NATIONAL WATER QUALITY MANAGEMENT STRATEGY

POLICIES AND PRINCIPLES

A Reference Document

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Agriculture and Resource Management Council of Australia and New Zealand

Australian and New Zealand Environment and Conservation Council

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EXECUTIVE SUMMARY

The management of water resources is an integral part of environmental management and an essential requirement for the continuing viability of most sections of our society. Changes to catchments including deforestation, soil erosion, the use of fertilisers and pesticides and the disposal of industrial and domestic wastes have generated major intrusions into virtually all stages of the hydrological cycle with the potential for significant detrimental impacts on water quality. Growing community concern about the condition of the nation's water bodies and increasing understanding that sustainable management of water resources requires recognition of environmental needs, has led to demands for changes in the management of water resources.

Ecologically sustainable management of the nation's water resources follows the guiding principles set out in the National Strategy for Ecologically Sustainable Development. Sustainable management of water resources requires the adoption of policies which integrate economic and environmental goals, recognise the value of the asset, provide for intergenerational equity and adopt a precautionary approach.

The Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) and the Australian and New Zealand Environment and Conservation Council (ANZECC) have accordingly agreed **to pursue the sustainable use of the nation's water resources by protecting and enhancing their quality while maintaining economic and social development**. This objective will be pursued through a strategy based on high-status national guidelines with local implementation.

In the development of this strategy ARMCANZ and ANZECC are giving priority to the development of a policy and management framework for water quality management (as set out in this paper): a review of drinking water guidelines; guidelines for the management of sewerage systems; guidelines for water quality management in the rural environment; and guidelines for water quality including national criteria. Other important matters include the development of guidelines for groundwater protection and for the management of urban stormwater systems.

A nationally consistent approach to water quality management will be achieved through the development of high-status national guidelines which can provide the point of reference when issues are being determined on a case-by-case basis. The adoption of national guidelines provides a shared national objective while allowing flexibility to respond to differing circumstances at regional and local levels. The management process provides for a consistent approach to the implementation of the strategy while recognising differing political, social and natural conditions.

A basic tenet of the water quality management strategy is the importance of identifying opportunities where economic instruments may be applied to achieve efficient allocation and

realistic valuation of water resources as an asset. The adoption of market incentives and sanctions can modify the use of water resources and work towards desired water quality outcomes. The correct price for water resources will reflect the full social cost, both financial and environmental, of using the resource as well as capital, operations and maintenance costs.

The strategy proposes the adoption of a complementary package of regulatory and market-based measures to take advantage of the strengths of both approaches. Pricing and allocation reform would be key elements of a package which could also include improved institutional arrangements, clarification of property rights and measures to increase community awareness and acceptance of improved practices for water use and the need to adopt an integrated approach to the management of natural resources.

Important information needs to support both regulatory and market-based tools are:

- water quality goals and objectives based on community preference and the scientific input of nationally consistent water quality criteria

- nationally consistent effluent guidelines encouraging the adoption of technology which provides cleaner production processes and the use of best management practices

- collection of appropriate water quality data.

The market-based aspects of the package could include pricing policies which reflect the full cost of supply, including operations and maintenance costs, and provide incentives for water users to take account of the cost of adverse environmental impacts which result from their use of the resource. Such an approach would not only ensure that social and environmental costs are recognised, but it would also encourage producers to adopt wastewater management practices which are cost effective and environmentally sound.

The proposed management approach explicitly recognises the importance of community involvement in the process of identifying the preferred uses of local water bodies. Community involvement is equally essential if genuine community acceptance is to be developed in relation to the costs associated with improved water quality. The costs and benefits associated with the proposed water use options can be made explicit when scientifically-based water quality criteria corresponding to each protected value are identified.

The determination of environmental values for local or regional water bodies represents the particular uses or values that the community wishes to preserve and should be the first step in the development of a water quality management program. These environmental values are matched with scientifically based water quality criteria to provide the water quality objectives. In the case of large catchments a different range of values may be given to segments of the stream or water body; however, the downstream effects on a water body would need to be considered when regional water quality objectives are set.

ARMCANZ and ANZECC will develop effluent quality guidelines for major industries which will set pollutant levels consistent with those achievable by accepted modern technology consistent with on-going economic viability. The effluent guidelines will not specify the technology to be used except in cases where effluent quality cannot be adequately assessed or defined. These guidelines

would apply from start-up of new installations and would be progressively phased in by existing dischargers.

Diffuse sources of pollution must also be addressed in a water quality management strategy. Diffuse sources of pollution occur in both rural and urban environments, however, the potential for this form of pollution is greatest in the rural environment and a range of measures will be required for its control. These measures could include identification of current contributors and decisions on the need for changed land uses and improved management practices. The development of plans or strategies for the adoption of best management practices on a catchment basis may in many circumstances provide the most effective and efficient means for community consultation and participation involving the community. The concept of best management practices provides the basis for an integrated approach to natural resource use and management of water quality outcomes.

In implementing a strategy along these lines, some significant management frameworks may need to be put in place. Efficient and effective management of water quality requires: national consistency in processes for setting goals and objectives, clear and explicit administrative processes, mechanisms for the involvement of regional communities in the identification of environmental values and monitoring and enforcement measures.

In the light of the agreed national objective, State water quality planning and policy processes can then provide the context within which regional and local water quality management plans could be developed. The catchment management approach will usually provide the most effective mechanism for community involvement and be the basis for strategic planning and implementation of pollution control measures. As central as community involvement and commitment is to an effective water quality management strategy, the role and responsibility of governments as the final decision makers in managing water quality in the interests of the whole community must be recognised.

POLICIES AND PRINCIPLES

- A REFERENCE DOCUMENT

PART A

POLICY PRINCIPLES FOR WATER QUALITY MANAGEMENT

1. INTRODUCTION

Over the past two hundred years, significant parts of the Australian environment have been degraded through a combination of misjudgments and uninformed decisions about the consequences of the effects of various land management and industrial practices and natural events. The relatively small proportion of the continent with arable soils and reliable and adequate rainfall, together with lack of knowledge regarding the impacts of alternative management practices has meant that some fragile environments have sometimes been over-exploited with adverse consequences for productive, social and environmental values. In some cases inadequate or inappropriate government policies have added to these problems.

Increasing understanding of the importance of the environment as the ultimate support for all life, together with some highly visible and serious examples of air and water pollution and land degradation, has led to growing community concern about the quality of the environment. The costs of environmental damage are difficult to estimate but loss of biodiversity and serious impacts on current and future productivity are evident. The declining condition of the nation's rivers, lakes and groundwater as a result of changes to their catchments, floodplains and instream conditions represents one important aspect of the environmental issues to be addressed.

The growing understanding of the fundamental links between a well managed environment and economic growth must be reflected in decisions about the use of resources. For this to be achieved in a socially optimal way, a clear national objective needs to be articulated and a strategy developed for its implementation.

Growing community concern about the condition of the nation's water bodies has led to demands for changes in the ways in which natural resources are managed. High quality water for consumption and adequate supplies of water for agricultural and industrial production are regarded as essential for Australia's future. At the same time, increasing recognition is being given to the needs of recreation, amenity and to sustaining ecological systems.

The resolution of the conflicting demands for water resources will have fundamental implications for the well-being of all Australians. Public expectations for improved management of natural resources requires the water industry to put in place measures and strategies which can overcome current problems as well as meet future expectations. An important part of the process will be ensuring transparency of costs attaching to each of the options available to resource users and the community generally. Only in this way can a robust community acceptance be developed with respect to the costs associated with the maintenance of water quality for both instream and extractive uses and values.

The determination of environmental values should be seen as a central part of the process of planning and allocation of water resources. Efficient allocation of resources is an important element of any management strategy, as well as making a substantial contribution to the on-going process of micro-economic reform. As part of this process, the water industry is currently examining institutional arrangements and opportunities for a more commercial approach in order to identify ways in which the volume and quality of services can be better matched to consumer preferences and provided more efficiently.

Opportunities and responsibilities for the management of natural resources are spread widely amongst different government agencies and resource users. The community has both an interest and an opportunity to be involved in environmental management in general and in water quality issues in particular. Against this perspective, water quality management is a nation-wide concern from which will come nation-wide benefits.

2. ENVIRONMENTAL MANAGEMENT AND WATER QUALITY

Water of adequate quality and quantity is central to the integrity of the environment. It is the interaction between water and the living environment that substantially shapes the character of the hydrological cycle, the regulation of climate, the formation of soils, the maintenance of soil fertility and the absorption and breakdown of pollutants. The accompanying biodiversity confers stability on ecosystems, provides for a range of resource use opportunities and offers alternate pathways for primary production and nutrient recycling when ecosystems are stressed.

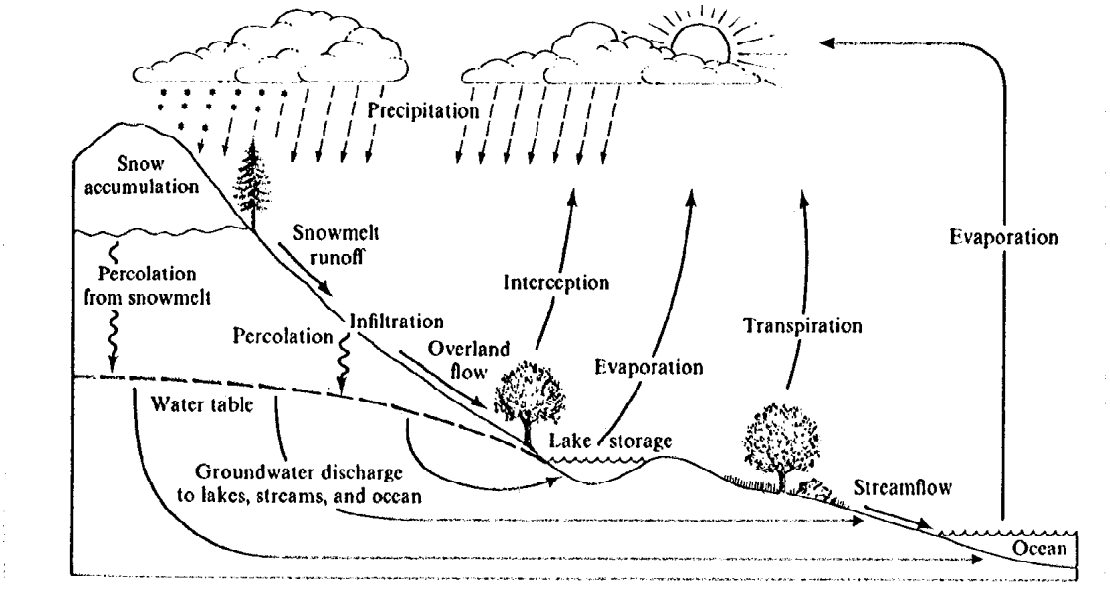
All species from the simplest to the most complex are adapted to a limited range of physical and chemical environments, of which land and water are the most significant. Water, its relative presence or absence and its quality, substantially determines the ecological richness and diversity of a particular region. Any marked change in the quality or quantity of water will result in an immediate change in the range and structure of ecosystems including the numbers and types of organism that can survive in the altered environment. Healthy ecosystems have been repeatedly demonstrated not only to be intrinsically important in themselves, but to confer indirect benefits on human water users.

Water is equally important in terms of the economic and social structures of society. Water as an economic input substantially determines the capacity of a region's resources to be marshalled for the generation of marketable outputs, be they derived from mining, manufacturing, fishing or irrigation and other agricultural enterprises. The availability of adequate supplies of clean water for domestic and economic use has shaped the geographic distribution of our population, its quality of life and culture.

The scope and complexity of water resources management issues together with the economic commitment involved in maintaining a water industry appropriate to Australia's needs makes this a national strategic endeavour in its own right. However, it must be recognised that water resources management is an integral part of the broader environment and that some solutions to a particular water resource problem could adversely impact on other parts of the environment.

The diagram on page 3 illustrates the complex array of physical processes that accompany the movement and storage of water within the environment. These processes are highly variable in time and space and are influenced by climate, regional topography and the local environment. Any changes in these factors will impact on the outcomes from the hydrological chain. Human activity can

generate major intrusions into virtually all stages of the cycle with the potential for significant, if not irreversible, impacts on water quality and aquatic habitat.



Other than in its vapour form, water is never pure; even in an undisturbed environment, the quality of water is highly variable. The quality of water is commonly defined by the physical, chemical, biological and sensory attributes that affect the suitability of water for the range of community uses. These include use in agriculture, industry and recreation, for drinking water and for the support of ecosystems.

The chemical characteristics of a water body in particular affect its use for human, agricultural and industrial purposes and its suitability for aquatic organisms. Industrial growth, economic development and the application of modern technologies have carried with them the harmful release to the environment of significant quantities of chemicals, many of which were previously foreign. Other human activity has greatly increased the concentrations of biodegradable wastes, plant nutrients, nitrogen and phosphorus and pesticides reaching waterways and groundwaters.

Over the years, growing urbanisation, changing agricultural practices and industrial needs have increased the demand for fresh water and have increased the pollution of water bodies. Water pollution has the potential to become a limiting factor for economic development, through adverse affects on drinking water supply, the rural environment and on particular activities such as fishing, recreation and tourism. The decline in water quality and the natural and cultural amenity of water bodies has already affected the productive use of the nation's water resources and degraded it as a habitat for other species. It is apparent that the solutions to the degradation of water resources will require changes not only within the water industry but also by a wide range of organisations and individuals.

Changes in urban and rural landuse have also increased the amount of sediment reaching waterways. These sediments degrade water quality in a biological and aesthetic sense, imposing costs not only to the natural ecosystem but also to the community's economic and social well-being. The sediments may not only overload aquatic systems with solids but may also harbour insidious toxic contaminants.

Human activities can also alter the naturally occurring thermal regimes of rivers by additions of, for example, waste heat or the release of cold water from the base of pondages. Where these effects are significant, aquatic ecosystems may undergo considerable change.

Water supports a whole world of its own where the 'health" of the water body is often indicated by the variety and composition of the population, both visible and microscopic. With pressures being placed on these resources by a growing population and a trend to a more urbanised society, these organisms are joined by a range of human-related disease carriers that may prove serious to health.

Naturally-occurring processes such as the leaching of soil chemicals or the breakdown of biomatter can impose a distinguishable character on a particular waterway. Pressures placed on these resources for industrial and urban development have further modified these characteristics. The interruption to natural flow through the construction of storages supplying irrigation and domestic needs and the use of rivers as irrigation channels or drains for the disposal of wastes have all led to relatively slow but ubiquitous changes to the resource.

Three fundamental conclusions emerge readily from the above brief consideration of the relationship between water quality and environmental management. First, water as a natural resource has two dimensions, quantity and quality, both of which are variable in time and space. Secondly, water is a natural resource that is fundamental to the ongoing viability of the environment in general and to the nation's social and economic structures. Of particular significance here is its importance as a habitat for aquatic life. Finally, its continued availability, in terms of both quality and quantity, is vulnerable, not only to the vagaries of nature, but also to direct and indirect impacts of water use within the hydrological cycle.

3. POLICY FRAMEWORK AND OBJECTIVE

3.1 Management Philosophy

The current emphasis by governments on ecologically sustainable development reflects growing community recognition that in pursuing material and social welfare, often insufficient attention has been given to the ecological degradation associated with development. The concept of ecologically sustainable development provides a comprehensive philosophical umbrella under which to pursue the issue of water quality management. This concept focuses on natural, economic and social phenomena as three elements within a closed system where a disturbance to one will impact on the others. This perspective however, does not imply a static view of the elements of the system or of their interaction on each other. On the contrary, it allows for changes in the profile and character of each of the elements and for the possibility of a range of equilibrium states.

To put it another way, the natural and human environments are not only interdependent; there is a wide range of choices open to society in determining the character of the equilibrium state it wishes to maintain. However, uncertainty in ascertaining what constitutes a true equilibrium state and the general preference of society to conserve the natural environment while maintaining economic and social development are factors to be taken into account in arriving at any such balance. The costs and benefits flowing from any potential trade-off should, in any case, be explicit and appreciated by society.

At the national level, the Commonwealth has published the National Strategy for Ecologically Sustainable Development (December 1992) which identifies core objectives and guiding principles as essential features of policies based on the concept of ecologically sustainable development. Consideration of these objectives and principles and their implications throws additional light on the nature and direction to which a water quality management strategy must aspire.

The core objectives are:

. to enhance individual and community well-being and welfare by following a path of economic development that safeguards the welfare of future generations

. to provide for equity within and between generations

. to protect biological diversity and maintain essential ecological processes and life-support systems.

The guiding principles are:

. decision making processes should effectively integrate both long and short term economic, environmental, social and equity considerations

. where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation

. the global dimension of environmental impacts of actions and policies should be recognised and considered

. the need to develop a strong, growing and diversified economy which can enhance the capacity for environmental protection should be recognised

. the need to maintain and enhance international competitiveness in an environmentally sound manner should be recognised

. cost effective and flexible policy instruments should be adopted, such as improved valuation, pricing and incentive measures

. decisions and actions should provide for broad community involvement on issues which affect them.

These guiding principles and core objectives need to be considered as a package. No objective should predominate over the others. A balanced approach is required that takes into account all these objectives and principles to pursue the goal of ESD. In the case of water resource management, the National Strategy for Ecologically Sustainable Development says that 'the challenge is to develop and manage in an integrated way, the quality and quantity of surface and groundwater resources and to develop mechanisms for water resource management which aim to maintain ecological systems while meeting economic, social and community needs.'

3.2 Policy Objective

The increasingly apparent degradation of the nation's natural resources has now assumed a significance beyond the purely economic. Understanding has grown of the links between the various elements of the natural environment and of the systemic shocks and breakdowns that can occur from inappropriate use of such fundamental natural resources as land and water. Similarly, the interaction between resource use and social structures is receiving increased recognition, most notably in terms of changes in the level and distribution or well-being of rural populations.

One of the core objectives of ecologically sustainable development is to protect biological diversity and maintain essential ecological processes and life-support-systems. A water quality management strategy should include a policy framework for the protection of aquatic systems based on an integrated catchment approach.

Resource conservation, use or improvement has a cost. Whether the respective costs are acceptable is a judgement to be made ultimately by governments, on the basis of full and careful consideration of community views and the wider community interest. That judgement must be seen as an amalgam of economic considerations and value judgements. No less than in such areas as health care, road safety or defence, society must determine the trade-offs that must acceptably balance its natural aspirations, economic realities and cultural values.

Of particular relevance is the growing social acceptance of the concept of inter-generational equity. This principle is integral to the philosophy of ecologically sustainable development and implies a reluctance to impair equivalent resource use opportunities for future generations.

If pursued in a narrow and rigid fashion, such an approach could imply static and unchanging water use. This would militate against responsive water resource management in the face of changing circumstances. A flexible and responsible approach to water resource use, grounded in sound policy is what is required.

Experience shows that development which maintains and enhances natural resources can yield social and economic benefits. These benefits are generally greater in the long term than those provided by the type of development which results in resource degradation. In the case of water resources impacts on both quantity and quality are relevant.

The increasingly accepted perspective of ecologically sustainable development implies a clear predisposition towards protecting and enhancing the quality of the nation's water resources. As a policy principle, it gives a fundamental strategic direction to water quality management.

In the light of these considerations, the national strategic water quality policy objective for the purposes of this paper is defined as follows:

> *to achieve sustainable use of the nation's water resources by protecting and enhancing their quality while maintaining economic and social development.*

Commitment to this policy objective would indicate Governments' acceptance of the importance of protecting the quality of the nation's water resources. In terms of the global management of the resource, maintenance and improvement is the preferred outcome. Moreover, as noted above, this preference needs to be reflected in a pragmatic and on-going way where all degradation is perceived as eroding the natural asset base.

The objective recognises that society's choices are not one dimensional. The adoption of a particular water quality goal can close as well as open, resource use opportunities. Given the diversity of environmental circumstances, economic opportunities and community priorities, the implementation of this policy must be pragmatic and flexible. It should take into account the circumstances and balance of opportunities of the particular case and incorporate prescriptive, economic, negotiative and educational instruments as appropriate. Indeed, where disposal of dangerous wastes is at issue or a particularly sensitive environment is at risk, a prescriptive standard or even a complete ban may be appropriate.

4. INTER-GOVERNMENTAL FRAMEWORK

At the present time, responsibility for environmental management is divided between the Commonwealth, the States and the Territories. All States and Territories have a common priority of developing appropriate policies and institutional arrangements to address environmental management issues. Emphasis to date in a number of States especially in New South Wales and Victoria and more recently at the national level, has been on the development of separate environment protection agencies to monitor the environment, to set standards and guidelines and to regulate wastes and pollution. The separation of these functions from the domain of the traditional resource managers has been prompted in part by a perceived advantage in public life of separating the regulatory from the operational function to avoid any conflict of interest in environment protection. However, these respective roles are seen as an essential underpinning to an evolving proactive approach to environmental management by all involved interests.

At the national level, the Constitution does not provide a clear basis for Commonwealth action on the environment apart from powers relating to quarantine, fisheries, meteorology, territories and certain aspects of its corporations, trade and external affairs powers. Many national environmental objectives have been achieved since the early 1970's through co-operative arrangements between the Commonwealth, States and Territories. Joint action initiated by the Australian and New Zealand Environment and Conservation Council (ANZECC) has been prominent. Other Ministerial Councils, including in particular the Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) contribute directly or indirectly to co-operative approaches to improve environmental management. The current development by the Council of Australian Governments of an integrated package of water resource reforms is another example of joint Commonwealth and State action to achieve a national approach to natural resource management.

There has been growing debate about the more formal structures within which a coherent national approach to the environment can be achieved. With respect to water quality, while recognising the administrative benefits of greater consistency, there is matching recognition that a single prescriptive approach to water quality management would deny the natural variability of water bodies and their range of uses. The co-operative theme has continued to be stressed, most notably in the development of the Inter-Governmental Agreement on the Environment. In his July 1989 statement on the environment, 'Our Country, Our Future', the then Prime Minister said that the Commonwealth wished

to advance with the States, development of agreed national approaches to issues of air, water and noise pollution. In his speech of 19 July 1990 on 'Towards a Closer Partnership', the then Prime Minister returned to the theme of co-operation in the context of a review of Commonwealth-State relations across a range of strategic policy areas, including the environment. This call for co-operation resulted in the Commonwealth, States, Territories and local government signing the Inter-Governmental Agreement on the Environment (IGAE). The agreement provides a means to facilitate a cooperative national approach to the environment, better definition of the roles of the respective governments and better environment protection. As part of the IGAE, governments have agreed to set up a National Environment Protection Council.

In the context of water quality management, the institutional framework for co-operation is provided by ANZECC and ARMCANZ. ANZECC is the peak council for consultation and co-ordination on environmental and nature conservation matters. Its position is likely to be further developed with the emergence of a National Environment Protection Council. The principal functions of ANZECC are to establish national objectives and policies for the monitoring, assessment and control of atmospheric, land and water environments and to provide guidance on environmental matters of national significance. With the accelerating pace of debate on ecologically sustainable development and other related initiatives, it is expected that the latter function will receive greater prominence. These objectives are achieved through a range of programs of national significance, liaison with other Councils including the National Health and Medical Research Council, and through participation in international fora.

Within this environmental framework, ANZECC has identified water quality as a priority issue. In 1989 ANZECC began the development of guidelines for a nationally consistent approach to water quality management through the setting of water quality goals and objectives including the management process for the setting of effluent standards and licensing of public and private sector discharges to water bodies. The compilation of water quality criteria and the development of a consistent method for selection of criteria appropriate to match adopted environmental values are central to any program for water quality management. Water quality guidelines translate the criteria into a form that can be used for management purposes once the environmental values for a particular water body have been determined. Water quality guidelines provide guidance for the application of the scientifically-based water quality criteria regionally and locally. Together with the criteria, they enable environmental values to be converted into quantitative water quality objectives for specific waterways.

As already noted, the scope and significance of water resource management issues and the size of the water industry (with a capital stock valued in excess of $50 billion) makes the water industry a strategic area of government policy focus and administration in its own right. The Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) provides the peak forum for the water industry for consultation, co-operation and liaison on the development of water industry policy at international, Federal, State and local levels. ARMCANZ was formed in 1992 by the amalgamation of the Australian Water Resources Council (AWRC), the Australian Soil Conservation Council and the Agricultural Council of Australia and New Zealand. The objective of ARMCANZ is to develop integrated and sustainable agriculture, land and water management policies, strategies and practices for the benefit of the community.

Traditionally, the AWRC concentrated on issues related to the efficient use and management of water resources but more recently attention has focused on water quality issues. In 1989, in response to growing awareness of the environmental implications of resource management and increasing community awareness of the current and potential problems with wastewater and industrial waste

disposal, AWRC committed itself to the development of a comprehensive approach to wastewater and effluent disposal as a pre-eminent strategic concern. It was recognised that these issues need to be addressed in the broader context of a water quality management strategy which encompassed the hydrologic cycle and the range of activities which impact on water quality. The economic implications of a water quality strategy are likely to be substantial and need to be developed in an orderly way.

Both ANZECC and ARMCANZ recognise the mutuality of interests which exists and have agreed to work in close co-operation while accepting that particular issues could require changing the leadership and liaison arrangements to reflect their different perspectives. This commonality of interest is reflected in their agreement on the need for nationally consistent principles for water quality management and to work cooperatively towards a model national management framework.

Historically there has not been a systematic approach to determining which natural resource policies should be implemented by the Commonwealth, which should be State responsibilities and which should be jointly implemented. The three main possibilities are through the exercise of Commonwealth powers where these are provided by the Constitution; parallel State, Territory and Commonwealth legislation; and high-status but non-legal guidelines.

High-status national guidelines can provide the point of reference when issues are being determined on a case-by-case basis. There is considerable experience with the use of this option and this is the basis for the Drinking Water Quality Guidelines in Australia developed jointly by the National Health and Medical Research Council (NH&MRC) and the AWRC as well as for maximum residue levels in foods and air quality goals set by the NH&MRC. Such an approach provides a shared national objective while allowing flexibility to respond to differing circumstances at regional and local levels. The appropriate response would be specifically tailored to the agreed local objective and be drawn from the suite of options ranging from regulatory standards to indicative codes of practice.

The agreed approach is pragmatic in that differing political, social and natural conditions are recognised. Co-operation between Commonwealth and State Governments and between peak councils provides leadership and commitment at a national level. Community involvement at local and regional levels will be needed to formulate community preferences for particular water bodies and to support appropriate management plans.

Reform of Commonwealth/State relations is at present proceeding at an increased rate and firmer administrative arrangements for environmental management seem likely to emerge. Evolution of the institutions should be able to accommodate the policies and principles of the National Water Quality Management Strategy now being developed cooperatively between ANZECC, ARMCANZ and NH&MRC. To the extent that they are based on a practical management process and sound scientific principles, they should suit any evolving structure.

5. NON-GOVERNMENTAL STAKEHOLDERS

The ultimate objective of all natural resource management is to enhance community welfare through ecologically sustainable use and protection of the natural environment. The general community, therefore, has a vital interest in the national objective to be adopted with respect to water quality management.

However, as evidenced by the earlier discussion of the hydrological cycle, the community is also important in terms of the potential impact of its water use on water quality. Domestic water use practices, disposal of wastes and garden management techniques on residential blocks are all examples of how the routine activities of the community can promote or inhibit the achievement of improved water quality.

There is a need to build on the growing community awareness of water-quality issues. Governments must assist the community to integrate the information already in the public arena into a balanced and relevant view of the community's responsibilities and opportunities in water management. Governments must then put in place policies and processes that can attract on-going community commitment and involvement.

As with the community generally, industry has a dual interest and involvement in water quality management. On the one hand, it has a major interest in maintaining water quality adequate to meet its needs. This applies particularly to rural industry. On the other hand, the potential exists for major industry location or process decisions to be made without due regard to the consequential impacts on water quality. Whatever short-term benefits might result from such opportunism, however, industry itself increasingly realises that a stable production and marketing environment is most likely to occur when industry and the community have interests in common. Responsible and responsive resource use practices must be an integral part of that coincidence of interest. However, it is important that there be flexibility for industry, commerce and society at large to achieve these goals in their own way. The management process for water quality management should therefore provide adequate boundaries which, while carefully designed to ensure sound handling of the resource, nevertheless allow society free development within its social and market structures.

To summarise, it is proposed that the application of the adopted policy principles encompass the entire water cycle. To be effective, all those individuals, groups and organisations whose activities have the potential to impact at any point along that chain, must be brought within the scope of the management process.

There is, therefore, a need to develop a management process which is recognised by all stakeholders. It must be credible and robust, providing for flexibility in response to local circumstances without losing coherence and direction at the national level. Stakeholder involvement will be essential at all stages, most obviously in identifying agreed priorities for action at the national level and model structures and processes for local implementation. This essentially derives not only from the key role of stakeholders in the implementation of a strategy; it also derives from the dynamics of inter-active involvement in terms of establishing a shared information base, sharpening perceptions, clarifying priorities and building robust networks and processes.

As central as stakeholder involvement and commitment will be to an effective water quality management strategy, the role and responsibility of governments as the final decision makers in managing water quality in the interests of the whole community must be recognised. Thus water quality goals for particular water bodies would be set by governments as the end result of a community consultation process and taking full account of community preferences. In terms of strategic planning and resource allocation, governments will also still need to ensure that local water resource management decisions are complementary to the state and national vision.

6. ACHIEVING THE NATIONAL POLICY OBJECTIVE

6.1 General

The national water quality policy objective for the purposes of this paper has been defined as:

> *to achieve sustainable use of the nation's water resources by protecting and enhancing their quality while maintaining economic and social development.*

For over a century practical attempts by governments to grapple with water quality problems have yielded several well tried operational instruments. These have been arrived at after a long debate in some fora as to whether emphasis should be on the water body itself or on the pollutant sources; both must receive equal attention.

A further dimension has been added with the recognition that diffuse sources of pollution, modified river dynamics and land use within catchments all play a role in water quality and need an integrated management approach. As part of a waste minimisation policy, preventative approaches reduce the amount of pollution from both point sources and diffuse sources.

Finally, there is a limit to the use of command-and-control legal mechanisms. Market-based instruments should also play a complementary role in achieving protection and enhancement of water quality.

6.2 Developing Water Quality Goals to Meet Community Preferences

6.2.1 Environmental Values (Beneficial Uses)

As already noted, the adoption of a particular water quality objective can close as well as open resource-use opportunities. Given the diversity of environmental circumstances, economic opportunities and community practices, regional water quality objectives must take into account the circumstances and balance of opportunities of the particular case.

These opportunities, called environmental values (commonly called in the past "beneficial uses"), are particular values or uses of the environment that contribute to public or private benefit, welfare, safety or health. There may also be particular environmental qualities which the community wishes to preserve. All require protection from the effects of pollution and waste discharges.

The determination of the regional community's preferential values and uses is the first step in developing a water quality management program. In large catchments, it may be desirable to consider rivers or aquifers in segments with different community preferences for each segment. Several preferential uses may be designated for a specific water body. Finally, the interests of downstream users of a water body must be considered in identifying possible uses of a water body and formulating regional water quality objectives.

6.2.2 Water Quality Criteria and Regional Water Quality Objectives

Water quality refers to the physical, chemical and biological attributes of water that affect its ability to sustain environmental values. Water quality criteria are parameters or maximum levels of contamination which can be tolerated, based on scientific evidence and informed judgement, for specific uses of water or for the protection of specific values. Knowledge of critical threshold levels of particular contaminants is incomplete and always likely to remain so to some extent. Accordingly, water quality objectives are generally set conservatively, in order to provide an additional safety factor. Once the regional values to be protected have been agreed, these can then be cross-referenced to the appropriate water quality criteria.

ANZECC has reviewed water quality criteria and guidelines developed overseas and in Australia where available, and issued Australian Water Quality Guidelines for Fresh and Marine Waters (November 1992).

6.3 Community Returns on Public Water Resources

Water resources are community-owned. Accordingly, the community can expect that their asset will be protected. Where water use does not involve any reduction in water quality, the fee-for-use could be expected to relate in some broad way to the cost of providing and maintaining community access to the resource. Where the agreed preferential uses for a water body degrades water quality, then it is important that the cost is brought to account. However, the precautionary principle comes into play at this point because it is usually not possible to place a reliable cost on degradation, particularly a cost which adequately accounts for the future. This essentially conservative approach to assessing returns is consistent with the strategic water quality policy objective.

6.4 A Systems Approach to Water Quality Management

Traditionally, Governments have tended to implement policies to protect water quality through direct command-and-control type regulation, coupled with monitoring systems and non-compliance sanctions. This approach has had the attraction of providing relatively guaranteed outcomes where monitoring and enforcement processes are good.

A management approach which introduces a broad range of economic instruments provides opportunities for a more effective decision process. The adoption of environmental values and scientifically based criteria allows the consequences of those decisions to be transparent.

Economic instruments provide incentives for decision makers to modify their behaviour so that resource use and waste disposal alternatives are chosen that lead to more socially optimal outcomes than would occur in the absence of those incentives. Regulatory instruments influence allocation decisions by placing formal impediments on particular resource uses and waste disposal options; market-based instruments influence allocation choices through the price and charging system, by changing price and cost relativities and hence profit opportunities.

A complementary package of regulatory and market-based-measures is needed to achieve improved water quality outcomes. Such a package could include pricing and allocation reform, together with improved institutional arrangements, clarification of property rights, measures to promote the adoption of best practices and community awareness and education.

6.4.1 Regulatory Approaches

Prescriptive regulation has traditionally been the most commonly used means of achieving environmental objectives. "Command-and control" regulatory controls may work by setting limits on the quantity of effluent an individual firm may produce; by setting limits on the nature and level of any environmental impact due to its disposal; or by specifying the complementary action to be taken to reduce environmental damage.

The most obvious strength of the regulatory approach is its clear focus. A specific threat to the environment, or class of threat, is identified and a protective regulation is appropriately formulated. Problems are met by a regulatory response that offers an assured outcome.

In most environmental situations, reliance on a regulatory base is likely to be essential even for a more economically attuned environmental management framework as outlined further below. This is because of the large measure of uncertainty inherent in predicting the environmental outcomes of a market-based process and the potential for irreversible environmental degradation. Hence this regulatory base is likely to provide the assured base for society on which more flexible economic management approaches may be constructed. The regulatory approach has the historical advantage of being in place and operational in most situations.

Against the advantages of regulation must also be set its disadvantages. A regulatory system can be rigid and unresponsive to legitimate differences in local circumstances. While flexibility can be incorporated into regulatory systems, the tendency is to narrow choices. Nevertheless prescriptive regulation is impact oriented and not generally concerned with the causes of the problems. The full integration of environmental regulation with changing commercial and technological opportunities is not always possible or timely.

Three specific disadvantages, with respect to the relative inflexibility of regulatory approaches, are worthy of note. First, regulations generally provide no incentive to achieve better than the prescribed standard. Secondly, regulations do not consider the distributional aspects of reducing environmental damage, either in terms of equity or efficiency. Finally, regulations may tend by their manner of formulation often not to allow individuals to choose the lowest cost response to meeting environmental objectives.

There is however, a place for regulation in environmental management. In some circumstances direct regulatory controls may be the most effective and efficient means of achieving environmental objectives. Where protection of sensitive or particularly valuable natural areas is required and risk needs to be avoided, the predictability of regulatory outcomes is a clear strength. Similar considerations arise where effluents are sufficiently noxious that a specific level of discharge should not be exceeded and this cannot be otherwise guaranteed. More obviously, contestable markets are not always in place, nor will the expected market response to altering price signals always be adequate to achieve environmental objectives.

6.4.2 Market-Based Approaches

Market-based instruments, rely on the regulatory establishment of market structures; they differ from merely prescriptive regulatory controls in that they seek to influence behaviour by changing the relative returns on environmentally benign and environmentally damaging activity. In particular, they attempt to ensure that resource-use decisions take into account all the social costs and benefits of those

decisions. Market-based measures may be used to influence decisions about the use of clean water and about the management of wastes. By bringing costs of these impacts to account, waste management becomes an integral part of decision making with respect to optimising production choices and profit opportunities. This perspective requires *inter alia* a shift in focus from end-of-pipe control of waste to one encompassing the full range of potential options to solve waste problems. A cradle-to-grave approach means that economic optimisation can be applied across the full length of the production chain and can also involve minimising costs of waste management.

Many resources are underpriced in terms of the opportunity cost of their use. There is also a downward bias in estimating the cost of supply of particular resources to the extent that external impacts such as environmental costs are not included. Application of the 'user-pays' principle is necessary to ensure that resource users pay fully for all costs to society.

Just as all input costs should be fully met, so too should all output costs. In particular, the real costs of pollution are generally not accounted for in pricing and investment decisions. This means that the costs of pollution caused by waste generation and disposal are borne by the community at large, rather than by those who benefit from the production process that generates the waste and pollution problem. One example is the use of water for irrigation which results in drainage waters of significantly lower quality; another involves the use of natural water bodies for wastewater disposal with consequential degradation of the former.

Polluters can no longer be allowed to simply pass on the cost of environmental damage to the general community. The 'polluter pays' principle offers the prospect of ensuring that the cost of managing the waste by-product is included in the over-all production decision.

The primary difficulty in implementing a market-based approach to waste management lies in costing the environmental damage caused by pollution. In relation to water quality management, this focuses on the social and environmental costs associated with the degradation of a particular water body by the addition of wastewater.

A useful insight into the cost of such degradation can be obtained by regarding the receiving water as a capital asset . Other things being equal, the use of a water body for wastewater disposal results in the depreciation of that asset through a reduction in water quality. The extent of that reduction can be measured scientifically. Its depreciation cost can be estimated on the basis of the treatment costs needed to restore the receiving water to its original state. The application of a discharge levy or pollution charge equivalent to the treatment cost of restoring the water to its original state could transfer to producers those costs currently borne by society.

The introduction of such a levy or charge could markedly change the choice of production function by waste producers. In essence, it would induce a re-evaluation of the relative profitability of pursuing, separately or in combination, other elements in the suite of actions open to producers to influence the ultimate requirement for wastewater disposal. Equally, it would encourage consideration of other disposal options, the environmental impact of which would also need to be costed.

Such an approach would strongly promote water resource management by strengthening cost pressures for efficiency in resource use, judged in the full production framework. Efficiency of resource use is the beginning of sustainable use of the nation's water resources, the central element in ARMCANZ's and ANZECC's agreed policy objective.

Moreover, the explicit costing for water asset depreciation would help make effective the Councils' policy to protect and enhance water quality, while maintaining economic and social development. Increasing the private cost of water degradation will inhibit its choice as a waste disposal option; consideration of other disposal options will be encouraged, as well as more fundamental responses such as waste minimisation.

6.4.3 Using a Mix of Regulatory and Market Approaches to Manage Wastewater Disposal

A comprehensive strategy for the achievement of sustainable water quality management should build on the strengths of both regulatory and market based approaches.

As already discussed, the strength of the regulatory approach is its relative directness of impact and predictability of outcome. However, acting in isolation, regulation tends to militate against the adoption of innovative approaches to wastewater management which are consistent with both commercial viability and environment protection.

On the other hand, market-based approaches offer the prospect of tapping the entrepreneurial vitality traditionally associated with private enterprise production. By establishing effective market signals, cost minimisation becomes the responsibility of individual producers, who have the insight and motivation to achieve it.

Waste management can be approached through one or more of the following hierarchy of actions; in decreasing order of environmental desirability:

- waste avoidance
- recycling or waste reclamation
- waste re-use
- waste treatment to reduce potential degrading impacts
- waste disposal.

Depending on the nature and circumstances of the particular production process, inclusion of waste management costs in aggregate production costs can lead to substantial reductions in the level and significance of demand for wastewater disposal. Most importantly, it can emphasise the advantages of waste minimisation (which is the preferred outcome, other things being equal).

Identification of the optimal mix of regulatory and market-based instruments will depend significantly on the particular link of the hydrological chain that is involved and the particular circumstances of the time and place. However, this section of the paper will consider some of the more important management focal points that could be expected to warrant priority attention.

6.4.4 Role of Technology

The capacity for technology to contribute to optimal waste management is fundamental. The capacity for technology to generate 'clean' as opposed to 'dirty' production processes goes a long way to establishing the practical limits of the waste disposal problem, particularly in terms of point source pollution. It is in this area that a particularly fruitful joining of regulatory and market-based measures can be implemented.

One of the direct consequences of internalising the hitherto external cost of degrading community resources would be to encourage a re-evaluation of the relative cost of waste minimisation, or changes in the waste stream, through improved technology. Under the historical approach that emphasised regulation of more serious waste disposal risks, the cost-saving potential of improved technology through waste reduction was commonly not an issue. Technological responses tended to be situation specific and more a reaction to negotiated regulatory outcomes rather than an attempt to minimise total production costs which included waste disposal.

A market-driven approach could be strengthened by taking full advantage of technological opportunities to reduce environmental stress consistent with local circumstances and commercial viability. Such technology could be assessed on the basis of its current installation in comparable economic circumstances elsewhere in the world. Given a fundamental policy commitment to ecologically sustainable development and recognition of the high economic, environmental and social costs of water degradation it could be appropriate to establish minimum wastewater discharge requirements on this technological basis. A further development of a market-driven approach would include measures that stimulate and encourage the development of new technologies, which result in improved quality of the discharge, for example, the adoption of tradeable discharge licences within a particular catchment could encourage the development of innovative technology.

A related approach is the 'Cleaner Production' initiative, which relies on the principle of waste minimisation. This calls for those discharging to the environment to seek to minimise the generation of wastes by adopting inherently more efficient industrial, commercial and domestic processes. Where waste generation is unavoidable, recovery, recycling and reuse of waste compounds are the next stage in the preferential hierarchy. Treatment and disposal to the environment is the 'last resort' stage in the hierarchy to be considered when opportunities for minimisation and recycling have been fully explored.

Efficiency of production is a clear goal of all industrial process management, but the focus on the waste generated by the process provides an impetus which can lead to increased productivity and efficiency. The application of waste minimisation principles has led to significant cost savings in many sectors of manufacturing elsewhere and produced major benefits for the environment. In general, it could be expected that the user-pays and polluter-pays principles would work towards technology mediated outcomes. To that extent, the regulatory application of technology based effluent standards could be seen as a measure of insurance against the occasional imprecision of market-based measures, particularly in the short to medium term, as the overall strategy develops and matures.

The requirement for the installation of accepted modern technology can be rapidly implemented in the case of new or greenfield developments. For existing plants, a progressive introduction of more stringent requirements is envisaged. Priority would be given to those plants where upgrading or expansion provides the opportunity to install accepted modern technology consistent with on-going economic viability, within a planned investment regime. Of course, where significant environmental damage is occurring, the installation of new equipment will need to be accelerated. This approach will serve to induce the progressive bias towards reduced demand for wastewater disposal to the environment.

6.4.5 Diffuse Source Pollution Management

In addition to point sources of pollution, a comprehensive water quality management program must consider diffuse sources of pollution which may affect environmental values.

The potential for this form of pollution is greatest in the rural environment, although also a significant consideration in the urban environment. It is the rural environment that provides the catchments from which the nation's water resources are harvested. Not only does the catchment environment gather water for extraction, the interaction between the water, soil and vegetation of the particular catchment stamps the water with a particular character or quality. That character is itself a consequence of land management practices. Whether the land is used for pasture, intensive agriculture, irrigation, or other purposes, the interaction between the land and other production inputs inevitably changes the physical and chemical characteristics of water.

Traditional water quality management difficulties are compounded by the intrinsic nature of the diffuse pollution process with its absence of any localised cause-and-effect linkage. Given that degradation is effected through the hydrological cycle itself, management strategies need to be system-based. As an over-arching principle, the concept of 'best management practice' invokes the traditional production discipline of cost minimisation but also brings to account environmental impacts of production activities. In so doing, it provides the basis for an integrated approach to natural resource use and management of water quality outcomes.

6.4.6 Public Sector Sewage and Wastewater Disposal

Sewage and wastewater disposal is generally the responsibility of public sector instrumentalities. With few exceptions, these instrumentalities are not open to market pressures. However, there is a concerted effort to make them more commercial and more market oriented.

In principle, it is legitimate for pricing and levy mechanisms to be used to recover the full cost of sewage and wastewater treatment from the users. However, although this would encourage operators to optimise the cost of their service provision, any financial imposts should be introduced in a progressive manner that does not place an unachievable burden on the community reliant on the service.

In addition, the management of wastewater disposal systems should not be influenced solely by economic considerations. The operation will be sustainable only if the discharge is of high enough quality to ensure that the receiving waters are not degraded in the long term. The pricing structure needs therefore to have incentives that encourage long term improvements in technology. Such improvements can further ease pressure on the environment.

PART B

A WATER QUALITY MANAGEMENT PROCESS

7. CONTEXT FOR DEVELOPMENT OF A MANAGEMENT PROCESS

Both ARMCANZ and ANZECC recognise their mutual interest in water quality management. This is reflected in their agreement on the need for nationally consistent principles and a nationally consistent management process. The high-status national guidelines can provide a common point of reference in shaping management responses in a local and regional context. While agreeing to work in co-operation, ARMCANZ and ANZECC have accepted that particular issues could require varying leadership and liaison arrangements to reflect their at times different perspective.

The National Water Quality Management Strategy provides a national framework in which all stakeholders can contribute to better water quality outcomes. The Strategy provides policies, a management process and national guidelines. This document sets out the underlying policies and outlines a model water quality management process. Other documents include guidelines and discussion papers which address specific water quality or waste management issues, water quality management monitoring and review processes and implementation approaches. The management process outlined provides a model which can be adapted to meet particular State or regional conditions and needs.

8. CHARACTERISTICS OF A MODEL WATER QUALITY MANAGEMENT PROCESS

8.1 General

Efficient and effective administration of the water quality management principles developed earlier in this paper would be secured by a management process reflecting the following considerations:

- national consistency in processes for setting goals, objectives and standards
- clear and explicit administrative processes
- clear and explicit assignment of responsibilities for the various phases of administration and operation
- auditing and reporting accountability
- matching of the administrative structures to the physical and social constraints, most commonly on a catchment or sub-catchment basis

- involvement of all stakeholders in definitions of goals, development of plans and implementation of strategies

- administrative mechanisms responsive to change and development including changing physical conditions over time, changing public preferences for environmental quality and new technical options

- provision for the harnessing of economic and market forces to the water quality management task.

8.2 Integrating National, State and Regional Planning

The national vision of achieving sustainable use of water resources by protecting and enhancing their quality while maintaining economic and social development, would be implemented at the State level using water quality planning and policy instruments. The principles and objectives articulated in this planning process would provide the necessary framework to ensure complementary planning at the regional level. The planning process would also need to recognise the potential for increasing population and changes to population distribution and levels of urbanisation to impact on water quality.

This would translate into a management process where:

- a State uses its own water quality planning and environmental policy tools to set water quality objectives, consistent with the agreed national guidelines

- in the context of this process, regional communities are encouraged to participate in the identification of local environmental values to be protected

- local management strategies are developed and implemented by relevant stakeholders.

A flow chart of the water quality management process outlined above is set out on the following page.

The establishment of appropriate natural resource planning processes is seen as a practical first step to achieving sustainable water quality management. Such processes should aim to:

- integrate land and water planning

- assess the economic, social and environmental tradeoffs involved in different water resource development options and environmental allocations

- demonstrate the private and public costs associated with each option

- establish efficient and effective management strategies

- maximise stakeholder involvement in both the planning and management phases.

The identification of regional water quality objectives by the community may require strengthening of locally based structures and community consultation processes. The cornerstone of these may vary, with local government councils and catchment management boards as two obvious possibilities.

Community groups should have relevant information provided to them to allow them to make informed recommendations on regional water quality objectives and resource management issues.

Any broadly based approach to environmental management and wastewater management in particular, will depend for its success on strong monitoring and reporting arrangements. These responsibilities should be met by the stakeholders and coordinated at a State level, with appropriate liaison arrangements to facilitate a coherent national approach.

8.3 Water Quality Goals and Objectives

The generally accepted mechanism for establishing in-stream or aquifer water quality requirements is a two-step process which involves:

- establishing a set of environmental values, and
- establishing scientifically based water quality criteria corresponding to each environmental values.

8.3.1 Environmental Values

Environmental values are particular values or uses of the environment that are conducive to public benefit, welfare, safety or health and which require protection from the effects of pollution, waste discharges and deposits. They are often called "beneficial uses" in the water quality literature. This term has not been adopted for this model because of its exploitative connotations. Five environmental values are:

- ecosystem protection
- recreation and aesthetics
- drinking water
- agricultural water
- industrial water.

The determination of environmental values should be an integral part of the process of developing appropriate regional allocation policies**.** In large catchments it may be desirable to consider rivers or aquifers in segments with different environmental values for each segment.

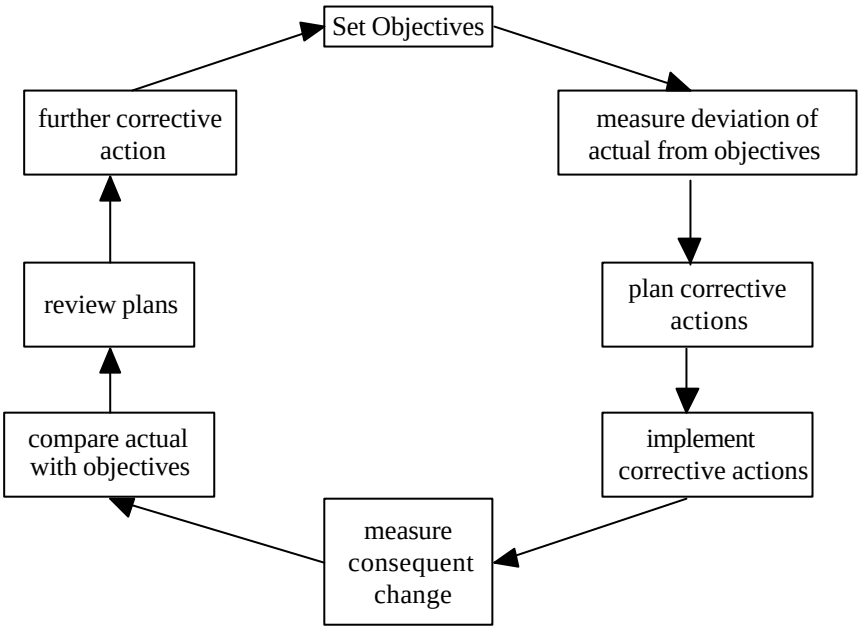
8.3.2 Water Quality Criteria for Australia

Water quality criteria (based on scientific evidence and judgement) describe the water quality which must be maintained in order to sustain specific uses or to protect specific values. The Strategy Paper, "Australian Water Quality Guidelines for Fresh and Marine Waters" translates the criteria into a form that can be used for management purposes. In many cases this may involve a value judgement on the acceptable risk to human health or ecosystem impairment and therefore they are generally set conservatively (at a low level of contamination) to offer long-term protection of environmental values. ANZECC published the Australian Water Quality Guidelines for Fresh and Marine Waters in November 1992. Several environmental values may be designated for a specific water body and in this case the most limiting or stringent guideline would need to be met; other values requiring less restrictive guidelines would then also be protected.

The administrative system adopted to implement the protection of environmental values may be different in different jurisdictions. Water quality objectives for ambient waters may be used as either non-mandatory targets or legally enforceable standards which represent desirable endpoints to be achieved by a water quality management program. In some cases, the responsible government and the community may prefer a legally enforceable standard. In determining whether to adopt standards or non-mandatory targets, the key issue is the most effective means of achieving the strategic objective embodied in this paper.

8.4. The Management Cycle

Achieving established water quality goals and objectives requires an administrative process involving a management loop which continues until the goals are achieved:



9. CATCHMENT MANAGEMENT

9.1 Significance in Water Quality Management

As point sources of pollution are controlled, diffuse sources emerge as one of the major impacts on water quality. The measures needed to control diffuse water pollution are diverse in nature. The spread of authority and responsibility for their implementation is broad. This calls for a mechanism different from that traditionally applied as end-of-pipe-control.

Sound catchment management embraces the following: a holistic approach to natural resource management within a catchment with water quality considered in relation to land use and other natural resources; co-ordination of all the agencies, levels of government and interest groups within the catchment; extensive opportunity for community consultation and participation.

There are advantages of involving managers at the catchment level (including local government, State agencies and community and sub-catchment groups) in this process rather than imposing it from the

State or Federal level: it involves a 'bottom-up approach'; it is more effective and efficient since local interests best understand the needs and problems; and it builds ownership of the objectives selected and therefore engenders commitment to the control action, which in the case of diffuse pollution can only really be successful at the local level.

There are some situations in which catchment management would not be necessary, would not be appropriate or would be premature. For example, it can be demanding of resources and may not be appropriate for adoption by all States and Territories immediately. Further, there are some situations where diffuse pollution is less dominant and direct regulatory point-source control is adequate to control water quality. In other situations, an integrated catchment approach is not applicable, for example to ocean waters. In these cases a more direct variant of the management process may be appropriate. It implies a less structured community involvement in the management process, less complexity and less administrative burden. However, on high public profile issues community input may still be substantial, as a result of either protest or planned consultation or both.

9.2 Functions of Catchment Management

Authorities responsible for managing activities in a catchment, identified herein by the generic term "catchment managers", need realistic and achievable water quality goals and objectives to properly engage in the water quality management process. The national guidelines and management process offer a framework within which catchment managers can participate in the selection of environmental values for their catchments and pursue their achievement. They may be reinforced by State regulations and policies as judged appropriate at State level.

Although in most cases the final responsibility for prescribing environmental values and the objectives which derive from them will rest with State agencies, the principal recommendations for the values to be adopted for specific waters within catchments should be made by the catchment managers. Thus, it is envisaged that catchment managers, using the legislative or administrative structures within their State or Territory would exercise the following functions:

. participate in goal and objective setting, by

  - seeking community, government and industry input on specific environmental values to be adopted,

  - resolving, as far as they were able, competing interests for adoption of environmental values having varying cost consequences for the community and different environmental impacts, and then

  - recommending to the relevant State/Territory authority the proposed environmental values to be designated for specific waters.

. develop strategic plans for water quality management within specific catchments on the basis of the goals and objectives adopted

. promote control of diffuse sources not amenable to licensing and encourage sound land use practices which minimise diffuse pollution

- ensure that the management of discharges is consistent with the strategic directions and the specific objectives adopted

- participate in water quality monitoring and reporting

- coordinate the activities of governmental authorities and private interests within a catchment for resource management purposes.

Development of catchment-based plans and strategies to achieve the goals and objectives is central to integrated catchment management. These would include not only the control of point sources of pollution, but also the control of future land use and where appropriate, the adjustment of existing land use practices to reduce diffuse source pollution, whether from urban or agricultural areas. The plans and strategies could be implemented by the catchment managers using their collective powers, usually deriving from other administrative sources, in a coordinated and cooperative manner. Thus land use planners, government resource managers, pollution controllers and providers of public services at all levels of government could exercise their specific powers, functions and skills to implement the catchment strategies.

Where the existing quality of waters is better than those objectives necessary to support the designated environmental values, the policy of protection and enhancement would predispose towards maintenance of the quality unless it were legitimately assessed that a lesser quality is necessary to accommodate important economic and social development. In any event, quality would not be allowed to deteriorate below the designated objectives. In allowing any lessening of water quality, all point-source dischargers should be required to meet certain minimum technology-based standards, recognising that even higher standards might be required where the latter would not achieve the designated objectives. Permitting of such discharges should be considered only where non-discharge options have proved impracticable. The use of carefully designed market-based mechanisms would be expected to play an important part in repairing degraded water quality and protecting good water quality.

Polluters generating diffuse contamination should be required by regulatory mechanisms or induced by market-based mechanisms to incorporate sound source controls and best land use practices to minimise the impact on water quality. Producers would be encouraged to treat wastes and wastewater to standards based on the principles of accepted modern technology consistent with economic viability and full consideration of waste minimisation opportunities prior to discharge. Where there was no specific point of discharge 'best management practices' would be employed. Proposals for new discharges to surface waters might also have to demonstrate that other options for reuse or land application have been fully considered.

The catchment-based approach is exemplified by the Murray-Darling Basin Algal Management Strategy, which has adopted the same principles as this Strategy. The Algal Management Strategy identifies five broad areas for action to reduce algal blooms and allocates responsibility for implementation of the proposed package of actions to the community and the three spheres of government. The Algal Management Strategy proposes managing diffuse sources of pollution by setting nutrient targets for catchments and developing plans to identify how to meet the targets. The targets will establish the responsibility each catchment group has to ensuring that nutrient management is internalised as far as practicable. As part of the process for developing catchment management plans, it could be necessary to identify current contributors to the nutrient load and the cost effectiveness of reducing the load through changed land uses and improved management practices.

10. MONITORING FOR PERFORMANCE

Monitoring is the systematic collection of physical, chemical and biological data. It is another key component of a water quality management program. Managers of the catchment need to know if water quality is sufficient to support environmental values. Monitoring is also used to identify problems, determine the effectiveness of regulatory programs, evaluate long-term trends in environmental quality and direct resource management decisions.

Water quality monitoring in Australia has rarely matched the levels considered essential for management in many other developed countries. Past Australian governments at all levels have failed to understand the critical importance of a sound water quality data base, except in the case of a few examples. Management action can only be soundly based on reliable and indicative data on quality and experts generally agree that the data base is deficient.

Water quality data can be collected according to two essential patterns, as a continuing series on a geographical or catchment grid, or as a series of profiles of river systems undertaken as periodic surveys. Both methods have their advantages and disadvantages; they tend to be complementary. Neither has been adequately undertaken in Australia. The adoption of water quality goals and objectives will no doubt induce greater public pressures for more data on quality to be collected.

Monitoring of groundwater quality can be costly if special monitoring bores need to be constructed. Drilling methods and bore construction need to be tailored towards the chemical data which is to be monitored.

Dischargers of pollutants should be required to provide water quality data not only by undertaking their own monitoring of effluents but should also contribute financially to the cost of ambient monitoring of receiving waters.

11. ENFORCEMENT

Whether the principal instruments for control of pollution be prescriptive regulations or economic instruments, it is essential that mechanisms be in place to ensure the "rules are kept" and all players participate fairly. An enforcement program is therefore vital to effective water quality management.

In recent years there has been significant pressure from the community for higher penalties for environmental offences and more stringent enforcement activities by governments. In some States penalties have been raised dramatically and devices such as 'on-the-spot' fines and penalty notices introduced. Enforcement is important in maintaining compliance, but it needs to be complemented by effective negotiation of environmental requirements, acceptance of responsibility by stakeholders for maintaining environmental quality and effective internalisation of environmental costs. Enforcement has not been a very effective mechanism for the control of diffuse pollution sources since the identification of contributions to pollution is extremely difficult.

In developing strategic plans, managers will have to take account of the realistic level of administrative support which will be available to implement any program, including enforcement activities.

12. KEY ELEMENTS OF A MANAGEMENT APPROACH

12.1. Point-Source Effluents

In order to manage the quality of a water body, catchment managers must understand and evaluate the relative contribution of point source discharges, diffuse sources and natural background conditions. Pollution from point sources (industries and municipal treatment works) should be controlled with discharge licenses and the licence limitations should be designed to ensure that water quality goals and objectives are met. Monitoring and modelling are important tools in this evaluation process in that they describe the relationship between ambient and effluent levels. However, a comprehensive monitoring data base or a rigorous operational model is frequently not essential for initiation of waste minimisation and pollution control programs. Programs which are directionally correct should be initiated to reduce environmental degradation without awaiting a precise scientific definition of the effect. This is especially the case when it is apparent that the action will move only partially towards meeting the scientific water quality objectives.

The licence discharge limits should conform with certain minimum technology-based performance criteria as well as being able to meet the in-stream or aquifer quality goals. These limits may be specified as administrative guidelines or encoded in regulations. This provides the 'level playing' field of industrial equity and preserves an environmental margin for the future. Economic incentives to induce 'clean production' can operate to achieve efficient and sustainable use of waters within these limitations.

12.1.1 Technology-Based Guidelines

Effluent quality guidelines for major industries will be developed as part of the National Water Quality Management Strategy. It is anticipated that the effluent guidelines would generally be adopted by the State and Territory agencies as minimum requirements in granting discharge licences and approvals.

Effluent guidelines will set pollutant levels which are consistent with those achievable by accepted modern technology consistent with on-going economic viability. This entails adoption of technology which has consistently demonstrated achievement of the desired effluent pollutant levels in economically viable operations; takes account of engineering and scientific developments in effluent treatment and pursues opportunities for waste minimisation. It is recognised that good effluent quality is not necessarily dependent on high technology and may often involve simple, innovative biological systems. The effluent guidelines will not specify the technology to be used except in cases where effluent quality cannot be adequately assessed or defined. They will be performance guidelines which are technologically achievable and are hence referred to as 'technology-based' as distinct from being specifications of the actual technology needed for achievement.

It is intended that these technology-based guidelines would be applied progressively to existing installations. In cases where the ANZECC/ARMCANZ guideline has been established, State and Territory agencies would follow the principles outlined here in developing local control programs. New installations would have to comply at start-up while existing dischargers would be expected to adopt phase-down programs to progressively come into compliance. Carefully designed economic instruments could also be more effective and efficient in achieving reductions in discharges than prescriptive regulations.

12.1.2 Relationship between Effluent Guidelines and Water Quality Objectives

When technology-based guidelines or standards are applied to new sources it is important that the quality of the receiving water be assessed where feasible by monitoring or modelling or both to see if the water quality objectives have been or can be met. If the water quality objectives cannot be met, then more stringent source controls (i.e. water-quality-based rather than technology-based effluent limits) for point source discharges may be necessary. In some situations approval might otherwise be given if offsetting benefits can be achieved. Before implementation of water quality-based limits, the relative contribution of diffuse sources and background conditions should, of course, be evaluated.

The requirement to use accepted modern technology consistent with on-going economic viability (i.e. technology-based guidelines) should be maintained even where this will secure higher water quality outcomes than the scientific water quality objectives would immediately require. This is consistent with the policy predisposition to protect and enhance water quality, the Policy Objective of Section 3.2 above. It overcomes the tendency of allowing waters to be rapidly polluted up to the limits, reserves the maximum opportunity for other present and future uses of the stream and allows the adoption of a precautionary approach where there is uncertainty about the environmental outcomes of development. A precautionary approach would nevertheless, be tempered by the extent of risk to water quality. Application of technology-based effluent quality standards is important where existing water quality, while still cleaner than the objective, is deteriorating, or is likely to deteriorate towards the objective as a result of development or use. Conversely, close adherence to such an approach may not be needed when existing water quality is substantially cleaner than the objective would require and there is no risk of progressive deterioration. Where disposal of dangerous wastes is at issue or a particularly sensitive environment is at risk, a prescriptive standard or even a complete ban may be appropriate. The preferred hierarchy of waste management options dictates that non-discharge options be considered in preference to discharge to waters. The use of market-based instruments could play a part in encouraging such waste minimising behaviour.

12.1.3 Sewer Overflows

With separate storm and foul water sewer systems largely predominating in the Australian cities, significant problems are experienced with surcharging and overflow of sewers in wet weather. Infiltration due to system leakage with illegal connection of roof drainage water causes the overflow of untreated sewage at thousands of locations in older urban areas. Many ameliorating steps can be taken to lessen the frequency of overflow; however, these are usually expensive and offer only a partial solution. Ultimately the solution in Australia may require licensing of all overflows and increasing the capacity of the sewerage systems to handle storm flows both in the collector mains and in the sewage treatment plants.

12.2 Control of Diffuse Source Pollution

In addition to the point sources of pollution, a comprehensive water quality management program must consider diffuse sources of pollution which are affecting the environmental values. Diffuse sources of pollution are inherently difficult to deal with in that they are usually spread over large areas with no discrete point of discharge where conventional pollution management techniques could be directly applied.

The lack of a measurable cause-and-effect linkage tends to complicate the application of regulation and market-based approaches to internalise water quality impacts in a way that leads to optimal production choices. However, recognition of the need for a systems approach to water quality

management in the rural sector and adoption of the 'Best Management Practice' criterion can encourage recognition of both direct and indirect costs in optimising resource use, including impacts on diffuse surface and groundwater pollution sources.

The perspective and discipline of a best management practice philosophy can guide water resource managers in optimising on-farm water use by irrigators and dry land farmers in sound soil conservation to avoid increased turbidity in regional water bodies, or judicious use of fertiliser to minimise nutrient transport. It does this by emphasising the same principle which underpinned the earlier discussion of point-source pollution management: namely, that producers in the rural environment internalise both the direct and indirect costs of their activities when determining their optimal resource use.

Implementation of best management practices requires the same suite of policy instruments including education, regulation, and market-based measures applicable to point source pollution. However, it also requires recognition of the indirect and imprecise impact that instruments primarily aimed at changing land management practices will have on water quality. Water quality managers need access to and the flexibility to employ the full range of those instruments. It is also clear that management of diffuse contamination will benefit from an enhanced research and development effort. Better understanding of the basic scientific and economic relationships will allow policies to be better targeted and refined.

12.2.1 Agricultural Runoff

Catchment managers and regulatory agencies need to develop source control measures and best management practices to reduce the impacts of diffuse sources from land used for agriculture and other primary-industries on water quality. Direct regulatory controls are impractical in many situations. Involvement of primary producers in catchment management and other related community-based activities offers a promising way forward. Education and co-operation need to be combined with regulatory enforcement. Market-based solutions are expected to be important in realising waste minimisation and pollution control in the rural situation.

Some of the measures to be considered are

- limitations on vegetation clearance and encouragement of tree planting
- soil erosion measures generally
- use of slow release fertilisers and avoidance of excessive fertilisation
- carefully controlled and designed use of weedicides and insecticides
- maintenance of stream-bank margins
- control of surface and groundwater pollution from intensive agricultural industries.

12.2.2 Urban Runoff

In 1988 ANZECC produced a guideline for urban runoff control by adoption of best management practices. Several States and Territories have produced matching guidelines. The measures for control of water pollution by urban runoff are still under development. They generally require substantial areas of land and hence tend to be difficult to retrofit to existing drainage systems.

Some of the measures employed in controlling the quality of urban runoff are:

- wet and dry detention basins

- artificial wetlands
- gross solids interceptors (trash racks)
- infiltration
- on-site detention
- use of grass swales and streams with natural banks for drainage
- source control measures such as improved waste collection and litter control
- sensitive siting of new developments.

While the incorporation of control measures in new developments is technically feasible, control in existing areas is fraught with difficulties. Strategies developed to address this problem will need to be sensitive to the local planning context, climatic differences and the relative impacts of point and diffuse sources.

13. GROUNDWATER

Groundwater, like surface water, is merely one mode of water occurrence in the hydrologic cycle. However, because of its large storage volume, its hidden nature, slow movement and slow flushing characteristics, it does require different management consideration.

Contamination of groundwaters from uncontrolled and difficult-to-control sources such as seepage from land-fill disposal sites, leakage from storage tanks or pipelines, poorly constructed tailings dams, etc., can occur. Groundwater is usually more at risk, but as many streams are fed by groundwater outflow, some degradation of surface water bodies can also result.

Contamination from these sources is of particular concern because of the wide variety of toxic substances which may leach from disposal sites or leak from storages. Clean up of such contamination is difficult and extremely costly as both the saturated and unsaturated zones may be affected and the contamination may have spread some distance in the aquifer before it comes to notice. In these cases control might be possible under other environmental legislation than that normally used for water quality management. There should also be provision for clean-up and remedial work.

Factors which need to be taken into account in addition to those relating to surface water include:

. the resource has a hidden nature and is seen only at its sampling points, with contamination only becoming apparent when it is too late to remedy.

. it is not always in contact with air and sunlight and the assimilative and breakdown processes of contaminants may be slower than for surface water.

. the groundwater storage may cross surface water catchment boundaries.

. clean up of contamination is more difficult as contaminants are trapped in recesses or adhere to aquifer material, and a gradient is required to move groundwater to the extraction point.

. because of the slower recharge rate than for surface water storages, the time between contamination causes and contamination effects could be in terms of years, as could the clean up process.

14. ECONOMIC INCENTIVES AND ENVIRONMENTAL MANAGEMENT

Since the regulatory mechanisms are by and large already in place, the introduction of economic instruments for the management of water quality will be progressive and in the first instance, supplementary to the established system. Where the traditional form of regulation is not already strongly established, for example in the control of diffuse pollution in rural areas, there is added incentive to initiate innovative approaches exploiting the potential of market based instruments.

A few of the means which have been either applied or seriously considered for enlisting economic forces in water quality management are:

- pricing of the water resource to reflect the environmental impact of the use and the decreased asset value where degradation occurs
- substantially higher licence fees reflecting recovery of the costs of regulatory and monitoring functions
- application of discharge levies or pollution charges
- trading in effluent permits
- non-compliance fees, where charges levied for exceeding limits reflect the profits obtained through non-compliance
- performance bonds, where money is held in trust, to be repaid once compliance with standards is achieved
- levies and higher rates on users of water and sewerage services
- special levies for specific remediation programs
- subsidies or soft loans and tax allowances to encourage the adoption or development of waste minimisation technology.

The OECD has recommended criteria for assessing the viability and suitability of such measures: environmental effectiveness, economic efficiency, equity, administrative feasibility and cost, and acceptability. It has also cautioned against confusing the objective of providing incentives with the revenue-raising purpose.

Development of instruments and incentives which are appropriate for the management of water quality in Australia will become a higher priority as a full range of management mechanisms are deployed. ANZECC and ARMCANZ will continue to explore and develop these options.