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CONTROL OF NON-POINT SOURCES OF WATER POLLUTION WITHIN AN ECOLOGICAL FRAMEWORK: THE CASE OF THE TRI-COUNTY REGION, MICHIGAN

By

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ABSTRACT

CONTROL OF NON-POINT SOURCES OF WATER POLLUTION WITHIN AN ECOLOGICAL FRAMEWORK: THE CASE OF THE TRI-COUNTY REGION, MICHIGAN

By

Peter Alphonsus Nortey

The United States is well endowed with resources of which water played a significant role in its early settlement. Its industrialization and rapid urbanization have led to a deterioration of the human environment. Of particular concern to the American public is water pollution because of its adverse effects on human health, aquatic and terrestrial ecosystems. In order to control water pollution from both point and non-point sources, the United States Congress passed the Federal Water Pollution Control Act Amendments of 1972. A point source refers to any discernible, confined and discrete conveyance from which pollutants are discharged. A non-point is defined as any non-confined area from which pollutants are discharged into a body of water. Section 208 of the Act specifically addresses non-point sources of pollution.

The study had two objectives: (1) To examine and suggest an ecological framework for understanding water pollution from non-point sources--primarily agriculture, silviculture, mining, and construction--in the Tri-County Region of Michigan, and (2) assess the region's institutions and institutional arrangements for planning water

pollution control under the provisions of Section 208 of the Act.

Non-point sources of water pollution was examined within an ecological framework. A conceptual ecosystems model was evolved to illustrate the natural and man-induced processes and mechanisms which caused water pollution. From this model, four principles were established. The principles, based on ecosystem relationships and interactions, dealt with regional considerations, environmental quality, carrying capacities and tolerances, and sound management practices. The principles were used as criteria to assess the approach to Section 208 planning adopted by the Tri-County Regional Planning Commission (TCRPC), the designated planning agency for the Tri-County Region.

The assessment indicated that the TCRPC's planning approach was basically sound and would contribute effectively to the attainment of the water quality goal set for 1983--water quality should be good enough for the protection of fish and shellfish, wildlife and for recreation.

It was recommended that the Tri-County Regional Planning Commission should be made the coordinator of all citizen participation activities pertaining to water pollution in the region, in view of the TCRPC's significant present and potential role in Section 208 planning. The identification of water pollution control strategies should be based on ecosystem relationships. Close functional relationship between the planning agency and the implementing agency/ies should be established at the earliest opportunity.

Section 208 planning is essentially a new kind of water quality planning which requires education of the public on its full implica-

tions. Education of the public for involvement in the Section 208 planning process must embrace both formal and non-formal education.

One area which required greater attention in the planning process of the TCRPC was the question of incentives to be employed to persuade people to adopt management practices which are compatible with water quality. Some incentives already exist but further research is required to identify the best combination of existing incentives and the creation of new ones.

Within the past few years, substantial progress has been made in initiating programs for improving environmental quality. One such program is the Section 208 program which has just began in the Tri-County Region. The program is likely to have a major impact not only on water pollution from non-point sources but also on land use and economic growth of communities in the region. The Section 208 program promises to be an effective means of solving the Tri-County Region's water pollution problem. The challenge facing the inhabitants of the region calls for continuing the Section 208 program and improving it to ensure the attainment and maintenance of a high quality environment.

To Grace, Catherine and Anne

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PREFACE

Water pollution is a serious problem in the United States.

Since 1948, the U.S. Congress has shown concern about this problem by passing laws to deal with various aspects of it. The Federal Water Pollution Control Act Amendments of 1972 are the most comprehensive legislation for controlling water pollution from both point and non-point sources ever enacted by the Congress. A point source refers to any discernible, confined and discrete conveyance, including any ditch, channel, tunnel or well, from which pollutants are or may be discharged. Any nonconfined area from which pollutants are discharged into a body of water is described as non-point source. Section 208 of the 1972 Act specifically addresses non-point sources of pollution, such as runoff resulting from agricultural and silvicultural activities.

The present study has a two-fold objective: (1) To examine and suggest a framework for understanding water pollution from non-point sources--primarily agriculture, silviculture, mining, and construction--in the Tri-County Region of Michigan, and (2) appraise the Region's institutions and institutional arrangements for planning water pollution control under the provisions of Section 208 of the Act.

Non-point sources of water pollution are examined within an ecological framework. Using the river basin or watershed as a unit of study, four principles are identified and used as criteria for

assessing the approach to Section 208 planning adopted by the Tri-County Regional Planning Commission. A discussion of the Federal Act is presented to provide the necessary background information for the above assessment. Recommendations for improving Section 208 planning in the Tri-County Region are presented. The planning approach of the Tri-County Regional Planning Commission (TCRPC) was found to be basically sound. It is concluded that sound management practices based on regional considerations and active public involvement in the planning process are the long term solution to the problem of water pollution from non-point sources.

The study has thrown considerable light on the processes and mechanisms involved in water pollution and has indicated the useful role which a regional planning agency (TCRPC) can play in attaining the water quality goals of the region and the nation. The Section 208 program offers the Tri-County Region and the other designated 208 planning areas in the United States a means of controlling water pollution and thereby contributing effectively to the attainment and maintenance of a high quality environment on a continuing basis.

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CHAPTER I

INTRODUCTION

Water has long been a matter of great consequence to individuals, to practical businessmen, and to governments. It is necessary for human existence and survival. Water is needed for the production of plants and animals. It has a wide variety of domestic uses--for drinking purposes, as a necessary ingredient in the preparation and processing of foods and as a personal household cleaning agent.

> Historically, water has served as a low-resistance medium on which to transport cargoes. It has served man as a means of disposing of wastes from towns and cities. It has served as a habitat for wildlife on which man has fed and, more recently, hunted for sport. Water has served as the setting, in many cases, for gratification of aesthetic and recreational needs.
>
> Water resources have also served as a form of mechanical power: first to liberate man from reliance on human and animal energy in early industrialization; later as an input in operation of mechanical steam engines; and finally, at the present stage of industrial arts, either as mechanical power or steam to move turbines in the production of electricity.[1]

Man's need for water for the various uses mentioned above has always made this resource a critical factor in land settlement and natural resource development.

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[1]John V. Krutilla and Otto Eckstein, Multiple Purpose River Development (Baltimore: John Hopkins University Press, 1958), p. 5.

Concern for Water Pollution

The early settlers of the United States found a vast country richly endowed with agricultural land, forest, lakes and streams, and other resources. The waters were for the most part unimpaired in quality by man's activities. The number of people inhabiting the land at that time was small, and a low level of economic activity took place. With a sparsely distributed population and low levels of economic activity, wastes could be assimilated by streams and other natural processes with only minor damage to the environment. This is no longer the case.

Many factors have contributed to the development of the United States. The rich natural resources, high rates of investment in technology and education, a large influx of skilled immigrants and a fortunate political and economic history have all combined to yield a bouyant economy and unequalled levels of material wealth. New technological developments have induced an ever increasing array of goods and services. Although some inequities in the distribution of wealth remain, on the whole the fruits of these developments have been widely shared to provide a high standard of living to many Americans.[2]

In recent years, the notion that large scale degradation of the environment is the essential ingredient for achieving higher levels of economic production is being seriously questioned. Along with material goods, the American public is giving a higher priority to the quality of the natural surroundings. Protection of natural biological communities, preservation of scenery, clean air and water, relief from

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[2]U.S. Environmental Protection Agency, Legal Compilation-Water Vol. V., January 1973, p. 2756.

noise and congestion, and open spaces for recreation have all assumed new importance. These changing desires stem from deeply rooted social and economic factors which show every indication of becoming increasingly pervasive. The public is justifiably alarmed at the deterioration of the environment resulting from man's activities. The capacity of rivers, lakes and the atmosphere to absorb waste loads is severely taxed, and all forms of pollution have reached or are rapidly approaching intolerable levels. Modern technology has made it possible for the massive alteration of the physical, chemical, and biological quality of the land, water and air. New chemical substances are confronting the environment with materials which may prove hazardous to living organisms including man. The public is beginning to appreciate the potential danger posed by the persistence of some chemical substances and their concentration in the food chain.

Water pollution is one, but an important, aspect of the quality of the environment. It is an indication that the environment is deteriorating. Water pollution refers to the condition or quality of water which makes it unsuitable for a particular use. The condition can be created by natural processes or processes precipitated by man's activities.

Damages from water pollution are tremendous and can be regarded as costs to the American public. There are economic losses as a result of contaminated fish and lost fishery resources. Lost amenities and recreational opportunities are less tangible but no less real economic and social costs. Industries must treat river water in order to meet the boiler feed or water requirements for cooling. Water hardness must be overcome by the use of more detergent. Farmers may

reap low harvests because of increased salinity of the water used for irrigation. The cumulative effect of these changes in the Lower Colorado River Basin and Southern California Water Service Area was estimated at $16 million annually in 1970.[3]

Objectives

Water pollution is a very complex subject and its control calls for knowledge from many different fields. The biological and social sciences can contribute immensely to the understanding of (1) the nature and extent of water pollution and (2) the institutional arrangements governing the use of water which provide a basis for controlling it.

Previous efforts at controlling water pollution have been directed at point sources of pollution. A point source of pollution is any discernible and confined conveyance of water including but not limited to any pipe, ditch, tunnel or well from which pollutants are or may be discharged. Non-point sources of pollution such as agricultural runoff, urban runoff, and sedimentation from construction sites have until recently been largely neglected.

The Federal Water Pollution Control Act Amendments of 1972 are comprehensive legislation covering both point and non-point sources of pollution. Section 208 of the Act deals specifically with non-point sources of water pollution. The present study covers the various aspects of Section 208 of the Act.

The principal aim of this study is to examine and suggest a framework for understanding water pollution in general, but with

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[3]Ibid.

particular reference to non-point sources of pollution in the Tri-County Region of Michigan. As a necessary prerequisite, the nature and extent of non-point sources of water pollution will be identified in connection with agriculture, silviculture, construction, mining and urban development.

The subsidiary objective of this study is to examine the role of institutions and institutional arrangements for 208 planning. Existing public and private institutions are evaluated in terms of their present and potential contribution to the attainment of the goals set by the Section 208 legislation. Proposals for improving the performance of existing institutions will be formulated.

In the final analysis, the success of the 208 program will depend on how well the capabilities and authorities at all levels of government are utilized in the plan preparation and implementation. However, the critical element is the role of local government and the people and interest groups which the government represents. The local government must ensure that the 208 program is relevant to their problems and effective in providing solutions. Section 208 of the Act makes provision for the involvement of the federal, state and local levels of government, citizen groups and individuals in the planning and implementation of water pollution control programs. Citizen participation in the 208 planning process is required by the Act.

Problem

Water is one of the many resources without which a nation cannot satisfy the fundamental wants of its people. Without water, life itself cannot be sustained. Water is put to a number of uses which

can be described as domestic, agricultural, industrial and recreational. These various uses require water of adequate quality.

Similar to other critical resources, the rate of use of water in the United States is rapidly increasing. As a result of competing demands upon water resources, resulting from increasing industrialization and urbanization, the nation (U.S.) has experienced deterioration in the quality of its surface and groundwater supplies.[4] This condition is charactertized as water pollution.

In order to make the problem of water pollution more explicit, Russell Ackoff's method of defining a researchable problem is applied. According to his method, the following conditions for the existence of a problem must be present:

> (1) An individual who has the problem: the decision maker;
> (2) An outcome that is desired by the decision maker;
> (3) At least two unequally efficient courses of action which have some chance of yielding the desired objective ...;
> (4) A state of doubt in the mind of the decision maker as to which choice is 'best';
> (5) An environment or context of the problem.[5]

The five conditions listed above were applied to the problem of the water pollution: (1) The decision maker may be an individual, a government agency, a local government, a private firm or an interest group. This is so because, potentially, water pollution can adversely affect the health of all people who live in a particular area and use the polluted water for drinking purposes. Polluted water may destroy some aspects of the environment cherished by the local people. In a sense,

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[4]U. S. National Water Commission, Water Policies for the Future (Washington: Government Printing Office, 1973), p. ix.

[5]Russell L. Ackoff, Scientific Method (New York: John Wiley and Sons, 1962), p. 30.

every citizen who lives in an area served by polluted water is a decision maker. The following categories of decision maker were identified: all government agencies, private organizations interest groups and concerned individuals.

(2) In order to define a problem, it is necessary to be able to find out what conditions currently exist and what outcome is desired. Previous efforts by local government to control water pollution had been concentrated on point sources of pollution. In many cases, the only water quality plans that existed were plans for the construction of individual treatment facilities. The major and in some cases only water quality problems addressed were those caused by untreated or undertreated municipal sewage. Virtually ignored were non-point sources of pollution such as urban runoff and sediment from agricultural and construction activities. Recognition of the shortcomings of then-existing pollution control strategies led to the enactment of the 1972 Amendments to the Federal Water Pollution Control Act. Unlike previous federal water quality programs, Section 208 planning provides for the management of non-point sources as well as point sources of water pollution. The outcome desired by the decision maker was to attain by 1983, " . . . water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water . . ."[6]

(3) The problem of water pollution lends itself to solution by the adoption of measures for the management of wastes. One approach might have been to allow the states and local governments to carry on

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[6]U. S., Congress, Federal Water Pollution Control Act Amendments of 1972, 33 USC, 1251, Section 101(a)(2).

with whatever planning and management programs they were implementing prior to Section 208 planning until state and federal research institutions came up with clear methods and standards for detecting and controlling pollution.

Congress has chosen another alternative: enacting a comprehensive law which coordinates all existing water pollution legislation, provides for the control of water pollution from all conceivable sources, and makes funds available for plan preparation and implementation. The local levels of government play a leading role in this approach, with the Federal Government serving as a catalyst to facilitate regional or areawide approaches to planning and management. The strategy is to make the best use of existing knowledge about pollution processes to control water pollution and to make the necessary adjustments or changes in pollution control in the light of new knowledge found through research. This is the alternative which has been adopted by the Tri-County Regional Planning Commission. This is the planning agency which has been designated to do Section 208 planning in the Tri-County Region.

(4) The states and local governments had some doubts as to the most effective way of tackling the water pollution problem. In the early stages of the implementation of the Section 208 legislation, these doubts were expressed in the form of hesitation by the states to designate Section 208 planning areas. Concerned citizens were also not sure of what the effects of the Section 208 plan on existing local plans and power structure would be.

(5) The context or environment of the water pollution problem consists of all factors which can affect the decision maker's objective

and which are not under his control. For example, not all water pollutants are generated by human activities. Some may result from natural occurrences such as soil erosion and major floods. Soil erosion can be minimized and its destructive effects on water quality considerably reduced, but it cannot be completely eliminated. To contemplate complete eradication of soil erosion is to assume that natural processes such as stream and sheet erosion will come to a stop. Major floods are unavoidable and cause considerable damage to property and vegetation in and adjacent to the flood plain. In addition, floods transport large quantities of pollutants into streams and lakes, thereby disturbing the aquatic ecosystems. Disruption of ecosystems calls for changes and adjustments by the biological communities which form each ecosystem. However, the reaction of the biological communities to such a changed situation cannot be predicted with certainty. This is beyond the influence of the decision maker and planners.

Also, citizen participation is required for Section 208 planning. It is difficult to make predictions on the extent and degree of success of citizen involvement. These and other uncertainties point to the need for choosing an approach to planning and management which has the best chance of solving the problem through an understanding of the processes and mechanisms associated with water pollution. The application of Ackoff's five criteria indicated that water pollution was a reasearchable problem.

Significance of the Problem

Total land area in the United States (50 states) is 2,263.6 million acres. The breakdown of this area according to major use

categories is shown in Table 1.

TABLE 1

MAJOR LAND USES IN THE UNITED STATES, 1970

Land Use Categories	Million of Acres	Percentage of Total land Area (50 states)
Cropland	370.6	16.4
Pasture and Grazing	827.0	36.5
Forest and Woodland	726.0	32.1
Miscellaneous Farm Areas	45.0	2.0
Non-agricultural Uses	295.0	13.0
Total	2,263.6	100.0

SOURCE: R. Barlowe, Land Resource Economics (2nd ed.; Englewood Cliffs, N. J.: Prentice Hall, 1972), p. 43.

Non-agricultural uses include urban areas, highways and roads, railroad rights of way, airports, state and national parks, state and national wildlife refuges and national defence areas. About 90 percent of the land, in the 50 states of the United States, comprises managed ecosystems. Urban areas occupy only about 60 million acres (about three percent of the total area). Therefore, almost 97 percent of the land area is rural in nature. In essence, all rural land and a substantial portion of the urban land area are potential non-point sources of pollutants.

In cities where secondary sewage treatment is provided, storm-generated discharges account for between 40-80 percent of the annual total of oxygen demanding materials. During heavy storms, 94-95 percent of the biochemical oxygen demand is directly attributed to surface runoff. Large quantities of heavy metals are transported by sotrm water. It has been estimated that a medium-sized city in the United

States will discharge 100,000-250,000 pounds of lead and 6,000-30,000 pounds of mercury each year into surrounding lakes and streams through storm water runoff.[7]

About 400 million acres of land are in cropland which accounts for two billion tons of sediment annually discharged into streams and lakes. The sediment includes approximately 440 million pounds of pesticides used annually in agriculture. Animal wastes from livestock alone are estimated at about two billion tons which is equivalent to 10 times the amount of human wastes.[8]

Silvicultural activities also pose water pollution problems. Approximately 10-12 million acres of commercial forests are harvested annually giving rise to sediment load of 5-10 percent of the total sediment load generated by all land uses.[9]

Fertilizer is used on a large scale in agriculture in the United States. About 41 million tons of commercial fertilizer are used annually. It has been estimated that 10-15 percent of the nitrogen which enters agriculture through fertilizer is lost to the nation's waters, and the total phosphorus emissions from non-point

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[7]Mark A. Pisano, "Non-Point Sources of Pollution: A Federal Program," (A paper presented at the American Society of Civil Engineers Convention, at New Orleans, Lousiana, April 14 - 18, 1975).

[8]J. M. Rademacher, "Animal Waste Pollution - Overview of the Problem," Proceedings Animal Waste Management Conference, Federal Water Pollution Control Act, Missouri Basin Region, Kansas City, Missouri, February 1969.

[9]U. S. Environmental Protection Agency, Methods for Identifying and Evaluating the Nature and Extent of Non-Point Sources of Pollutants (Washington: Government Printing Office, 1973), p. 4.

sources amount to .8 million tons per year.[10] Both nitrogen and phosphorus are capable of accelerating lake eutrophication when they are discharged in large quantities.

Surface mining has disturbed over three million acres of land and an equal area is devoted to the storage of mineral wastes from mining activities.[11] In some parts of the United States, such as Appalachia, non-point pollution associated with mining presents more serious water quality problems than does sediment. The affected areas are normally related to mining activities. While the area of influence of the mineral pollution is more localized than that of sediment, it is a serious water quality problem in the localized regions where they occur.

Estimates made in 1972 showed that approximately 35 percent of the nation's waterways violated water quality standards, and about 40 percent of these violations were attributable to non-point sources.[12] These estimates present a very bleak picture of the future of water quality in this country and thereby stress the need for additional action to control water pollution beyond point sources of pollution. Unless effective measures are taken to alleviate the effects of non-point sources of pollution upon the nation's waters, a steadily worsening situation could well wipe out the gains made through large investments in the control of municipal and industrial wastes.

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[10] Ibid., p. 12.

[11] Mark A. Pisano, "Non-Point Sources of Pollution: A Federal Program," (A paper presented at the American Society of Civil Engineers Convention, New Orleans, Louisiana, April 14 - 18, 1973), p. 3.

[12] Ibid., p. 5.

The land use picture in Michigan is similar to that of the nation as shown in Table 2.

TABLE 2

MAJOR LAND USES IN MICHIGAN, 1967

Land Use Categories	Thousands Acres of	Percentage of Total Land Area
Agricultural Land	10,940	30.1
Forested Land	18,846	51.9
Outdoor Recreation Land	677	1.9
Transportation Land	1,110	3.1
Urban and Developed Rural	1,539	4.2
Other Land	3,192	8.8
Total	36,304	100.0

SOURCE: Michigan State University Cooperative Extension Service, Land Use in Michigan, Extension Bulletin No. 610, 1st ed., January 1969, pp. 10-16.

It is assumed that the share of urban and developed rural land and outdoor recreation land is increasing at the expense of agricultural land. Nevertheless, a large percentage of the land continues to be used for agriculture and forestry which are non-point sources of pollutants. Urban lands and rural developed land have been used for residential, commercial, manufacturing or processing purposes. These developments are concentrated in the southern half of the Lower Peninsula of Michigan where the Tri-County Region is located. This is an area of rapid urbanization, and of industrial and commercial development. The great changes taking place in the southern half of Michigan together with the present and potential impacts of these changes on water quality make a serious consideration of non-point sources of water pollution one of prime importance.

Approach

In studying non-point sources of water pollution it can immediately be established that water pollution may come from natural or man-made sources. It is however assumed that water pollution caused by human activities tends to be more serious to the environment and man himself than that due to natural processes. This assumption does not preclude pollution induced by natural processes. In fact, a clear understanding of non-point sources of water pollution requires an examination of both natural and man-induced processes. The method of this study, therefore, is to examine non-point sources of water pollution within an ecosystem framework. Within this framework natural processes such as weathering and erosion together with their transport mechanisms are examined. The ecosystem approach helps establish the relationships among natural processes and human activities such as agriculture and silviculture.

The river basin or watershed is taken as the unit of study. This unit of study is considered appropriate because of its potential usefulness in evolving a conceptual ecosystems model of the mechanisms and processes involved in water pollution. Within the river basin exist many ecosystems which under natural conditions interact harmoniously with one another and are in a state of dynamic equilibrium.

The Section 208 planning program is intended to be regional in scope, and the planning area must cover a whole region. Different criteria can be used to define a region, depending upon the type of problem the region is intended to solve. The Tri-County Region is made up of the Counties of Clinton, Eaton and Ingham. The boundaries of this

region were determined by the rectangular survey system.[13] Under this type of land survey, principal meridians running north-south, and base lines running east-west, have been established in various parts of the United States. Working out from the intersection of these two lines, additional meridians and parallels have been surveyed at six mile intervals. The intersections of these lines form a huge grid of six mile squares (36 square miles each) representing a township. Sixteen townships are normally combined to form a county. The Tri-County Region is delimited by county boundaries which have no ecological basis. The boundaries are useful for administrative and political purposes.

An ecosystems model was developed and parameters essential for understanding the natural and man-induced processes were identified and discussed. The major components of the model are terrestrial and aquatic processes, land-water interactions, land-water-man interactions and institutional arrangements governing man's use of land and water resources. Human institutions determine how the various natural resources including land and water are used by man. Institutions can therefore enhance or mar ecosystem relationships.

Based on the ecosystems model, the Section 208 planning process as it is carried out by the Tri-County Regional Planning Commission was examined and evaluated. Planning under Section 208 of the Federal Water Pollution Control Act Amendments of 1972 is new in the United States. Nevertheless, it appears enough work has already been done by the Tri-County Regional Planning Commission to make an appraisal

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[13]Barlowe, op. cit. pp. 39-40.

of its approach to water pollution control worthwhile as an illustration of joint federal, state, and local government cooperation in solving a serious problem.

Data Sources

Library research provided data on the legislative history of Section 208 of the Act. Specifically, data were retrieved from the relevant volumes of the Congressional Record, House and Senate Hearings, House Resolutions, Senate Resolutions, House and Senate Joint Resolutions, House Reports, and Senate Reports. The other sources of data were the Legal Compilation and the many publications of the Environmental Protection Agency, Washington.

Data on the Tri-County Region, the study area, concerning water quality and waste treatment management planning were obtained from the offices of the Tri-County Regional Planning Commission in Lansing. As an offshoot of the many past and on-going studies and plans made by the Tri-County Regional Planning Commission, a substantial amount of data pertinent to the identification of both point and non-point sources of pollutants has been accumulated. The data were considered appropriate for the present study because they were found to be comprehensive, reasonably current and pertinent to water pollution analysis.

Organization of Remainder of Report

A conceptual framework for understanding non-point sources of water pollution is provided in Chapter 2. Also examined is the ecosystems model and its relevance to water pollution. Chapter 3 puts Section 208 of the Federal Water Pollution Control Act Amendments of

1972 into a historical perspective. The provisions of Section 208 are discussed along with their relationship to existing legislation and their implications for planning and management of water quality programs. A case study of the efforts being made by the Tri-County Regional Planning Commission to control water pollution through Section 208 planning is undertaken in Chapter 4. The emphasis in this case study is on the approach to planning rather than on concrete results achieved, since these have not yet occurred. In Chapter 5, the ecological principles established in Chapter 2 are used to assess the Tri-County Regional Planning Commission's approach to Section 208 planning. Summary and Conclusions are given in Chapter 6.

CHAPTER 2

ECOSYSTEM CONCEPT

The ecological system (eocsystem) is one way of looking at the human environment. This viewpoint incoporates a study of the interactions of all populations (hence, all organisms including man) in a given area at the community level of organization. An ecosystem refers to a community with abiotic (nonliving) interactions. A proper understanding of the relationships among the various components of an environment is an important requirement for identifying strategies to improve deteriorating conditions in the environment. The significance of the ecosystem concept is that it provides an ecological framework for explaining the various processes and interactions in the environment.

Water quality is a combined function of natural processes and processes which are attributed to man's activities. Natural processes tend to be nondiscrete and diffuse, and they emit discharges to the environment not amenable to treatment. This is an important characteristic of non-point sources of water pollution. Man's contribution to water pollution takes the form of localized operations which generate localized discharges into streams and lakes. In addition, man is the originator of substantial non-point discharges to the environment. Examples of non-point discharges for which man is responsible are agriculture, urban and rural construction, urban storm runoff, silviculture and rural based recreational activitiy.

The mechanisms resulting in point and non-point sources of water pollution are interrelated. The various processes are also interdependent. The ecosystem concept provides a means of grasping the processes and linkages involved and gaining insights into the capability of a particular environment to support life.

Meaning and Nature of Ecosystems

The term ecosystem or ecological system is derived from two concepts, ecology and system. The term, ecology, was coined by Ernest Haeckel in 1869. It is derived from two Greek words, oikos, meaning 'house' or 'place' and logos meaning 'study of'. Literally, ecology is the study of organisms in their homes. In scientific literature, ecology is defined as the study of the relationships of living organisms with each other and their biotic and abiotic environment. Eugene P. Odum, a prominent ecologist, defines ecology as a study of the structure and function of nature.[1] Ecology considers how organisms and groups of organisms are structured and how they interact with one another and with the environment.[2]

A system is an integrated network of interacting elements, events or parts that can be seen as a single whole thing. An open system depends upon the outside environment to provide it with inputs and to accept inputs. Where a system uses some sort of feedback mechanism to regulate itself, it is described as a cybernetic system.[3] The systems

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[1]Eugene P. Odum, Ecology (New York: Holt, Rinehart and Winston, 1963), p. 3.

[2]Ibid.

[3]David B. Sutton and N. Paul Harmon, Ecology: Selected Concepts (New York: John Wiley and Sons, 1973), p. 15.

approach is a way of thinking about the world, an approach to problem solving and model building of complex events.

It has been suggested by Odum that areas of biological study can be viewed as a spectrum composed of many levels, each level representing a type of biological system. Ecology is primarily concerned with the following levels of organization: populations, communities and ecosystems. Each level of organization involves a biotic component interacting with an abiotic component through the exchange of matter and energy.[4]

A population refers to a group of organisms belonging to one species or kind and living in a specific geographic area. A community comprises all populations that exist and interact in a given area. An ecosystem refers to a community and its related non-living environment interacting together as a unit.[5] There are several different types of ecosystems. Examples of aquatic ecosystems are lakes, ponds, rivers, swamps, and coral reefs. On the land, large ecosystems--usually called biomes--are forests, grasslands tundra and deserts.

All the different types of ecosystems on earth are connected to one another to form the largest unit or planetary ecosystem called the biosphere. The biosphere can be visualized as a vast system of diverse ecosystems interrelated in a complex fabric of life. Disrupting or stressing an ecosystem in one place can have some complex, often unpredicted and sometimes undesirable effects elsewhere.

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[4]Ibid., p. 11.

[5]Sutton and Harmon, op. cit., p. 12.

Ecosystems are not static. Improvement in the quality of human life requires that some change must occur in the various ecological systems. To be useful, these changes must occur in directions anticipated and desired by society. This calls for a thorough understanding of how ecosystems function. Management of ecosystems must be based on knowledge about their interrelationships and interactions.

The ecosystem is the basic unit of study of ecology, but it is not necessarily the basic unit for managing a group of ecosystems. The basic management unit is the smallest assembly of ecosystems that will permit the attainment of societal objectives or the solution of identified problems.[6] If the objective is to optimize water quality in a lake waste treatment system, the ecosystem may correspond to the management unit. However, if the objective is to optimize water quality in a large reservoir, the existing land uses and the natural processes associated with them become increasingly important. Urban runoff, forest management, agricultural practices and other activities in the surrounding river basin or watershed have profound effects on the quality of water in the reservoir. In the case of non-point sources of water pollution, the most appropriate unit would be a watershed. The rest of this chapter is devoted to a description of a conceptual model for understanding the processes involved in the generation of pollutants from non-point sources.

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[6]Kent W. Thornton, "Systems Thinking in Applied Ecological Research," General Systems, Twentieth Yearbook of the Society for General Systems Research (Ann Arbor: Society for General Systems Research, 1975), 59-62.

Process Involved in Non-Point Sources of Water Pollution

This section describes the natural and man-induced processes connected with non-point sources of water pollution as a basis for understanding a model of a drainage basin. Such a model should explain the effects of terrestrial ecosystems on the water system and at the same time make explicit the feedback control mechanism between the land and water components. Eventually, the key variables of the model should be quantified. Quantification is not undertaken in the present study.

Man's activities exert some of their greatest effects on the processes that link land and water ecosystems together. Adverse impacts resulting from human activities can be minimized to a point tolerable by the environment, if the processes are understood and taken into consideration in the management of ecosystems.[7]

Natural Processes

Weathering. All sub-aerial processes that cooperatively cause the disintegration and decay of rocks is referred to as weathering. Weathering does not involve large scale movement of the loosened rock particles. The particles, subject to the laws of gravity, fall or slip downwards, thus exposing fresh rock surfaces for further disintegration.[8]

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[7]Orie L. Loucks, "Models in Linking Land-Water Interactions Around Lake Wingra, Wisconsin," in Coupling of Land and Water Systems edited by Arthur D. Hasler (New York: Springer-Verlag, 1975), p. 53.

[8]Doris L. Holmes, Elements of Physical Geology (New York: Ronald Press, 1969), p. 5.

In physical or mechanical weathering, rocks are disintegrated by temperature changes, frost action and organisms. But in chemical weathering, minerals are dissolved or decomposed and loosened by water, oxygen and carbon dioxide of the atmosphere, and by organisms and the products of their decay. In real life, the physical, chemical and biological agents of weathering cooperate with one another.

Materials produced by weathering include minerals and broken rocks, residual products of decomposition such as clay and soluble decomposition products which are removed in solution. The products of weathering differ in different places according to the climatic conditions and the relief of the land.

Rock disintegration by temperature changes occurs in places affected by frosts. When water fills cracks and crevices and freezes, it expands by more than nine percent of its volume, resulting in a breaking of the rock. Many cycles of freezing and thawing result in the accummulation of rock fragments. The fragments are transported by a stream or wind at a later stage.

Animals and plants play an important role in physical weathering. Worms consume large quantities of soil as they extract food from it. The ingested particles are passed out as worm casts. In a soil of average fertility, there may be 150,000 worms to the acre, and in the course of the year, they raise 10-15 tons of material to the surface.[9]

The dead remains of organisms or dead roots decompose in the soil largely as a result of the work of bacteria. This decomposition

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[9]Ibid., p. 76.

liberates carbon dioxide and organic acids which increase the solvent power of soil water. Rootlets bind the soil into a woven mat so that it remains porous and able to absorb water without the soil being washed away. Forests considerably reduce physical weathering by minimizing the destructive impact of torrential rain in the soil.

Rocks may be disintegrated by chemical action. Water--acting as a carrier of dissolved oxygen, carbon dioxide, and various acids and organic products derived from the soil--causes alteration and solution of rock material. The chief changes which occur in chemical weathering are solution, oxidation, hydration and the formation of carbonates. A few minerals such as quartz and muscovite resist decomposition. Carbonate minerals can be entirely removed in solution. Most silicate minerals break down into relatively insoluble residues such as clay minerals.[10] The combined action of physical and chemical weathering results in a mantle of rock waste, which if not converted into soil and colonized by plants and organisms, will be transported by the agents of erosion.

Erosion. A river and its tributaries constitute a river system and the area drained by the river system is the river basin, drainage basin or watershed. Geologic processes that occur in such a basin are erosion, transport and deposition.

Erosion by running water (including streams and rivers) has two main phases. One of these is the wearing down of the interstream areas by surface runoff before it becomes concentrated in a channel to become a point source of pollution. The second phase of erosion is the

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[10]Ibid.

development of valleys and other landforms by a river system.

The ability of a stream to erode its channel is dependent to a large extent upon the speed at which the water moves. Velocity is in turn determined by a number of factors of which the most important is the gradient of the river bed.

Erosion by a stream involves hydraulic action, abrasion and solution. Hydraulic action is the lifting and moving of loose particles by the force inherent in the flow of the water.[11] Abrasion refers to the mechanical wear of rock on rock. The friction and impact between rock particles accelerates abrasion. Solution occurs as the water of the stream dissolves minerals embedded in the bedrock of the channel. However, most of the material in solution was dissolved by the groundwater and contributed to the streams later as water percolated into them.[12]

The material transported by a river can be classified as (1) load carried in solution and (2) load carried mechanically as sediment. Sediment can be carried in suspension or along the bed as sand or gravel or both. The suspended load usually consists of fine grained material such as clay or silt.

Cycle of Erosion. The concept of a cycle of erosion was introduced by William M. Davis. It is the sequence of landforms, essentially valleys and hills, through which a land mass is thought to evolve

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[11] C. R. Longwell and R. F. Flint, Introduction to Physical Geology (New York: John Wiley and Sons, 1961), p. 164.

[12] Ibid.

from the time it begins to be eroded until it reaches base level.[13] By analogy with the divisions of a lifetime, the three stages in the cycle of erosion are described as youth, maturity and old age. Davis argued[14] that as valleys are widened, the bordering slopes tend to become less steep during their retreat. During the stage of maturity, none of the original upland surface remains and the divide between adjoining valleys and drainage basins become rounded crests that gradually decrease in height. Finally, during the long period of old age, the region is worn down and reduced to an undulating plain. The low lying erosion surface which is the product of old age is called a peneplain.

The cycle of erosion concept was attacked by Walter Penck[15] who argued that most hillside slopes would not flatten out as they are worn back. Instead, he maintained that such slopes would recede without further change in declivity. In 1930, Davis agreed that there was empirical evidence in arid and semi-arid regions to support Penck's contention. The cycle of erosion concept was considered applicable to forested areas and soil mantled slopes in humid regions.[16]

Significance of Erosion. Sediment is a major pollutant which is transported by runoff water. Not only does sediment destroy fishing

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[13]Longwell, op. cit., p. 185.

[14]Douglas W. Johnson, ed., Geographical Essays by William M. Davis (New York: Dover Publications, 1954), pp. 249-78.

[15]Walter Penck, Morphological Analysis of Landforms, a Contribution to Physical Geology (London: Macmillan, 1953), pp. 7-10.

[16]W. M. Davis, "Rockfloors in Arid and Humid Climates," Journal of Geology, XXXVIII, 1930, pp. 1-27, 136-58.

grounds, but it also acts as a carrier of certain mineral pollutants in colloidal form.[17] Sediment resulting from soil erosion is regarded as the largest pollutant that affects water quality in the United States.[18]

Man-induced Processes

Potential sources of water pollutants from non-point sources and induced by human activities include agriculture, silviculture, mining and construction. The relative importance of these activities as degraders of water quality is presented in Table 3.

TABLE 3

REPRESENTATIVE RATES OF EROSION FROM VARIOUS LAND USES

Major Land Uses	Metric Tons/ sq. km/year	Tons/sq. mi/year	Relative to Forest=1
Forest	8.5	24	1
Grassland	85	240	10
Abandoned Surface Mines	850	2,400	100
Cropland	1,700	4,800	200
Harvested Forest	4,250	12,000	500
Active Surface Mines	17,000	48,000	2,000
Construction	17,000	48,000	2,000

SOURCE: U. S. Environmental Protection Agency, Methods for Identifying the Nature and Extent of Non-point Sources of Pollutants (Washington: Government Printing Office, 1973), p. 6.

[17] U. S. Environmental Protection Agency, Control of Water Pollution from Cropland, Vol. I--A Manual for Guideline Development (Washington: Government Printing Office, 1975), p. 5.

[18] U. S. Environmental Protection Agency, Methods for Identifying and Evaluating the Nature and Extent of Non-Point Sources of Pollutants (Washington: Government Printing Office, 1973), p. 35.

Agriculture. Modern agriculture employs complex machinery and high yielding seeds. Fertilizers and pesticides are also used on a large scale. Animals are kept in confined feedlots to serve the needs of urban centers. These practices provide pollutants to both ground and surface water. Pollutants coming from agricultural discharges include sediments, salt loads, nutrients, pesticides, organic loads, and pathogens. Agricultural lands, particularly croplands, are large contributors of sediment. Cropland has been credited with 50 percent of the sediment delivered to streams and lakes, and this totals about two billion tons annually in the United States.[19] Sediment also carries with it significant quantities of plant nutrients, pesticides, organic and inorganic matter, and other pollutants. It was estimated by Wadleigh that the average amount of sediment contained 0.1 percent nitrogen, 0.08 percent phosphorus, and 1.25 percent potassium.[20] Thus the loss of nitrogen and phosphorus to the nation's waters would be approximately 2 lb of nitrogen per ton of sediment, and 1.6 lb of potassium per ton of sediment.[21] Erosion is thus an important factor in the loss of nutrients to surface waters.

Many substances which are either present on land as plant residues, are introduced on cropland by man, or are produced as wastes

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[19]J. N. Holeman, "The Sediment Yield of Major Rivers of the World," Water Resources Research, IV (August, 1968), 737-47.

[20]C. H. Wadleigh, "Wastes in Relation to Agriculture and Forestry," USDA Misc. Pub. No. 1065, 1968.

[21]U. S. Environmental Protection Agency, Methods for Identifying the Nature and Extent of Non-point Sources of Pollutants (Washington: Government-Printing Office), p. 39.

by agricultural activities, have significant effects when introduced into receiving waters. Pesticides and nutrients are the most publicized of these materials. Due to their adverse effects on food chain organisms, especially on aquatic communities, pesticides have been receiving much attention. However, the movement of pesticides residues from cropland into waterways is a complex process, and depends on many factors such as the physical and chemical properties of the toxicant, the formulation, the rate and type of application, the crop to which it was applied, tillage practices, topography of field, topography of area between the application site and waterways, distance between application site and waterways, weather conditions, and amount and velocity of rainfall following application.

Some of the earliest erosion problems in the west of this country developed on badly managed grassland. Overgrazing and the resultant loss of groundcover rendered the grasslands susceptible to erosion. About 540 acres of land in the United States are used for grazing. Most of the grazing lands are found in the western part of the country. Grassland forms part of grazing lands. The chief characteristics of most grazing lands are aridity, other unfavorable climatic factors, rough topography in many cases, often soils unsuited to cropping and native vegetation.[22]

The chief source of livestock feed on grazing lands are native plants, which grow with comparatively little improvement through ploughing or seeding. These include grasses and shrubs which are palatable and nutritious to livestock. A major part of the land for

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[22]Marion Clawson et al., Land for the Future (Baltimore: John Hopkins Press, 1960), pp. 362-64.

grazing is owned by the Federal Government, and an additional acreage is owned by other governments. These publicly-owned lands are used by private ranchers under lease, licence or permit.[23]

To cater to the needs of the increasing population of the nation for meat and dairy products, especially in the urban areas, feedlots have been established. The usual practice is to concentrate a large number of animals in a relatively small area for feeding and fattening purposes. This practice leads to the accummulation of large quantities of animal wastes, which pose a threat to the water quality of nearby streams and groundwater. It has been discovered that soil below feedlots contained 2,000 lb/acre of nitrate nitrogen, while the nitrate nitrogen in the surface soil on adjoining areas ranged from 50-150 lb/acre. It has also been noted that contamination of water from nitrate remained even after an area had been abandoned for animal use.[24] Barnyards, feedlots, and manure piles have been shown as sources of excessive nitrate nitrogen in shallow wells in Illinois and Nebraska.[25]

Silviculture. This section discusses forest culture, harvesting and logging practices. Over one-third of the United States is covered with forests, of which 67 percent is classified as commercial forest.[26]

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[23]Ibid.

[24]R. C. Loehr, "Pollution Implication of Animal Wastes--A Forward Oriented Review," Kansas University, Lawrence, Kansas, July 1968.

[25]U. S. Environmental Protection Agency, Methods for Identifying the Nature and Extent of Non-point Sources of Pollutants (Washington: Government Printing Office, 1973), p. 43.

[26]Ibid., p. 93.

Commercial forests total 500 million acres. The forest lands may produce substantial quantities of pollutants to surface and groundwater, depending on the natural and land use characteristics.

A well-managed forest reduces the amount of pollutants emitted to the aquatic environment. The tree cover, which deprives rainfall of most of its erosive power, and the high rate of infiltration are often able to accommodate intense rainfall, without runoff and the accompanying transport of silt by erosion. Man's efforts to maintain high forest productivity over a long period of time requires the harvest of trees.

The concept of silvicultural cycle includes the relatively long period of growth which can be essentially free of pollutional output, and a relatively short period of harvest and reafforestation. The period of reafforestation can be a time of high output of pollutants.

Silvicultural activities commonly undertaken by man consist of harvesting, forest growth promotion, disease prevention, fire fighting and fire prevention. Pre-commercial thinning may be necessary to remove poor quality growth if overstocking is the problem. Forest thinning provides space for the best quality trees. As the forest grows a forester will provide protection and maintenance to the timber stands through the use of insect sprays, fire retardants, and other physical or biological techniques.

Methods of harvesting timber recognized by the forestry profession in the United States, are clear cutting, seedtree, and shelterwood.[27] These methods are based on ecological and economic

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[27]U.S. Department of Agriculture, "Silvicultural Systems for the Major Forest Types of the United States," U. S. Department of Agriculture, Agricultural Handbook No. 445, March 1973.

considerations. The ecological factors considered in the selection of a harvesting method include timber species, the relationship between forest and wildlife, and potential insect and disease problems. Marketing and management costs constitute the principal economic considerations.

In the harvesting process, clearcutting requires the virtual removal of all trees and the creation of bare land for the establishment of a new forest composed of trees which are somewhat of the same age. If not properly planned and executed, clearcutting may lead to serious water pollution problems through the acceleration of sediment production.

Harvesting by the seedtree method removes all trees in an area leaving a few of the most desirable trees for seed production. When sufficient reproduction is established the seed trees are harvested. Next to clearcutting, the seed tree method probably has the highest potential of releasing sediment into streams.

The main difference between the shelterwood method and the two previously discussed methods is that establishment of a new crop is accomplished before the final forest is removed. The method involves the gradual removal of an entire stand in a series of partial cuttings extending over a fraction of the rotation.

The transportation of felled trees is an important aspect of silviculture. This is described in logging parlance as skidding, yarding, or snaking operations. Methods of log transport often used include tractor, high lead, skyline cable, balloon and helicopter. Most of these methods increase soil erosion.

Tractor skidding is the commonest method used on land with less than 30 percent slope. In the skidding process, the tractor exposes a large area of bare soil. The erosion potential of tractor skidding is great. Mechanical compaction of the surface soil by tractors and other machines may reduce infiltration and produce surface runoff.

The high lead log transport system is adapted especially to clearcutting. A metal tower is mounted to a mobile frame. Guy lines hold the tower in place. The logs are dragged on the ground to a yarding area by a winch and a set of cables attached to the tower. Soils which happen to lie in the path of the dragged logs are heavily disturbed and made susceptible to erosion by surface runoff. At the yarding area the logs are loaded into a truck.

Using a helicopter, logs are lifted from point of felling and transported to the loading area. Helicopter logging has been found to be a very versatile system for moving logs from felling sites to loading areas, but it is also more expensive than the other methods.[28]

Silvicultural activities produce pollutants similar to those generated by agriculture. Sediment is the most important pollutant. It is eroded and transported to surface waters by the action of run-off and rainwater. In addition, thermal pollution in streams may result from the reduction of shade cover caused by clearcutting along stream banks. Water temperature is increased by such an activity. Temperature strongly influences dissolved oxygen concentration, which affects squatic life and bacteria population in streams. Increased

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[28]Virgil W. Binkley, "Helicopter Logging with the S64E Skycrane, Report of Sale," ([n.p.]: U. S. Forest Service, [n.d.]).

population of pathogenic bacteria may kill fish.[29]

Organic matter ranging from green vegetative refuse through well-decomposed humic matter serves as pollutants when transported to surface water by runoff. The organic matter, floating debris, is sometimes a nuisance, it sometimes physically interferes with normal aquatic ecology and nearly always becomes involved in biochemical processes leading to the degradation of organic matter.[30]

Pesticides used in silviculture include insecticides, herbicides (silvicides) and rodenticides. Pesticides deposited directly in surface water courses by careless application or transported there in surface runoff. Pesticides are by design toxic to some part of the environment.

Evaluation of water pollution caused by pesticides is complicated by many issues. Required for such an evaluation are knowledge of the persistence of the pesticide at point of use, rates of degradation, mode of degradation and identities of biological and chemical metabolites, and mechanisms of transport through the environment to target as well as non-target species.

Mining. This is an activity which disturbs the earth's crust. Mining is accomplished by a variety of techniques. Mine shafts are sunk to provide access to minerals deep in the earth. Minerals which lie near the surface of the land are extracted by surface mining techniques such as strip mining or open pit.

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[29]J. R. Brett, "Some Principles in the Thermal Requirements of Fishes," Quarterly Review Biology, XXXI (June, 1956), 75-87.

[30]U. S. Environmental Protection Agency, Methods for Identifying the Nature and Extent of Non-point Sources of Pollutants (Washington: Government Printing Office, 1973), p. 101.

Surface mining creates more visible disturbance of the earth's surface than shaft mining. Indiscriminate surface mining of the past has created problems which are still present in some parts of the country. However, land disturbed by surface mining can be reclaimed. Techniques are being developed by which mining and reclamation can be integrated almost into a single operation.[31]

Mine drainage generated by oxidation of pyritic material is the most serious pollutant arising from mining activities. This pollutant is an acidic mixture of iron, salts and sulphuric acid. Mine drainage arises from both underground and surface mining sources, and from coal and many metal mining sources.

Other types of non-point pollutants arising from mining operations are sediments, leachates of various types (other than mine drainage), radioactivity, and to a limited extent pesticides.

Surface mining of coal and other sedimentary minerals creates large areas of disturbed land which is highly erosive and can contribute large quantities of sediment to surface water if the land is not properly reclaimed after mining. Vast piles of finely grained material called tailings are created when raw minerals are processed in order to concentrate ore. The problem of tailings as potential contributors of sediment is exemplified in Western United States where the tailings are spread over a wide expanse of land. Control of leachate pollution from tailings is often hampered by the desire to save the tailings for future mineral extraction.

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[31]Council on Environmental Quality, Coal Surface Mining and Reclamation: An Environmental and Economic Assessment of Alternatives (Washington: Government Printing Office, 1973).

Effective reclamation of land disturbed by mining activities requires the use of fertilizers and pesticides to promote vegetative stabilization. These materials are potential pollutants and the extent of pollution is governed chiefly by the care exercised in their use. It is unrealistic to assume that pollution from mining activities can be completely eliminated; it is however realistic to expect that pollution from mining can be markedly reduced by taking appropriate control measures.

Construction. It has been estimated that the accelerated increase in the population of the United States through the year 2000 will require the daily development of about 4,000 acres of land to satisfy the requirements for new housing and related services, utilities, sewer and wastewater treatment networks and transportation.[32] All these developments are oriented towards construction.

Activities likely to modify the physical and biological properties of water resources include: construction of transportation and communications networks; housing; office buildings and related land development; energy networks; water resources development and other multiple use recreational developments.[33] Construction activities are capable of generating many types of water pollutants. The location of a construction activity relative to environmentally vulnerable waterways or groundwater recharge areas is crucial to construction

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[32]U. S. Department of Housing and Urban Development, "Proceedings of the National Conference on Sediment Control," Washington, D.C., September 14-16, 1969.

[33]U. S. Environmental Protection Agency, Methods for Identifying and Evaluating the Nature and Extent of Non-point Sources of Pollutants (Washington: Government Printing Office, 1973), pp. 233-34.

practice.

Land clearing and pest control are operations which may appear initially on any construction site. Their impact on ecosystems is great in the construction of transportation and energy networks, particularly interstate highways, electric transmission lines and pipelines for oil and natural gas. Unwanted vegetation is cleared from the construction site. In some cases, the surface soil may be stripped and stockpiled for reuse during the period of site restoration. These operations can be viewed as major disturbances of the land surface with possible deleterious effects on the ecosystem of the development site, adjacent areas and water resources. Pest control may take the form of spraying the site with insecticides, herbicides or rodenticides to remove insects harmful to man, herbaceous and woody plants that obstruct development, or unwanted animals.

Rough grading is characteristic of essentially all construction activities with particular reference to highway cuts and fills, excavations for dams and pipelines, and housing and related land development. Heavy construction equipment used, such as bulldozers and trucks, becomes both a direct and indirect source of water pollutants. Petroleum products such as diesel fuel, oil and lubricants are direct sources of pollution. Construction equipment also causes severe compaction of clayey soils, thereby reducing the rate of water infiltration and lowering the rate of soil aeration. The revegetation of graded areas will be considerably more difficult if the above factors are ignored.

Dam construction involves many operations which produce sediment and other types of pollutants. Construction haul roads are potential sources of large quantities of sediment and construction related pollutants. Large areas of forested hillside are often cleared to permit excavation and construction of the dam. Turbid water is emitted from the dam site. This water becomes a pollutant unless it is treated in settling ponds or clarifiers before being allowed to enter the waterway.[34]

Types of pollutants resulting from construction activities can be grouped under sediment, chemical pollutants and biological pollutants. Sediment includes solid and organic materials transported by rainfall, runoff, wind, ice and the pull of gravity. The major categories of chemical pollutants are petroleum products, pesticides, fertilizers, synthetic organic materials, metals, soil additives and miscellaneous wastes such as construction debris. The biological pollutants are those of animal and human origin. These organisms may or may not be pathogenic to animals and humans.

Agents directly responsible for the transportation of pollutants from construction areas to receiving streams include runoff, wind, landslides and seepage. Some chemical and biological pollutants generated at the construction site are adsorbed pollutants. Construction related solid wastes carried by runoff include paper, beer cans, beverage cans, aluminium foil and plastic wrappers.

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[34]R. R. Robinson et al., Special Report on Control of Turbidity During Construction of Teton Dam and Power and Pumping Plant (Washington: U. S. Dept. of Interior, Bureau of Reclamation, 1973), pp. 1-16.

Intensive use of land finds its best expression in the urban built up areas. In the urban environment, most of the natural vegetation has been removed to make room for the construction of homes, community facilities and roads. Urban construction leads to the creation of an impervious layer of concrete and asphalt over the soils. This layer collects pollutants such as dust, oils, chemicals and dirt. It also effectively reduces the amount of infiltration of the soil by precipitation and thereby accelerates surface runoff. All these pollutants are fed to the untreated stormwater in the urban area which ultimately finds its way into streams and lakes.

Ecosystems Model

The drainage basin serves as a useful unit of study for a better understanding of the principal ways by which landscapes influence water bodies or water quality, and some of the feedback processes through which aquatic systems, in turn, affect land. Natural eutrophication of lakes occurs in a drainage basin. Nutrients, especially nitrogen and phosphorus compounds, are metabolized by algae, the first link in the aquatic food chain which affects the production of all successive trophic levels. The process of eutrophication is relatively slow depending on the richness and size of the basin in relation to the size of the lake and to the time of the renewal of the water. By means of agricultural fertilization and erosion, the rate of eutrophication can be accelerated.

The purpose of the ecosystems model is to identify the structural features of the drainage basin and to elucidate the processes by which materials are transported through the ecosystems. Water pollution

problems in a watershed are complex and call for models or submodels appropriate for analysis at different levels, namely, the regional or watershed level, the component level such as lakes and terrestrial ecosystems, and the component level.[35] The main concern in this study is the regional or watershed level.

Natural Watershed

Conceptually, a watershed which has not been inhabited or influenced significantly by man's activities can be viewed as a natural watershed. The relationships between land and water systems in such a drainage basin are illustrated in Figure 1. Each terrestrial ecosystem has the following components: primary producers, consumers, and decomposers. The primary producers convert the radiant energy from the sun into chemical energy by producing energy rich carbon compounds which are stored in plant tissues. Consumers are the organisms which derive their nutrition directly from plants (herbivores). Other organisms such as bacteria and fungi break down dead plants and animal material to obtain their energy requirements. These are the decomposers. Nutrients (substances necessary for the normal growth and development of organisms) are cycled in the ecosystem and in the terrestrial ecosystems as a unit.

Processes similar to those which occur in the terrestrial ecosystems operate in the aquatic ecosystems. In both terrestrial and aquatic ecosystems, materials which are not assimilated are transferred to the land-water interactions group of ecosystems where through

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[35]Herman E. Koenig and William E. Cooper, Design and Management of Environmental Systems, Vol. III (East Lansing, Michigan: Michigan State University, 1974), p. 13.

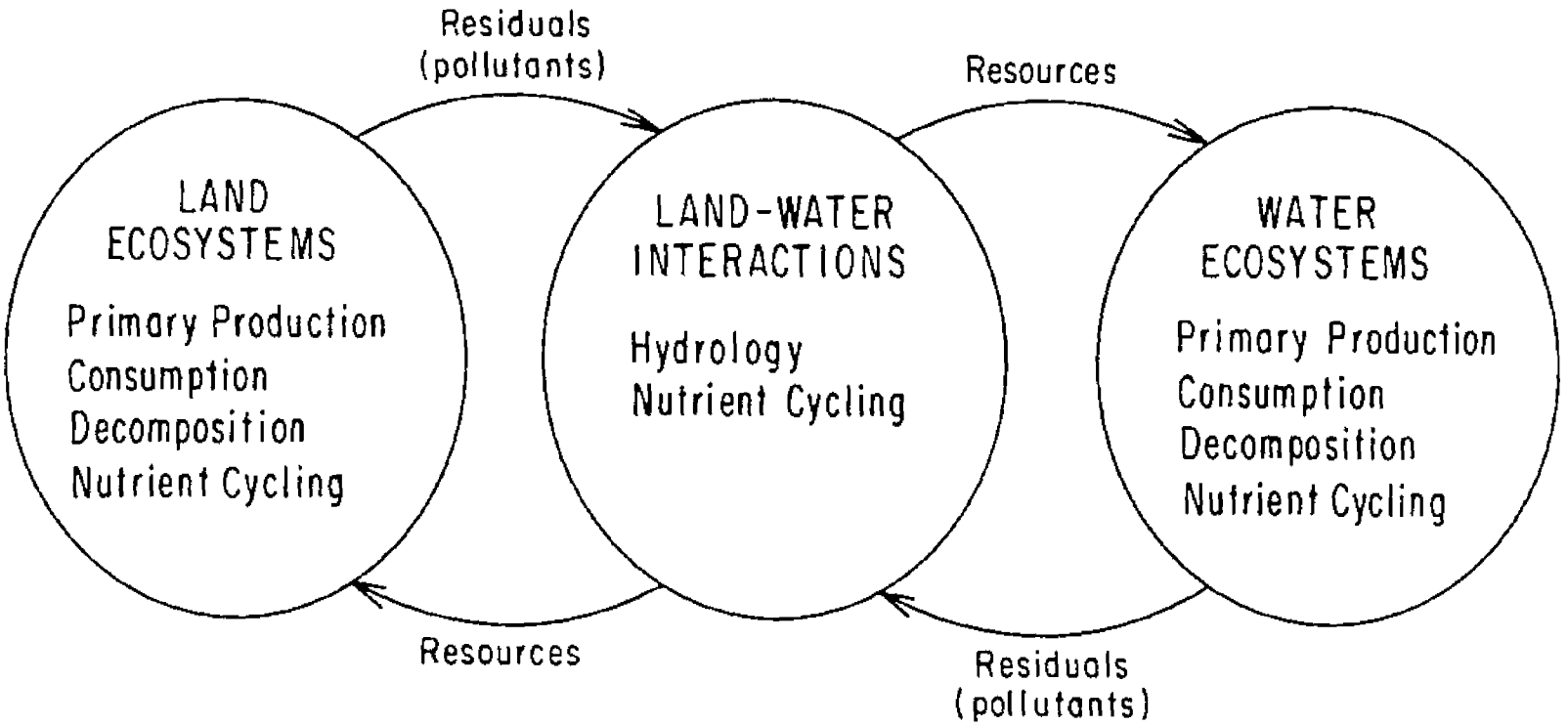

Figure 1. Ecosystem Relationships in a Natural Watershed

hydrologic processes and further nutrient cycling residual materials are made compatible with the environment. The whole system comprising land and water ecosystems is maintained in a state of equilibrium by some cybernetic mechanism. Thus, the water budget and nutrient budget for the soil and plants are also maintained.

Biogeochemical Cycles

Living organisms require elements such as oxygen, carbon, nitrogen, sulphur and phosphorus for development. The supply of these elements is limited and, by means of biogeochemical cycles, the elements through the atmosphere, hydrosphere, lithosphere and biosphere constitute the biogeochemical cycles.[36]

By means of a biogeochemical cycle, nutrient elements are moved from the environment to organisms and back to the environment. Nutrients and other materials that are coupled to the nutrients are cycled simultaneously. The other materials, most of which are introduced into the environment by man, are not essential to the survival of the ecosystem. Such materials include hard pesticides[37] and nutrients from fertilizer. In order to fully understand land-water interactions in a drainage basin, there should be sub-models of the coupling effect mechanisms.

Diffuse water (non-point), dissolved chemicals, particulate matter in precipitation and groundwater can be viewed as components of both land and water ecosystems, but they are also the materials through which activities on the land and the lower atmosphere affect streams, lake systems and surface runoff. Thus water acts as a

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[37]See Appendices B, C, D, E, F, and G.

solvent and carrier of nutrients and materials for both systems. The rate and amount of precipitation determine the chemical flux from the atmosphere to either the land or the water system, as well as the flux from the land phase of a drainage basin to the aquatic phase.

Transported Materials

There is the need to define materials transported by the water systems. The materials include sand and sediment, nutrients, and other elements in solution. Sediment yield is relatively easy to measure.[38] The term, sediment yield, may be defined as the amount of the eroded soil material that is transported and deposited in a stream either as suspended sediment or as settled bed material or as both. Sediment yield is dependent on gross erosion in the watershed and on the ability of the runoff to transport and deposit eroded material into streams and reservoirs. Gross erosion includes sheet and rill erosion and channel type erosion. Nutrients such as nitrogen present problems in tracing their movements in the ecosystem because of the various chemical forms assumed by them and the transformations they undergo in the system.

Nitrogen in the ecosystem is continually being exchanged to and from nitrogen gas, ammonia, nitrates, nitrites and organic nitrogen. Phosphorus has three basic forms, namely, phosphate, orthophosphate, and organic phosphorus. Each form can occur in solution, as colloid or in particulate. A model of the transport of nutrients between the

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[38]U. S. Environmental Protection Agency, Methods for Identifying and Evaluating the Nature and Extent of Non-point Sources of Pollutants (Washington: Government Printing Office, 1973), p. 51.

land and water systems within a drainage basin should consider the transfer attributable to flux of the carrier system and transfers due to change among forms of the material being transported.

Transport Mechanisms

Water is a major carrier of nutrients and pollutants. The atmosphere is also a carrier system, although recognition of its significance in the transport of nutrients and other contaminants of aquatic ecosystems came late. In recent years, meteorologists have developed models for the dispersal and transport of particulate and gaseous forms of important materials.[39] The soil is also a carrier system when it acts as the agent by which nutrients, particularly phosphorus, are carried from the land to water systems during erosion. The various carrier systems are interdependent.

The hydrologic carrier system merits close examination because of its relationship with both point and non-point sources of water pollutants.[40] The rectangles indicate system variables and the arrows show the natural processes and transport mechanisms involved in the hydrologic cycle. See Figure 2.

Precipitation that falls on the land and eventually becomes runoff may be classified as surface runoff, subsurface runoff or groundwater runoff, according to the path of flow to the stream. Surface runoff (or overland flow) refers to water that travels over

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[39]Orie L. Loucks, "Models in Linking Land-Water Interactions Around Lake Wingra, Wisconsin," in Coupling of Land and Water Systems edited by Arthur D. Hasler (New York: Springer-Verlag, 1975), p. 57.

[40]D. D. Huff, "Hydrologic Transport Model," Eastern Deciduous Forest Biome, Memo Report No. 73-74 (Madison, Wisconsin: University of Wisconsin, 1972).

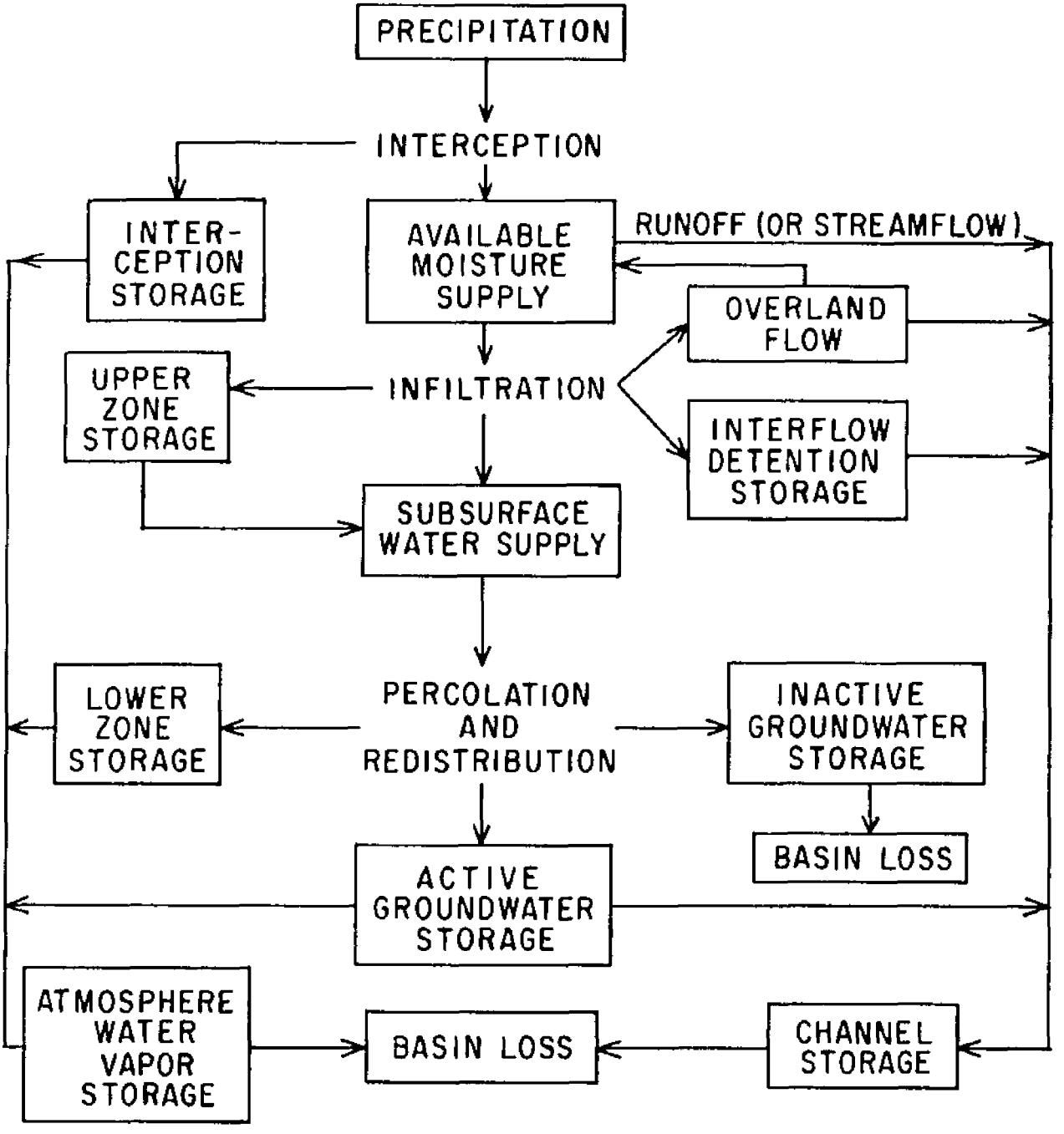

Figure 2. A Flow Chart for the Stanford Watershed Model as adapted by Huff and others

ground surface to reach the stream. Since this water does not flow in an identifiable channel it is regarded as water from non-point sources. Subsurface runoff (also called subsurface flow, subsurface stormflow or storm seepage) is water that infiltrated the surface soil and moved laterally through the upper horizon above the water table towards the stream. Groundwater runoff (or groundwater flow) refers to the water that has infiltrated the surface soil, percolated the general groundwater table and then moved laterally to appear in the stream.

Surface runoff moves rapidly and occurs shortly after a storm. Subsurface runoff moves somewhat more slowly than surface runoff, but appears in the stream during and shortly after a storm. Groundwater runoff may be in transit for days, or years, depending on the rock structure and other factors. The three types of runoff illustrated in this flow chart are not mutually exclusive because any body of water in a watershed may use a combination of modes of travel to a stream. The amount of water that moves by each of the three routes must be known before transport of agricultural chemical or pollutants from a field can be described in detail.

Surface runoff may carry pollutants in solution, in suspension or adsorbed to suspended soil particles. Subsurface runoff and groundwater runoff can only carry soluble pollutants that are not strongly adsorbed to soil particles. A non-persistent chemical transported by groundwater runoff may not be a threat to water quality by the time it reaches a surface stream because of the long travel time

required for its transportation.[41] A non-persistent chemical is biodegradable within a relatively short time.

Ecosystem Relationships Affected by Man

Many drainage basins have been inhabited by people and have in some way been influenced by man's activities. Frequently, cultural manipulations of agricultural lands, forests and streams have tended to upset both the water budget and the nutrient budget in the soil, in turn affecting both the water table and base flow to springs, streams and lakes. Man's activities such as the use of fertilizer in agriculture affect the nutrient content of the waters and result in a modification of water quality and associated structure of the ecosystem.

Figure 3 illustrates the relationships among land ecosystems, water ecosystems, and human institutions. Society through its many institutions, receives information from both land and water ecosystems. On the basis of the information received, decisions--social, political, economic--are made. These decisions and human activities determine how the land and water resources are used. The decisions also influence the methods adopted to exploit the natural resources. By means of the "institutional control box" the various human activities which affect land and water ecosystems are regulated. The harmonious relationships existing among the various ecosystems in the model are buttressed on ecological principles which the preceding discussion has

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[41]U. S. Environmental Protection Agency, Control of Water Pollution from Cropland, Vol. I (Washington: Government Printing Office, 1975), p. 7.

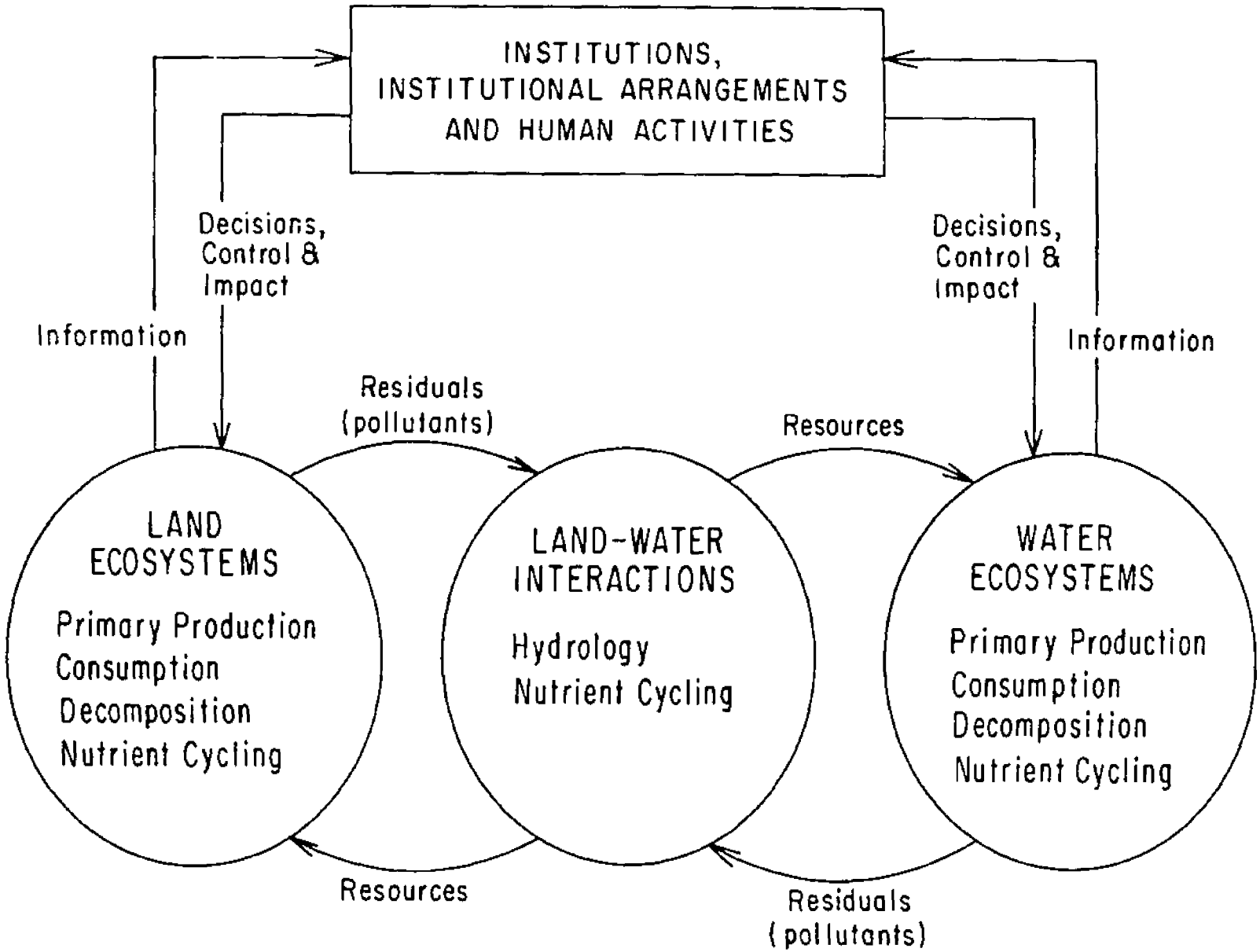

Figure 3. Schematic Model of Land-Water Interactions as Influenced by Man

attempted to elucidate.

Principles

The following ecological principles must be considered when dealing with the control of water pollution from non-point sources: (1) The region must serve as the basis for studying non-point sources of the water pollution; (2) Consideration of water pollution must form part of environmental quality; (3) Knowledge of carrying capacities and tolerances must guide man's control of ecosystems; and (4) Ecosystems must be managed holistically in order to minimize the generation of pollutants.

(1) Regional Considerations. The term, "non-point source of water pollution" is taken to mean any non-confined area from which pollutants are discharged into a body of water. The difficulties involved in identifying a particular spot as the source of pollution makes it necessary to consider carefully the geographical area or region from which pollutants are generated. There are different ways of defining a region. The criteria for such a definition may be physical, economic, social, political, ethnic or any combination of the above. For the control of water pollution, it should be realized that pollution from non-point sources usually transcends boundaries set for economic and administrative reasons.

The watershed is taken as a single unit for modeling purposes because of its ecological importance. It illustrates the interactions among the various components of an ecosystem and at the same time shows the interrelatedness of all ecosystems within the watershed. The emphasis is on the interrelationships and interactions

among ecosystems. Ultimately, all the ecosystems of the earth taken together constitute the biosphere. Changes in an ecosystem in one part of the biosphere are likely to affect other ecosystems because of the interrelationships existing among all ecosystems. It is this question of interrelatedness and interdependence of ecosystems which makes it necessary to study water pollution on a regional basis. Consequently, an appropriate region must be defined as the basis for studying water pollution from non-point sources.

(2) Environmental Quality. The concept of environmental quality is defined in terms of the quality of the human environment. Environmental quality recognizes the place of man within the biosphere which is composed of ecosystems. In the biosphere, there are natural and man-made systems. A natural system comprises geological, physical, chemical and biological processes which mould the earth's surface without a dominant influence by man. Man uses the resources found in the biosphere to satisfy his basic needs of food, shelter, and clothing as well as his aesthetic needs. He measures the quality of his environment in terms of his own experience, survival and well-being. Environmental quality is, therefore, defined by human perceptions of and reactions to the natural and man-made systems. The definition of environmental quality must be related to the survival, health and well-being of the human population and the individuals in it.

Water pollution from non-point sources can be viewed as the outcome of man's efforts to satisfy his needs from natural systems which are interdependent. Pollutants from non-point sources may have direct impacts on water bodies but may also have indirect adverse

impacts on other natural systems in the biosphere and ultimately on man. Water pollution is, therefore, not an isolated issue. It is closely linked with other issues of the human environment. Water pollution from both point and non-point sources must be tackled as part of environmental quality.

(3) Carrying Capacities and Tolerances. Environmental quality connotes an optimum environment for man. Implicit in environmental quality is the concept of carrying capacity which refers to the ability of a particular environment to support life. This concept is used in many fields of study. However, the need for human survival and well-being makes it imperative to consider carrying capacity from the perspective of ecosystems and the biosphere. The biosphere contains limited natural resources and the question of the earth's carrying capacity concerns the long-run balance between the overall capacity of the natural environment to produce and the sum total of human needs.

Technological advancement can increase the carrying capacity of the biosphere by making more resources available for human use. The development of high-yielding seeds and the application of fertilizer to agriculture has led to substantial increases in food production in many countries. The carrying capacity of the environment can also be diminished through poor management of ecosystems. Carrying capacity is therefore a dynamic concept.

If natural systems are adversely affected by water pollution, resources made available for human use will be impaired in quality and this will, in turn, affect environmental quality. Natural systems such

as streams and lakes have tolerances. Streams and rivers can render human wastes harmless to the environment, given a certain amount of sewage and sufficient time for stream recovery. Water pollution occurs when the assimilative capacity of the streams and rivers are exceeded. Knowledge about the tolerance limits of natural systems is a necessary prerequisite for understanding and controlling water pollution. Based on these tolerances, realistic standards for improving the human environment can be set.[42] In the light of the foregoing, man's control of ecosystems must be guided by the carrying capacities of the ecosystems and tolerances of natural systems.

(4) Sound Ecosystem Management. It has been pointed out that man depends on natural resources in the natural systems for his survival and well being. The production and consumption of these resources leads to the creation of residuals or pollutants which are returned to the natural environment. Since the natural systems and man can tolerate pollution up to a certain level, it is essential to ensure that the rate at which pollutants are generated does not exceed what the natural systems can tolerate. Sound ecosystem management aims at achieving harmony between man's pollution-prone activities and natural systems.

Since man's activities are mainly responsible for pollutants which adversely impact natural systems, "The environment must be managed primarily through the management of men."[43] Effective manage-

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[42]Lynton K. Caldwell, Environment: A Challenge to Modern Society (Doubleday and Co., Anchor Books, 1970), p. 71.

[43]Ibid., p. 60.

ment of ecosystems requires a comprehensive examination of man's activities and natural systems, as well as those human institutions which provide guidelines for the utilization of natural resources. In order to minimize the harmful impacts of pollutants, ecosystems must be managed holistically.

CHAPTER 3

FEDERAL WATER POLLUTION CONTROL ACT AMENDMENTS OF 1972, SECTION 208

Legislative History

The Federal government first showed concern about the quality of the nation's waters by passing the Refuse Act of 1899, the main objective of which was to prevent impediments to navigation.[1] The Act states that "It shall not be lawful to throw, discharge or deposit . . . any refuse matter of any kind or description whatever . . . into the navigable waters of the United States,"[2] without permission from the Army Corps of Engineers. Violators of the law, subject to civil and criminal action, could be sued by the government or by private citizens, if the public agencies refused to act. This legislation indirectly dealt with water pollution control in navigable waters.

The first Federal legislation directed specifically at the main sources of water pollution was not passed until 1948.[3] Prior to 1948, authority for the control of water pollution was exercised by the states and municipalities. In most states, the power to control water

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[1] U. S., Congress, Rivers and Harbors Act, 30 Stat., 1152, March 3, 1899.

[2] Ibid.

[3] U. S., Congress, Public Law 80-845, 80th Cong., 2nd Sess., S. 418, June 30, 1948.

pollution had passed to the states because the municipalities could not effectively control water pollution originating from places outside the jurisidction of the municipal or local government.

Between 1935 and 1940, many bills were introduced in the United States Congress, requesting Federal financial assistance for the construction of waste treatment plants. Most of the bills provided for Federal financial support for comprehensive pollution control planning.[4] Some of the bills contained provisions for enforcement powers to be exercised by the Federal Government in order to reduce pollution in interstate waters. None passed, however.

Water Pollution Control Act of 1948

The States and municipalities were eager to accept Federal financial assistance for the construction of waste treatment plants. This eagerness prepared the groundwork for the Water Pollution Control Act of 1948. The purpose of the Act was "To provide for water pollution control activities in the Public Health Service of the Federal Security Agency and in the Federal Works Agency and for other purposes."[5] The authority contained in the legislation was limited to five years, but the Act was extended for an additional three years in 1953.[6] The Act recognized the primary responsibilities of the states

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[4]J. Clarence Davies III and Barbara S. Davies, The Politics of Pollution (Indianapolis: Pegasus, 1975), p. 28.

[5]U. S., Congress, Public Law 80-845, 80th Cong., 2nd Sess., S. 418, June 30, 1948.

[6]U. S., Congress, Public Law 82-579, 82nd Cong., 2nd Sess., July 17, 1952.

in controlling water pollution and made provision for technical research to improve methods of treatment of industrial and other wastes. It also provided for Federal technical assistance to state and interstate agencies and municipalities in the formulation and execution of programs for the abatement of stream pollution.

Promotion of public health was the principal aim of the 1948 Act. The Surgeon General under the supervision and direction of the Federal Security Administrator of the Public Health Service and Federal Works Administrator was given the authority to administer the Act. The Act also established a Water Pollution Control Advisory Board in the Public Health Service. It was the duty of the Board to review the policies and programs of the Public Health Service and to make recommendations thereon in reports to the Surgeon General for necessary action to be taken.[7]

Water Pollution Control Act Amendments of 1956

In the Water Pollution Control Act of 1948, it was established that the Federal Government had some role in abating pollution in interstate waters. However, this role was subordinate to that of the states. For many years, controversy over water pollution legislation centered on Federal enforcement powers, and financial assistance for the construction of waste treatment plants. Provisions of the Water Pollution Control Act of 1948 proved difficult to enforce.

In 1956, after long hearings, the Congress passed a revision of the enforcement provisions and thereby removed many of the difficulties

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[7]U. S., Congress, Public Law 80-845, 80th Cong., 2nd Sess., S. 418, Section 6(b), June 30, 1948.

found in the 1948 Act. The purpose of the Water Pollution Control Act Amendments of 1956 was to extend and strengthen the 1948 Act. It retained the provision that Federal court action could be instituted against water polluters and other offenders with the consent of the state concerned. The retention of this provision was an obstacle to the enforcement of the law by the Federal Government. In 1961, President John Kennedy endorsed a bill sponsored by Representative John Blatnik of Minnesota which removed the obstacle to federal enforcement.[8]

The administration under President Kennedy favored financial assistance to states for the construction of waste treatment plants. Consequently, a bill was signed by the President in 1961 to appropriate funds for waste treatment grants for the period 1962 to 1967. The bill authorized appropriations for waste treatment grants of $80 million in 1962, $90 million in 1963, and $100 million for each fiscal year between 1964 and 1967.[9]

The early 1960's saw the discontentment of the Congress with the pace at which water pollution control programs was moving. It was felt that the states were not effectively handling the water pollution problem, and the Public Health Service, the Federal Agency responsible for administering the Federal Water Pollution Control Act, appeared unable to compel them to take the necessary action. As chairman of the newly-created Senate Subcommittee on Air and Water Pollution, Senator Edmund Muskie introduced amendments to the Act in

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[8]Davies, op. cit. p. 31.

[9]Ibid., p. 32.

1963, and this led to a transfer of the Federal administrative authority for the Act from the Public Health Service to a new Federal Water Pollution Control Administration in the Department of Health Education and Welfare. Federal and state enforcement of the provisions of the Act was based on water quality standards for interstate waters. The bill passed the Senate by a large majority but did not pass the House due to procedural delays.

The Water Quality Act of 1965

In the 89th Congress, Senator Muskie introduced and the Senate passed a new bill on water pollution. The House of Representatives passed an amended version of the bill. The Senate and House versions of the bill went to a Conference Committee in April 1965. Following a unanimous approval of the Conference Report by the Senate and the House on September 21, 1965, President Lyndon Johnson signed the legislation on October 2, 1965.[10]

Each state had up to one year from the date of the enactment of the law to file a letter of intent to establish water quality standards for its interstate waters. The Secretary of the Department of Health, Education and Welfare was authorized to review and give approval to the standards. If a state did not file the letter of intent and also failed to establish water quality standards by the stipulated date, the Secretary of the Department of Health, Education and Welfare was empowered to establish standards for the state concerned

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[10]United States, Congressional Record, 89th Cong., 2nd Sess., (1965), CXI, No. 19, 25023-26378.

subject to review by a hearing board.[11]

The 1965 Act gave the states an important role in setting and enforcing standards for water quality. However, congressional description of the Act did not provide enough detail. The Act simply provided that the standards shall be such as "to protect the public health or welfare, enhance the quality of water and serve the purpose of the Act," taking into consideration the use and value for public water supplies preservation of fish and wildlife, recreational purposes, and agricultural, industrial and other legitimate uses.[12] For this reason, many years were required to establish satisfactory standards. Nevertheless, the concept of water quality standards provided the foundation for an effective national strategy for water pollution control. So far, the main concern was with point sources of water pollution.

The Clean Water Restoration Act of 1966

A bill was introduced in January 1966 by Senator Muskie and other cosponsors to authorize $6 billion for construction grants, and to increase the share of the Federal Government in the costs of constructing waste treatment plants. The administration submitted rival legislation aimed at reducing the construction grants. According to the proposal of the administration, regional agencies were to be established in selected river basins. The regional agencies were to

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[11]U. S., Congress, Public Law 89-234, 89th Cong., 1st Sess., S. 4, Section 5(c)(2), October 2, 1965.

[12]U. S. Congress, Public Law 89-234, 89th Cong., 1st Sess., S. 4, Section 5(c)(3), October 2, 1965.

have their administrative expenses paid by the Federal Government, and they were to draw comprehensive plans for water pollution control.

The bill, as introduced by the administration, ran into opposition in Congress. After some amendments which incorporated most of Senator Muskie's proposals, the bill was signed by the President on November 3, 1966.

Between 1967 and 1970, water pollution legislation focused on pollution caused by oil and acid mine drainage, and on research on lake and stream eutrophication. In 1969, the massive oil leak from a drilling rig off the shore of Santa Barbara, California, resulting in the pollution of beaches, underscored the urgency of passing a pending water pollution legislation entitled Water Quality Improvement Act.

On March 25, 1969, the House Public Works Committee reported out a bill, HR 4148, which covered oil, vessel, thermal and acid mine drainage pollution and eutrophication. The House passed the bill on April 17. Further hearings were held on the bill by Senator Muskie's Committee. It reported out a revised version in August, which was passed with some modification by the Senate in October. The House and Senate Bills were sent to a Conference Committee.

The Conference Committee reported out a bill which was approved by both houses of Congress on March 25, 1970, and was signed by the President on April 3. The law held owners of vessels liable for oil spills up to a limit of $14 million. Thermal pollution problems were also dealt with. Federal licence or permit was required for construction or operation of facilities which might pollute

navigable waters. An important condition for granting a Federal permit is a state certification that a facility would not violate water quality standards.[13]

The Water Pollution Control Act Amendments of 1972

In the latter part of 1969, the Congress came under public pressure to take action to improve the performance in air and water pollution control. Environmental quality had become one of the priorities of the Republican administration. In a special message to Congress on February 10, 1970, President Richard Nixon recommended water pollution control legislation which would authorize the imposition of federally approved effluent standards on all sources of industrial and municipal pollution.

Over a seven-month period, the House Committee on Public Works conducted long and intensive hearings. Starting in May 1971, it held 38 days of hearings, listened to 294 witnesses and received 135 additional statements for the record.[14]

The Senate Public Works Committee reported out a bill on October 31, 1971. The Senate bill authorized $14 billion over a four-year period to finance new construction of municipal waste treatment plants, and an additional $2.4 billion to reimburse states and municipalities for past construction costs.[15] Enforcement of the law

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[13]J. Clarence Davies III and Barbara S. Davies, The Politics of Pollution (Indianapolis: Pegasus, 1975), p. 39.

[14]U. S., Congress, House, Committee on Public Works, House Report Number 911, 92nd Cong., 2nd Sess. (Washington, D.C.: Government Printing Office, 1972), p. 6.

[15]U. S., Congress, Senate Report of the Committee to accompany S. 2770, Report No. 92-414, October 28, 1971.

was to be based on a system of permits. The bill passed the Senate.

Opposition to the bill came from the administration which appealed to the House Public Works Committee to reopen its hearings for further evidence against the Senate provisions. The administration wanted to have the funding authorization reduced. Further hearings were held and the bill was passed on March 29, 1972.

On May 11, the House and Senate Conferees began to reconcile their respective versions of the bill. After 40 meetings they agreed on a compromise bill which (1) declared as national goals 1981 and 1985 deadlines for the elimination of water pollution and (2) authorized $24.7 million over three years. The Conference Report was approved by the House and Senate on October 4, 1972.

On October 17, President Richard Nixon vetoed the bill but did not have enough votes to sustain his veto. Both House and Senate voted to override the President's veto. Thus the bill became law over the objections of the President.[16]

The Federal Water Pollution Control Act Amendments of 1972 (hereinafter referred to as the Act) is the most comprehensive measure for the protection of the waters of the United States ever considered by the Congress. Previous legislation on water pollution control emphasized water quality standards. While the Act deals with water quality standards as well as effluent discharges, it tends to lay emphasis on the latter. The rest of this chapter is devoted to an examination of the provisions of the Act with particular reference to Section 208.

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[16]United States, Congressional Record, 92nd Cong., 2nd Sess. (1972), CXVIII, No. 29, 37054.

Provisions of Section 208

Place of Section 208 in the Act

The Federal Water Pollution Control Act Amendments of 1972 is divided into five titles. Each title is further divided into sections and subsections. The titles deal with the main components of the Act as follows: Title I-Research and related programs; Title II-Grants for construction of treatment works; Title III-Standards and enforcement; Title IV-Permit and licences; and Title V-General provisions.

The two goals of the Act are stated in Title I: By 1985 the discharge of pollutants into navigable waters should be eliminated; and water quality should be good enough for the protection of fish and shellfish, wildlife, and for recreation by 1983. The national policies are the prohibition of discharge of toxic pollutants, the provision of Federal financial assistance for the construction of publicly owned water treatment works, the preparation and implementation of areawide waste treatment and management plans. These policies will be supported by research and demonstration effort sponsored by the Federal Government. The responsibility of the States in pollution abatement is underscored. The Act appreciates the international significance of pollution and authorizes the President of the United States to cooperate with foreign countries in their efforts to prevent, reduce and eliminate pollution in their, and in international waters. The Environmental Protection Agency is the administrator of the Act.

Sections 102 and 103 of the Act deal with comprehensive programs for the control of water pollution and the enactment of uniform laws

for water pollution control to promote interstate cooperation. The administrator is required to establish national programs for the prevention, reduction, and elimination of pollution. In this connection, the administrator is authorized to conduct research and make grants to states and municipalities for the purpose of researching new and improved methods of controlling water pollution.

In order to implement the water pollution control programs, the Act gives authorization for the appropriation of sums of money. Federal, state and local government financial responsibilities are specified in Section 106 of the Act. Sections 107 and 108 deal with mine water pollution of the Great Lakes. There is provision in the Act for the training of personnel to operate and maintain treatment works. (Section 111). A number of demonstration projects are also authorized.

The purpose of Title II of the Act is to require states and municipalities to prepare and implement waste treatment management plans and to develop practices which will achieve the goals of the Act (Section 201). Such plans are subject to the approval of the Administrator (Sections 203).

Section 206 provides for partial reimbursement of costs to states and municipalities for any approved publicly-owned treatment works on which construction was begun between June 30, 1966 and July 1, 1972.

Waste treatment management on an areawide basis is covered in Section 208. The purpose of this section is to encourage and facilitate the preparation and implementation of waste treatment management plans. Upon the request of the Governor, the Administrator

shall provide technical assistance in the development of such management plans. Section 208 addressed specifically non-point sources of water pollution. The Act states that any plan prepared under Section 208 will include but not be limited to a process to (i) identify, if appropriate, agriculturally and silviculturally related non-point sources of pollution, including runoff from disposal areas and from land used for livestock and crop production, and (ii) set forth procedures and methods including land use requirements to control to the extent feasible such sources, and a process to identify mine-related sources of pollution and set forth procedures and methods to control such sources.

In Title III, standards of water quality, effluent limitations, and enforcement of the Act are covered. The Administrator is required to publish periodically the criteria for water quality and effluent limitation guidelines which reflect the latest scientific knowledge and technology. In addition, the Administrator shall from time to time provide guidelines for identifying and evaluating the nature and extent of non-point sources of pollutants. Provision is made for water quality inventory by all states and an annual report indicating the status of the quality of navigable waters of each state is required by the Act (Section 306). Procedures to be followed in the abatement of international pollution are dealt with in Section 310.

Each state is also required to identify and classify all publicly-owned fresh water lakes according to eutrophic condition, and procedures for the control of sources of pollution. Under Section 315, a National Study Commission is established to conduct a

comprehensive investigation and study of all aspects of potential impacts resulting from achieving or not achieving effluent limitations and the goal set for 1983. Pollution from thermal discharges is treated in Section 316.

Detailed procedures governing the application for and granting of permits and licences are set out under Title IV. The Administrator has the power to issue a permit for the discharge of any pollutant or combination of pollutants provided such discharge will meet certain prescribed requirements. Criteria for ocean discharge of pollutants, permits for dredge and fill material, and disposal of sewage sludge are discussed in Sections 403, 404, and 405.

Title V covers general provisions such as regulations, record keeping, publication in Federal Register and definitions. The Administrator is granted powers to bring suit against any water polluter, in case of emergency, notwithstanding any other provision of the Act (Section 504). Section 505 provides that any citizen may commence civil action on his own behalf against any person, including the United States and any other governmental agency (to the extent permitted by the eleventh amendment of the United States Constitution) who is alleged to be in violation of an effluent standard or limitation. The Administrator is required to submit to each session of Congress a report on measures taken in the process of attaining the goals of the Act.

Rationale of the 208 Program

Section 208 of the Act ties together the various Federal water pollution abatement requirements, and places the responsibility for

planning and implementing areawide waste treatment management plans on regional and local agencies. The Congress was guided by certain principles in creating Section 208.[17] First, water quality protection in a large country such as the United States, raises complex technical and institutional problems which vary widely across the nation. Solutions to these problems necessarily require a long time and decentralized system of management. Full involvement of state and local levels of government in 208 planning process was considered imperative for success.

The need for a decentralized system of management is supported by the fact that there are technical obstacles to the attainment of uniform requirements. A recent report of the Environmental Protection Agency to Congress discloses the following about the nation's water quality problems:

> Pollution exists in 3,300 water segments of varying lengths and areas, in the 56 states and territories reporting. About half of the segments are so heavily polluted that dischargers located on them will be required to go beyond base level controls required by 1977 to enable water quality standards to be met.[18]

This means that after applying base levels of pollution control for point sources, there will still be places where higher levels of abatement will be required to meet water quality goals of fishable

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[17]U. S. Environmental Protection Agency, Guidelines for Areawide Waste Treatment Management Planning (Washington: Environmental Protection Agency, August 1975), p. ii.

[18]U. S. Environmental Protection Agency, Office of Water Planning and Standards, National Water Quality Inventory-1974 Report to Congress (Washington: Environmental Protection Agency, 1974), pp. 1-3.

and swimmable waters.[19] Furthermore, the water quality problems are not entirely due to point sources such as industrial and municipal discharges but also due to runoff from both urban and rural areas. This indicates that uniform national requirements for abating pollution from industrial and municipal sources would be insufficient in many areas to meet water quality standards because even after high levels of treatment for the point sources of pollution, non-point sources of pollution would cause problems.

Institutional constraints also militate against uniform requirements. The most obvious institutional problem is the fragmentation of waste treatment management agencies. There are no simple solutions to this problem but it is clear that economies of scale can be achieved through the enlargement of treatment plants and service areas. On the other hand waste treatment on a regional scale requires a careful consideration of regional growth patterns and policies of affected jurisdictions. This raises the overall question of how decisions made about sewer service will affect growth, which in turn affects water quality not only through sewage generation but also increased pollution from urban runoff. Finally, until recently, the institutional questions

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[19] U. S., Congress, Public Law 92-500, Federal Water Pollution Control Act Amendments of 1972, Section 301(b). For municipal sources, secondary treatment is required by July 1, 1977 and Best Practicable Waste Treatment Technology is required by July 1, 1983. For industrial sources, Best Practical Technology is required by July 1, 1977 and Best Available Technology is required by July 1, 1983.

raised by the necessity to manage pollution from non-point sources have hardly been considered in the water programs of this nation.[20]

Second, sound ecosystem management is an important premise of the Federal Water Pollution Control Act Amendments of 1972. Basically the concept of ecosystem management recognizes that man's activities cycle resources, returning them to the environment in an altered state, and expending energy in the process.[21] Man's misuse of natural resources has led to many environmental problems. There is a close relationship between resource use and the generation of pollutants. If many of the complex pollution problems are to be solved, it will be necessary to apply the concept of sound ecosystem management as opposed to the more traditional water pollution abatement. Efficient ecosystem management implies the full use of resources to the benefit of man, and at the same time returning resources (residuals) to the environment with the least possible disturbance to ecological systems. Resource use is viewed in the context of a total process by which resources and polluting by-products are cycled.

Third, much of the legal authority and financial commitment required for the solution of water quality problems rests with local

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[20]Joseph Wiley, "Rationale of the 208 Program-Decentralized Management to Solve Complex Water Quality Problems," (This paper is based on a speech delivered by Mark Pisano, Director of Water Planning Division, U. S. Environmental Protection Agency, at ASPO Conference, Vancouver, British Columbia, April 15, 1975).

[21]Howard T. Odum, "Energetics of World Food Production," Readings on Ecological Systems: Their Function and Relation to Man, ed. Ariel E. Lugo and Samuel C. Snedaker (New York: MSS Educational Publishing Company, 1971), pp. 252-80.

government. This implies that Section 208 programs will require a new legislation for water quality control at the local level which makes the participation of the public and locally elected officials a prerequisite for success. Fiscal responsibility is related to local and public involvement in 208 programs. The provision of services such as sewage treatment and protection of water supply and water uses, and the coordination of these services with other community services are intimately related to the fiscal viability of the community.

Goals and Policies

As a national goal, the Federal Water Pollution Control Act Amendments of 1972 aims at preventing the pollution of navigable waters caused by the discharge of pollutants by 1985. An interim goal set for 1983 is to achieve water quality which is safe for recreational use and which protects fish and wildlife.[22]

It is the national policy to prohibit the discharge of pollutants in toxic amounts. Federal funds will be provided for the construction of treatment works owned by the public. In each state, areawide waste treatment planning and management processes will be developed and implemented. The states will retain their rights and responsibilities in the elimination of water pollution and in the preparation of plans for the development and use of land and water resources. Provision is made for public participation in the

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[22]U. S., Congress, Public Law 92-500, Water Pollution Control Act Amendments of 1972, Section 101(a), 92nd Congress, S. 2770, October 18, 1972.

development, revision, and enforcement of regulations meant to protect water quality. It is also the policy of Congress to ensure that the President, acting through the Secretary of State and other international organizations, will encourage foreigh countries to take meaningful action to prevent and eliminate pollution in their waters and in international waters.

Planning Process for Waste Treatment Management

The purpose of Section 208 of the Act is to encourage and facilitate the development and implementation of areawide waste treatment management plans in areas which, as a result of urban and industrial concentrations and other factors, have substantial water quality control problems. The Section 208 program is unique because state and local governments must prepare a plan and also make a commitment to implement the proposals of the plan in order to meet the 1983 water quality standards. Furthermore, Section 208 is the most positive statement on the need to identify and develop programs to solve water pollution problems arising from non-point sources.[23]

On the basis of guidelines provided by the administrator of the Act, the Governor of each state or the chief elected officials of local governments shall designate areas and a single representative organization to develop an areawide waste treatment management plan for such areas. Where an area lies in two states, the Governors of the respective states shall cooperate in carrying out the provisions

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[23]U. S., Congress, Public Law 92-500, Federal Water Pollution Control Act Amendments of 1972, Section 208(b)(2)(F-I).

requiring the designation of the areas.[24] The state shall act as the planning agency for areas which are not designated. All designations shall be subject to the approval of the Environmental Protection Agency.

The designations which the Governor submits to the Environmental Protection Agency must be accompanied by formally-adopted resolutions which show that local governments involved will join together to develop and implement a plan which will result in a coordinated waste treatment management system for the area.

Plans prepared in accordance with the waste treatment planning process shall contain alternatives for waste treatment and management and shall be applicable to all types of waste generated within the area involved.[25] Any plan prepared under Section 208 shall identify treatment works to meet the waste treatment needs of municipalities and industries in the area. Agencies for the construction, operation and maintenance of facilities will be identified. A process for identifying non-point sources of pollutants from agriculture, forestry, construction, mining and other activities will be evolved. The plan will specify procedures and methods, including land use control, for managing such sources.

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[24]U. S., Congress, Public Law 92-500, Water Pollution Control Act Amendments of 1972, Section 208(a)(3).

[25]U. S., Congress, Public Law, Water Pollution Control Act Amendemtns of 1972, Section 208(b)(1).

Technical and Management Planning Needs. Since the aim of the 208 planning process is to formulate an areawide waste treatment plan that can be implemented by a management agency or agencies, technical and management needs must be recognized and integrated into the planning process. The technical portion of the planning process concentrates on identifying priorities in water quality problems of the area, recognizing constraints in solving the problems, and developing alternatives to achieve water quality goals.

To be conducted simultaneously with technical planning is management planning. The various components of the plan are geared to implementation and hinge upon the development of an effective management plan for their execution. Management planning identifies existing water quality management problems such as lack of authority for controlling residual wastes in a given area. Bottlenecks in devising an effective management approach must be identified. On the basis of a management analysis, alternative systems for effective water quality management are formulated. The alternatives are evaluated in terms of their feasibility in implementing a technical plan.

The Act provides for "the establishment of a regulatory program to regulate the location, modification and construction of any facilities within such area which may result in any discharge . . . ."[26] This provides authority for the management agency to regulate the loca-

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[26]U. S., Congress, Public Law, Water Pollution Control Act Amendments of 1972, Section 208(b)(2)(C)(ii).

tion of new pollutant dischargers by determining the location of municipal treatment facilities, control of other pollutant sources, and by seeking appropriate changes in land use plans and controls from the agencies possessing land use jurisdiction in the area.

The Environmental Protection Agency has indicated that 208 planning must relate to areawide and local land use policies and plans. If existing land use plans will not interfere with the achievement of water quality standards, there is no mandatory requirement for changing such plans. In fact, they may be used as a basis for 208 planning. The Environmental Protection Agency stresses the need for meaningful land use plans throughout the designated area.[27]

Implementation. The implementation of a 208 plan will be undertaken by waste treatment management agencies (which may be existing or newly created). It is part of the planning function to ensure that the agency has the proper legal authority to perform its tasks.

The costs associated with a 208 program are divided into four categories: traditional resource costs, social costs, environmental costs, and economic costs. These costs are spelled out in greater detail in the Environmental Protection Agency guidelines.[28] The question of cost effectiveness is measured by the attainment of the 1983 water quality goals.

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[27]U. S. Environmental Protection Agency, Draft Guidelines for State and Areawide Water Quality Management Program Development (Washington: Environmental Protection Agency, Feb. 1976), p. 6-2

[28]Ibid., pp. 11-1 to 11-7.

Applications which meet the Environmental Protection Agency criteria will be funded by the administrator. The Agency has full authority to use all monies provided in the Act as follows: $50 million in the fiscal year 1973, $100 million in the fiscal year 1974, and $150 million in the fiscal year 1975. The Environmental Protection Agency derives its authority from the following:

> The amount granted to any agency under paragraph (1) of this subsection shall be 100 per centum of the costs of developing and operating a continuing area-wide waste treatment management planning process under subsection (b) of this section for each of the fiscal years ending on June 30, 1973, June 30, 1974 and June 30, 1975 and shall not exceed 75 per centum of such costs in each succeeding fiscal year.[29]

After the fiscal year ending on June 30, 1975, the state and local governments concerned will have to bear 25 percent of the cost of implementing a 208 plan.

Public and Private Involvement

The state designates 208 planning areas, reviews 208 grant applications, and gives approval and certification to plan on an annual basis. The state is also responsible for establishing the water quality objectives consistent with the appropriate 303 Basin Management Plan and the water pollution control goals of 1983.

If the agency for a 208 planning area submits a plan to the state for approval and the state does not approve it because it is incompatible with the state basin plan, the 208 agency is required by law to amend its plan to comply with the state's provisions. However, a state's decision not to certify an agency plan can be overridden

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[29]U. S., Congress, Public Law 92-500, Federal Water Pollution Control Act Amendments of 1972, Section 208(f)(3).

by the Environmental Protection Agency admonistrator or the regional administrator of the Environmental Protection Agency.

The 208 program determines who makes water quality decisions which affect growth and land use and who implements the decisions. The program emphasizes collaboration among governments to solve areawide problems. If a state does not designate, it will have to undertake areawide planning without the advantage of 208 funding from the Federal Government. State water quality decisions will have a significant impact on the growth and development of communities under the jurisdiction of local governments.

Since the optimum degree of public involvement will usually not occur spontaneously, simply providing information to those who ask for it is not adequate. An active program is needed to seek out and encourage those who can provide inputs as well as those who will be affected by the plan.

The 208 program should be responsive to all interested citizens. Participation in planning should not be dominated by any one interest group or individual.[30] This can best be done by including without exception in mailings, notifications, etc., all parties who express interest in the planning process or who have been involved in community issues related to water quality planning and management.

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[30]U. S. Environmental Protection Agency, Water Planning Division, Draft Guidelines for State and Areawide Water Quality Management Program Development (Washington: E.P.A., Feb. 1976), p. 4-5.

Relationship between 208 program and other programs

208 Plan and 303 Basin Plan. Section 303 basin plans provide water quality standards and goals, define critical water quality conditions, and provide waste load constraints. The 303 plans are prepared by the state and constitute the overall framework within which 208 plans are developed for specific portions of the basin. The 208 areawide plan selects load allocations and target dates defined by the state in a particular area and attempts to find the most reasonable way of achieving these goals. Section 208 plans will form an integral part of the basin plans, and must be certified annually by the Governor as being consistent with approved basin plans.

Section 208 Planning and 201 Facilities Planning. Preliminary design portions of plans and studies related to actual construction of publicly-owned waste treatment works are covered under section 201 facilities plans. Facilities plans are intended to assure development of cost effective and environmentally sound local waste treatment systems. In essence, facilities plans are limited to the abatement of pollution from point sources and those industries served or to be served by waste treatment systems.

Section 208 and 201 facilities plans can be implemented concurrently. Features included in the approved 201 facilities plans should be incorporated in 208 plans. Ultimately the 208 plan will serve as the facilities plan for the designated area.

208 Plans and the National Pollutant Discharge Elimination System Permit Program. The Section 402 permit program is designed to ensure that discharges do not exceed prescribed standards. A

permit will provide the essential tool for implementing a 208 plan. No permit may be issued for point sources which are in conflict with approved 208 plans, since such plans become a part of the general 303 basin plan.

208 Programs and Federal Programs. The relationship between Section 208 and other Federal programs is in the embryonic stage. The ensuing discussion covers Federal programs relating to water quality management. The objective is to provide designated 208 areas with the opportunity to maximize the use of available assistance in accomplishing an areawide water quality program.

The Department of Housing and Urban Development (HUD) 701 comprehensive planning funding program may prove to be a worthwhile planning input into 208 areawide planning. The HUD recently entered into an interagency agreement which provides for coordination between 701 land use aspects and 208 planning. The agreement encourages the use of HUD 701 funds for land use plans to regulate growth, in keeping with 208 land use control objectives.[31]

Under wastewater management, the Environmental Protection Agency's state and local Manpower Development Program provides training for local operators of waste treatment facilities in advanced wastewater treatment technology. Two other Federal programs help to fund wastewater treatment plants. Loans to small businesses under the Federal Water Pollution Control Act Amendments of 1972 is a low interest loan

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[31] U. S. Environmental Protection Agency, Water Planning Division, Federal Programs Impacting Regional Water Quality Management (A Draft Report prepared for the Miami Valley Regional Planning Commission, January 1976), p. 2.

program administered by the Small Business Administration. It provides loans to small businesses for the construction of waste treatment facilities for industrial wastes. Water and Waste Disposal Systems for Rural Communities is also a low interest loan program administered by the Farmers Home Administration. By means of this program rural communities are given assistance to meet the 25 percent local share required for funding under 201 waste treatment facilities grants program.

The National Flood Insurance Program administered by the Department of Housing and Urban Development deals with flood plain management. The program issues insurance to owners of newly constructed and existing structures and it requires that local communities impose strict land use controls on development in flood plains. This includes requirements for proper siting and flood-proofing of wastewater treatment facilities constructed on flood plains. Through the Watershed Protection and Flood Prevention Program the Soil Conservation Service provides technical assistance to land owners.

There are many Federal programs which can contribute to the alleviation of agricultural runoff and other forms of water pollution. These contributions take the form of technical assistance, grants and loans to rural landowners and public bodies. The pertinent programs and their administering agencies are presented on the following page.

Program	Administering Agency
Soil and Water Conservation	Soil Conservation Service technical assistance
Soil Survey	Soil Conservation Service
Soil and Water Loans	Farmers Home Administration
Watershed Protection and Flood Prevention	Soil Conservation Service technical assistance
Watershed Protection and Flood Prevention Loans	Farmers Home Administration
Irrigation, Drainage and Other Soil and Water Conservation Loans	Farmers Home Administration
Water Bank Program	Agricultural Stabilization and Conservation Service Grants
Agricultural Conservation Program	Agricultural Stabilization and Conservation Service Grants
Resource Conservation and Development Loans	Farmers Home Administration

SOURCE: U. S. Environmental Protection Agency, Water Planning Division, Federal Programs Impacting Regional Water Quality Management (Draft Report prepared for the Miami Valley Regional Planning Commission, January, 1976), p. 4.

The present Federal commitment to solid waste management is minimal. The Environmental Protection Agency's Solid Waste Technical Assistance, Training and Information Services provide assistance to public authorities and agencies in solving the solid waste environmental problems. Through its Resource Conservation and Development Program, the Farmers Home Administration makes loans available to rural landowners for waste treatment facilities, including landfills and incinerators.

An input into the control of sediment erosion on highway construction is provided by the Federal Highway Administration of the U. S. Department of Transportation through regulations in its Federal Aid Highway Programs Manual. These are the regulations which state highway departments must adhere to during the construction of any highway using Federal funds.

A-95 Review. In accordance with the Office of Management and Budget Circular A-95 Revised, dated November 13, 1973, all applicants under Federal programs which provide assistance to state, local and areawide projects and activities planned on multijurisdictional basis must notify the appropriate state and areawide planning and development clearing house for review and comment. The proposed application will be reviewed for its consistency with areawide plans including comprehensive planning, environmental concerns, water supply and distribution systems, sewage facilities and waste treatment works, and land use. In most cases, either a regional planning agency or the Council of Governments serves as the regional clearing house, and as mentioned above, may be utilized as the areawide planning agency under Section 208.

Planning Implications

Planning is conceived as a continuous process which embraces plan preparation and plan implementation. In this respect some aspects of planning were carried out by various agencies in this country long before the ambitious requirements of Section 208 became law in 1972. In some cases, Section 208 makes provision for the employment of existing practices to achieve the goal of the Act; in other

respects, drastic changes are required. The implications of Section 208 for planning are discussed below.

Areawide/Regional Approach to Planning. Prior to the 1972 Amendments, Federal programs relied very heavily on independent actions by various jurisdictions to abate water pollution. Regional approaches to the solution of water quality problems were rarely encouraged.

Section 208 is problem-oriented. In this legislation, water pollution is viewed in its totality. Water pollution problems do not respect jurisdictional boundaries, especially when non-point sources of pollution are considered. The Act, therefore, directs that as much as possible, 208 planning is to be done on an areawide or regional basis. However, planning on a regional basis in an area of well-established local units of government raises some questions. One significant problem is how to reconcile the interests of all the local governments in order to achieve the goal of the Act.

Intergovernmental Cooperation. In a designated area, federal, state, and local levels of government may have programs which are pertinent to water quality. For example, authority for setting water quality standards is vested in the Environmental Protection Agency and the states; construction planning responsibility is given to the metropolitan government; and land use control powers are vested in local governments. Since decisions taken by the various levels of government have some impact on water quality, it is necessary to find a way to make their programs compatible with one another, and at the same time make them serve the purposes of the Act. This suggests that no planning agency for a designated area should operate in isolation.

It must recognize the important contribution which existing agencies can make to the planning process, and to design planning and decision-making processes that coordinate the varying responsibilities as the 208 plan unfolds. The need for coordination--horizontally and vertically--is brought into sharp focus. The purpose of this co-ordination is to eliminate unnecessary and avoidable duplication of effort, and thereby pool resources for the effective solution of water quality problems found in the designated area.

Water Quality as one of many goals. The objective of Section 208 is to determine ways to attain the water quality goal for 1983 as stated in the Act. Many considerations are required for the achievement of this goal. Processes which generate pollutants from both point and non-point sources merit examination. In this connection, land uses are relevant to water quality determination. Section 208 is not a land use program but it does have a definite relationship to land use. Land use can therefore be expected to receive serious attention in a 208 plan. Related to land use is the complex question of resource utilization. Section 208 will undoubtedly provide impetus to existing public and private efforts made to ensure that decisions on land and other resources accurately reflect the long term needs of the public. However, public decisions on resource use are influenced by many public goals, and water quality should be regarded as only one of the important goals. This implies that the weight assigned to water quality as a goal should be weighed against the other public goals.

Planning and Management Agencies. The Section 208 legislation fully recognizes the need to prepare a plan and to manage or implement its proposals. The Act requires that

> The Governor in each state in consultation with the planning agency designated under subsection (a) of this section, at the time a plan is submitted to the Administrator, shall designate one or more waste treatment management agencies . . . for each area designated under subsection (a) of this section and submit such designation to the Administrator.[32]

However, the split between planning and management presents the challenge of establishing a strong and functional relationship between the planning agency and the management agency/agencies. All water pollution problems will not be solved by the first plan prepared by the planning agency and all necessary management are not likely to be vested in a single sewer agency. Planning should therefore be regarded as a continuous process which receives feedback from implementation or management at specific times. Planning and management should be inextricably intertwined.

Interprofessional Relations. The abatement of water pollution has many facets which require the special knowledge of many different professionals. This presents the challenge of interprofessional cooperation. Traditionally, solutions to water pollution problems have been the province of civil and sanitary engineers. Within the large context of water resource and environmental management, other professionals such as the planner, the public administrator, the ecologist and the lawyer are needed. The task is one of deciding on the complementary roles of and relationship among the professionals to

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[32]U. S., Congress, Public Law 92-500, Federal Water Pollution Control Act Amendments of 1972, Section 208(c)(1), 92nd Congress, S. 2770, October 18, 1972.

serve on the staff of the planning agency. The group of professionals must work together as a team. Although the 208 plan is to be prepared by a planning agency, the latter needs inputs from many concerned citizens and professional people outside its regular staff.

Section 208 of the Act afforded all states and local governments the opportunity to tackle their water pollution problems more effectively than they had ever done. But state designation of planning areas did not proceed as quickly as was expected in the initial stages, until the Natural Resources Defence Council sued the Environmental Protection Agency over the issue of funding for state 208 programs.[33] The court decision, which established complete state responsibility for 208 planning areas outside designated areas within the state, accelerated the rate of gubernatorial designations. By the end of the financial year, 1975, a total of 149 planning agencies had been designated.[34] One of those agencies was the Tri-County Regional Planning Commission. The ensuing chapter discusses the 208 planning approach of this planning agency.

Summary

The first Federal legislation directed specifically to water pollution was the Water Pollution Control Act Amendments of 1948. Its purpose was to protect public health. The Act was amended in 1956 to facilitate Federal enforcement of water quality standards.

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[33] Natural Resources Defence Council et al. v. Train, et al., 396 F. Supp. 1386 (D. D. C., 1975).

[34] U. S. Environmental Protection Agency, National Profile of Section 208 Areawide Management Planning Agencies (Washington: Environmental Protection Agency, 1975), p. 3.

Water pollution legislation in the 1960's focused on the establishment of water quality standards by states and pollution from oil and acid mine drainage.

Following a review of all legislation on water pollution which began in 1969, the U. S. Congress enacted the Federal Water Pollution Control Act Amendments of 1972, which aims at preventing pollution of navigable waters of the nation by 1985. Its intermediate goal for 1983 is to achieve water quality which is safe for recreational use and which protects fish and wildlife.

Section 208 of the Act deals specifically with non-point sources of water pollution. The 208 planning process involved the designation of a planning area, a planning agency, and management agency/ies by the governor or the chief elected representatives of the state. The planning agency shall prepare a 208 plan which contains alternatives for waste treatment and management, and shall be applicable to all types of waste generated within the planning area. The 208 plan shall form an integral part of the Section 303 basin plan. It shall also have a close relationship with 201 facilities planning, the 402 permit program and the other federal programs.

Section 208 legislation emphasizes the need to coordinate planning efforts by different agencies, and to reconcile water quality goals with community goals. It also raises the question of functional relationships between the planning agency and management agency/ies, and the complementary roles of various professionals engaged in Section 208 plan preparation. The discussion of Section 208 legislation has provided the necessary background information for making

an assessment, in Chapter 5, of the approach to 208 planning by the Tri-County Regional Planning Commission.

CHAPTER 4

INSTITUTIONAL ARRANGEMENTS FOR CONTROLLING WATER POLLUTION

The issue of institutional arrangements for areawide waste treatment management planning is important in connection with its impact on traditional state and local institutional relationships. Two major concerns are: (1) whether or not traditional powers of either state or local governments will be weakened through a shift in authority between the levels of government as a result of Section 208 requirements; (2) whether Section 208 of the Act would necessitate the creation of a new intermediate level of government that would radically change traditional relationships.

Section 208 of the Act is not interpreted as a mechanism to reorganize state and local government by the Environmental Protection Agency.[1] One important consequence of areawide waste treatment planning and management will be increased cooperation between state and local governments, and among local governments in matters concerning water quality. Each level of government has a vital role to fulfill in 208 planning and management in order to achieve the 1983 goal of

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[1] U. S. Environmental Protection Agency, Executive Summary of Section 208 Program for Designated Areas (Washington: Environmental Protection Agency, 1974), p. 6.

the Act. Radical changes in traditional powers and relationships are not required.[2]

However, much of the success of 208 planning will depend on how the designated planning agency and management agency/ies discharge their responsibilities. This chapter discusses 208 planning in the Tri-County Region with emphasis on approaches to planning and management being followed by the designated agency (Tri-County Regional Planning Commission) and with a view to making recommendations for the future direction of areawide waste treatment planning in the region.

The Tri-County Region

The Tri-County Region is one of the 13 state planning regions in Michigan. It comprises the counties of Clinton, Eaton and Ingham. The region is located in the south-central part of the Lower Peninsula of Michigan, (See Figure 4) and it covers an area of 1,697 square miles. Its population in 1970 was 378,423.[3]

Drainage

The Grand River, one of Michigan's largest rivers, flows through the central portion of the Tri-County Region. The Grand River Basin (or Watershed) encompasses most of the region. South-west Eaton County and the extreme south-east corner of Ingham County are not part of the Grand River Basin. (See Figure 5).

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[2]Ibid.

[3]U. S. Department of Commerce, Bureau of the Census, United States Census of Population: 1970, General Population Characteristics, Michigan, Pc(1)-B24, pp. 178-80.

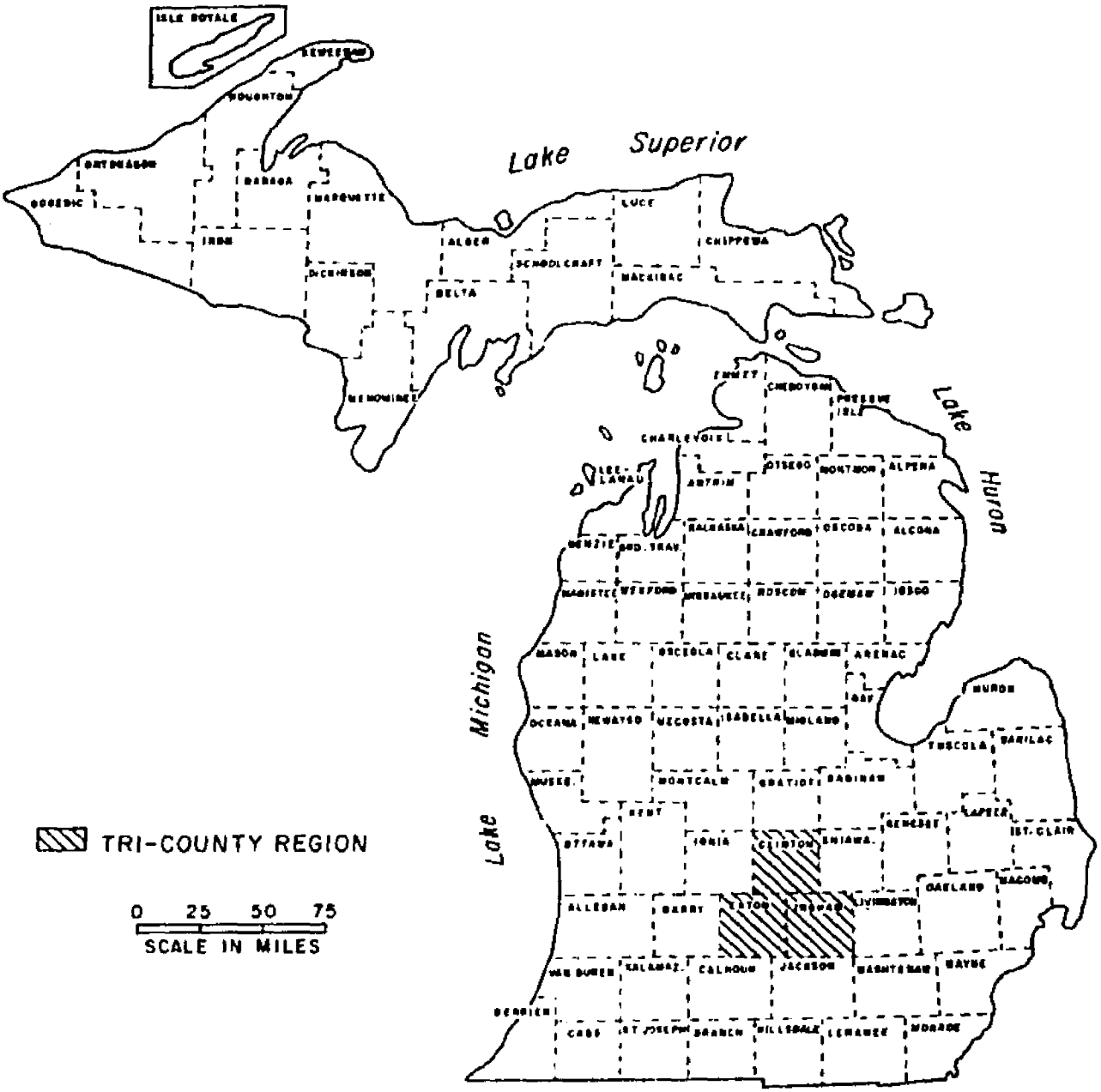

Figure 4. Map of Michigan showing the Tri-County Region

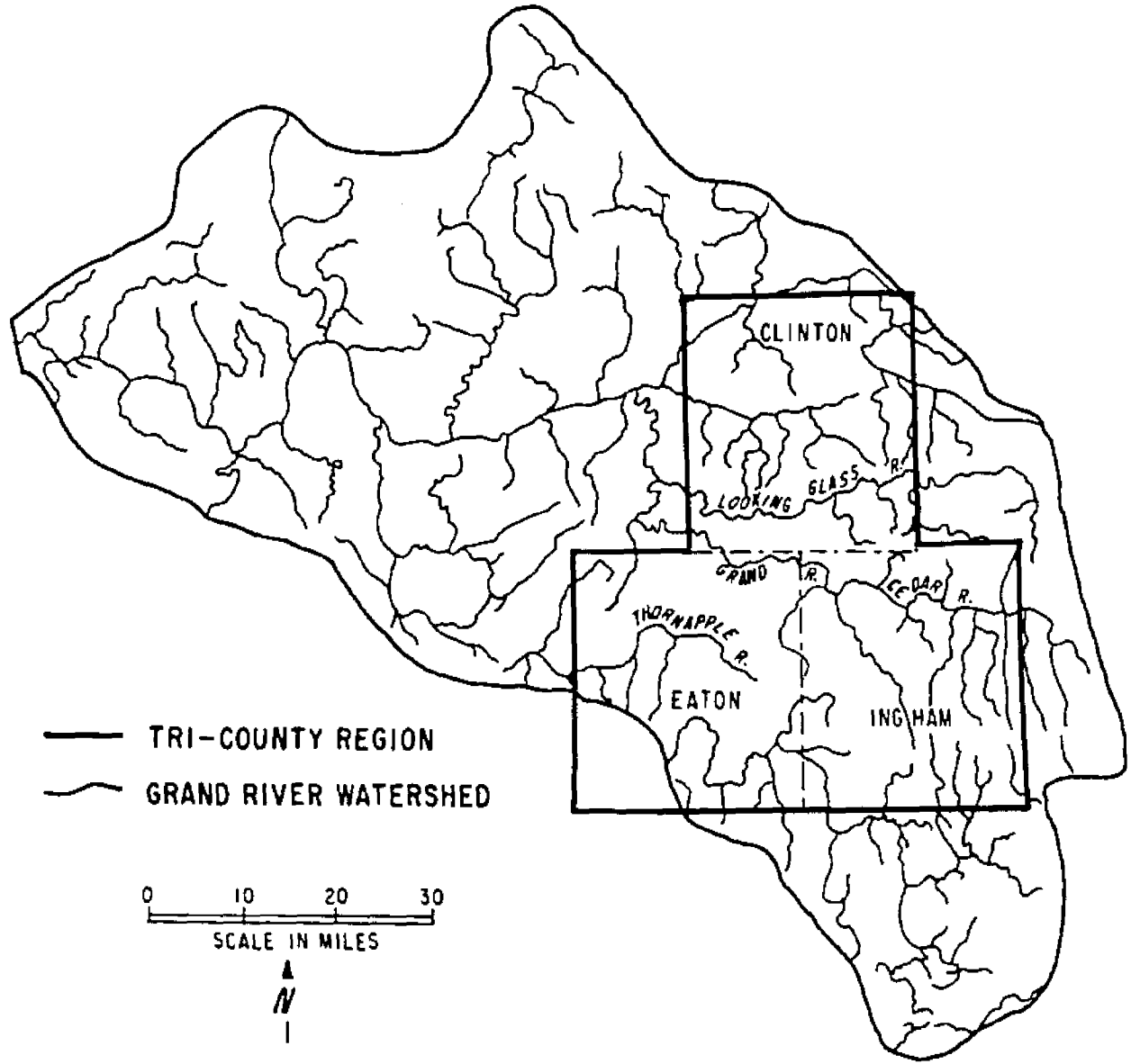

Figure 5. The Tri-County Region in the Grand River Watershed

It was at the confluence of the Grand River and the Red Cedar River, the largest tributary of the Grand, that the first settlement of the Grand River Basin was sited. This early settlement later became known as the City of Lansing. The Red Cedar flows through East Lansing and Williamston in the Ingham County. The 450-2,600 foot wide Intermediate Regional floodplain[4] covers extensively developed areas near the confluence with Sycamore Creek in Central Meridian Township. A portion of the developed area of Williamston is within the confines of the Intermediate Regional Floodplain. A number of residential, commercial and industrial facilities in addition to roads crossing the Red Cedar River would be inundated by the Intermediate Regional Flood.[5]

Sycamore Creek is a tributary of the Red Cedar River. Its northern extremity flows through south-eastern Lansing. Some residential areas are now within the 200-3,200 foot width Intermediate Regional Flood boundary. Industrial and commercial facilities as well as farmlands would be inundated by the Intermediate Regional Flood.[6]

The Maple and Lookingglass Rivers in Clinton County are located in rural areas of the Tri-County Region. DeWitt and Maple Rapids are the only concentrated developments along the rivers. A few houses may

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[4]In April 1947, a flood inundated 100 blocks in Lansing leaving 2,500 people homeless. This flood was approximately one foot less than the 50-year Frequency Flood as calculated at points along the Grand and Red Cedar Rivers. An Intermediate Regional Flood (a flood that has an average frequency of occurring once in 100 years) would be approximately two to three feet above the April 1947 flood.

[5]Tri-County Regional Planning Commission, Environmental Framework Study (Lansing: TCRPC, [n.d.]), p. 25.

[6]Ibid., p. 26.

be affected by the Intermediate Regional Flood, but for the most part, farmlands and scattered houses would be in any danger of flooding.

In Eaton County flow the Thornapple and Battle Creek Rivers. The Thornapple River flows through northern Eaton County where only scattered residential and agricultural lands lie within the Intermediate Regional Floodplain. The Battlecreek River flows through Bellevue where a few houses are located within the floodplain.

The land surface of the Tri-County Region is either flat or gently rolling. In general terms, this type of landform is characteristic of the central parts of Michigan. There are 24 natural lakes, the majority of which are too small for large scale recreational use. A large portion of the region is swampy with wetlands covering many square miles.

Land Use

Land use data are essential in planning and development. To be useful, the data must be kept up-to-date on a continuing basis because land use is subject to change. Land use changes reflect the values and goals of people. The Tri-County Region has experienced changes in its land use. Signs of land use change are evident in most parts of the region. Sprawling suburbs and new country homes are scattered in many farming areas. Almost every community in the region seems to have its new residential subdivision, and some of them have a suburban shopping center and an industrial park. There is evidence also of a

rapidly changing agriculture--fields are getting larger and mechanization is common.[7]

Land uses have a direct impact on water quality. Table 3 shows the main categories of land use in the Tri-County Region.

TABLE 4

LAND USE IN THE TRI-COUNTY REGION, 1969

Use	Clinton		Eaton		Ingham	
	Acres	%	Acres	%	Acres	%
Forestry	45,000	12.3	55,800	15.3	58,300	0.2
Agriculture	286,958	78.4	259,883	71.1	230,949	64.5
Transportation	12,392	3.4	13,923	3.8	16,800	4.7
Recreation	8,807	2.4	233	0.1	6,702	1.9
Urban Development	4,180	1.1	8,117	2.2	34,984	9.8
Other	8,669	2.4	27,548	7.5	9,961	2.8
Land Surface	366,016	99.8	365,504	99.8	357,696	99.8
Inland Water	704	0.2	576	0.2	704	0.2
Total Area	366,720		366,080		358,400	

SOURCE: Cooperative Extension Service, Michigan State University, County and Regional Facts for the Counties of Clinton, Eaton and Ingham (Lansing: Cooperative Extension Service, M. S. U., n. d.), p. 35.

The category for inland water includes the surface area of all bodies of water within the boundaries of the Tri-County Region. Only 0.2 percent of the total area of the region is covered by inland water. This situation supports the need to protect water quality in the region. Agriculture is the predominant land use followed by forestry, urban development, transportation and recreation in a descending order.

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[7]William J. Kimball, "A Changing Michigan," in Land Use in Michigan (First revision; East Lansing: Cooperative Extension Service, Michigan State University, January 1969), p. 2.

Urban Development

In its early history, the region was heavily forested. Today, as a reuslt of urbanization and conversion of forest land to agricultural and other uses, forest lands are arranged in woodlots which dot the rural areas. The soils have provided a good basis for agricultural activities.

Other economic activities have led to the growth of diverse types of rural and urban communities. In the center of the region is located the Lansing Metropolitan area which serves as the focus of industrial and commercial activities. In recent years, rapid urban growth has been experienced on the periphery of the metropolitan area. Outside the metropolitan area are ten cities ranging in size from 1,000-9,000 in population, and about 15 rural communities. It has been estimated that nearly 90 percent of the land area is rural in nature.[8]

Water Pollution Problem

The Tri-County Region has very complex water pollution problems. Four stream segments within the region--parts of the Grand and Red Cedar Rivers, the entire length of the Sycamore Creek and a large portion of the Battle Creek River--are classified by the Michigan Department of Natural Resources as four of the fifteen most polluted rivers within the entire State of Michigan.[9]

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[8]Tri-County Regional Planning Commission, Regional Water and Wastewater Management - Technical Report (Lansing: TCRPC, 1971), p. II-3.

[9]Tri-County Regional Planning Commission, 208 Areawide Waste Treatment Management Program, Work Program (Lansing: TCRPC, March 1976), p. 9.

River or stream water pollution is partly due to the seasonal fluctuation of the rivers. During the summer months, when water flows are low, the ability of streams and rivers to assimilate waste is diminished almost to nothing. Even when the water is cleaned to 95 percent purity, microorganisms which are discharged into the water during low flow conditions use available oxygen and leave the rivers in an unacceptable condition.

A concerted effort is being made my many governmental units in the region to clean up waste dischargers by providing secondary and tertiary treatment to domestic and industrial waste. But the achievement of high water quality is complicated by non-point sources of pollution. It has therefore been determined by governmental units of the Tri-County Region, the Michigan Department of Natural Resources and the U. S. Environmental Agency that 208 planning together with implementation is the only available means of dealing with the region's water pollution problem.

Designations

In September 1973, the U. S. Environmental Protection Agency published Planning Area and Agency Designation Regulations in the Federal Register. These regulations set forth criteria which planning areas and agencies would have to satisfy to be eligible for a 208 deisgnation. Pursuant to the Act and the Planning Area and Agency Designation Regulations, Section 208 planning areas and agencies are to be designated by the governor of a state or, in some instances, by locally-elected officials of the area. In a letter of March 28, 1975, to the chairman of the Tri-County Regional Planning Commission,

Governor William Milliken of Michigan, designated all of Clinton, Eaton and Ingham Counties as an areawide waste treatment management planning area. The Tri-County Regional Planning Commission (TCRPC) was designated as the areawide waste treatment management planning agency for the Tri-County Region.[10]

Area Designation

The designation of the Tri-County Region was made because of the serious water quality problems identified for the region. Portions of the Red Cedar, Grand and Battle Creek Rivers, and the Sycamore Creek have been identified as polluted. These problems were considered such that they could hamper the attainment of water quality goals established in the Act. The problems are partly due to urban/industrial concentration in the region.

Concern for water quality has been shown in various ways by local units of government, state and federal government agencies in the region. Many studies and plans on water quality in the region have been made. The Grand River Basin Planning Study,[11] Water Quality Management Plan for the Grand River Basin,[12] Report on Stormwater Facilities,[13]

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[10]An official letter, dated March 28, 1975, was sent to Mr. Mr. Almond B. Cressman, Chairman, Tri-County Regional Planning Commission by William G. Milliken, Governor, State of Michigan.

[11]Grand River Coordinating Committee, Army Corps of Engineers, Grand River Basin Comprehensive Water Resources Planning Study, 11 Volumes (Washington: U. S. Department of Agriculture, 1973).

[12]Water Resources Commission, Michigan Department of Natural Resources, Water Quality Management Plan for the Grand River Basin, Draft (Lansing: State of Michigan, 1974).

[13]Tri-County Regional Planning Commission, Report on Combined Stormwater Facilities (Lansing: TCRPC, 1972).

and Water Supply Development and Management Alternatives for Clinton, Eaton and Ingham Counties[14] are some of the studies pertinent to water quality considerations on a regional scale. In some instances, waste treatment plants have been built and are being operated by individual units of local government. Regional water quality problems defy solutions on a local uncoordinated basis. There is therefore the need for a cooperative effort by units of local government and other jurisdictions to solve the problem on an areawide basis. All these considerations led to the designation of the Tri-County Region as a 208 planning area.

Planning Agency Designation

Since 1956, the Tri-County Regional Planning Commission has been conducting studies which have a bearing on water quality. The considerable previous work conducted in the region will serve as a foundation upon which to base Section 208 program. This work includes substantial inventory of land use and transportation planning activity at the regional and local levels, modeling of many aspects of surface and groundwater and continuing water quality data collection effort by the State of Michigan and the Grand River Watershed Council, and regional waste water studies by the Tri-County Regional Planning Commission completed in the early 1970's.

The goal of the 208 program in the Tri-County Region for the period July 1, 1975, to June 30, 1977, is to develop a well-integrated

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[14] K. E. Vanlier et al., Water Supply Development and Management Alternatives for Clinton, Eaton and Ingham Counties, Michigan, Report No. 1965, A Geological Survey Water Supply Paper which focuses on the time period of 1969-1990 (Washington: U. S. Geological Survey, 1969).

strategy for joint land use-wastewater management.[15] Policies already formulated by the TCRPC aim at achieving this goal. In a study, "Regional Drainage Management--Preliminary Report," the goal has been stated as a regional drainage plan integrated with a regional development plan.[16]

The Grand River, for example, flows through all the three Counties of the region. The use or misuse of a drainageway by one community often affects the use of that portion of the same drainageway serving adjacent communities. This is a case in support of a regional approach to accommodate stormwater runoff. A comprehensive development plan showing the location of proposed land development has been prepared for Clinton, Eaton and Ingham Counties. This regional plan hopefully reflects the development plans prepared by local units of government located in the region, including the cities of Lansing and East Lansing.

The comprehensive development plan adovcates an orderly development of efficient and economical drainage facilities.[17] The development of drainage facilities which enhance natural beauty, foster environmental quality, and conserve natural resources constitutes another goal of the plan. The administration of the plan is based on the drainage system. Under each of the above goals guidelines for orderly development are provided.

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[15]Tri-County Regional Planning Commission, 208 Areawide Waste Treatment Management Program, Work Program (Lansing: TCRPC, 1976), p. 10.

[16]Tri-County Regional Planning Commission, Regional Drainage Management--Preliminary Report (Lansing: TCRPC, 1972), p. I-2.

[17]Ibid.

In another study, Rural Water and Wastewater Management,[18] guidelines for managing wastewater at the local and regional levels are suggested. One guideline requires the TCRPC to designate specific service areas for water and sewer utilities in the nine-township metropolitan area. Such designation was generally expected to result in economies of construction and operation of the waste treatment plants. The study further points out that the interrelated urban and rural water problems require that land use control on a broad basis should be adopted. Such requirements for water and wastewater management should be combined with recreational and open space requirements. There is also a guideline to protect groundwater recharge areas.[19] Groundwater recharge areas should be protected against stripping of vegetation, regrading of land surfaces, creation of impermeable surfaces and pollutants in the natural infiltration zone.

For local communities, the Rural Water and Waste Management Report recommends the development of a specific development plan to cater for the provision of adequate water and waste water control systems. Implementation of local water and sewer improvement programs should be preceded by factual public relations program. Local leadership for the successful implementation of the plan is emphasized by the report.

In another report, The Environmental Framework of the Tri-County Region, the TCRPC has delineated the environmental capacity of the

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[18]Tri-County Regional Planning Commission, Rural Water and Wastewater Management, 1971. This Report, financed by the Farmers Home Administration, studied water and wastewater needs in municipalities of under 5,500 inhabitants.

[19]Ibid., p. 16.

region for growth. The environmental features considered regionally significant included groundwater, floodplains, wildlife habitats, agricultural lands, mineral resource deposits, forestlands, soils, slope and historical sites. Each feature was studied to determine its regional and statewide importance. On the basis of a range of land uses, increasing in intensities, five classes of land use intensities were developed. The five classes of developable land were described as Critical, sensitive, limited, favorable, and preferred. Land uses were recommended for each of these classes. The report made suggestions for further detailed studies, should impending conflict of resource use become apparent.

The reports discussed above indicate just a few of the studies made by the Tri-County Regional Planning Commission. These and other studies of the TCRPC can be found in the 208 Areawide Waste Treatment Management Program.[20]

Following the governor's designation, the U. S. Environmental Protection Agency gave the Tri-County Regional Planning Commission an award of $70,400 to provide areawide waste management planning in the Tri-County Region. The award was made in recognition of the TCRPC's commitment to water pollution control as shown by its many previous studies and plans.[21]

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[20]Tri-County Regional Planning Commission, 208 Areawide Waste Treatment Management Program, Work Program (Lansing: TCRPC, March 1976), pp. 24-7.

[21]A letter to Mr. Herbert D. Maier, Executive Director, Tri-County Regional Planning Commission dated June 27, 1975, from Francis T. Mayo, Regional Administrator, Region V, U. S. Environmental Protection Agency.

Management Agency Designation

In order to implement a 208 areawide plan, it is necessary to set up a 208 management program which includes a structure of organizations and institutions and their responsibilities in carrying out the areawide plan. These organizations may be new ones or existing agencies of general purpose state and local government, special districts, multipurpose regional agencies, or any combination of these. The management agency's functions, organizational structure, powers and funding are all elements of the management program. The 208 plan will describe a management program, and the governor will actually deisgnate those agencies to carry out the plan. The governor will submit his choice of these agencies along with the 208 plan to the Environmental Protection Agency for Approval, within two years after 208 planning has been initiated.

The designated planning agency, the Tri-County Regional Planning Commission, is in the process of preparing a 208 plan for the Tri-County Region. The 208 plan should be completed by June 30, 1977. By that time sufficient detail on the functions and activities of the prospective management agency/ies will have been provided by the TCRPC, to enable the governor to make a designation.

Relationship of 208 Planning to 208 Management

Management can be considered the 'doing' phase of the 208 planning process. In planning, wastewater management policies are set and agreed upon. Then, the management agencies take over and carry out these policies and plans on a day-to-day basis. Thus planning is the designing phase and policy-formulation element, while management

is the operational phase, when policies are translated into action and implemented.[22]

Planning is a continuous process. It is not a two-year affair that concludes with the completion of the first plan in 1977, but rather continues to give guidance to all management agencies involved in areawide water protection and clean-up. The Federal law calls for the 208 plan to be reviewed each year to ensure its continuity. The substantial funding at the beginning of planning in the Tri-County Region is intended to encourage continuing, and even more essential, planning in the long run.

Staffing

The Tri-County Regional Planning Commission is made up of representatives from the Counties of Clinton, Eaton and Ingham, Lansing and East Lansing. As of March 1976, there are 16 members of the TCRPC, and the Chairman is Milford J. Moore of Eaton County.

As regards staffing, the philosophy of the TCRPC is to promote an integrated staff-consultant effort to ensure an on-going planning program which can be updated in years to come. Staff composition attempts to reflect this philosophy, in that not all the required professionals can be found on the TCRPC's regular staff. There is an engineer to coordinate all engineering in on-going 201 facilities plans and to review and work closely with the engineering consultants hired by the TCRPC. The environmental planner is responsible for work dealing with the abatement of non-point sources of water pollution. There is

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[22]U. S. Environmental Protection Agency, Management Agencies Handbook for Section 208 Areawide Waste Treatment Management (Washington: E.P.A., 1975), p. 2.

also a water quality specialist, and a planner responsible for citizen participation. The latter's responsibility involves the performance of research and analysis of management systems, and the provision of assistance to facilitate optimum citizen participation. In addition, there is a systems analyst on the staff. The Project Director coordinates the operation of the 208 planning program. The staff is dominated by professional planners. There is also a full range of non-professional staff including general office aide, stenographers, account clerk, and draftsmen.

Six consultants have been selected to assist the Tri-County Planning Staff in the 208 planning effort. These are Snell Environmental Group--engineering; Ecol Sciences--river modeling and the environmental impact statement; Wilbur Smith Associates--management systems; Michigan State University (Remote Sensing Project)--land use activity mapping; Michigan Department of Natural Resources--coordination and limited technical assistance; and Johnson and Young--lake investigations.[23]

Section 208 Planning Process

General Description

The purpose of the areawide planning process is to formulate an implementable areawide water quality management plan. Through the planning process, both technical needs for pollution control and management arrangements capable of implementing the controls will be integrated. Activities undertaken in an areawide waste treatment

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[23]Tri-County Regional Planning Commission, 208 Areawide Waste Treatment Management Program, Work Program (Lansing: TCRPC, 1976), p. 116.

management planning process are to include: basic data gathering and analysis, primarily, water quality data; projections of future population, employment and land use activities; a land use analysis to delineate land use and water quality relationships; development of waste load allocations for alternative plans consistent with water quality standards; development of point and non-point source subplans; management analysis for the area and development of alternative plans consistent with technical plans; combining alternative plans and selecting an areawide water management plan.

The relationships between land use and water quality are important in the Tri-County Region. Of particular significance is the effect of the type and intensity of land use on groundwater. The Saginaw formation is the region's principal bedrock aquifer and offers the greatest potential for future water supply development. The Grand River, Bayport, and Michigan bedrock formations also provide the region with water. The ability of an aquifer to yield supplies of water is controlled by the degree of recharge which can occur. By the recharge process, water which is withdrawn from the aquifer through wells is replaced by permitting water on the land surface to permeate subsurface soils and enter the aquifer. The recharge process is most effective where favorable rock formations for aquifer recharge occur. The favorable rock formations are composed of sandstone aquifers overlain by permeable sand and gravel. To enhance the ability of the aquifer to meet the needs of the region for fresh water, it is important that recharge processes are not hindered by constructions such as urban development and multi-lane highways. In connection with 208

planning, recharge zones are to be identified and land uses compatible with aquifer recharge are to be recommended.

A flow chart displaying the basic components of the planning process in a simplified form is presented in the Environmental Protection Agency Guidelines.[24] Using this chart as a guide, the 208 planning agency may use discretion to employ any logical process as long as the process addresses major issues of areawide waste treatment management and produces an areawide plan, the content of which is set forth in the Interim Grant Regulations.[25] Using the Environmental Protection Agency flow chart as a guide, the Tri-County Regional Planning Commission has evolved its own planning process as shown in Figure 6.

Technical Planning Coordinating Committee (TPCC). The objective of the TPCC is to examine water quality problems or issues pertinent to the Tri-County Region, give advice and make recommendations to the regular professional staff of the planning agency (TCRPC). To facilitate the work of the TPCC, areas of interest have been identified as shown in Figure 6. There are eight technical subcommittees one for each area.

The subcommittee for land use gives advice on land use policies, plans and means of implementation such as zoning ordinances, subdivision and regulations. Advice on the management of old and

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[24]U. S. Environmental Protection Agency, Executive Summary of Section 208 Program for Designated Areas (Washington: Environmental Protection Agency, 1974), p. 14.

[25]U. S. Congress, Federal Register, Vol. 39, No. 93, May 13, 1974.

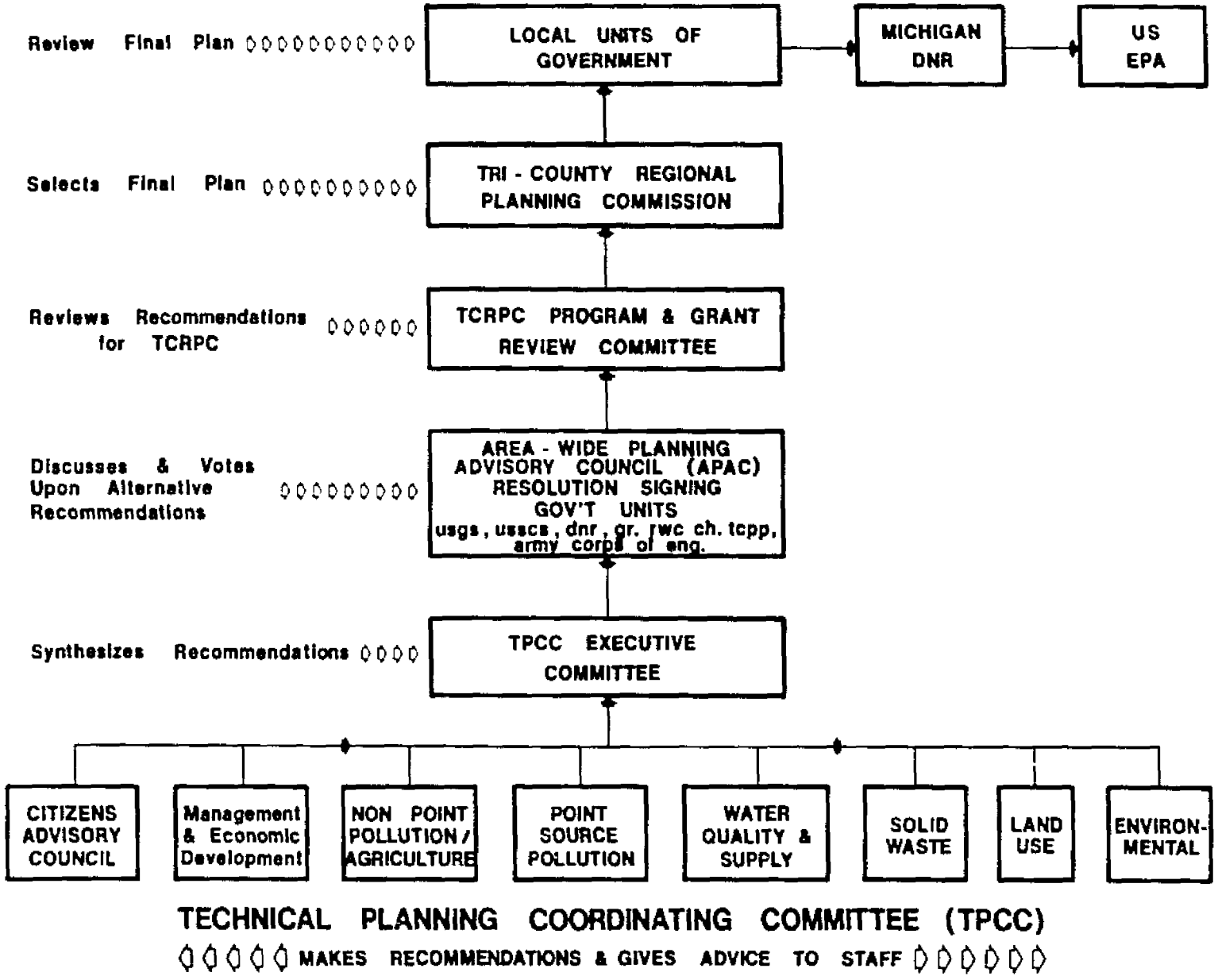

Figure 6. Section 208 Water Quality Planning Process

presently operative landfill sites, and the location, planning and management of new facilities is given by the solid waste subcommittee. Water quality goals and the possibility of achieving them through various means of treatment and management are handled by the water quality subcommittee. The point source subcommittee advises on the identification of point source pollution and methods of abatement. The management and economic development subcommittee advises on methods and feasibility of implementing alternative 208 plans. It also deals with the economic impact of various plan alternatives on the region as well as local organizations, business groups, units of government. Advice on pollution problems from non-point sources is furnished by the agricultural and non-point source pollution subcommittee. Advice on critical areas requiring preservation and means of preserving them is handled by the environmental subcommittee. The TCRPC citizens advisory council acts as a sounding board for alternative plan development and gives advice on the involvement of the general public in the planning process.[26]

Membership on each of these subcommittees is open to all citizens of the Tri-County Region. Thus, persons with technical knowledge about particular aspects of water quality and lay people are found in the same subcommittee. The recommendations of all these subcommittees are to be sent to the Executive Committee of the TPCC, consisting of chairmen of the eight technical subcommittees. The TPCC Executive Committee synthesizes the recommendations with the view

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[26]Tri-County Regional Planning Commission, "Technical Planning Coordinating Committees," January 8, 1976. (A one-page guideline issued by the Citizen Participation Division of the TCRPC).

to identifying viable alternative recommendations. The recommendations are then passed on to the Areawide Planning Advisory Council (APAC).[27]

The APAC is to discuss and vote upon the alternative recommendations submitted to it by the Executive Committee of the TPCC. The TCRPC has one voting delegate on this Committee. From the APAC, the recommendations are to be sent to the TCRPC's Programs and Grant Review Committee which will review and pass them on to the TCRPC for the selection of the final plan.

The local units of government constituting the Tri-County Region are then to be given the opportunity to comment on the final plan, before it goes to the Michigan Department of Natural Resources for state approval and thence to the U. S. Environmental Protection Agency for final approval. By means of an effective citizen participation program, Section 208 planning will probably follow closely the path outlined above. However, there is the possibility that some local units of government may in their review of the final plan, reject some of the plan proposals for political and/or other reasons. Such a situation would require a further consideration of the plan by the TPCC, APAC and the Tri-County Regional Planning Commission.

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[27]As of April 7, 1976, the Council had representatives from the following: Clinton, Eaton and Ingham Counties, East Lansing, Eaton Rapids, Grand Ledge, Lansing, Leslie, Mason, Williamston, Delhi Charter Township, Delta Charter Township, DeWitt Township, Lansing Charter Township, Meridian Charter Township, Watertown Charter Township, Michigan Department of Natural Resources, U. S. D. A. Soil Conservation Service, U. S. Army Corps of Engineers, U. S. Geological Survey, Grand River Watershed Council, TPCC chairman, and Tri-County Regional Planning Commission.

Study Design and Work Tasks

In August 1975, with a grant from the U. S. Environmental Protection Agency, research was conducted on the study design for Section 208 planning in the Tri-County Region.[28] From this study emerged a Program Evaluation Review Technique (PERT) Chart which identified the work tasks to be carried out in Section 208 planning process for the period July 1, 1975, to June 30, 1977. (See Appendix 3). The salient features of the PERT Chart are that it shows the critical path to be followed, when quarterly reports to the EPA are due, and the times for holding Areawide Planning Advisory Council meetings.

Along the critical path, two routes are followed. Both routes start from the point where the consultant is selected, and, passing through a number of work tasks, they meet at the point where Technical Subplans are combined with management alternatives. From this point, the final areawide plan is prepared for review by the local units of government, state government and federal government in that order.

From the consultant selection stage, the first route leads to the compilation and review of institutional, financial and legal capabilities. The next stage is to determine the institutional, financial, and legal arrangements for implementing the plan. The findings are to be used at the stage where alternatives are examined.

The second route passes through the following stages on the path: remote sensing, mapping and integration with physical features

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[28]TCRPC, Areawide Waste Treatment Management Program, Study Design, (Lansing: TCRPC, 1975), p. 2.

and an inventory of non-point sources of pollutants. The next stage is the development of a first generation model followed by testing and sampling for pollutants. Subsequently, a second generation model is to be developed. Using this model, water quality site development policies are to be formulated. Then a meeting is to be arranged with municipalities whose plans or development controls are inadequate, in order to come to some acceptable understanding. The route then moves to where non-point source control and reduction alternatives are developed. From this point the route passes through the stage where subplans are screened to meet the first route.

The PERT Chart (208 Work Flow Chart) identifies all the work tasks required for 208 planning. It is supplemented with textual material which describes each work task in terms of its objective, sources of information, description of the task and its products.

Scope of Planning Program

Previous studies and plans prepared by the TCRPC have provided useful data for Section 208 planning. Since July 1, 1975, the principal activities of the 208 planning staff have been (1) data gathering on various aspects of water quality and (2) programs intended to educate the public on the full implications of the 208 planning process and the role of the public in making it a success. Ultimately, the TCRPC's 208 data development program will provide detailed information regarding the character and magnitude of current and expected future continuous point dischargers, intermittent point source

dischargers and the nature of non-point source problems.[29] Since TCRPC is to come up with a plan by June 30, 1977, most of the staff's current efforts are geared to meeting that requirement.

From the basic inventory and analysis work, a plan of priorities in construction and management of waste treatment plants will be prepared. The plan will aim at the maximizing the coordination of current treatment and regulatory programs to achieve overall performance of wastewater management. Specific issues to be addressed include improvement of existing treatment systems, commitments already made to fund certain additional facilities and non-point source control programs.

There are treatment systems in the region which need improvement in their operation. In addition to existing treatment plants, prior commitments to fund new waste treatment plants have been made. In some cases, the plans are being implemented and there is the need to carefully evaluate them to determine their full roles in the achievement of the overall water quality goals. Commitments have also been made to implement some non-point source pollution control measures through programs such as those required by the State Soil Erosion Control Ordinance. These commitments need a thorough appraisal.

Aims of the Plan. The TCRPC's 208 plan has a four-fold objective. The plan is to provide a sound beginning for a long-range program of regional water quality improvement and maintenance, particularly as it is related to land development and utilization. A comprehensive

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[29]Tri-County Regional Planning Commission, 208 Areawide Waste Treatment Management Program, Work Program (Lansing: TCRPC, 1976), pp. 20-22.

review of waste treatment facilities (in current use and being developed), to judge their adequacy in meeting the 1983 water quality goals, is another objective of the plan. The potential need and feasibility of pre-treatment of wastes to aid the achievement of water quality goals requires consideration. Specific priorities for construction and management programs which can realistically be achieved constitutes another objective. In this regard, the four designated water quality segments in the region--Red Cedar, Grand, Battle Creek Rivers and Sycamore Creek--will receive the highest early action priority. The final objective of the plan is to achieve environmentally sound approaches for sludge disposal in a manner which is well-coordinated with related programs in air quality and solid waste management.

Coordination of Efforts. TCRPC's 208 plan (Tri-County Water Quality Plan) will elaborate and refine information on dischargers, water quality levels and control programs for inclusion in the Grand River Basin and Kalamazoo River Basin 303(e) Plans.[30] At-source and in-stream water quality monitoring programs will be improved. This task will be performed in cooperation with the State, the Grand River Watershed Council and the U. S. Geological Survey, and will contribute to an expanded STORET data network.[31]

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[30]Section 303 basin plans are prepared by the state and constitute the overall framework within which 208 plans are developed for specific portions of the basin.

[31]Donald P. Dubois, STORET II: Storage and Retrieval of Data for Open Water and Land Areas (Washington: U. S. Department of Interior, [n.d.]), pp. 1-2.

The planning effort of the TCRPC will be coordinated with those of other programs and plans shown in the following list.

Plan/Program/Study	Agency
303(e) Basin Plans (Grand River and Kalamazoo)	State Department of Natural Resources, Bureau of Water Management
Grand River Basin Plan	Army Corps of Engineers and Great Lakes Basin Commission
Small Watershed Studies in the Maple River	U. S. Soil Conservation Service
Regional Solid Waste Study	Tri-County Regional Planning Commission and Ingham County Drain Commissioner

The Section 208 work program will be closely integrated with other programs being carried out or completed by the Tri-County Regional Planning Commission. These include updating regional and local land use plans, transportation plans, and other work being done on regional solid waste management. The 208 program has been included in the 1976 Unified Work Program of the TCRPC.

The growing interest in the use of rivers and streams in the region for recreation requires a careful consideration of water quality and its coordination with other land uses. Furthermore, certain areas, particularly in Northern Clinton County along the Maple and Lookingglass Rivers, are environmentally important since they serve as wildlife and fisheries habitat and are threatened by intensive land use.

Citizen Participation

In order to attain its goals, the Federal Water Pollution Control Act Amendments of 1972, Section 208, calls for citizen participation in the planning process from the very beginning. The intent of the Act is to assure that the public is informed about the specific issues that are being weighed, so that it may share in the decisions of how water quality is to be achieved.

The requirement of the Act for citizen participation is reiterated by Governor Milliken in his letter designating the Tri-County Regional Planning Commission as the areawide waste treatment management planning agency for the Tri-County Region. The letter states in part that

> . . . It is important that all local units of government and interested citizens of the region be given full opportunity to review and comment upon your planning activities. I will be particularly sensitive to the concerns of local governmental units when the plan is presented to the State for review.[32]

Citizen participation has been taken seriously by the TCRPC, and a conscious effort is being made to involve local citizens in the planning process. The activities of the TCRPC with regard to citizen participation have been facilitated by the Federal grant for 208 planning. The U. S. Environmental Protection Agency grant to the TCRPC is $704,000. EPA recommends that 10 percent of all grants to planning agencies be earmarked for citizen participation.

A conscious effort to involve citizens in the 208 planning process began in August, 1975, when a mailing list was compiled.

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[32]Governor William Milliken's letter of March 28, 1975 to Mr. Almond B. Cressman, Chairman of the Tri-County Regional Planning Commission.

The mailing list reflects the interests of a broad cross section of citizens of this region. Letters were sent out to some 200 people to attend the first meeting to discuss the citizen's role in 208 planning. Sixty-five people attended the first meeting. Currently, the mailing list has 130 addresses and about 50 people attend meetings regularly.

Through television, radio broadcasts, newspaper articles and speeches to interested groups, the TCRPC is attempting to forge a strong link between the citizens at the local level and the planning process. Large posters publicizing 208 planning have been distributed to public libraries, high schools, offices and other public places.

Actual citizen involvement requires the representation on committees whose decisions form an integral part of the planning process. One such committee is the Technical Planning Coordinating Committee. Membership of each of the eight technical subcommittees is not only voluntary but it is positively encouraged by the TCRPC. Local units of government have a critical role to play in the planning process. They have to review the final plan before it goes to the State of Michigan for approval. General involvement of citizens in other activities of local governments will pave the way for cooperation to achieve the goals of 208 planning.

Workshop on Water Quality ("Cooperation for Clean Water"). The most significant activity to date of the TCRPC in connection with citizen participation in Section 208 planning appears to have been a one-day workshop held at the Kellogg Center, Michigan State University on April 7, 1976. The workshop was sponsored by four citizen groups, two local institutions of high education and the local/regional

newspaper in the Lansing area,[33] in cooperation with the TCRPC. More than 700 notices of the workshop were mailed to local government officials and other citizens interested in legislation for clean water. Of these, 138 people registered for the workshop. They represented a broad cross-section of interests in the Tri-County Region. Some of the workshop participants had not heard of the 208 planning legislation before; others were already active members of the Technical Planning Coordinating Sub-Committees investigating various aspects of water pollution control.

Local units of government for cities, townships and the three counties of Clinton, Eaton and Ingham were represented at the workshop. No villages were represented. Federal agencies represented include the U. S. Environmental Protection Agency--Washington and Chicago Regional Offices, U. S. Army Corps of Engineers, U. S. Department of Agriculture--Agricultural Stabilization and Conservation Service (of the Counties of Clinton, Eaton and Ingham) and Soil Conservation Service, and U. S. Department of Interior--Bureau of Outdoor Recreation. Local groups represented ranged from private consultants to citizen groups and clubs, and educational institutions.[34]

The workshop had two phases: a general session for the presentation of substantive information on the significant requirements of

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[33]Lansing Area League of Women Voters, Lansing Community College, Lansing Jaycees, Lansing Regional Chamber of Commerce, Michigan State University, Michigan Townships Association, and The State Journal.

[34]Tri-County Regional Planning Commission, A Report of the Workshop: "Cooperation for Clean Water," held on April 7, 1976, at the Kellogg Center for Continuing Education, Michigan State University (Unpublished).

Section 208, with emphasis on citizen participation, and a session for discussion groups. The keynote address was delivered by Mrs. Helen Fenske, Special Assistant to Russell Train, EPA Administrator. The legislative provisions of the Federal Water Pollution Control Act Amendments of 1972, Section 208, were highlighted. A review of regional options in water quality was made by the TCRPC staff. It was reported that the TCRPC staff would analyze about 900 stream and sewer samples from the spring through the winter of 1976/77. The staff had already updated the Commission's regional land use maps by contracting with the Michigan State University Remote Sensing Project to identify some 20 different land uses located in the region. As a result of this contract, different types of vegetation including various crops, grass, forests, and buildings, water, and highways, have been mapped by means of infra-red photographs.

The TCRPC staff also presented three hypothetical plans[35] for analyzing what can be achieved under Section 208 legislation. Each of the plans was based on a different set of assumptions; each asked what practical consequences would follow if its assumptions were true. The plans itemized the technical solutions that would be used to control different sources of pollution, the management required, and suggested agencies that might be charged with the responsibility for action.

Because of the lack of information about causes and loads of pollution, none of the discussion groups wanted to consider directly

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[35]See Appendices I, J, and K.

the hypothetical plans at that stage. However, each discussion group raised questions pertinent to the topics in the plans.

Discussion Groups.[36] Workshop participants were given the option to choose the group they wanted to serve on. Each group had a moderator, a recorder and resource person. After discussing the assigned topic, the group presented some proposals to guide the planning agency. In no instance, were the proposals voted upon by the members of the group.

The land use group proposed development of a regional set of controls provided there was sufficient local input. It also proposed that there should be incentives which would invite cooperation without imposing restrictions. The group observed that past local control had led to the present unsatisfactory conditions in the use of land, such as loss of prime agricultural land and development on floodplains and in unique areas of natural beauty. The group did recognize, reluctantly and sadly, that some higher control of land use was needed.

Discussion by the Social Aspects group ranged from broad considerations to specific proposals for making the waters of the region safe for bodily contact. Citizen input was discussed extensively. The group recommeneded that neighborhood groups, conservation and garden clubs should be especially solicitied for support. Another recommendation was that the news media should be systematically informed about the impact of the areawide plan on recreation, health, housing and growth.

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[36]There were five discussion groups, namely, Land Use; Social Aspects: Impacts on Recreation, Health, Housing, and Growth; Non-point Sources of Pollution; Economic Impacts; and Implementation of the Plan.

Participants in the Non-point Sources of Pollution discussion group largely represented agricultural interest. They felt that most farmers were already employing good soil conservation practice and were in fact ahead of the plans to be prepared under Section 208. It was pointed out that most farmers in the Tri-County Region do not use excessive fertilizer since they can ill-afford to have it run off into streams. There is already a mechanism for feedlot pollution control under regulations of the U. S. Environmental Protection Agency and the state Soil Erosion Act.[37] Most farmers currently use methods such as "no till" to reduce erosion. The consensus of the group appeared to be that most farmers were already doing what was necessary to avoid stream pollution and that they did not need more regulation.

The Economic Impact Group pointed out that if the real cost of treatment of pollution were charged, the user might do something to reduce the pollution. Another suggestion was that a positive and negative incentive program could be a useful alternative to government control. Participants wanted to retain local power to control water pollution as much as possible, and were prepared to make the necessary trade-offs between individual rights and community values. They suggested that the U. S. Environmental Protection Agency or the Michigan Department of Natural Resources should develop guidelines for assessing these trade-offs. Everyone agreed on the need for more technical information and more reliable cost estimates.

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[37]Office of Federal Register, Federal Register, Vol. 39, No. 2, Feb. 14, 1974. (The guidelines on water pollution from beeflots provided in this document took effect on April 15, 1974).

The basic concern of the group for Implementation of the Plan was to develop a systematic pattern for citizen participation. Presently, there is a lack of understanding about lines of communication, and interested persons often do not know where to turn for advice and direction. One official asked, for example, how the TCRPC was dealing with waste treatment systems which were already overloaded, plants which were underdesigned when construction started and upon which increased demands for service were made daily. To respond to such questions, the Areawide Planning Advisory Council (APAC) was established. The APAC is composed of representatives of local governments who want to take part in the development of the Water Pollution Abatement Plan. Local governments may directly influence the final plan through this body.

In order to find a way to assure feedback from the TCRPC to the local jurisdictions, it was recommended that blueprints of data and a one-page digest of significant actions taken by the Technical Planning Coordinating Committee should be mailed to local government officials. The distribution of this information should be followed by subregional town meetings.

On the whole, the workshop participants were firm in their desire to retain local control of the planning for water pollution abatement in the Tri-County Region; they were unwilling to relinquish that control to the state or federal government. They preferred incentives to regulations, wherever possible. There was a clear demand for another workshop before the completion of the plan.

Constraints on Water Quality Goal Attainment

The overall aim of the planning effort of the TCRPC is to meet the water quality goal set for this nation by the Congress, namely, to achieve by 1983 water quality which is safe for recreational use and which protects fish and wildlife. This time limit exerts a great pressure on the planning agency. The situation is aggravated by the fact that public participation in 208 planning is a requirement which must be fulfilled by all planning agencies. Not only must the public be involved in the planning process, but also the final plan must be acceptable to the local people. Public acceptance of a 208 plan such as the one under preparation by the TCRPC tends to defy definite time limits.

The intention of 208 planning legislation is that local governments should continue planning on a financially self-sustaining basis when the initial two-year period expires. In the Tri-County Region, the period expires on June 30, 1977. The local governments in the region may not be able to raise enough money on their own for a continuing planning process. Furthermore, it is doubtful whether the local governments consider themselves bound by their resolutions of intent to continue 208 planning after the termination of the grant by the Environmental Protection Agency. Presently, local governments are not showing any commitment to the 208 planning process beyond 1977.[38] The time for federal and state financial assistance to

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[38]U. S. Environmental Protection Agency, National Profile of Section 208 Areawide Management Planning Agencies (Washington: Environmental Protection Agency, 1975), p. ix.

local governments will therefore have to be extended, if the 208 planning process is to be the on-going program it was intended to be.[39]

Another constraint is the existence of political and administrative jurisdictions whose original boundaries were not determined by ecological considerations. Power to implement plans is vested in these local jurisdictions. Section 208 planning is also institutionally complex: it involves many levels of governmental units, making horizontal and vertical coordination of efforts a key issue.

There is a strong commitment on the part of the designated planning agency to develop and implement a management system, but at this point in the planning process, no management agency has been designated in the Tri-County Region. Most designated planning agencies, however, foresee a single planning agency and several management agencies as a probable framework. It would also seem that the majority of the planning agencies would opt for modifications of existing institutional arrangements rather than major institutional changes. A cautionary note must be sounded at this point. Rigid insistence on "local autonomy" by jurisdictions within the designated area will be a serious constraint on developing innovative regional waste treatment management alternatives.

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[39]Ibid., p. 50

CHAPTER 5

ASSESSMENT OF THE TRI-COUNTY REGIONAL PLANNING COMMISSION'S APPROACH TO 208 PLANNING

The discussion in the previous chapters have provided the necessary background material for an assessment of the approach to Section 208 planning adopted by the Tri-County Regional Planning Commission (RCRPC). In Chapter 2, the ecosystem approach to viewing water pollution from non-point sources was examined in order to identify ecologically based principles. These principles have been established and are recapitulated as follows: (1) Non-point sources of water pollution must be studied on a regional basis; (2) Consideration of water pollution from both point and non-point sources must form an integral part of the broad issue of environmental quality; (3) Institutional econtrol of ecosystems must be guided by their tolerances to pollutants or carrying capacities; and (4) Land and water resources must be managed holistically in order to minimize the generation of water pollutants. In the present chapter, each of the above principles is discussed in relation to 208 planning in the Tri County Region.

The Region as a Basis for Planning

The Federal Water Pollution Control Act Amendments of 1972, Section 208, specifies that planning must be done on an areawide or

regional basis, leaving the criteria for selecting a region to the state or local government concerned. Using this option the Governor of the State of Michigan has designated the Tri-County Region of Michigan as a 208 planning area. This region coincides with an existing area, having long established local jurisdictions and certain clearly defined powers. Such powers are jealously guarded against encroachment by other levels of government. There are definite advantages for plan formulation and implementation in having a region with clearly defined local jurisdictions. The democratic decision-making process is well-established. In the democratic form of government, planning at the local level is expected to reflect the hopes and aspirations of the local people. This presupposes that the problems to be solved through planning are confined to the Tri-County Region.

Water pollution, especially one emanating from non-point sources, is a problem which cuts across the boundaries of the Tri-County Region. The region forms part of the Grand River Basin and, ideally, the planning area should be the whole basin. In this sense, a number of watersheds (small ecosystems) whose interactions can be identified. Within this framework, the relationship between man's activities and natural processes can be established. Recognition of the natural processes and man's role in these processes is the most meaningful way of viewing the water pollution problem and identifying strategies to control water pollution. This recognition also provides a strong case in support of inter-jurisdictional cooperation in combating water pollution.

Some jurisdictions such as Ionia and Clinton Counties lie entirely within the Grand River Watershed. But the boundary of the watershed cuts across counties such as Shiawassee, Gratiot, and Ottawa. This would cause jurisdictional problems but such problems are surmountable. In any case, there will be the problem of co-ordination of planning efforts. But coordination based on principles underlying ecosystem interactions is the most appropriate way of gaining deep insights into man-environment relationships and water pollution.

Most of the Tri-County Region lies in the Grand River Watershed. This location provides the region with the opportunity to seek long term solutions to the problem of water pollution. Natural and man-induced processes which generate pollution can be identified. It is clear that pollutants generated by both natural and man-made processes in the Tri-County Region are likely to cause damage to water quality in places which lie outside the region, even though the immediate impact of the pollutants might be experienced in the region. Because of this situation there is an urgent need for all 208 planning agencies in the Grand River Watershed to cooperate with one another to solve water pollution problem.

Inter-planning agency cooperation to solve water pollution problems is recognized in the Federal Act, but it is not given the emphasis it deserves. The legislation is not as strong on this inter-agency cooperation as it is, for example, on citizen participation in the planning process. The Act provides no guidelines for inter-planning agency cooperation. The form in which inter-agency cooperation for 208 planning is taking in southern Michigan is that the 208

planning agency directors meet on an informal basis to exchange views on the planning activities of their respective planning agencies. This is one form of needed cooperation which has its merits. But cooperation for the solution of a problem as vital as water pollution calls for adherence to certain basic principles or guidelines. The ecosystem relationships provide these guidelines. For example, the whole of the Grand River should be regarded as a system and the various planning agencies in the basin should know to what extent their respective efforts contribute to the whole system in solving the water pollution problem.

Environmental Quality

Man is the central figure in any consideration of environmental quality. What man, as an individual and as a member of organized society, decides as best for the satisfaction of his biological and aesthetic needs determines environmental quality. Environmental quality can therefore be defined by human perceptions and reactions. It is related to the functioning and survival of the human population and the individuals within it. "The concept of environmental quality represents the unique perspective and awareness of the human species as to the various aspects of its existence--and the potential we have for managing our environment not only to support some (optimum) population but to achieve an optimum environment for man."[1]

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[1]Ronald L. Shelton, "Principles of Political Ecology," (East Lansing: Department of Resource Development, Michigan State University, 1976), p. 18. (Mimeographed.)

An optimum environment for man raises a number of questions, such as problems in developing environmental indicators. A significant provision of the National Environmental Policy Act, signed on January 1, 1970, concerns the development of environmental indicators. Section 102(2)(B) of the Act directs all federal agencies to "identify and develop methods and procedures, in consultation with the Council on Environmental Quality . . . which will ensure that presently unquantified environmental amenities and values may be given appropriate consideration in decision making along with economic and technical consideration."[2] Section 204 of National Environmental Policy Act further provides that the Council on Environmental Quality shall "document and define changes in the natural environment, including the plant and animal systems, and to accummulate necessary data and other information for continuing analysis of these changes or trends and an interpretation of the underlying causes."[3] Fulfillment of these requirements calls for the development of classification systems, criteria for measurement, indicators and indices that can be used to describe objectives and trends in environmental management.

The development of meaningful indicators of environmental quality calls for the quantification of an array of qualitative value judgments and perceptions. Other problems arise because of the lack of suitable measuring devices and clearly defined goals that relate to the use of

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[2]U. S., Congress, National Environmental Policy Act of 1969, P.L. 91-190, Section 102(2)(B), 91st Cong., S. 1075, January 1, 1970.

[3]Ibid., Section 204(b).

environmental resources. The application of the concept of environmental quality is fraught with many hurdles to be cleared.

Most of the success enjoyed with the development of environmental indicators to date in the United States has come with those indicators used to describe air, water, noise pollution and radiation. With these examples, extensive use is made of physical measures of the quantity of pollutants in the air or water, decibels of sound, or levels of exposure to ionizing radiation. These readings are checked against assumed and documented health and comfort standards to provide measures of quality. Water quality is one aspect of environmental quality and this perspective should not be lost in considering the control of water pollution.

Carrying Capacities and Tolerances

Closely related to environmental quality is the concept of carrying capacities and tolerances of the various elements that make the environment. The quality of water is what man considers best for his various needs. Rivers and streams through natural processes assist man to achieve this quality. But there is a limit to the capacity of streams to assimilate wastes without impairing the water quality which man desires. The concept of carrying capacity is applicable to other resources such as parks, forests and wilderness areas for recreation. In any particular area, the planner must be considering simultaneously the carrying capacities of different resources.

In its previous studies, upon which the 208 for the Tri-County Region is going to be based in part, the Tri-County Regional Planning

Commission addressed many issues related to the human environment. The Environmental Framework Study[4] of the Tri-County Region represents one of several special studies which has a strong environmental bias. In this study nine environmental features have been identified as being significantly related to the future development of the Tri-County Region. These are groundwater, wildlife habitat, agricultural lands, mineral deposits, historical sites, soils, slope, and woodland. The features listed above become more significant when they are viewed as parts of system of which man is part. It is only when the features are seen as components of a system that environmental quality and carrying capacities assume a useful place in the Section 208 planning process. This perspective appears to permeate the planning process of the Tri-County Regional Planning Commission. Water quality is the objective of Section 208 planning, but its achievement requires serious consideration of other aspects of the human environment.

To maintain the environment in a state appropriate for the satisfaction of human needs, some control of ecosystems is required. This control is achieved through human institutions, by laws, regulations, and incentives. The useful lives of streams, rivers, and lakes can be prolonged, if their tolerances to waste and pollutants are understood, identified, and this knowledge utilized in making regulations.

Knowledge of environmental quality and carrying capacities is being crystallized but the principle that tolerance levels of natural

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[4]Tri-County Regional Planning Commission Environmental Framework Study (Lansing: TCRPC [n.d.]).

systems should be respected in the control of water pollution is worth trying. This principle has been given strong support in the 208 planning process by the Tri-County Regional Planning Commission. Pursuant to the guidelines of the Environmental Protection Agency, the TCRPC is laying emphasis non-structural approaches to water pollution control.

Sound Management Practices

As regards water pollution from non-point sources, sound management practices for agricultural, silvicultural, mining and construction activities will solve the problem. An encouraging development in the Tri-County Region is that most farmers are already employing good soil conservation practices to reduce the adverse effects of agricultural runoff. The method of "no till" is used by many farmers in the Tri-County Region to reduce soil erosion. In addition, most farmers do not use excessive amounts of fertilizer since they cannot afford to have it drained into streams.[5]

Good management practices employed by individual farmers are not enough in solving water pollution from non-point sources. Management techniques should be seen within the framework of "Best Management Practices." The term, best management practices, is defined as a technique or combination of techniques, that is determined by a state or designated areawide planning agency after problem

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[5]"Cooperation for Clean Water . . . a workshop on the quality of our water," A one-day workshop on Section 208 of the Federal Water Pollution Control Act Amendments of 1972 sponsored by interest groups in the Lansing Area in cooperation with the Tri-County Regional Planning Commission, Lansing, on April 7, 1976, at the Kellogg Center, Michigan State University.

assessment, examination of alternative practices, and appropriate public participation to be the most effective and practicable means of preventing or reducing the amount of pollution generated by non-point sources to a level compatible with water quality goals.[6]

The definition of best management practices provides some tests or criteria which should be applied by the state in selecting a management rool. The best management practices should be practicable and capable of managing pollution generated by non-point sources. They should be most effective in preventing or reducing the amount of pollution generated and at the same time compatible with water quality goals.

The concept of best management practices will be useful in controlling both point and non-point sources of pollution. In practical terms, all non-point sources of pollution should be studied and full consideration should be given to their total effect on the environment in the selection of the best management practices. The reason for this holistic approach is that management practices applied to prevent or reduce water pollution could result in adverse effects on the other portions of the environment are not only undesirable but will also delay the implementation of best management practices to control water pollution.

There are many useful techniques which can be applied to the management of agricultural and silvicultural activities. These techniques are well documented elsewhere. It must be pointed out

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[6]U. S. Environmental Protection Agency, Draft Guideline Areawide Water Quality Management, Supplement No. 1 (Washington: Environmental Protection Agency, 1976), p. 2.

that the individual farmer or silviculturist, for example, is not guided by a regional or holistic perspective as he adopts a particular management practice. This perspective is to be provided by the planning agency, Tri-County Regional Planning Commission. Provision of such a perspective places a heavy responsibility on the TCRPC. Acquaintance with existing management practices in the Tri-County Region is not enough. What is required is knowledge about the cumulative effect of certain practices on the region, in terms of water pollution.

Most farmers in the Tri-County Region are already coversant with agricultural practices which yield high profits. But best management practices in terms of water quality may lead to reduced monetary benefits to the farmer. The planning agency will be faced with the problem of persuading the farmer to adopt a technique which seems less attractive than those he is familiar with. An effective way of ensuring the adoption of a seemingly unattractive technique, which enhances the quality of the human environment, will be to provide real incentives. The provision of meaningful incentives to encourage the adoption of best management practices appears to be lacking in the 208 planning process of the Tri-County Regional Planning Commission. The question of incentives is a serious one which requires very careful thought. Many incentives already exist but additional research is required to identify the best combination of options offered by these incentives.

Water pollution due to residual wastes poses serious problems. Residual wastes are those solid, liquid or sludge substances resulting

from urban, agricultural, silvicultural, construction and mining activities found in the environment. In the past, these wastes were regarded as a problem rather than as a potential asset--and for economic reasons, were dumped into streams, oceans or on the land. This attitude has changed in recent years and consideration is now given to site maintenance for waste disposal, resource recovery and recycling. In the State of Michigan, for example, legislation was passed in 1974 to encourage recycling and resource recovery.[7] Residual wastes must be considered as largely untapped resources with potentials for beneficial use. Water pollution from residual wastes is amenable to abatement by the best management practices approach which can be expected to produce systematically waste stabilization, waste reduction, resource recycling and recovery. The best management practices approach cannot be established and utilized on an individual basis, but must be integrated into an overall system for the effective management of residual wastes.

Recommendations

There are a number of citizen participation programs in the Tri-County Region. These programs deal with various aspects of water quality. But in view of the comprehensive nature of Section 208 program, the Tri-County Regional Planning Commission should be made the coordinator of all citizen participation activities in the region pertaining to water pollution.

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[7]Michigan, Public Acts 1974, No. 366. This Act took effect on January 1, 1975.

The Tri-County Regional Planning Commission has shown its concern for the human environment by identifying the nine environmental features discussed earlier. These nine features should be conceived as components of a system. The ecosystem approach to viewing the environmental features provides guidelines for identifying water pollution control strategies.

There are a number of designated 208 planning areas in southern Michigan. It is recommended that there must be a formal arrangement for coordinating all 208 planning activities in the Grand River Basin.

Recycling of wastes should be encouraged. In this connection, provision should be made in the land use plan for the storage of residuals (pollutants which are regarded as potential resources) until they can be put to a useful purpose. This is another area which requires research.

The dichotomy between 208 planning and 208 implementation should be narrowed as much as possible. The management agency/ies should be involved in the planning activities of the planning agency from the beginning. It is recommended that the Tri-County Regional Planning Commission should undertake urgent studies to provide the necessary information to enable the governor to designate the management agency/ies before the first Section 208 water quality plan is finalized.

CHAPTER 6

SUMMARY AND CONCLUSIONS

Summary

The United States is well endowed with resources of which water played a significant role in its early settlement. Industrialization and urbanization have led to a deterioration of the environment. Of particular concern to the American public is water pollution because of its harmful effects on human health, aquatic ecosystems and water-based recreational areas.

The main objective of this study was to examine and suggest a framework for understanding water pollution, particularly non-point sources of pollution, in the Tri-County Region of Michigan. A subsidiary objective was to appraise institutions and institutional arrangements for planning under the provisions of Section 208 of the Federal Water Pollution Control Act Amendments of 1972. This Act is the most comprehensive legislation to control water pollution ever enacted by the United States Congress.

Water pollution satisfies the five conditions required for the existence of a researchable problem as suggested by Russell Ackoff. Nationally, water pollution is a serious problem. Estimates made in 1972 showed that about 35 percent of the nation's waterways violated the water quality standards established by the respective states, and about 40 percent of these violations were attributed to pollution

from non-point sources. Rural America, which occupies about 97 percent of the land area, is a major non-point source of pollution. Southern Michigan where the Tri-County Region, the study area, is located has experienced rapid growth in industry and urban population and, in a sense, epitomizes the national water pollution problem.

The method of approach of this study was to examine non-point sources of water pollution within an ecological framework. A conceptual ecosystems model was evolved to illustrate the processes and mechanisms which caused water pollution. Using the watershed as a unit of study, four principles were identified and used as criteria to assess the approach to Section 208 planning adopted by the Tri-County Regional Planning Commission. Data on legislative history, provisions and implications of Section 208 were obtained from U. S. Environmental Protection Agency (EPA) documents and other available sources. Existing data on water quality collected by the Tri-County Regional Planning Commission were utilized for this study because they were found to be comprehensive, reasonably recent and pertinent to water pollution analysis in the region.

The rest of this chapter has the following sequence: a summary discussion of the ecosystem concept and its relevance to water pollution, the Federal Water Pollution Control Act Amendments of 1972, Section 208, institutional arrangements for 208 planning, and conclusions.

The conceptual ecosystems model provided the necessary framework for examining the natural and man-induced processes. Weathering and erosion are two of the natural processes. By weathering,

the earth's crust is disintegrated to provide material (potential pollutants) to be transported by the agents of erosion. Human activities tend to accelerate the natural processes. Those selected for close examination were agriculture, silviculture, mining and construction. The use of complex machinery, high yielding seeds, fertilizers and pesticides on a large scale in American agriculture has led to the generation of pollutants to both ground and surface water. Sediment is a pollutant and also a carrier of other chemical pollutants adsorbed to it.

In silviculture, timber harvesting and logging practices account for substantial quantities of sediment and pesticides. Clear cutting of timber is a major contributor of sediment. Transportation of logs by tractors and other methods disturb the soil, rendering it easily susceptible to erosion. Reduction of shade trees along stream banks raises water temperature to cause thermal pollution.

Mining and construction also disturb the soil and contribute pollutants to streams and lakes. In addition to sediment, mining produces mine drainage. Some of the fertilizers and pesticides used to stabilize the vegetation of mined areas become pollutants depending on how they are applied. Construction activities which modify the biological and physical properties of water include transportation and communications network, housing and related land development. Urban development creates an impervious layer of concrete and asphalt which eliminates infiltration and accelerates runoff.

Conceptually, a river basin in which man's activities have had a negligible impact on the ecosystem can be described as a natural basin or watershed. Such a watershed has three parts: land ecosystems, water ecosystems and land-water interactions. Through the action of primary and secondary producers, decomposers and nutrients cycling, the land and water ecosystems are maintained.

When the natural processes are disturbed by man's activities, the impact of the human institutions on the environment must be considered. Human institutions receive information from the land and water ecosystems. On the basis of this information, decisions are made to regulate the use of land and water resources. Out of these relationships were established the following principles which were used to assess Section 208 planning process in the Tri-County Region: non-point sources of pollution must be studied on a regional basis; water quality considerations must be part of environmental quality; control of ecosystems (environment) must be guided by their carrying capacities and tolerances of natural systems; and land and water resources must be managed efficiently to minimize the generation of pollutants.

Since the 208 planning legislation is part of the Federal Water Pollution Control Act Amendments of 1972, the historical roots of the Act need examination. Congressional concern for water quality dates back to 1899 when the Refuse Act was passed to prevent impediments to naviagtion. The first Federal legislation directed specifically to water pollution was the Water Pollution Control Act Amendments of

1948. Its purpose was to protect public health. The 1948 Act was amended in 1956 to facilitate Federal enforcement of water quality standards.

In 1965, a new Act was passed which required each state to indicate its intention to establish water quality standards for its interstate waters. Between 1967 and 1970, water pollution legislation was focused on pollution from oil and acid mine drainage.

In response to public demand for improvement in performance in air and water pollution control in the latter part of 1969, Congress began to review all legislation on water pollution. In October 1972, the Federal Water Pollution Control Act Amendments of 1972 became law. The Act deals with both water quality standards and effluent discharges.

Section 208 of the Act deals specifically with non-point sources of pollution. It ties together the various Federal water pollution abatement requirements and places the responsibility for planning and implementing areawide waste treatment management plans on regional and local agencies.

The Act aims at preventing pollution of navigable waters by 1985. Its intermediate goal for 1983 is to achieve water quality which is safe for recreational use and which protects fish and wildlife. National policies of the Act include the prohibition of the discharge of pollutants in toxic amounts, provision of Federal funds for the construction of publicly-owned waste treatment works, and the development of regional or areawide waste treatment planning and management. There is provision in the Act for public participation in the development, revision and enforcement of water quality regulations.

The 208 planning process begins with planning area designation by the Governor or the chief elected representatives of the state. The Governor also designates a planning agency and management agency/ies. The designations, accompanied by a formally adopted resolution that local governments involved will join together to develop and implement a plan, are sent to the Environmental Protection Agency for approval. A Section 208 plan shall contain alternatives for waste treatment and management and shall be applicable to all types of waste generated within the designated planning area.

The 208 plan shall form an integral part of the basin plan which prescribes water quality standards and defines critical water quality conditions. Other programs with which the 208 plan shall have a close relationship are 201 facilities plan, 402 permit program, and other federal programs. An application for 208 grant is subject to review under Circular number A-95 of the Office of Management and Budget.

Among the planning implications of Section 208 legislation is the need to coordinate efforts by different levels of government in the same planning area. There is the problem of reconciling water quality goals with other community goals. A strong functional relationship is required between the planning agency and management agency/ies. Interprofessional relationship must be so arranged as to take full advantage of the complementary roles of the various professionals engaged in the preparation of a 208 plan.

The preceding discussion furnished the necessary background for the assessment of 208 planning in the Tri-County Region. The Tri-County Region comprising Clinton, Eaton and Ingham counties,

covers 1,697 square miles and is drained by the Grand River system. Four streams segments in the region are classified by the Michigan Department of Natural Resources as polluted. Non-point sources of pollution have frustrated efforts by local government units to clean up the waste dischargers, and Section 208 planning is seen as the most effective means of dealing with the region's water pollution problem.

Governor William Milliken designated the Tri-County Region a planning area and designated the Tri-County Regional Planning Commission as the planning agency on March 28, 1975. The area designation was justified on grounds of current water pollution problems. The Tri-County Regional Planning Commission has done considerable work pertaining to water quality from which 208 planning will benefit. For the period, July 1, 1975 to June 30, 1977, the objective of 208 planning in the Tri-County Region is to develop a well integrated strategy for joint land use-waste water management.

The Tri-County Regional Planning Commission is in the process of preparing a 208 plan for the region. This first plan is due for completion by June 30, 1977. The designation of a management agency for the Tri-County Region must therefore await the completion of the 208 plan.

Staffing in the Tri-County Regional Planning Commission is guided by the philosophy of promoting an integrated staff-consultant effort to ensure an on-going program. Six consultants, including Michigan State University and the Michigan Department of Natural Resources, have been hired to assist the planning agency in its planning effort.

The Tri-County Regional Planning Commission has developed a 208 planning process at the base of which is the Technical Planning Coordinating Committee comprising eight subcommittees. Each subcommittee deals with one aspect of water quality in the region. The recommendations of the technical subcommittees are to be synthesized by the Executive Technical Committee in order to identify viable alternative recommendations. The alternatives are then to be passed on to the Areawide Planning Advisory Committee (APAC) which will discuss and vote upon them. After a review by the Commission's Program and Grant Review Committee, the recommendations are sent to the Commission for selection of the final plan. Units of local government in the region are given the opportunity to comment on the final plan before it is sent to the Michigan Department of Natural Resources for state approval and thence, to the United States Environmental Protection Agency for final approval.

A Program Evaluation Review Technique (PERT) chart has been prepared by the Commission to identify the necessary work tasks for 208 planning. The chart is supplemented with text which describes the objective, sources of information, and the products of each work task.

The Section 208 planning process in the region is meant to provide a sound beginning for a long range program of regional water quality improvement and maintenance as it relates to land use. The Tri-County Water Quality Plan (208 plan) will elaborate and refine information on dischargers, water quality levels, and control programs for inclusion in the 303(e) plans. The 303 basin plans are prepared by the state, and constitute the overall framework within which 208 plans

are developed. The basin plans provide water quality standards and goals, define critical water quality conditions and provide waste load constraints.

The Act stipulates that through citizen participation, the public must be informed about specific issues under discussion so that it may share in decisions on how water quality is to be achieved. Citizen involvement in the planning process has been taken seriously by the Tri-County Regional Planning Commission. Its most outstanding activity in this connection was a one-day workshop held in April 1976 at the Kellogg Center, Michigan State University, to explain various aspects of the 208 planning process and invite input from the public.

An assessment of the planning approach of the Tri-County Regional Planning Commission must recognize the time constraint imposed by the Act. It is also doubtful whether the local governments will be able to continue the planning process after the Federal grant expires. Difficulties associated with coordinating the activities of different agencies must also be noted.

The planning approach was assessed in terms of the ecological principles identified earlier. Many previous studies of the Tri-County Regional Planning Commission dealt with aspects of the environment. All features of the environment should have been regarded as parts of a system in order to give environmental quality and carrying capacity a meaningful place in the 208 planning process. The boundaries of the Tri-County Region will pose problems as regards ecosystem management. Ecosystems constituting the human environment must be controlled in order to satisfy human needs, but to be effective in the long run, the control must be guided by knowledge of environmental

tolerances and the quality of human life resulting from our actions regarding the environment. This principle is supported by the Tri-County Regional Planning Commission. By pursuing the concept of 'best management practices' as defined by the U. S. Environmental Protection Agency, and laying stress on non-structural approaches to water pollution control, the TCRPC will give concrete expression to this principle.

Conclusions

Section 208 Planning Legislation

The Federal Water Pollution Control Act Amendments of 1972 (P.L. 92-500) are comprehensive legislation for controlling water pollution in the United States. Section 208 of the Act addresses non-point sources of water pollution which until recently have been largely neglected. This section of the Act requires the preparation and implementation of waste treatment management plans by state and units of local government.

Section 208 planning is essentially a new kind of water quality planning, requiring education of the public on its full implications. Public education for citizen involvement in the 208 planning process is currently going on in many states. The legislation requires that non-structural innovative approaches be utilized to solve the problem of water pollution from non-point sources. Furthermore, there is a provision in the Act for the creation of new institutions to implement these new approaches. State and local laws may be enacted. State or local administrative actions may be needed or even a state constitution revised in order to create powers and capabilities for

management agencies to implement the 208 plan. Despite this provision, the Act gives the impression that new institutional arrangements or drastic changes in existing institutions are not encouraged. Such changes are definitely not required for Section 208 planning.

Existing institutions and institutional arrangements in the Tri-County Region can be utilized to evolve new approaches to solve the problem of water pollution from non-point sources. These institutions include all units of local government which have the authority to prepare plans and exercise control over land uses in their respective areas of jurisdiction. Land uses and water pollution are closely related and effective public direction of land use offers a good opportunity for controlling water pollution. Public measures for directing land use include zoning ordinances, land subdivision regulations, and taxation.

Zoning as a method of controlling land use can be used in many ways to promote socially desired goals. But like many other public powers, it can be and sometimes is abused, resulting in discrimination against minority groups and protection of the rights of key groups. However, zoning is a useful and an effective instrument for directing the use of land, if the zoning regulations are based on a comprehensive land use plan of the area. In order to be effective a zoning ordinance must be preceded by a comprehensive land use plan. Measures intended to prevent or minimize the generation of pollutants can be incorporated in the land use plan.

To encourage people to adopt measures for preventing pollution from non-point sources, it is essential to provide them with incentives. The Forest Yield Tax provides an example of such an incentive. This

tax is already in force in the States of Michigan, Minnesota and Wisconsin. The Forest Yield Tax exempts the forest owner from taxes on the land so long as the timber is not harvested. This tax incentive encourages the forest owner to take a long term view in the management of his resources. Without this incentive the forest owner will be tempted to cut out all the timber at the earliest opportunity and thereby expose the land to soil erosion and the resultant generation of sediment will aggravate pollution problems in nearby streams and lakes. Other incentives can be explored. The provision of meaningful incentives for the adoption of management practices which prevent or minimize the generation of water pollutants is one area which requires intensive research.

Citizen Participation

Citizen participation in 208 planning is a requirement of the Act, and the Tri-County Regional Planning Commission has made a good start in its citizen involvement program. Meetings with government agencies, interest groups and individual citizens have been held to explain the provisions of the 208 legislation and the citizen's role in its implementation. The one-day workshop on 208 planning process organized by the Tri-County Regional Planning Commission was a significant step towards the achievement of citizen participation.

Like the planning process, citizen participation is intended to be a continuous activity which does not stop with the completion of the 208 plan. It involves the education of the whole community on a continuous basis. Citizen participation must not be regarded as something separate from normal education. The full implication of

this concept of citizen participation is that education for citizen involvement in the planning process should permeate all levels of both formal and non-formal education in the region. The education authorities in the region should be consulted to see how citizen participation in Section 208 planning and implementation can be incorporated in the normal school curriculum.

In the Tri-County Regional Planning Commission only one staff member is responsible for citizen participation. In view of the importance of citizen participation, the staff for citizen participation in the TCRPC should be expanded to enable them to spell out the full implications of citizen involvement in a continuing planning process. It is suggested that the expanded staff should be made up essentially of people with sound training in education and teaching, and who are familiar with the Section 208 planning process and the politics of local communities of the Tri-County Region.

Sound Resource Management

The Tri-County Regional Planning Commission has made many studies and plans for various aspects of the environment. Many environmental features have been addressed but there appears to be an absence of a concept which ties the various aspects of the environment together. It would seem reasonable to assume that this unifying concept is beginning to emerge because of the Commission's acceptance of the concept of sound resource management. Basically this concept recognizes that all of man's activities cycle resources, return them to the environment in an altered state, and use energy in the process. Good resource management implies the fullest possible

use of any resources cycled in processes of benefit to man and the return of resources (residuals and pollutants) to the environment with the least possible disturbance of environmental media (air, water and land) and ecological systems. The Tri-County Regional Planning Commission's readiness to foster best management practices in the Tri-County Region is in furtherance of this concept.

Within the past few years, the spotlight of public attention in the United States has been focused on issues of ecology and the environment. A great deal of progress has been made in delineating the causes and effects of environmental deterioration. Much of the public has become environmentally conscious. Substantial progress has also been made in initiating programs for the maintenance and enhancement of environmental quality. One such program is Section 208 program which is just getting underway in the Tri-County Region. This program is likely to have a major impact not only on water pollution control but also on land use and economic growth of communities in the region. The Section 208 program is destined to become one of the most important means of continuous management of the Tri-County Region's water pollution problem. The major challenge facing the people of the region calls for continuing the Section 208 program that has been started and improving it so that attainment and maintenance of high quality environment can become a continuing reality.

APPENDICES

APPENDIX A

FEDERAL WATER POLLUTION CONTROL ACT

AMENDMENTS OF 1972, SECTION 208

APPENDIX A

1972 Federal Water Pollution Control Act Amendments (P.L. 92-500)

AREAWIDE WASTE TREATMENT MANAGEMENT

Section 208

a) For the purpose of encouraging and facilitating the development and implementation of areawide waste treatment management plans-

(1) The Administrator, within ninety days after the date of enactment of this Act and after consultation with appropriate Federal, State, and local authorities, shall by regulation publish guidelines for the identification of those areas which, as a result of urban-industrial concentrations of other factors, have substantial water quality control problems.

(2) The Governor of each State, within sixty days after publication of the guidelines issued pursuant to paragraph (1) of this subsection, shall identify each area within the State which, as a result of urban-industrial concentrations or other factors, has substantial water quality control problems. Not later than one hundred and twenty days following such identification and after consultation with appropriate elected and other officials of local governments having jurisdiction in such areas, the Governor shall designate (A) the boundaries of each such area, and (B) a single representative organization, including elected officials from local governments or their designees, capable of developing effective areawide waste treatment management plans for such area. The Governor may in the same manner at any later time identify any additional area (or modify an existing area) for which he determines areawide waste treatment management to be appropriate, designate the boundaries of such area, and designate an organization capable of developing effective areawide waste treatment management plans for such area.

(3) With respect to any area which, pursuant to the guidelines published under paragraph (1) of this subsection, is located in two or more States, the Governors of the respective States shall consult and cooperate in carrying our the provisions of paragraph (2), with a view toward designating the boundaries of the interstate area having common water quality control problems and for which areawide waste treatment management plans would be most effective, and toward designating, within one hundred and eighty days after publication of guidelines issued pursuant to paragraph (1) if this subsection, of a single representative organization capable of developing effective areawide waste treatment management plans for such area.

(4) If a Governor does not act, either by designating or determining not to make a designation under paragraph (2) of this subsection, within the time required by such paragraph, or if, in the case of an interstate area, the Governors of the States involved do not designate a planning organization within the time required by paragraph (3) of this subsection, the chief elected officials of

local governments within an area may by agreement designate (A) the boundaries for such an area, and (B) a single representative organization including elected officials from such local governments, or their designees, capable of developing an areawide waste treatment management plan for such area.

(5) Existing regional agencies may be designated under paragraphs (2), (3), and (4) of this subsection.

(6) The State shall act as a planning agency for all portions of such State which are not designated under paragraphs (2), (3), or (4) of this subsection.

(7) Designations under this subsection shall be subject to the approval of the Administrator.

b) (1) Not later than one year after the date of designation of any organization under subsection (a) of this section such organization shall have in operation a continuing areawide waste treatment management planning process consistent with section 201 of this Act. Plans prepared in accordance with this process shall contain alternatives for waste treatment management, and be applicable to all wastes generated within the area involved. The initial plan prepared in accordance with such process shall be certified by the Governor and submitted to the Administrator not later than two years after the planning process is in operation.

(2) Any plan prepared under such process shall include, but not be limited to-

(A) the identification of treatment works necessary to meet the anticipated municipal and industrial waste treatment needs of the area over a twenty-year period, annually updated (including an analysis of alternative waste treatment systems), including any requirements for the acquistion of land for treatment purposes; the necessary waste water collection and urban storm water runoff systems; and a program to provide the necessary financial arrangements for the development of such treatment works;

(B) the establishment of construction priorities for such treatment works and time schedules for the initiation and completion of all treatment works;

(C) the establishment of a regulatory program to-

(i) implement the waste treatment management requirements of section 201(c),

(ii) regulate the location, modification, and construction of any facilities within such area which may result in any discharge in such area, and

(iii) assure that any industrial or commercial wastes discharged into any treatment works in such area meet applicable pretreatment requirements;

(D) the identification of those agencies necessary to construct, operate, and maintain all facilities required by the plan and otherwise to carry out the plan;

(E) the identification of the measures necessary to carry out the plan (including financing), the period of time necessary to carry out the plan, the costs of carrying out the within such time, and the economic, social, and environmental impact of carrying out the plan within such time;

(F) a process to (i) identify, if appropriate, agriculturally and silviculturally related nonpoint sources of pollution, including runoff from manure disposal areas, and from land used for livestock and crop production, and (ii) set forth procedures and methods (including land use requirements) to control to the extent feasible such sources;

(G) a process to (i) identify, if appropriate, mine-related sources of pollution including new, current, and abandoned surface and underground mine runoff, and (ii) set forth procedures and methods (including land use requirements) to control to the extent feasible such sources;

(H) a process to (i) identify construction activity related sources of pollution, and (ii) set forth procedures and methods (including land use requirements) to control to the extent feasible such sources;

(I) a process to (i) identify, if appropriate, salt water intrusion into rivers, lakes, and estuaries resulting from reduction of fresh water flow from any cause, including irrigation, obstruction, ground water extraction, and diversion, and (ii) set forth procedures and methods to control such intrusion to the extent feasible where such procedures and methods are otherwise a part of the waste treatment management plan;

(J) a process to control the disposition of all residual waste generated in such area which could affect water quality; and

(K) a process to control the disposal of pollutants on land or in subsurface excavations within such area to protect ground and surface water quality.

(3) Areawide waste treatment management plans shall be certified annually by the Governor or his designee (or Governors or their designees, where more than one State is involved) as being consistent with applicable basin plans and such areawide waste treatment management plans shall be submitted to the Administrator for his approval.

(4) Whenever the Governor of any State determines (and notifies the Administrator) that consistency with a statewide regulatory program under section 303 so requires, the requirements of clauses (F) through (K) of paragraph (2) of this subsection shall be developed and submitted by the Governor to the Administrator for application to all regions within such State.

c) (1) The Governor of each State, in consultation with the planning agency designated under subsection (a) of this section, at the time a plan is submitted to the Administrator, shall designate one or more waste treatment management agencies (which may be an existing or newly created local, regional, or State agency or political subdivision) for each area designated under subsection (a) of this section and submit such designations to the Administrator.

(2) The Administrator shall accept any such designation, unless, within 120 days of such designation, he finds that the designated management agency (or agencies) does not have adequate authority-

(A) to carry out appropriate portions of an areawide waste treatment management plan developed under subsection (b) of this section;

(B) to manage effectively waste treatment works and related facilities serving such area in conformance with any plan required by subsection (b) of this section;

(C) directly or by contract, to design and construct new works, and to operate and maintain new and existing works as required by any plan developed pursuant to subsection (b) of this section;

(D) to accept and utilize grants, or other funds from any source, for waste treatment management purposes;

(E) to raise revenues, including the assessment of waste treatment charges;

(F) to incur short-and long-term indebteness;

(G) to assure in implementation of an areawide waste treatment management plan that each participating community pays its proportionate share of treatment costs;

(H) to refuse to receive any waste from amy municipality or subdivision thereof, which does not comply with any provisions of an approved plan under this section applicable to such area; and

(I) to accept for treatment industrial wastes.

d) After a waste treatment management agency having the authority required by subsection (c) has been designated under such subsection for an area and a plan for such area has been approved under subsection (b) of this section, the Administrator shall not make any grant for construction of a publicly owned treatment works under

section 201(g)(1) within such area except to such designated agency and for works in conformity with such plan.

e) No permit under section 402 of this Act shall be issued for any point source which is in conflict with a plan approved pursuant to subsection (b) of this section.

f) (1) The Administrator shall make grants to any agency designated under subsection (a) of this section for payment of the reasonable costs of developing and operating a continuing areawide waste treatment management planning process under subsection (b) of this section.

(2) The amount granted to any agency under paragraph (1) of this subsection shall be 100 per centum of the costs of developing and operating a continuing areawide waste treatment management planning process under subsection (b) of this section for each of the fiscal years ending on June 30, 1973, June 30, 1974, and June 30, 1975, and shall not exceed 75 per centum of such costs in each succeeding fiscal year.

(3) Each applicant for a grant under this subsection shall submit to the Administrator for his approval each proposal for which a grant is applied for under this subsection. The Administrator shall act upon such proposal as soon as practicable after it has been submitted, and his approval of that proposal shall be deemed a contractual obligation of the United States for the payment of its contribution to such proposal. There is authorized to be appropriated to carry out this subsection not to exceed $50,000,000 for the fiscal year ending June 30, 1973, not to exceed $100,000,000 for the fiscal year ending June 30, 1974, and not to exceed $150,000,000 for the fiscal year ending June 30, 1975.

(g) The Administrator is authorized, upon request of the Governor or the designated planning agency, and without reimbursement, to consult with, and provide technical assistance to, any agency designated under subsection (a) of this section in the development of areawide waste treatment management plans under subsection (b) of this section.

h) (1) The Secretary of the Army, acting through the Chief of Engineers, in cooperation with the Administrator is authorized and directed, upon request of the Governor of the designated planning organization, to consult with, and provide technical assistance to, any agency designed under subsection (a) of this section in developing and operating a continuing areawide waste treatment management planning process under subsection (b) of this section.

(2) There is authorized to be appropriated to the Secretary of the Army, to carry out this subsection, not to exceed $50,000,000 per fiscal year for the fiscal years ending June 30, 1973, and June 30, 1974.

APPENDIX B

AGRICULTURAL HERBICIDES: TYPES, TRANSPORT MODES, TOXICITIES, AND PERSISTENCE IN SOIL

APPENDIX B

AGRICULTURAL HERBICIDES: TYPES, TRANSPORT MODES, TOXICITIES, AND PERSISTENCE IN SOIL

Common Names of Herbicides	Chemical Class[1]	Predominant Transport Mode[2]	Toxicity[3]		Approximate Persistence in Soil, days
			Rat, Acute Oral LD_{50}, mg/kg	Fish[4] LC_{50}, mg/liter	
Alachlor	AM	SW	1200	2.3	40-70
Ametryne[5]	TZ	SW	1110	Low toxicity	30-90
Amitrole	TZ	W	2500	>50	15-30
Asulam	CB	W	>8000	[6] 5000	25-40
Atrazine	TZ	SW	3080	12.6	300-500
Barban	CB	S	1350	[7] 1.3	20
Benefin	NA	S	800	[6] 0.03	120-150
Bensulide	AM	S	770	0.72	500-700
Bentazon	DZ	W	1100	190	
Bifenox	AR	S	4600	1.8	40-60
Bromacil	DZ	W	5200	70	700
Bromoxynil	NT	SW	250	0.05	
Butylate	CB	S	4500	4.2	40-80
Cacodylic Acid	AS	S		[8] >40	
CDAA	AM	W	700	2.0	20-40
CDEC	CB	SW	850	4.9	20-40
Chloramben	AR	W	3500	[6] 7.0	40-60
Chlorbromuron	UR	SW	2150	0.56	
Chloroxuron	UR	S	3700	[8] >15	300-400
Chlorpropham	CB	SW	1500	[6] 10	120-260
Cyanazine	TZ	SW	334	4.9	
Cycloate[5]	CB	SW	2000	4.5	120-220
2,4-D Acid	PO	W	370	[9] >50	10-30
2,4-D Amine	PO	W	370	[8] >15	10-30
2,4-D Ester	PO	S	500-875	[6] 4.5	10-30
Dalapon	AL	W	6590	>100	15-30
2,4-DB	PO	S	300	4.0	
DCPA	AR	S	3000	>500	400
Diallate	CB	S	295	5.9	120
Dicamba	AR	W	1028	35	
Dichlobenil	NT	S	3160	10-20	60-180
Dinitramine	NA	S	3000	6.7	90-120
Dinoseb	PH	SW	5	[7,10] 0.4	15-30
Diphenamid	AM	W	970	25.0	90-180
Diquat	CL	S	400	12.3	>500
Diuron	UR	S	3400	>60	200-500
DSMA	AS	S	600	>15	
Endothall	PH	W	38	1.15	
EPTC	CB	SW	1360	19.0	30
Fenac[5]	AR	SW	1780	7.5	350-700
Fenuron	UR	W	6400	53	30-270
Fluometuron	UR	SW	7900	[10] >60	
Fluorodifen	AR	S	15000	0.18	
Glyphosate	AI	S	4320	Low toxicity	150
Isopropalin	NA	S	5000	Toxic	150
Linuron	UR	S	1500	16.0	120
MBR 8251	AM	SW	633	312	
MCPA	PO	SW	650	10.0	30-180
Metribuzin	TZ	W	1930	>100	150-200
Molinate	CB	W	501	0.29	80
Monuron	UR	SW	3600	1.8	150-350
MSMA	AS	S	700	>15	
Naptalam	AR	W	1770	>180	20-60

Agricultural herbicides: types, transport modes, toxicities, and persistence in soil (continued)

Common Names of Herbicides	Chemical Class[1]	Predominant Transport Mode[2]	Toxicity[3]		Approximate Persistence in Soil, days
			Rat, Acute Oral LD_{50}, mg/kg	Fish[4] LC_{50}, mg/liter	
Nitralin	NA	S	2000	Low toxicity	
Nitrofen	PO	S	2630	Toxic	
Oryzalin	AM	S	>10000	Low toxicity	
Paraquat	CT	S	150	[6] 400	>500
Pebulate[5]	CB	S	921	[11] 6.3	50-60
Phenmedipham	CB	S	2000	[10] 20	100
Picloram	AR	W	8200	2.5	550
Profluralin	NA	S	2200	Toxic	320-640
Prometone[5]	TZ	S	1750	[9] >1.0	>400
Prometryne[5]	TZ	S	3750	[9] >1.0	30-90
Pronamide[5]	AM	S	5620		60-270
Propachlor[5]	AM	W	710	1.3	30-50
Propenil[5]	AM	S	1384	>100	1-3
Propazine[5]	TZ	S	5000	>100	200-400
Propham	CB	W	5000	[6] 32	20-60
Pyrazon	DZ	W	2500	[12] 40	30-60
Silvex	PO	SW	375	[9] 0.36	
Simazine	TZ	S	5000	5.0	200-400
2, 4, 5-T	PO	W	300	0.5-16.7	
TCA	AL	W	3370	[13] >2000	20-70
Tebacil	DZ	W	5000	[14] 86	700
Terbutryne[5]	TZ	SW	2400	Low toxicity	20-70
Triallate[5]	CB	S	1675	4.9	30-40
Trifluralin	NA	S	3700	[6] 0.1	120-180
Vernolate[5]	CB	SW	1625	9.6	50

[1] Chemical type designations: AL, aliphatic acids; AM, amides and anilides; AR, aromatic acids and esters; AS, arsenicals; CB, carbamates and thiocarbamates; CT, cationics; DZ, diazines; NA, nitroanilines; NI, nitriles; PH, phenols and dicarboxylic acids; PO, phenoxy compounds; TZ, triazines and triazoles; UR, ureas.

[2] Where movement of herbicides in runoff from treated fields occurs, S denotes those chemicals that will most likely move primarily with the sediment, W denotes those that will most likely move primarily with the water, and SW denotes those that will most likely move in appreciable proportion with both sediment and water.

[3] Expressed as the lethal dose, or lethal concentration, to 50% of the test animals (LD_{50} or LC_{50}, respectively).

[4] 48- or 96-hour LC_{50} for bluegills or rainbow trout, unless otherwise specified.

[5] Trade name; no corresponding common name exists.

[6] 24-hour LC_{50}.

[7] For goldfish.

[8] For killifish.

[9] For spot.

[10] LC_{100}.

[11] For mullet.

[12] For harlequin fish.

[13] For catfish.

[14] For sunfish.

SOURCE: U. S. Department of Agriculture, Committee of Scientists of Agricultural Research Service, Control of Water Pollution from Cropland, Vol. I, A Manual for Guideline Development (Washington: G.P.O., 1975, pp. 48-9.

APPENDIX C

AGRICULTURAL HERBICIDES: OFTEN-USED TRADE NAME SYNONYMS

APPENDIX C

AGRICULTURAL HERBICIDES: OFTEN-USED TRADE NAME SYNONYMS

Trade Name	Name in Table 8a	Trade Name	Name in Table 8a
AATrex	Atrazine	Lasso	Alachlor
Alanap	Naptalam	Lorox	Linuron
Amiben	Chloramben	Maloran	Chlorbromuron
Amino Triazole	Amitrole	Milogard	Propazine
Avadex	Diallate	Modown	Bifenox
Avadex BW	Triallate	Norex	Chloroxuron
Balan	Benefin	NPA	Naptalam
Banvel	Dicamba	Ordram	Molinate
Basinite	Dinoseb	Paarlan	Isopropalin
Betanal	Phenmedipham	Planavin	Nitralin
Betasan	Bensulide	Pretar	Bensulide
Baladex	Cyanazine	Preforan	Fluorodifen
Bromex	Chlorbromuron	Premerge Dinitro	Dinoseb
Butoxone	2,4-DB	Princep	Simazine
Butyrac	2,4-DB	Pyramin	Pyrazon
Caparol	Prometryne	Ramrod	Propachlor
Carbyne	Barban	Randox	CDAA
Casoron	Dichlobenil	Ro-Neet	Cycloate
Chloro-IPC	Chlorpropham	Rexelan	Oryzalin
CIPC	Chlorpropham	Roundup	Glyphosate
Cobex	Dinitramine	Sencor	Metribuzin
Dacthal	DCPA	Smbar	Terbacil
Destun	MBR 8251	Sinox	Dinoseb
DNBP	Dinoseb	Soyex	Fluorodifen
Dowpon	Dalapon	Stam F-34	Propanil
Dymid	Diphenamid	Surflan	Oryzalin
Enide	Diphenamid	Sutan	Butylate
Eptam	EPTC	Telvar	Monuron
Eradicane	EPTC	Tenoran	Chloroxuron
Far-Go	Triallate	Tordon	Picloram
Furloe	Chlorpropham	Treflan	Trifluralin
Igran	Terbutryn	Vegadex	CDEC
IPC	Propham	Vernam	Vernolate
Karmex	Diuron		

SOURCE: U. S. Department of Agriculture, Committee of Scientists of Agricultural Research Service, Control of Water Pollution from Cropland, Vol. I, A Manual for Guideline Development (Washington: G.P.O., 1975), p. 50.

APPENDIX D

AGRICULTURAL INSECTICIDES AND MITICIDES: TYPES, TRANSPORTATION MODES, AND TOXICITIES

APPENDIX D

AGRICULTURAL INSECTICIDES AND MITICIDES: TYPES, TRANSPORTATION MODES, AND TOXICITIES

Common Names of Insecticides-Miticides	Chemical Class[1]	Predominant Transport Mode[2]	Toxicity[3]	
			Rat, Acute Oral LD_{50}, mg/kg	Fish[4] LC_{50}, mg/liter
Aldicarb[5]	CB	W	0.93	
Aldrin	OCL	S	35	0.003
Allethrin	PY	S	680	0.019
Azinphos ethyl[6]	OP	S	7	0.019
Azinphos methyl	OP	S	11	0.010
Benzene hexachloride	OCL	S	1000	0.79
Binapacryl	N	U	120	0.04
Bux[6]	CB	S	87	0.29
Carbaryl	CB	SW	500	1.0
Carbofuran[6]	CB	W	8	0.21
Carbophenothion	OP	S	10	0.23
Chlorbenside	S	S	3000	
Chlordane	OCL	S	335	0.010
Chlordimeform	N	W	162	1.0
Chlorobenzilate[6]	OCL	S	700	0.71
Chlorpyrifos	OP	U	97	0.020
DDT	OCL	S	113	0.002
Demeton[5]	OP	W	2	0.081
Diazinon[5,6]	OP	SW	76	0.030
Dicofol[6]	OCL	S	684	0.10
Dicrotophos	OP	W	22	8.0
Dieldrin	OCL	S	46	0.003
Dimethoate	OP	W	185	9.6
Dioxathion	OP	S	23	0.014
Disulfoton	OP	S	2	0.040
Endosulfan	OCL	S	18	0.001
Endrin	OCL	S	7.3	0.0002
EPN	OP	S	8	0.10
Ethion	OP	S	27	0.23
Ethoprop	OP	U	61.5	1.0
Fensulfothion[5]	OP	SW	2	[7] 0.15
Fonofos[6]	OP	S	8	0.03
Heptachlor	OCL	S	90	0.009
Lindrin[6]	CB	SW	178	0.95
Lindane	OCL	S	88	0.018
Malathion	OP	W	480	0.019
Metaldehyde	O	W	1000	>100.0
Methidathion	OP	U	25	
Methomyl	CB	U	17	~0.9
Methoxychlor	OCL	S	5000	0.007
Methyl demeton[6]	OP	W	65	4.0
Methyl parathion[6]	OP	SW	9	1.9
Mevinphos	OP	W	4	0.017
Mexacarbate	CB	SW	22.5	1.73
Monocrotophos	OP	W	21	7.0
Naled	OP	S	250	0.078
Ovex	S	S	2000	0.70
Oxythioquinox	S	S	1100	0.096
Parathion	OP	S	4	0.047
Perthane[6]	OCL	S	>4000	0.007
Phorate[5]	OP	SW	1	0.0055
Phosalone	OP	S	96	3.4
Phosmet[6]	OP	S	147	[8] 0.03

AGRICULTURAL INSECTICIDES AND MITICIDES: TYPES, TRANSPORTATION MODES, AND TOXICITIES

Common Names of Insecticides-Miticides	Chemical Class[1]	Predominant Transport Mode[2]	Toxicity[3]	
			Rat, Acute Oral LD_{50}, mg/kg	Fish[4] LC_{50}, mg/liter
Phosphamidon	OP	W	11	8.0
Propargite[6]	S	U	2200	0.03
Propoxur	CB	W	95	[9] 0.025
TDE	OCL	S	3360	0.009
TEPP	OP	W	1	[9] 0.39
Tetrachlorvinphos	OP	S	4000	0.53
Tetradifon	OCL	SW	14000	1.10
Thionazin	OP	W	12	[7] 0.10
Toxaphene	OCL	S	69	0.003
Trichlorfon	OP	W	275	0.16

[1] Chemical type designations: CB, carbamates; N, miscellaneous nitrogenous compounds; O, cyclic oxygen compounds; OCL, organochlorines; OP, organophosphorus compounds; PY, synthetic pyrethrin; S, aromatic and cyclic sulfur compounds.

[2] Where movement of insecticides in runoff from treated fields occurs, S denotes those chemicals that will most likely move primarily with the sediment, W denotes those that will most likely move primarily with the water, SW denotes those that will most likely move in appreciable proportions with both sediment and water, and U denotes those whose predominant mode of transport cannot be predicted because properties are unknown.

[3] Expressed as the lethal dose, or lethal concentration, to 50% of the test animals (LD_{50} or LC_{50}, respectively).

[4] 48- or 96-hour LC_{50} for bluegills or rainbow trout, unless otherwise specified.

[5] Registered as both insecticide and nematicide. Nematodes are controlled only on limited acreage and predominantly in the Southern states, but application rates when used as nematicides are 2- or 3-fold higher than when used as insecticides.

[6] Trade name, no correspondent common name exists.

[7] 24-hour LC_{50}.

[8] For killifish.

[9] For minnows.

SOURCE: U. S. Department of Agriculture, Committee of Scientists of Agricultural Research Service, Control of Water Pollution from Cropland, Vol. I, A Manuary for Guideline Development (Washington: G.P.O., 1975, pp. 51-2.

APPENDIX E

AGRICULTURAL INSECTICIDES AND MITICIDES: OFTEN-USED TRADE NAME SYNONYMS

APPENDIX E

AGRICULTURAL INSECTICIDES AND MITICIDES: OFTEN-USED TRADE NAME SYNONYMS

Trade Name	Name in Table 9a	Trade Name	Name in Table 9a
Acaraben	Chlorobenzilate	Imidan	Phosmet
Azodrin	Monocrotophos	Kelthane	Dicofol
Basudin	Diazinon	Lannate	Methomyl
Baygon	Propoxur	Marlate	Methoxychlor
BHC	Benzene Hexachloride	Meta-Systox	Methyl demeton
Bidrin	Dicrotophos	Mocap	Ethoprop
Cygon	Dimethoate	Morestan	Oxythioquinox
Dasanit	Fensulfothion	Morocide	Binapacryl
DDD	TDE	Neguvon	Trichlorfon
Delnav	Dioxathion	Omite	Propargite
Dibrom	Naled	Phosdrin	Mevinphos
Dimecron	Phosphamidon	Prolate	Phosmet
Dipterex	Trichlorfon	Rabon	Tetrachlorvinphos
Di-Syston	Disulfoton	Sevin	Carbaryl
Dursban	Chlorpyrifos	Spectracide	Diazinon
Dyfonate	Fonofos	Supracide	Methidathion
Dylox	Trichlorfon	Systox	Demeton
Ethyl Guthion	Azinphos ethyl	Tedion	Tetradifon
Fundal	Chlordimeform	Temik	Aldicarb
Furadan	Carbofuran	Thimet	Phorate
Galecron	Chlordimeform	Thiodan	Endosulfan
Gamma-BHC	Lindane	Trithion	Carbophenothion
Gardona	Tetrachlorvinphos	Zectran	Mexacarbate
Guthion	Azinphos methyl	Zinophos	Thionazin
		Zolone	Phosalone

SOURCE: U. S. Department of Agriculture, Committee of Scientists of Agricultural Research Service, Control of Water Pollution from Cropland, Vol. I, A Manual for Guideline Development (Washington: G.P.O., 1975), p. 53.

APPENDIX F

AGRICULTURAL FUNGICIDES: TYPES, TRANSPORT MODES, AND TOXICITIES

APPENDIX F

AGRICULTURAL FUNGICIDES: TYPES, TRANSPORT MODES, AND TOXICITIES

Common Names of Fungicides	Predominant Transport Mode[1]	Toxicity[2]	
		Rat, Acute Oral LD_{50}, mg/kg	Fish[3] LC_{50}, mg/liter
Anilazine	S	2710	0.015
Benomyl	S	>9590	0.5
Captafol	S	5000	[4] 0.031
Captan	S	9000	0.13
Carboxin	SW	3200	2.2
Chloroneb	W	4000	5.0
Chloranil	U	11000	>4200.0
Cycloheximide	W	2.5	1.3
DCNA	S	4040	
Dichlone	S	1300	0.047
Dichlozoline	U	3000	
Dinocap	S	980	[5] 0.14
Dodine	W	1000	0.9
ETMT	U	2000	
Fenaminosulf	W	60	23.0
Ferbam	SW	>17000	[4] 12.6
Folpet	S	>10000	[6] 1.56
Maneb	S	6750	[7] 1.0
Metiram	U	6400	>4.2
Nabam	W	395	[4] 21.1
Oxycarboxin	W	2000	
Panogen	U	>5000	[8] ~5.0
PCNB	S	1650	0.7
SMDC	W	820	[7] 1.0
Thiram	S	375	[4] 0.79
TPTH	U	108	
Zineb	S	>5200	0.5
Ziram	W	1400	[4] 1.0

[1] Where movement of fungicides in runoff from treated fields occurs, S denotes those chemicals that will most likely move primarily with the sediment, W denotes those that will most likely move primarily with the water, SW denotes those that will most likely move in appreciable proportion with both sediment and water, and U denotes those whose predominant mode of transport cannot be predicted because properties are unknown.

[2] Expressed as the lethal dose, or lethal concentration, to 50% of the test animals (LD_{50} or LC_{50}, respectively.)

[3] 48- or 96-hour LC_{50} for bluegills or rainbow trout, unless otherwise specified.

[4] For catfish.

[5] For harlequin fish.

[6] For mullet.

[7] LC_{100}.

[8] For fathead minnow.

SOURCE: U. S. Department of Agriculture, Committee of Scientists of Agricultural Research Service, Control of Water Pollution from Cropland, Vol. I, A Manual for Guideline Development (Washington: G.P.O., 1975), p. 54.

APPENDIX G

AGRICULTURAL FUNGICIDES: OFTEN-USED TRADE NAME SYNONYMS

APPENDIX G

AGRICULTURAL FUNGICIDES: OFTEN-USED TRADE NAME SYNONYMS

Trade Name	Name in Table 10a	Trade Name	Name in Table 10a
Actidione	Cycloheximide	Phaltan	Folpet
Benlate	Benomyl	Phygon	Dichlone
Botran	DCNA	Plantvax	Oxycarboxin
Cyprex	Dodine	Polyram	Metiram
DCNA	Botran	Spergon	Chloranil
Demosan	Chloroneb	Terrachlor	PCNB
Difolatan	Captafol	TMTD	Thiram
Dexon	Fenaminosulf	Vapam	SMDC
Dyrene	Anilazine	Vitavax	Carboxin
Karathane	Dinocap		
Parnon	Parmol		

SOURCE: U. S. Department of Agriculture, Committee of Scientists of Agricultural Research Service, Control of Water Pollution from Cropland, Vol. I, A Manual for Guideline Development (Washington: G.P.O., 1975), p. 55.

APPENDIX H

208 WORK FLOW CHART

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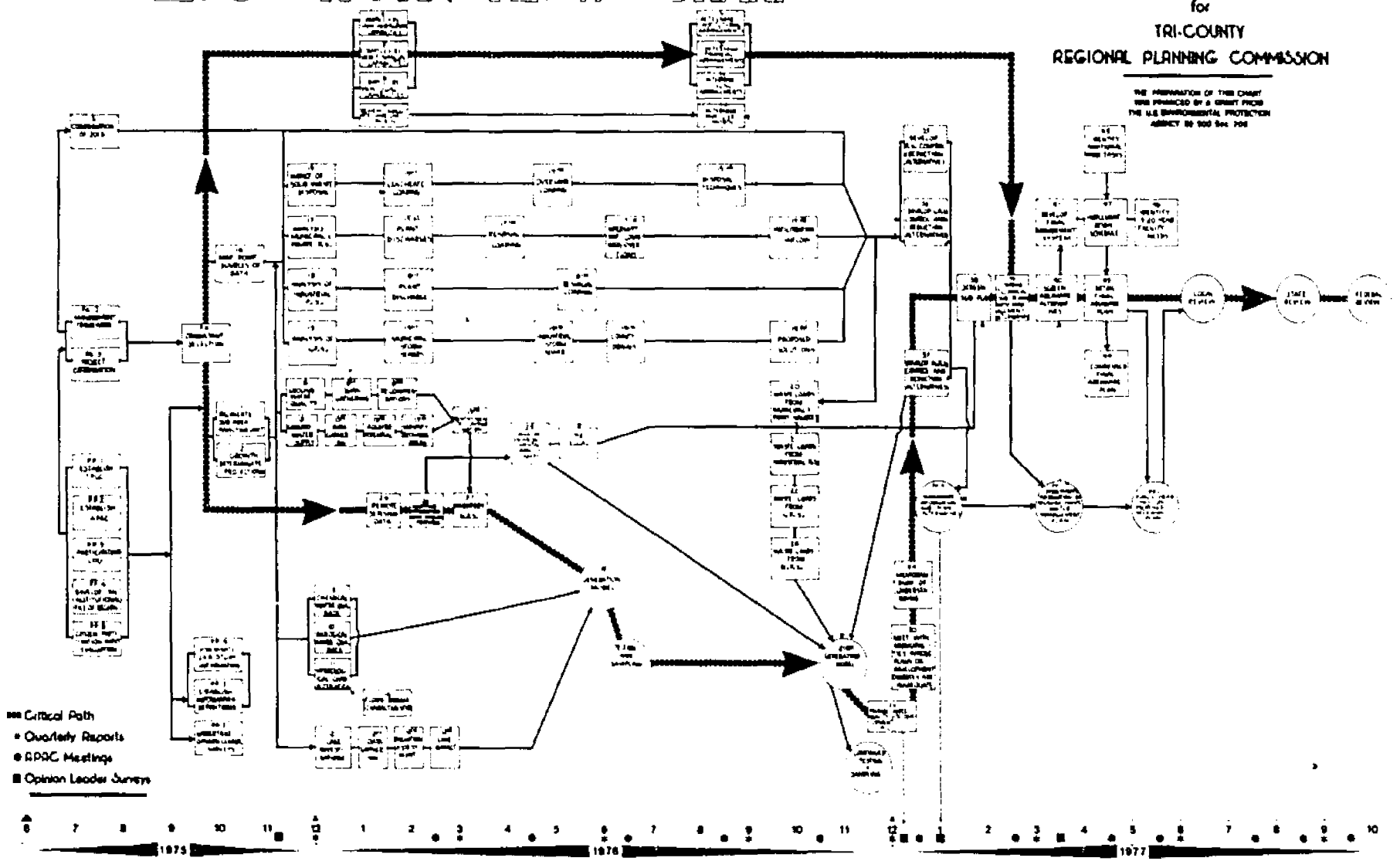
208 WORK FLOW CHART

for

TRI-COUNTY

REGIONAL PLANNING COMMISSION

THE PREPARATION OF THIS CHART WAS FINANCED BY A GRANT FROM THE U.S. ENVIRONMENTAL PROTECTION AGENCY UNDER SEC. 208



APPENDIX I

TCRPC: HYPOTHETICAL PLAN NO. 1

APPENDIX I

TCRPC: HYPOTHETICAL PLAN NO. 1

ASSUMPTIONS: Stream characteristics and pollutional loads from domestic and industrial wastes require improvements in plant treatment capabilities and reduction in total number of point source dischargee. Urban run-off is a prime source of pollutional loads.

NEW TREATMENT PLANTS: Dansville, Elsie, West Regional

PLANTS TO BE ABANDONED: Delhi, DeWitt City, Dimondale, Fowler, Olivet, Ovid, Potterville, Webberville, and Westphalia

MANAGEMENT SYSTEM: The establishment of a regional advisory council composed of local elected officials to review actions by member units of governments which affect plan implementation. The establishment of intergovernmental agreements and contracts (sanitary districts) for waste treatment, i.e., East Lansing/Meridian, Delta/Windsor/Potterville, Lansing/Delhi, etc. Coordination of activities and programs for urban run-off controls.

DETAILS OF 208 MANAGEMENT

Water Pollution Source	Technical Solution in 208 Plan	Management Action Required by 208 Plan	Management Agency
- Municipal and Industrial Wastes	- Collect wastes to environmentally optimum sites	- Plan, finance, construct, O & M	- Local units of government, sanitary districts
		- Plan reviews and recommendations on the regulation of dischargers	- Pollutional Abatement Advisory Council (PAAC)
	- Treat, dispose, and/or reuse wastes	- Plan, finance, construct, O & M	- Local units of government, sanitary districts
		- Regulate dischargers	- Michigan Dept. Natural Resources - Water Resources Commission (Mich. DNR-WRC)
- Direct Industrial Dischargers	- Adequate on-site treatment and conservation measures to reduce waste generation	- Regulate siting location	- Local units of government
		- Review sites	- PAAC
		- Regulate dischargers (NPDES permits)	- Mich. DNR-WRC
- Septic Tanks	- Stringent site approval	- Regulate location, design	- Local units of government, sanitary districts, County Health Departments
	- Specified areas have to connect to sewers	- Plan, finance, construct, O & M	- Local units of government, sanitary districts
		- Plan reviews	- PAAC
- Storm and/or Combined System Discharges	- Construct retention basins, treat storm water, separate combined systems	- Plan, finance, construct, O & M	- Local units of government, sanitary districts
		- Plan reviews	- PAAC
- Agricultural Run-off	- Improved land management	- Soil conservation plans	- Soil Conservation Districts
		- Technical assistance and information	- Extension agents, U.S. Soil Conservation Service, Soil Conservation Districts
- Urban Run-off	- Water quality sensitive development policies	- Technical assistance and information	- PAAC
	- Protection of lands during construction	- Soil Erosion Act	- County or Local Enforcing Agency
	- Protection of environmentally sensitive areas	- Specialized ordinances	- Local units of government
		- Development proposal reviews	- PAAC
	- Intensive street cleaning programs	- Procedural methods and schedules	- Local units of government

POSITIVE IMPACTS:
- Improved Water Quality
- Maintenance of local autonomy and accountability
- Ease of transition
- Required legislation already enacted
- Economies in service delivery

NEGATIVE IMPACTS:
- Potential difficulties in maintaining EPA goals
- Inherent weaknesses of advisory councils

APPENDIX J

TCRPC: HYPOTHETICAL PLAN NO. 2

APPENDIX J

TCRPC: HYPOTHETICAL PLAN NO. 2

ASSUMPTIONS: Existing treatment plants, after improvements to meet 1983 Water Quality goals will handle domestic and industrial waste loadings. Land run-off is causing serious pollutional problems which require substantial nonpoint source and land use controls.

NEW TREATMENT PLANTS: Dansville, Eagle and Elsie

PLANTS TO BE ABANDONED: City of DeWitt, Dimondale and Olivet

MANAGEMENT SYSTEM: A "segmented" grouping of authorities. First, the metropolitan area would establish an Authority composed of elected officials and citizens which would own and operate the treatment facilities and have definite land use planning powers. Second, each county would have a Department of Public Works which would own and operate the treatment facilities outside of the metro-authority.

DETAILS OF 208 MANAGEMENT

Water Pollution Source	Technical Solution in 208 Plan	Management Action Required by 208 Plan	Management Agency
- Municipal and Industrial Wastes	- Collect wastes	- Plan, finance, construct, O & M	- Local units of government
		- Plan consultations, regulate	- Metropolitan Authority (Metro), County Department of Public Works (DPW)
	- Treat, dispose and/or reuse wastes	- Plan, finance, construct, O & M	- Metro, County DPW
		- Regulate discharges (NPDES permits)	- Michigan Department of Natural Resources - Water Resources Commission (Mich. DNR-WRC)
- Direct Industrial Dischargers	- Adequate on-site treatment and conservation measures to reduce waste generation	- Certification of NPDES permits	- Metro, County DPW
		- Issuance of NPDES permits	- Mich. DNR-WRC
- Septic Tanks	- Specified areas have to connect to sewers	- Plan, finance, construct, O & M	- Local units of government
	- Stringent site approval	- Regulate location, design	- County Health Departments, local units of government, Metro, County DPW
- Storm and/or Combined System Discharges	- Construct retention basins, separate initial combined systems	- Plan, finance, construct, O & M	- Metro
	- Divert and collect storm flow for groundwater recharge	- Plan, finance, construct, O & M	- Metro
	- Site development policies requiring on-site retention	- Plan and oversee construction	- Local units of government
		- Regulate (permit issuance)	- Metro, County DPW
- Agricultural Run-off	- Improved land management	- Tax inducements for soil conservation plans	- County DPW, Soil Conservation Districts
		- Technical assistance and information	- Extension agents, U.S. Soil Conservation Service, Soil Conservation Districts
	- Pesticide use	- Regulate	- Mich. DNR and Dept. of Agriculture
- Urban Run-off	- Water quality sensitive development policies	- Specialized ordinances for protection of run-off generating activities	- Local units of government, Metro
	- Protection of lands during construction	- Soil Erosion Act	- County or Local Enforcing Agency
	- Protection of environmentally sensitive areas	- Development permits in designated areas	- Metro, County DPW
	- Interim street cleaning programs	- Procedural methods and schedules	- Metro, County DPW

POSITIVE IMPACTS:
- Improved Water Quality
- Lower construction costs
- Groundwater recharge program
- Economics in service delivery
- Establishment of an institution for the implementation of other activities, i.e., solid waste disposal, open space, land use planning, etc.

NEGATIVE IMPACTS:
- Less local control of land use decisions
- Steps for the creation of new legislation
- Greater expenditures for policing of nonpoint reduction activities

APPENDIX K

TCRPC: HYPOTHETICAL PLAN NO. 3

APPENDIX K

TCRPC: HYPOTHETICAL PLAN NO. 3

ASSUMPTIONS: High level of treatment of domestic and industrial wastes required to meet 1983 goals. Minimum nonpoint source problems.

NEW TREATMENT PLANTS: North, West and South Interregional

PLANTS TO BE ABANDONED: Bellevue, Delhi, Delta, Dimondale, Fowler, Grand Ledge, Maple Rapids, Ovid, Olivet, Potterville, Webberville, Westphalia and Williamston.

MANAGEMENT SYSTEM: Regional Authority composed of elected officials and citizens appointed by their respective units of government which own and operate waste treatment plants. Land use controls exercised on the local level with review functions performed by the Authority.

DETAILS OF 208 MANAGEMENT

Water Pollution Source	Technical Solution in 208 Plan	Management Action Required by 208 Plan	Management Agency
- Municipal and Industrial Wastes	- Collect wastes to environmentally optimum sites	- Plan, finance, construct, O & M	- Local units of government, sanitary districts
		- Plan reviews, regulate dischargers and sewer use	- Pollution Abatement Control Authority (PACA)
	- Treat, dispose and/or reuse wastes	- Plan, finance, construct, O & M	- PACA
		- Regulate dischargers (NPDES permits)	- Michigan Department of Natural Resources - Water Resources Commission (Mich. DNR-WRC)
- Direct Industrial Dischargers	- Pre-treatment and connection to municipal systems or adequate private treatment	- Regulate siting location	- Local units of government, PACA
		- Regulate by pricing policy	- PACA
		- Regulate dischargers by permits, pre-treatment standards	- PACA
		- Regulate dischargers (NPDES permits)	- Mich. DNR-WRC
- Septic Tanks	- Specified areas have to connect to sewers	- Plan, finance, construct, O & M	- Local units of government, PACA
	- Stringent site approval	- Regulate location, design	- Local units of government, PACA, Mich. DNR-WRC County health departments
- Storm and/or Combined System Discharges	- Construct retention basins, separate critical combined systems, computerized management of flows through collection and treatment systems	- Plan, finance, construct, O & M	- PACA
	- Site development policies requiring on-site retention	- Regulate construction of new systems	- Local units of government
- Agricultural Runoff	- Improved land management practices	- Ordinance to require soil conservation plans	- Soil Conservation Districts, PACA
	- Pesticide use and better land management	- Regulate and technical assistance	- Mich. DNR and Dept. of Agriculture
- Urban Runoff	- Improved site development policies and protection of "sensitive" lands	- Ordinances to require staging the preparation of sites for construction	- Local units of government, PACA
		- Soil Erosion Act	- Drain Commissioner, PACA

POSITIVE IMPACTS:
- High water quality
- Economies in service delivery
- Uniformity in land use decision criteria
- Regional control of the priority list for construction
- Establishment of an institution for the implementation of other activities, i.e., solid waste disposal, open space, water supply, etc.
- Dispersion of benefits throughout the region

NEGATIVE IMPACTS:
- Costs of construction
- Abandonment costs
- Less local control of land use decisions

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