable level of long term protection of water resources and water users, and society's present requirements for economic growth and development. The total prevention of pollution, while an ideal for which to strive in the long term, is not practical in the short to medium term, since neither the emission of waste to the water environment, nor the impacts of land uses on the water environment, can be prevented entirely. However, they can and must be managed and regulated to achieve adequate long term protection of water resource quality. This is the aim of the resource protection policy.

Implementation of the policy rests on the combined use of four types of regulatory activities:

- resource-directed measures, i.e. defining a desired level of protection for a water resource, and on that basis, setting clear numerical or descriptive goals for the resource quality of the resource (the Resource Quality Objectives);
- source-directed controls, i.e. controlling impacts on the water resource through the use of regulatory measures such as registration, permits, directives and prosecution, and economic incentives such as levies and fees, in order to ensure that the Resource Quality Objectives are met;
- managing demands on water resources in order to keep utilisation within the limits required for protection;
- monitoring the status of the country's water resources on a continual basis, in order to ensure that the Resource Quality Objectives are being met, and to enable us to modify programmes for resource management and impact control as and when necessary.

3.3.2 Resource directed measures: resource quality objectives

Resource Quality Objectives

The Resource Quality Objectives for a water resource are a numerical or descriptive statement of the conditions which should be met in the receiving water resource, in terms of resource quality, in order to ensure that the water resource is protected.

Because they are a statement of water resource quality, and not just water quality, the Objectives have four critical components, to cover each of the aspects of ecological integrity which are necessary for protection of the Resource Base. The definition of resource quality given in the National Water Act is:

> "resource quality" means the quality of all the aspects of a water resource including -
>
> *(a)* the quantity, pattern, timing, water level and assurance of instream flow;
>
> *(b)* the water quality, including the physical, chemical and biological characteristics of the water;
>
> *(c)* the character and condition of the instream and riparian habitat; and
>
> *(d)* the characteristics, condition and distribution of the aquatic biota;

Resource Quality Objectives for a water resource are set on the basis of acceptable risk: that is, the less risk we are prepared to accept of damaging the Resource Base and possibly losing the services provided by the water resource, the more stringent would be the objectives. A higher risk to the Resource Base might be accepted, in return for greater short term utilisation, and then the Resource Quality Objectives would be set at less stringent levels.

The Scientific Basis for Objectives

Resource Quality Objectives are scientifically derived criteria, based on the best available scientific knowledge and understanding. They represent our best assessment of the resource quality which is necessary to provide a desired level of protection to a water resource, with a particular degree of assurance or risk. Resource Quality Objectives would be derived for individual water resources, such as river reaches, sub-catchments, estuaries, coastal marine waters, wetlands or groundwater resources, on the basis of formally accepted Department of Water Affairs and Forestry policy statements, methodologies or publications.

For aquatic ecosystems, objectives can be derived which are based on measurement and understanding of the behaviour of ecosystems in field and laboratory conditions, and especially understanding of their behaviour under stress, induced by changes in water quantity, water quality or habitat integrity.

For recognised water users, the primary focus of objectives would be on water quality aspects. Objectives for water quality for recognised water users are based on scientific understanding of the direct physiological effects of changing water quality (such as effects on human health, or damage to a sensitive crop, or toxicity to livestock), or on assessment of economic impacts (such as the cost of increased water treatment, or the loss of productivity).

The Purpose and Application of Objectives

Once Resource Quality Objectives have been set for a resource, then those objectives would serve as a basis for water resource management. Objectives have a number of purposes in the context of resource management:

- Objectives represent a definite goal for the desired protection level and resource quality status of a water resource, towards which management can be directed. The goal might have to be approached in steps, as part of a long term programme, and then interim objectives can be used to define the steps and the time frame for achievement.
- Objectives provide a clearly understood line between which activities and impacts are acceptable and which are not acceptable. This includes the impacts of point sources, non-point sources, incident sources, land use and development, and water abstraction;
- Objectives provide a quantifiable, verifiable baseline for measuring the success of resource management activities and for reviewing the effectiveness of source-directed control and regulatory activities;
- Objectives give a stable framework, which can be kept in place for an agreed time period, for both resource managers and the regulated community to undertake decision making and planning.

Setting Objectives on the Basis of Acceptable Risk

The need for caution, and the desire to prevent unintentional exceedance of the limits of sustainable utilisation, are recognised as cornerstones of the policy of protection. The approach which has been adopted is that of setting limits on the basis of acceptable risk. Hence the resource protection policy requires that quantifiable Resource Quality Objectives be set which reflect our understanding and acceptance of **a particular level of risk** of exceeding and possibly causing irreversible damage to a water resource.

The extent of the risk which we will accept is related to the value or importance which we place on a specific water resource. Some resources will have a very high value to us, whether because of their ecological importance and value, or because of their sensitivity to certain forms of utilisation, or because of a need to maintain long term reliability of the services provided. In such a case, we would set especially stringent Resource Quality Objectives, to minimise the risk of irreversible damage.

For other water resources, our short term needs for water or economic development might be so important or so urgent, that we would accept a greater risk of exceeding the "point of no return", and hence a greater risk of failure of the resource, in exchange for allowing more utilisation. However, the particular level of risk should be accepted by all stakeholders, including impacters and water users, with a clear and common understanding of the possible long term consequences.

Adopting a risk-based approach provides a nationally consistent basis for deciding on the acceptability of impacts, while at the same time allowing natural site-specific differences to be taken into account. It is the concepts of levels of risk, and levels of protection, which are nationally applicable, rather than the numerical objectives themselves. In only a few cases (such as for persistent toxic substances) would it be practical to set numerical objectives which would be applicable to all water resources of a particular class wherever they were in the country. A concentration which posed only a slight risk to a particular ecosystem in one geographical region may result in a much higher risk in another geographical region, depending on the resilience of the adapted ecosystem, the background quality of the water, and the natural flow regime.

A truly risk-based approach is technically quite sophisticated. The field of Ecological Risk Assessment is still in its infancy around the world, but show promise and the ability to provide tools to help in setting risk-based objectives. For South Africa, a quantitative risk-based approach to setting of resource quality objectives is probably not achievable yet, due to lack of ecological data and lack of expertise.[14] However, the policy tools currently in development are designed on the basis of a qualitative risk-based approach, and as knowledge and understanding grow, we hope to be able to develop policy and regulatory tools which more closely reflect a true risk-based approach.

Resource Quality Objectives and the Reserve

In the Water Law Principles, the Reserve is specifically identified as that water quantity and quality necessary to protect basic human needs, and aquatic ecosystems. The Resource Quality Objectives for a water resource are a rigorous numeric or descriptive statement of the requirements of the Reserve for that particular water resource, in measurable, enforceable terms.

It is especially important to note that the Reserve is **not just the minimum** water quantity, water quality, habitat and biotic integrity required for protection. For a water resource which is classified as being of high protection status, the Reserve would be set at a higher level, which would correspond to the idea of minimum risk and maximum caution. For a water resource in a lower protection class, the Reserve would be set at a level which should still afford protection to the resource, but without the benefit of the buffer which caution provides.

Yet to assume that a "higher" Reserve necessarily means that only a greater quantity of water is allocated to protection of the resource is somewhat simplistic. The assurance or reliability of water, especially under extreme climatic conditions, is just as critical an aspect of the Reserve as the quantity and quality.

3.3.3 Protection-based classification of water resources

Depending on the level of risk which is acceptable, Resource Quality Objectives could be set at any level on a continuum between no protection at all (certain damage) and maximum protection (no risk). In practice, the decision on the level of protection which is desirable, the subsequent setting of objectives to reflect that decision, and the control and regulation of activities impacting on a water resource, can be streamlined and facilitated by the implementation of a protection-based classification system.

Under a national protection-based classification system, water resources can be grouped into classes representing different levels of protection. The risk which can be accepted in each class is related to the level of protection required for that class. This provides a nationally consistent basis and context for deciding on an acceptable level of short term risk, against the requirements for long term protection of a water resource. For water resources which are especially important, sensitive, or of high value, little or no risk would be acceptable, and they would be assigned a high protection class. In other cases, the need for short to medium term utilisation of a water resource may be more pressing: the resource would still be protected, but would be assigned a class which reflected a higher risk. In addition, certain activities or impacts would be regulated or controlled to a certain degree in each class. Some impacts might be prohibited entirely in the highest protection class.

A system comprising a few protection classes has been recommended and is now in development (due for first-phase completion at the end of 2000): the highest class, requiring the greatest level of protection, and allowing no risk to the Resource Base, would include "special" water resources of very high value. These might be special in terms of their conservation importance, or because they support very important and sensitive uses. (In some countries, the term "heritage rivers" is used to denote the highest class.) The lower classes would reflect slight risk, moderate risk or high risk of damage to the Resource Base, and the Resource Quality Objectives in each case would reflect the level of risk associated with the class.

Overall, the assignment of a specific class to a water resource gives a clear message to both users and impacters regarding the social, economic and ecological value of that water resource. Classification represents a vision of how people feel their water resource should be managed, in terms of resource quality.

The Process of Classifying a Resource and Setting Objectives

Classification of a water resource, and the subsequent derivation and setting of objectives, should ideally be undertaken in a formal process of negotiation and consensus-seeking among all stakeholders. Stakeholder groups which should be represented in this process include water user sectors, industrial sectors, agricultural sectors, public sectors, special interest groups, local and regional government, as well as other government departments responsible for resource development and for resource protection.

Through such a process, all stakeholders, including water users, impacters and the regulatory agency, can come to agreement on the level of protection which will be given to the resource, in full understanding of the implications for the degree of utilisation which can be sustained, and for the kinds of impacts which are acceptable.

Ideally, the process of classification and setting of objectives should be conducted within an integrated catchment management framework, and could be co-ordinated through the relevant catchment authority or management body. The representation of local interests in this process is very important; however, since water is managed as a national resource, there should also be representation of regional and national interests, perhaps through the formal participation of regional and national government and regulatory agencies.

3.3.4 Practical examples of classification

The purpose of a classification system is to provide a set of nationally consistent rules to guide decision making about water resources - what we will allow to happen in our water resources, and what we will not. A national classification system allows transparency, accountability and long term goal-setting to be incorporated into water resources management. Water resources which need to be improved can be identified, and the necessary control measures can be implemented to meet the requirements associated with the assigned class.

A classification system need not be highly complex. In some countries, the terms “drinkable”, “swimmable” and “fishable” are used to classify water resources: the water quality requirements would be most stringent for the “drinkable” class, and focused on microbiological contaminants in water. Immediately a class such as “drinkable”, “swimmable” or “fishable” is assigned to a water resource, it is possible to set rules about what may be allowed to be discharged to the resource and what conditions must be maintained in the resource.

Table 1 shows an example of how classification of a water resource might be used to set water environment objectives which reflect an agreed balance between protection and utilisation. The new policy requires that the classification system should encompass resource quality, not just water quality, and so objectives for ecological aspects must be incorporated into classification, in the manner proposed in Table 2. The characteristics of the ecological integrity protection classes A through D are described qualitatively in Table 3, and resource quality objectives can be derived in order to protect and maintain those characteristics. In a similar manner, the fitness for use classes set out in the South African Water Quality Guidelines (for agricultural, domestic, recreation and industrial use) serve as a basis for deriving numerical objectives to maintain certain water quality characteristics for water uses.

The objectives for utilisation (water quantity, water quality and land use) would of necessity be set within the constraints of what would be suitable for the aquatic ecosystem: for example, a largely unmodified river could be assigned a class B status, but natural background conditions may be such that the water in the river would not meet, say, Class I irrigation objectives due to naturally high TDS. Nevertheless, the objectives for maintenance of ecological integrity at class B status would determine or constrain the activities which would be permitted and the human uses for which that river might be fit.

Table 2: A classification approach to balancing the requirements of protection and utilisation.

Water resource	Ecosystem protection class	Desired status for domestic use	Desired status for agricultural (irrigation) use	Desired status for recreational use	Classification
River X, reach 1	A	Class I	Class II	full contact	$Ad_Ia_{II}r_f$
River X, reach 2	B	Class II	Class III	intermediate contact	$Bd_{II}a_{III}r_I$
River X, reach 3	B	Class II	Class IV	intermediate contact	$Bd_{II}a_{IV}r_I$

Thus River X, reach 2 would have a classification of $Bd_{II}a_{III}r_i$. This means that

B: the ecological integrity status of that reach would be maintained at class B (see Table 3)

d_{II}: the water quality would be fit for domestic use with conventional treatment (see Table 2);

a_{III}: the water quality would be fit for irrigation of moderately tolerant crops, depending on site-specific soil conditions;

r_i: the water resource would be fit for intermediate contact recreation.

Once these characteristics, related to the desired status of a water resource, have been decided, then numerical and narrative water environment objectives can be set for the reach in question, for flow, water quality, habitat integrity and biotic integrity, such that the desired ecological and fitness-for-use status can be achieved and maintained.

3.3.5 Proposed classification system for water resources

The final, full classification system for water resources in South Africa will integrate the rules for ecosystem protection (4 classes A to D), the rules for protection of basic human needs (5 classes blue to purple[15], assuming basic treatment) and water users (recreation, agriculture, industry, bulk domestic supply). Three management classes have been proposed, as follows:

Class I: Special Water Resources

- Retain natural or almost natural ecological characteristics
- Safe for contact recreation and most water uses, including sensitive uses
- Can be used for basic human needs with minimum treatment

Class II: General Water Resources

- Retain a high degree of ecological function and integrity
- Safe for some recreation and non-sensitive water uses
- Can be used for basic human needs with conventional treatment

Class III: "Hard-working" Water Resources

- Retain at least some ecological function, but probably highly modified from natural
- Safe for some non-contact recreation and some non-sensitive water uses
- May require advanced treatment to meet basic human needs requirements

Table 3: Proposed framework for setting ecological resource quality objectives on the basis of a classification system.

Class	Water quantity	Water quality	Instream habitat	Riparian habitat	Biota
A	Natural variability and disturbance regime: Allow negligible modification.	Negligible modification from natural. Allow negligible risk to sensitive species. Within Aquatic Ecosystems TWQR for all constituents.	Allow negligible modification from natural conditions. Depends on the instream flow and quality objectives which are set.	Allow negligible modification from natural conditions. Control of land uses in the riparian zone in order to ensure negligible modification (e.g. no disturbance of vegetation within set distance from banks)	Negligible modification from reference conditions should be observed (based on the use of a score or index such as SASS).
B	Set instream flow requirements to allow only slight risk to especially intolerant biota.	Use Aquatic Ecosystems TWQR and CEV to set objectives which allow only slight risk to intolerant biota.	Allow slight modification from natural conditions. Depends on the instream flow and quality objectives which are set.	Allow slight modification from natural conditions.	May be slightly modified from reference conditions. Especially intolerant biota may be reduced in numbers or extent of distribution.
C	Set instream flow requirements to allow only moderate risk to intolerant biota.	Use Aquatic Ecosystems TWQR, CEV and AEV to set objectives which allow only moderate risk to intolerant biota.	Allow moderate modification from natural conditions. Depends on the instream flow and quality objectives which are set.	Allow moderate modification from natural conditions.	May be moderately modified from reference conditions. Especially intolerant biota may be absent from some locations.
D	Set instream flow requirements which may result in a high risk of loss of intolerant biota.	Use Aquatic Ecosystems TWQR, CEV and AEV to set objectives which may result in high risk to intolerant biota.	Allow a high degree of modification from natural conditions. Depends on the instream flow and quality objectives which are set.	Allow a high degree of modification from natural conditions.	May be highly modified from reference conditions. Intolerant biota unlikely to be present.

4 DEVELOPMENT OF PROCEDURES FOR DETERMINING THE RESERVE AND RESOURCE QUALITY OBJECTIVES

4.1 Available tools and approaches

When the drafting of water legislation began in 1997, a selection of tools were already available which were in line with the new thinking arising from the Water Law Principles and the National Water Policy. The tools had not, at that time, been specifically tailored to fit the legislation (since the legislation itself had yet to be developed in detail), but it was clear that existing scientific approaches and procedures had potential to serve as the foundation for a new suite of policy and regulatory tools for implementation of policy and legislation.

4.1.1 Instream Flow Requirements

In response to requirements for environmental impact assessment, and as a result of the Department's commitment to follow the Integrated Environmental Management procedure (DEAT, 1994) in planning and implementation of major water resources developments, a considerable amount of effort within the South African scientific community was focused on finding ways to assess the water requirements of aquatic ecosystems (Instream Flow Requirements). This information was required at the planning stage of major developments such as dams and inter-basin transfers.

The accepted practice in 1997 for assessing Instream Flow Requirements (IFR) of aquatic ecosystems was the Building Block Methodology (BBM) (Tharme & King, 1998). This methodology had been widely accepted by the scientific community, and applied in more than 20 planning studies on South African rivers. As it stands at present, it relies on several field surveys by a multi-disciplinary group of scientists, including experts in hydrology, hydraulics, geomorphology, fish and invertebrate ecology.

4.1.2 Water quality guidelines for aquatic ecosystems

The publication of the South African Water Quality Guidelines for Aquatic Ecosystems (DWAF, 1997) provided a critical tool for establishing instream water quality objectives for protection of aquatic ecosystems. The guidelines themselves are derived from the first clear policy statement regarding the need to protect aquatic ecosystems, in recognition of the role of the ecosystem as the base of the resource, rather than as a competing user for water.

4.1.3 Biomonitoring

Methodologies for assessing riverine habitat, both instream and riparian, had also been in development, and a procedure for habitat assessment was already in place by 1997 - the aerial habitat survey developed by Kleynhans (19XX). The need for biological monitoring in order to assess the impacts of management decisions and actions over the long term had led to the development of several tools for measuring the condition of aquatic biota in response to various stressors: notably, these tools included the South African Scoring System (SASS) for measuring the composition and health of benthic invertebrate communities (Chutter, 19XX) and the Fish Integrity Index (FII: Kleynhans, 19XX).

4.1.4 The River Health Programme

The River Health Programme (RHP: formerly the National Aquatic Ecosystem Biomonitoring Programme) was established in 19XX (ref report). An important aspect of the RHP is the development of biological monitoring and assessment tools. By the time drafting of the water legislation began, the results of pilot testing and implementation of the RHP had generated (and continue to generate) valuable insights into the management of water resources on an ecosystem basis. Being a national, multi-agency programme, the RHP also helped to establish a wide awareness and pool of expert capacity to implement new tools, both within the resource management agencies such as DWAF, DEAT and the provinces, and amongst the scientific community.

4.1.5 Human health requirements

Quantification of the basic human needs Reserve is perhaps a less technically complex business than quantification of the ecological Reserve, since it is essentially about one species: human beings.

Many other countries and international organisations have already addressed the issue of how much water people needed for their basic drinking and sanitation needs, so experience in this regard was available. What was still needed, however, was a procedure for working back from what was required at the tap, to what was required in the water resource which was the source of supply. This required close linkage with the Water Services Act of 1997. The Water Services Act, already in place when drafting of the National Water Act commenced, provided guidance on determination of basic human needs for water.

In addition, the South African Water Quality Guidelines for Domestic Use (DWAF, 1996) were available in their second edition, and a joint publication by DWAF, the Department of Health and the Water Research Commission, entitled "Quality of Domestic Water Supplies – Volume 1: Assessment Guide" was in preparation (DWAF, DOH & WRC, 19XX). These gave the basis for setting the quality aspect of the basic human needs Reserve.

4.2 Phased implementation of policy and legislation

4.2.1 The need for phased and progressive implementation

It was recognised that implementation of the new Water Act should be carried out in a "phased and progressive manner". The new definition of water use required a much broader approach than in the past; the provisions for ecosystem protection required new skills and capacity, and the introduction of catchment management agencies required a new institutional structure.

Three critical phases which will determine and guide the development of policy and regulatory tools are:

- the period leading up to "day 1", which required only the most essential procedures to be in place on the day on which the entire Act came into effect (1 October 1999);
- the transitional phase, a three to five year period of transition from "day 1", during which special transitional tools and procedures might be required, in an environment which would allow pilot testing and refinement of tools, and development of the full suite of tools needed to implement the Act;
- full scale implementation in selected areas or catchments around the country, a phase covering the five to ten year time frame after the Act comes into effect.

4.3 Tools for the transitional period

4.3.1 Planning for a transitional period

The abolishment of the riparian principle, and the introduction of water use allocations instead, was expected to lead to an increase in the number of water use licenses issued under the new Act, in comparison to the number issued under the 1956 Act.

The principal method for determining instream flow requirements of aquatic ecosystems, the BBM, is a procedure which takes 8 - 12 months to complete with a reasonably high degree of confidence. A large demand for Reserve determinations around the country in the transitional period would have swamped the available capacity and expertise, and caused significant delays in evaluation and issuing of water use licenses, with a resulting negative effect on economic activity.

Hence, as a transitional measure, there was a need to develop tools for determining the Reserve which could provide answers within a relatively short period, in order to meet initial demands, until such time as high-confidence Reserve determinations could be carried out.

4.3.2 Preliminary determinations of the class and Reserve

A transitional phase is allowed for in Chapter 3 of the National Water Act. This means that until such time as the Minister prescribes by notice the full classification system and procedures for Reserve determination, a preliminary classification and Reserve determination may be carried out (NWA sections 14 and 17), and water use licenses may be issued on that basis.

The NWA also states that no water use license may be issued without at least a preliminary determination of the Reserve having been undertaken. Once the classification and Reserve determination procedures have been prescribed, that preliminary determination must be reviewed, after which the associated licenses may also be reviewed.

It must be noted that, **until the classification and Reserve determination procedures have been prescribed in the Government Gazette, all RDM determinations (rapid, intermediate or comprehensive) are considered to be preliminary**. The only substantial difference between preliminary determinations under NWA sections 14 and 17, and determinations under NWA sections 13 and 16 is that preliminary determinations do not have to be published in the Government Gazette, and the rigorous consultation and comment procedures do not necessarily have to be applied in full.

4.3.3 Development of preliminary tools as a priority activity

Phases 1 and 2 of the RDM project (beginning in August 1997) focused almost entirely on development of tools for the preliminary determination of the ecological Reserve and preliminary ecological classification of water resources, since this was the most urgent short-term priority.

Later phases will see the development, testing and refinement of full-scale tools for classification of water resources, determination of the Reserve and determination of resource quality objectives.

4.3.4 Different levels of RDM determination

The full suite of RDM determination methods now comprises:

- procedures for desktop estimates of the class and Reserve (water quantity only);
- procedures for rapid determinations of the class and Reserve (water quantity and quality);
- procedures for intermediate determination of the class, Reserve and relevant resource quality objectives for habitat and biota;
- procedures for the comprehensive determination of the class, Reserve and resource quality objectives (including habitat, biota, water uses and land-based activities)

These various levels of tools are in different stages of development for rivers, groundwater, wetlands and estuaries. Generally, development is most advanced for rivers and groundwater.

The RDM project team developed the desktop estimation method specifically to serve the needs of the National Water Balance, a national-scale long-term water resource planning exercise presently being undertaken by DWAF. Both the desktop and rapid methods are likely to have a relatively short lifespan, since as more intermediate and comprehensive Reserve determinations are carried out, the desktop and rapid determinations will be replaced by the higher-confidence determinations.

4.4 Designing preliminary RDM methodologies

4.4.1 Design specifications for preliminary RDM methodologies

When Phase 1 of the RDM project began, a number of tools were available, including the BBM, the South African Water Quality Guidelines for Aquatic Ecosystems, the habitat assessment procedure and biotic integrity indices. However no single methodology for RDM determination had been formalised. In order to meet the short term needs of implementation of the National Water Policy, it was necessary to develop transitional tools suitable for use in preliminary RDM determinations.

At the outset, the design specifications for preliminary RDM methodologies were:

- that they be **legally defensible**, since they had to serve as a basis for issuing legally valid water use licenses;
- that they be **scientifically defensible**, and based on sound ecological principles in line with the integrated ecosystem approach to water resource management;
- that they **match administrative requirements**, i.e. that the information be provided to the licensing agencies in a format and at a spatial scale which could be used as a basis for drawing up water use allocation plans and catchment management strategies, and for setting individual water use license conditions;
- that they provide **conservative estimates** of the water quantity and quality required to meet the ecological Reserve, since the preliminary determinations were intended to serve the transitional period and prevent irreversible degradation of water resources in that time, in line with the protection policy;
- that there be options for **reasonably rapid** determinations in order to meet projected demands for NWA implementation in the transitional period. To this end, a time frame of approximately two months was considered reasonable for an intermediate determination, in comparison to the 8-12 month period required for a comprehensive Reserve determination.

4.4.2 Desired characteristics of RDM methodologies

Given the starting design specifications, the following characteristics of preliminary RDM methodologies emerged in early discussions within the project team.

- The methodologies would be derived from **available technologies and understanding** in South Africa or for southern hemisphere ecosystems, since that would give some confidence in the scientific validity and acceptance, and also there was likely to be more specialist capacity available to implement procedures or approaches which were already in use. Preferably these technologies should have been published in the scientific literature.
- The methodologies would **utilise a holistic ecosystem endpoint**, rather than a purely hydrological one or a purely chemical one. The extent, availability and condition of instream and riparian habitat was identified as the endpoint for water quantity Reserve determinations, since the relationship between biota and changes in flow rate or flow volume is not yet sufficiently quantifiable with available tools. For water quality Reserve determinations, the endpoint is the ecosystem "no observed effects level" (NOEL) as described in the SAWQG-AE (Roux et al, 1996 - SAJS paper).
- To balance confidence in the end determination with rapidity of application, but taking into account the present and probable future lack of specialist expertise within the Department, the methodologies would rely on **expert judgement applied within a very structured and consistent process**. The process would be such that it could be initiated and administered by non-specialist staff of the Department, utilising expert input at given points.
- All assumptions made at any stage in development and application of the methodology should be **verified by a group of specialists**, and all assumptions should be fully documented and justified.
- **Independent review** would be integrated into the methodology, to ensure quality control and consistency in application as far as possible.
- The methodology should allow for **ongoing refinement** of procedures and tools, and for refinement in the determination to improve confidence should this be desired. Higher confidence than that offered by the comprehensive Reserve methodology would be an optional extra if an accepted methodology was available which could provide this (e.g. the IFIM methodology – ref Tharme 19XX).

From this basis, the RDM team designed the seven-step generic RDM methodology, described in Figure 1, within which all four RDM determination tools (desktop, rapid, intermediate and comprehensive) fit. Detailed discussion of each step in the methodology can be found in the relevant manual.[16]

4.4.3 Applicability to rivers, groundwater, estuaries and wetlands

The generic methodology has been found to be applicable to all kinds of resources, be they rivers, groundwater bodies, estuaries, wetlands, lakes or floodplains. However, the specialist procedures within each step may be different for different kinds of resource.

The methodology is designed to promote integrated water resource management, recognising the unity of the hydrological cycle. Guidelines for integrating and matching RDM determinations for rivers, groundwater, estuaries and wetlands are given in the Integrated Manual and in the various procedural manuals.

4.5 Different levels of RDM determinations

Table 1: Levels of RDM procedures for various levels of RDM determinations

Level	Term	Characteristics	Use
1	Desktop estimate	Very low confidence, about 2 hours per water resource	For use in National Water Balance Model only
2	Rapid determination	Low confidence; desktop + quick field assessment of present status, takes about 2 days	Individual licensing for small impacts in unstressed catchments of low importance & sensitivity; compulsory licensing "holding action"
3	Intermediate determination	Medium confidence, specialist field studies, takes about 2 months	Individual licensing in relatively unstressed catchments
4	Comprehensive determination	Relatively high confidence, extensive field data collection by specialists, takes 8-12 months	All compulsory licensing. In individual licensing, for large impacts in any catchment. Small or large impacts in very important and/or sensitive catchments.
	Flow management plan	Acknowledges present operating constraints (mostly structural) on a river; modified operating rules are drawn up between the management agency and RDM study team, which will result in a more environmentally friendly flow regime, as far as possible.	For use in highly regulated systems where present flow control structures do not have outlets from which releases can be made to provide for the water quantity component of the Reserve.

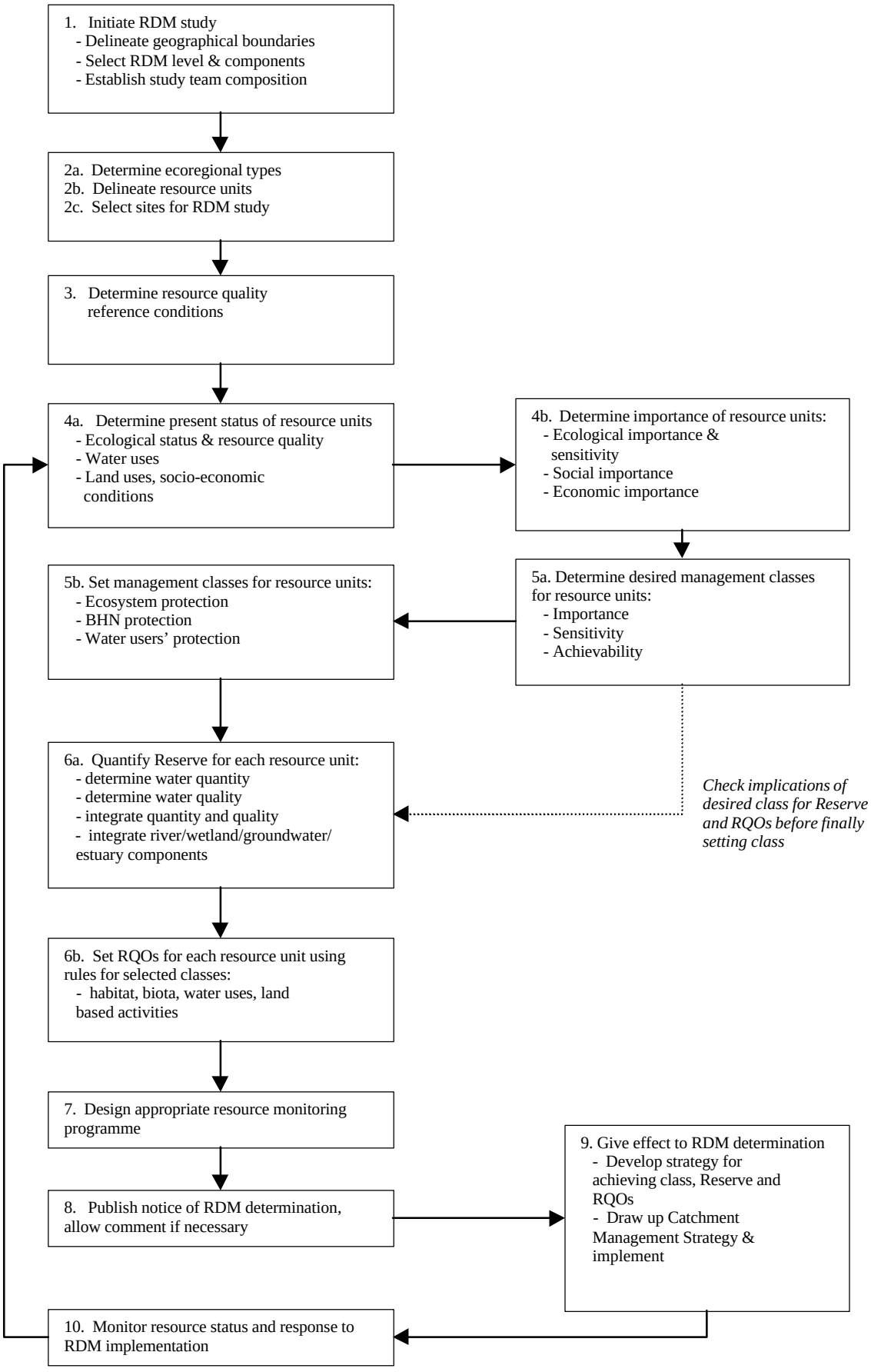

Figure 1: Generic procedure for determination of the class, Reserve and resource quality objectives for a water resource

5 THE STRATEGY FOR IMPLEMENTATION OF RESOURCE DIRECTED MEASURES (RDM)

The National Water Act clearly established that implementation of the new provisions will be undertaken "in a phased and progressive manner". The Act was deliberately worded in this way since it was understood that capacity constraints would certainly not allow South Africa to fully implement such far-reaching legislation across the country in a short time frame. Several clauses in the Act, including the one relating to the Minister's responsibility to develop, publish and implement a national classification system for water resources, are accompanied by the condition that these tasks should be done "as soon as is reasonably practical". While there is always the risk, with this approach, that nothing will be done and the law will remain an empty shell, it is nevertheless necessary to consider a realistic time frame to change from the 1956 Water Act to the radically different 1998 Water Act – fifty years of water use can not be changed overnight, and the introduction of new policy and regulatory tools must be done at a pace that does not cause turmoil in the water use administration systems or the economy of water in the country.

5.1 Developing a schedule of national priorities

As with the other aspects of the new water policy, there was a need to develop a systematic programme for phased and progressive implementation of the determination of resource directed measures (class, Reserve and resource quality objectives).[17] Since the driving factor behind the need for RDM determination is primarily the need to evaluate water use license applications, the programme needed to be informed by the priorities for the management, control and licensing of water use.

A process of prioritization began in November 1999. For all sub-catchments in each of the 19 Water Management Areas in the country, a small team within the RDM programme, working with the Department's line functions and regional offices, evaluated three primary criteria for prioritization:

- The current levels of water resource stress, including water quantity, water quality and ecosystem health;
- The expected demand for water use licenses, arising either from known new developments or pending applications;
- The ecological importance and sensitivity ratings for each sub-catchment (these ratings had already been mapped for all quaternary catchments in the country during a series of provincial Water Resource Situation Assessments earlier in 1999).

The outcome of this process is a proposed list of national priorities for RDM determination. The catchments which are most stressed as well as most ecologically important and/or sensitive with an urgent demand for issuing of water use licenses are at the top of the list. Catchments which are presently not very stressed and where new water use on a large scale is not expected, tend to be lower down the list. From this list, a master schedule of work is being drawn up so that systematic determination of RDM can be undertaken, on a priority basis, with the schedule being matched to the available financial and human resources. The proposed priority list is now being circulated for discussion and input from various groups within the Department, after which it must be circulated nationally for comment from other agencies, such as the national and provincial departments dealing with environment, agriculture and economic development.

The priority list and the subsequent master schedule provide the programme for systematic coverage of the country with a first round of RDM determinations. This could take 10-15 years, depending on the available capacity in the country. There is still a need to deal with new developments and/or water use license applications that arise while we are busy with the systematic coverage. A process of dynamic prioritization has also been established, which allows each new application to be evaluated in terms of potential impact on the water resource, socio-economic benefit and urgency, and then fitted in to the master schedule at an appropriate place.

5.2 Building and maintaining the capacity to implement RDM

In parallel with the development of the procedures for determination of RDM, the last three years has seen considerable effort go into development of a long term strategy for building and maintaining the capacity for implementation.[18] The capacity building strategy is now itself becoming operational, and will be described in more detail in the next version of this document.

5.3 Managing water resources to achieve the desired protection status

In many cases in South Africa, our water resources are already stressed or over-allocated. We are likely to find that, once the Reserve has been determined, it has already been allocated for existing lawful water use under the 1956 Water Act, or the water resource is so impacted from other sources that the Reserve can not immediately be met. We need to turn the situation around, but this may take time.

The Reserve and resource quality objectives provide an agreed goal against which management of a water resource can be judged. A key aspect of real implementation is to establish not only what the target is (i.e. set the Reserve and resource quality objectives), but to develop a plan of action for reaching the target. The plan needs to set out strategies, time frames and responsibilities. The legal tool provided in the Water Act for doing this is the Catchment Management Strategy. Drawn up by the catchment management agency (the Department's regional offices are the default catchment management agencies until these new institutional bodies are established) in consultation with stakeholders, the catchment management strategy provides an agreed framework for moving towards the desired balance between protection of the water resource and utilisation of the services provided by the water resource.

The business of water resource management is an ongoing, cyclical process, which must allow for adaptive management, flexibility to changing issues and situations and constant learning. [19] The National Water Act provides for an integrated, adaptive process of water resource management. The various provisions of the core chapter of the Act are more or less arranged according to a logical process, which is shown schematically in Figure 2. The relationship of Resource Directed Measures to the whole management cycle is also shown in the figure.

In the development of the RDM procedures, the rules for their application, and in building the links between RDM and the water use planning and licensing processes, the water resource management cycle shown in Figure 2 was used to provide an overall context.

Some notes on Figure 2:

- Transition period
  Ideally, the water resource management cycle should start with articulating the vision for management of a particular water resource (a catchment or sub-catchment, say), and this is where the Water Act begins in the Preamble and Chapter 1: with the vision of sustainability and equity. However, we are in transition from the old Water Act to the new. There is existing use made of water resources in South Africa, much of that use is lawful under the old Act and will be lawful under the new Act. There will be applications for new water uses (according to the broad section 21 definition of water use), and these will have to be evaluated, licensed and controlled together with the existing water uses. Thus, initially, the requirement for changing from the old legislation to the new in any particular water resource will be triggered by a water use licence application. Before a licence can be considered, the preliminary class, Reserve and resource quality objectives (the RDM) for the water resource in question must be determined. So initially, RDM determinations will be undertaken in response to licensing needs. In years to come, as we move towards full scale implementation, the water resource management process will move through the review phase, to revisit the vision for each water resource and determine the RDM at a full scale level.

- Review periods
  The Water Act does not specify the review period within which the RDM should be reviewed to see if the source directed controls and other management provisions are indeed achieving the vision and class that were set for the resource, but a review period of at least 5 years is considered to be sufficient. The review may be only a formality, or it may be a substantial revision of the management goals for the resource, particularly if there have been significant changes in the socio-economic or biophysical situation.

- Feedback loops
  When a water use licence is evaluated, ideally it is first checked against the allocation plan to see if the proposed water use can easily be accommodated. If so, then it is reasonably certain that the provision of the class, Reserve and RQO will not be violated by the proposed water use. If the allocatable resource is nearing its limit, then the proposed water use may potentially impact on the class, Reserve and RQO and a more detailed assessment and evaluation may be necessary.

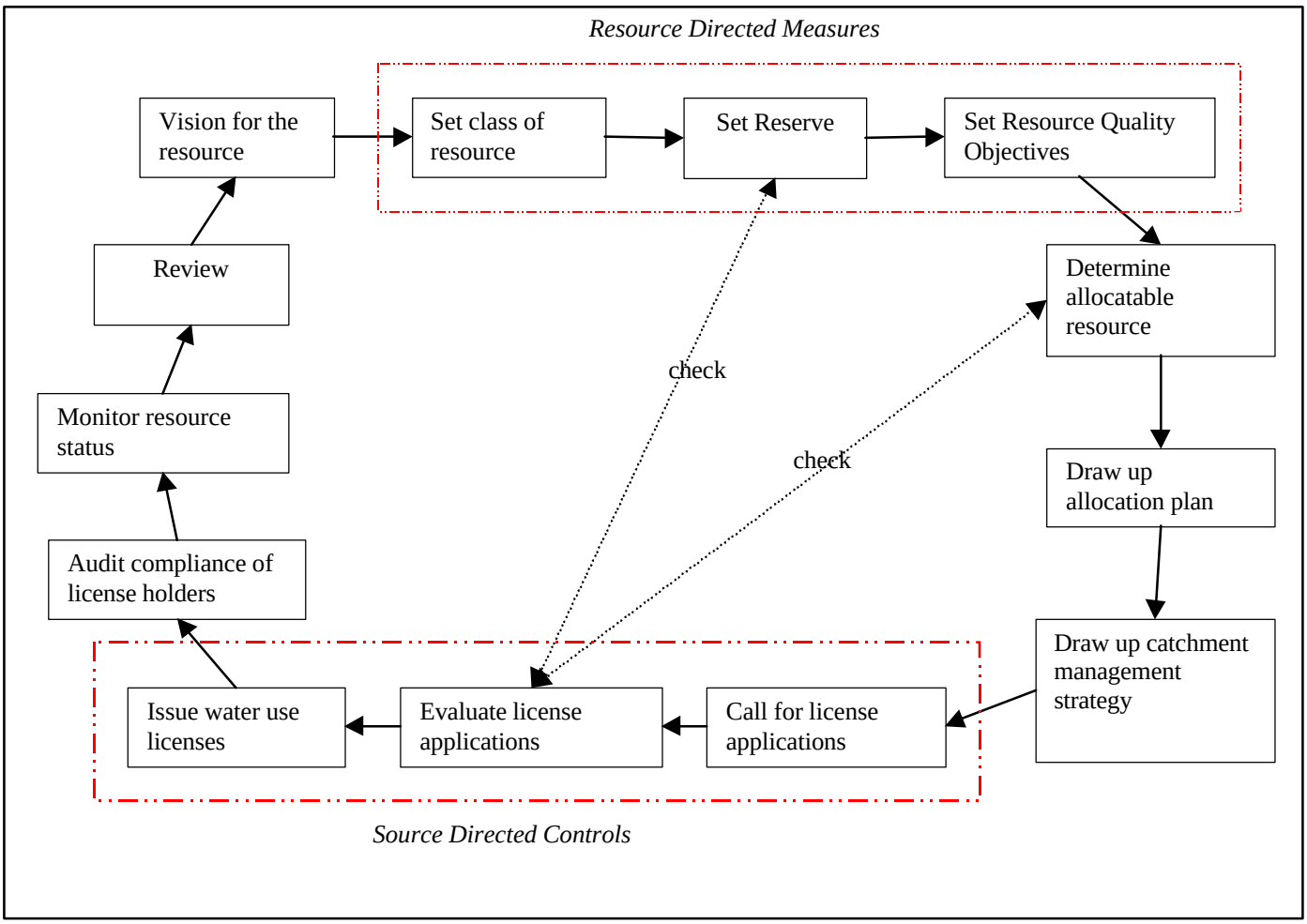

Figure 2: Water resource management business process (MacKay, 1999).

**** still to add: relevant NWA section numbers in each box*

6 SOME LESSONS LEARNED FROM THE POLICY DEVELOPMENT PROCESS

Though it is still early in the process of development and implementation of the new water policy and legislation, there is a need for reflection at this time, to see where we have come from and what we have learned till now that might make the path ahead clearer. Note that these points are an entirely subjective view from the author at this time, and do not necessarily represent the view of the Department !

Only a brief discussion of each is provided at this time: an in-depth critical review of the process is part of the development of later versions of this document.

- **The value of strong vision and leadership**

Initiating such a far-reaching change in the very basics of the way in which we see and manage water requires strong vision and leadership. The value of this cannot be understated, but often we see emphasis placed on the need for vision and leadership at a higher political level. While there is no doubt that political leadership and will are absolutely essential, what is sometimes overlooked is the need for sustained strong vision and leadership, *over a long period*, within the implementing agency or organization. This kind of leadership can not be provided by an external agency which is providing funds or policy support – it must be internally based within the implementing organisation, though it can be supported, assisted and nurtured by external partners. Without this sustained leadership, the organizational change needed to fully implement policy will not be felt throughout all levels of the organization; things on the ground are likely to go on much as they always have done, simply because people have a natural inertia when it comes to changing the way in which they carry out their daily tasks.

- **True integration is neither easy nor cheap**

At a technical level, true integration between disciplines requires ongoing energy and commitment. Integration between water quantity and water quality aspects, between the various specialist ecological disciplines, takes considerable effort and time. It requires team work and team thinking (though not "groupthink"). At a specialist level this can really only happen face to face. Getting people together face to face costs money and time and takes strong project management skills, but is essential if we are to move towards truly integrated water resource management.

Many of the barriers to integration are organizational and can hopefully be overcome through organizational change, but some are set in tertiary education programmes, long before people enter the organisation. Only very recently have we seen some South African universities responding to the challenge of producing truly integrative thinkers in the water sciences, and this change will take time to become evident in the cadre of professional water resource managers.

- **Use rapid prototyping and learn-by-doing**

New policy requires new tools, and new ways of operating systems, be they administrative systems, information systems, or water resource systems. If we wait for the ultimate, most elegant, most precise tool, we will wait too long. The rapid prototyping approach has worked very well for us in South Africa, at least in the development of procedures for determination of the Reserve and resource quality objectives.[20] As we apply the prototype tools, we will hopefully learn more about what works and what doesn't, how systems respond to our management actions and how we need to refine our tools.

- **Generate new thinking and project management skills**

Integrated thinking and integrated management of water resources, not to mention the development of technologies to support integrated management, requires some new skills that many scientists and resource managers lack.

The classic scientific challenge of "Ill-defined problem, ill-defined solution" was presented when we had to develop workable, practical procedures for Reserve determination. We found that the Theory of Constraints

approach[21] helped to generate and support the integrative thinking that was required to produce truly integrative, integrated tools. Critical chain project management approaches ensured that a large team (more than 100 specialists), scattered across the country in several organizations, managed to deliver working prototypes on brief, on budget and on time.

- **Mobilize capacity through "virtual" teams & partnerships**

The Department does not maintain a large core of specialist ecological expertise, and is unlikely ever to do so, since this is not really cost-effective for a government agency, especially in a developing country. Hence, in the last three years, the very small group within the Department tasked with development of tools for aquatic ecosystem protection has generated and become part of a much larger "virtual" partnership involving key specialists from several organizations in the country. Initially, it was the Department who supplied the impetus in the form of consultancy funding, but once the team had formed and was operating well together, we found that team members, all fully committed to the programme, began to take responsibility for mobilising other resources to support development, including finding additional funding, sourcing additional knowledge and human resources through their own networks.

The RDM team has now grown into a national group, indeed a national asset, since it is this core group which has developed and maintains expertise related to aquatic ecosystem protection policy. This group now serves as a crucial skilled supporting and advisory function at a national level, helping while the Department builds the capacity in its line functions to implement the aquatic ecosystem protection policy tools, and continuing the ongoing development and refinement of policy tools. The Department provides a certain amount of core consultancy funding to support the team's ongoing work.

- **A free flow of information reduces resistance to change**

In any process of change at a scale like this, there is resistance, both from the stakeholders who are being affected in the way they use and make use of water, and in the implementing organization which has to make substantial changes to its business procedures and philosophies.

A constant free flow of information at all stages definitely reduces the resistance to change, whether the resistance is due to people feeling that their interests are threatened, or whether just due to natural human inertia in the face of change. Even if policy and tools are in early stages of development, spreading information about the concepts and principles helps people adjust along the way, and ensures later uptake of the technologies or tools in everyday resource management.

In the aquatic ecosystem protection policy development, the flow of information, in a format which people could understand, was sometimes neglected as we raced to meet the challenges, where these challenges were partly of a highly technical nature, partly provided by the unmoving "day 1" deadline of enactment of the new legislation. This was in spite of us having a formal communication strategy in place, communication specialists on the team and a substantial budget allocated just for communication.[22] Later, it took considerable energy and time to "catch people up" and overcome their resistance.

- **Face up to deep-seated issues of organizational change**

The crucial importance of issues of organizational change has been well documented in recent management literature, but is often not apparent to people from a more technical background. Yet no matter how good the technical tools are, if the organization is not able to take them up and implement them, the development is wasted.

Probably it is better in processes of change for form to follow function, i.e. for us to understand first exactly what it is we want to do and only then set in place the organizational and institutional structure which can expedite what we want to do. However, as understanding about the functions develops through learning by doing, so tension builds since it becomes more and more difficult for the existing organizational forms to carry out those new functions. While a certain amount of tension is necessary and good, since it provides motivation for organizational change, too much tension can result in negativity and resistance to change, possibly followed by

failure to take up and implement the new functions properly, as the organization rather falls back into its old "comfort zones".

Evaluating the tension between old form and new function, knowing the right moment to initiate structural changes or new institutional arrangements, require judgement and courage, and rest in the realm of great leadership. Here is the link back to the first learning point, that strong sustained vision and internal leadership is essential, not only to initiate change, but to have the courage to lead continuing change and do what has to be done to take policy to full implementation. It is doubtful whether interventions from external supporting agencies can adequately address this at a national level, though interventions can be very successful at a more local or project level. The building and utilization of virtual partnerships shows some potential, and the ongoing development of the role of a group such as the RDM team may provide some pointers for the future.

Like many other developing countries, South Africa is short on strong leaders with the necessary vision and expertise, particularly within government agencies and resource management agencies. Probably this is the greatest challenge of all facing implementation of our new water policy, and the one where the outcome is least assured.

7 WHERE ARE WE NOW ?

The short answer is: at the end of the beginning of a long process of change. However, two generic questions now tend to arise in almost every water resource management decision, at almost every level:

- Can we turn around the trend of degradation in our water resources ?
- Can we afford not to ?

Though some decisions may still reflect political or economic expediency, the fact that these questions are being asked and debated in the public arena is proof of significant steps forward towards sustainable management of water resources in South Africa.

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