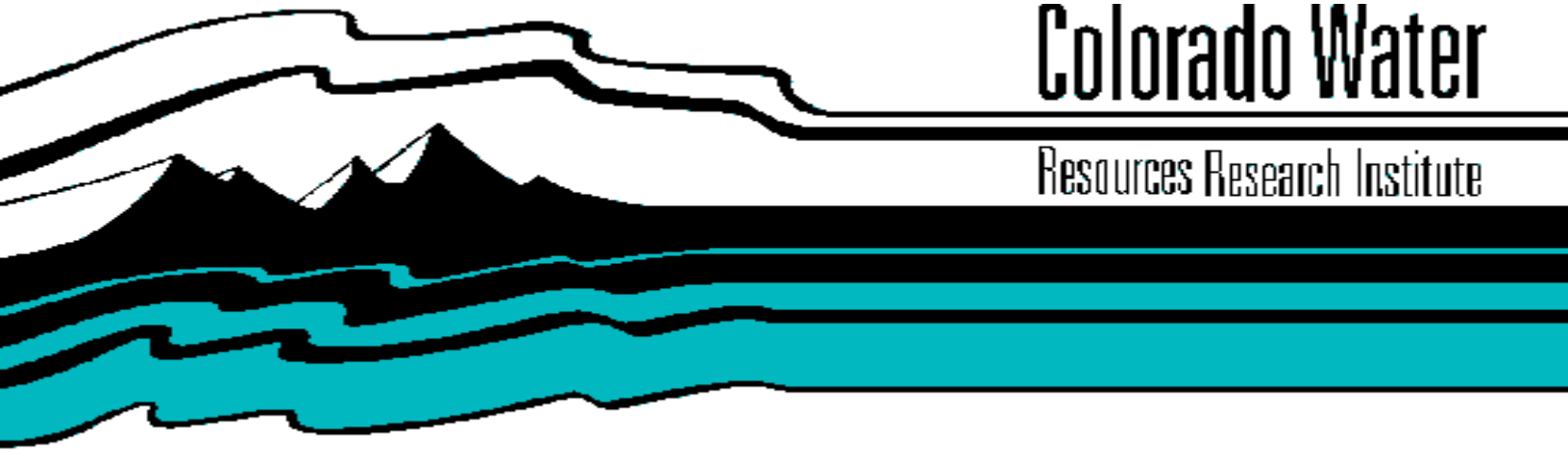
The Larimer-Weld Council of Governments 208 Water Quality Plan: An Assessment and Suggestions for Future Directions

By

Leonard F. Bryniarski, Kenneth W. Carter,
Howard D. Danley, and Joseph E. Gurule



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THE LARIMER-WELD COUNCIL OF GOVERNMENTS 208 WATER QUALITY PLAN: AN ASSESSMENT AND SUGGESTIONS FOR FUTURE DIRECTIONS

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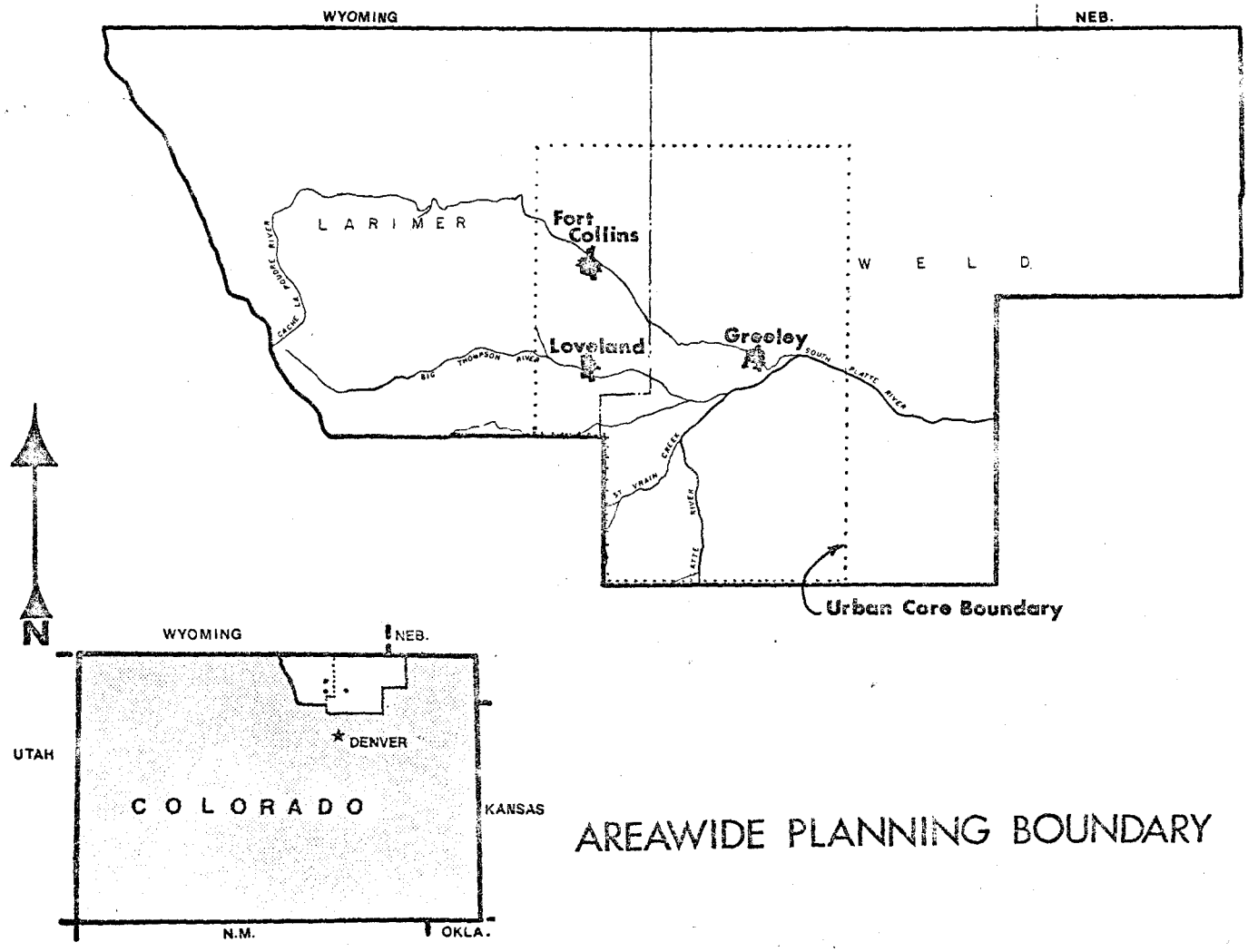

AREAWIDE PLANNING BOUNDARY

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FOREWORD

This paper was done in collaboration with the Larimer-Weld Regional Council of Governments (LWRCOG) 208 Program Director, Mr. Eric Eidsness. Its purpose is to evaluate the Draft Areawide Water Quality Management Plan - hereinafter called the Draft Plan, with respect to national goals and objectives set out by the Federal Water Pollution Control Act (P.L. 92-500) and the 1977 Amendments (P.L. 95-217) - hereinafter called the Act, and to provide constructive comments that look ahead toward potential problems that may be encountered in the second phase. Included for consideration by the 208 Director and the LWRCOG planning staff are comments with regard to how well the goals and objectives have been met; potential weaknesses and problems that are recommended for further analysis; and knowledge gaps that may still need to be filled.

I. BRIEF HISTORY OF FEDERAL WATER POLLUTION CONTROL LEGISLATION

Prior to 1948, water pollution in the United States was considered to be a local problem. The first major Congressional effort to establish a comprehensive water pollution control policy--the Water Pollution Control Act (P.L. 80-845)--was approved by Congress in 1948. The main thrust of this legislation was to assign powers of enforcement in water pollution control to the Governors of the States. Federal agencies were authorized only to support research for new technology in water pollution projects and to provide limited loans to assist the financing of treatment plants. Pollution control was considered to be primarily a local responsibility.

During the next eight years, State and Federal efforts in water pollution control changed very little. Most Americans considered the water pollution control problem to be localized and moderate.[19]

In 1956, after meeting fierce resistance, largely from the executive branch, Congress approved the first major revision of the 1948 Act--the Water Pollution Control Amendments (P.L. 84-660). The primary purpose of the revision was to strengthen and extend Federal involvement in pollution control activities. This became the basic act to which the subsequent amendments were added until the major revision was enacted in 1972. Major elements of the 1956 Act were (1) grant funding appropriations for projects and research were substantially increased and grants to states were based on meeting Federal requirements, (2) the requisite for state approval of water pollution action remained in effect, (3) the term "abatement" was replaced with "prevention and control," which altered the reactive nature of the original legislation, and (4) the water

pollution conference was established as a major enforcement procedure.[2] However, federal funding authorized fell short of need.[16]

The legislative amendments of 1961--Federal Water Pollution Control Act Amendments of 1961 (P.L. 87-88)--effected several significant changes in policy and administrative procedure. These revisions were (1) water pollution control authority was shifted from the Public Health Service (PHS) to the Department of Health, Education, and Welfare (HEW); (2) substantial increases in funding appropriations were approved; (3) the HEW Secretary could directly request the initiation of a suit without the permission of the State Government; and (4) navigable waters were included for protection, thus, the legislation included intrastate as well as interstate waters.[2]

In the ensuing years, it became apparent that the enforcement provisions in the 1956 Act were not effective. Many states were slow in establishing strong water pollution control programs and the regulatory powers of the 1956 Act had not led to significant progress. In an effort to prod the states into action, a second set of major legislative decisions for the water pollution control program--the Water Quality Act (P.L. 89-234)--was approved in 1965.[14] The primary intent of the 1965 Act were (1) the Federal Water Pollution Control Administration (FWPCA) was established within HEW to have jurisdiction over all water pollution matters;[2] (2) individual states were required to develop and submit standards for water quality for all interstate navigable waters and their tributaries flowing within its boundaries to the federal government for approval by June 1967;[14] (3) water quality considerations were expanded to include aesthetic as well as health aspects; fish, wildlife, recreational, agricultural, and industrial uses of water were recognized;

(4) the objective of the act was to "enhance" water quality, as well as to prevent and control pollution; (5) a "non-degradation clause" was inserted despite considerable resistance; and (6) in planning storage reservoirs, Federal agencies were required to give consideration to regulation of stream flows for water quality control purposes.[2]

Congress moved again in 1966 and amended the 1965 Act by broadening and intensifying the federal support of states' efforts in water pollution control by passing the Clean Water Restoration Act (P.L. 89-753). Major elements of the 1966 Act were (1) states were given prerogative in establishing standards and administering grants, as was the intent of the 1965 Act; (2) the size limitation on grants to states was removed, effectively encouraging development of large, regional-type facilities; and (3) the functions of the FWPCA were transferred from the Secretary of HEW to the Secretary of the Interior.

The National Environmental Policy Act of 1970 was passed to provide policy criteria dealing with several environmental matters, including water quality. Elements of this act which affected water quality were (1) a Council on Environmental Quality was established to advise the President on environmental matters, and (2) environmental impact statements on all projects were required from all agencies.[2]

The Environmental Protection Agency (EPA) was created in a reorganization plan by the President in 1970. This plan consolidated control of water quality programs into a single agency.

In 1970, Congress approved further amendments to the 1965 Act--the Water Quality Improvement Act of 1970 (P.L. 91-224). This Act provided for (1) grant appropriations expansion, particularly in the

fields of research and development and personnel training; (2) federal government development and promulgation of standards for hazardous polluting substances in navigable waters; and (3) demonstration projects for development of methods to abate acid and other mine water pollution.[2]

Thus, the federal government's role had been one of supplying subsidies to local governments for water treatment, of reviewing state-set standards, and of technical assistance and research and development activities. The federal government did have enforcement powers over interstate waters and could intervene when the states did not do an adequate job of controlling major pollution discharges; but the laws had assigned the primary responsibility to the states for implementing the programs. The overall pattern was one of federal-state cooperative activities, especially shared standard-setting and jointly funding control programs.[14]

During 1970 and 1971, the Senate Subcommittee on Air and Water Pollution held public hearings concerning water pollution control and abatement. The Subcommittee found that the national effort to abate and control water pollution had been inadequate in every vital aspect:

-- Many of the Nation's navigable waters were severely polluted, and major waterways near the industrial and urban areas were unfit for most purposes;

-- Rivers were the primary source of pollution of coastal waters and the oceans, and many lakes and confined waterways were aging rapidly under the impact of increased pollution;

-- Rivers, lakes, and streams were being used to dispose of man's waste rather than to support man's life and health; and

-- The use of any river, lake, stream, or ocean as a waste treatment system was unacceptable.[19]

During this period there had been much criticism of the 1948 Act which had been amended five times from 1956 to 1970. The enforcement procedures were criticized for their length and inconclusiveness and the water quality standards program had become involved in numerous federal-state disputes.

Because of the feeling that the nation's waters were not getting cleaner, it was felt that a shift in the strategy to abate and control water pollution was necessary.[14]

A major change in environmental and intergovernmental policy occurred in 1972 with the passage of the Federal Water Pollution Control Act Amendments of 1972 which committed this nation to a course of restoring and maintaining the highest quality of water in our streams and waterways. This Act represented a complete rewriting of the language of the original 1948 Act and all subsequent Amendments. Its effect was to vastly expand the federal role in water quality management, and to establish the necessary mechanics to administer a massive program to meet definitive water quality goals.

The stated objective of the Act is to restore and maintain the chemical, physical, and biological integrity of the nation's waters.[9] In order to achieve this objective, the Act has stipulated a national goal, that, wherever attainable, an interim level of water quality which provides for the protection and propagation of fish, shellfish and wildlife and provides for recreation in and on the water be achieved by 1 July 1983. The ultimate goal of the Act is elimination of the discharge of all pollutants into the navigable waters by 1985.

The Act establishes, as a national policy, that areawide treatment management processes be developed and implemented to assure adequate control of sources of pollutants in each state.[9] Essentially, the Act established a program that contains three main elements: (1) an expanded system of federal grants to plan and construct publicly-owned sewage treatment plants (Section 201), (2) an administrative program to regulate discharge of pollutants into the nation's water (Section 402), and (3) the establishment of state plans and planning processes for administering and enforcing water quality standards (Sections 303 and 208). Section 303 requires each state to develop a continuing planning process with primary emphasis on water quality management plans.

Section 208, the other key planning provision of the Act, requires the development of areawide water quality management plans which become a part of the state water quality management plan.

The 1972 Act was amended by the Clean Water Act of 1977. The changes to be made by the 1977 Act were touted as only "mid-course corrections" when Congress began tinkering with the Law. This Act postponed certain deadlines established in the 1972 Act for water pollution abatement, transferred greater water pollution control authority to states, reduced federal controls over wetlands, and extended authorization of construction grants to states.[7]

II. SECTION 208 AND REASONS FOR ITS INCLUSION IN THE ACT

The primary purpose of Section 208, is to encourage and facilitate pollution control activities for the development and implementation of areawide water quality management plans.

In general, Section 208 studies are designed to anticipate municipal and industrial waste treatment needs, establish priorities for construction of new waste treatment facilities, regulate the modification, construction and siting of new waste treatment facilities, and establish procedures to control non-point sources of pollution. Additionally, Section 208 establishes a procedure by which local or regional government agencies are provided a unique opportunity to plan and manage a comprehensive program based on integrated planning and control over such activities as municipal and industrial wastewater, non-point source pollutants (concentrated animal feeding, mining, construction, silviculture, stormwater runoff), and land use as it relates to water quality.

One of the main reasons for inclusion of Section 208 in the Act is the regulation of non-point sources of pollution through land use controls. Congress felt that the most efficient and acceptable means of regulating non-point sources was through land use controls at the local levels. Whether this involves the establishment of voluntary Best Management Practices for agriculture or stringent subdivision regulations to control erosion and runoff, it was felt that it would be more efficient and more acceptable by the public if done at the local level. Also, national and state land use legislation has been resisted; and land use regulations are required to control non-point sources of pollutants. Therefore, Section 208 was included to solve these problems. In relation to the land use provisions of Section 208, the Director of the Water Resource division of EPA has stated:

> "...while 208 is not a land use program, it does have definite relationships to land use. Water quality is affected, often significantly, by land use decisions. As a result, land use issues can

> be expected to receive attention in the plan. Section 208 will undoubtedly provide impetus to existing public and private efforts to ensure that actions reflect long-term public needs and desires. However, there are many public goals that enter into decisions on resource usage, and water quality should be only one of those goals..."

Through a locally controlled planning agency, an area can develop a plan that is realistic and implementable for the given area and at the same time achieve the 1983 goals of the Act. Initially, the plan should focus on an integrated approach for identifying and controlling the most serious water pollution problems and, over time, for resolving the remaining problems, where feasible. Particular emphasis could be placed upon non-structural approaches to pollution control as a means of reducing the normally large investments associated with traditional structural measures. The area would also choose the management agency or system best suited for assuring implementation of the plan. Periodic review and updating of the plan and management arrangements would enable timely changes in the plan in response to changing conditions and new information within the area.[27]

III. CONTENT OF SECTION 208 PLANS[26]

In general, the following 16 elements would normally be addressed in a water quality management plan:

1. Planning boundaries - Each designated study area should be compatible with approved state planning areas included in the state planning process, and with those areas in which facilities planning has been deemed necessary by the state. Additionally, locations of

water quality and effluent limitation segments, significant discharges and fixed monitoring stations should be identified.

2. Water quality assessment and segment classification - Each designated area should have an assessment of water quality problems (existing and potential) by identifying the types and degrees of both point and non-point sources.

3. Inventories and projection - Each plan should contain an inventory of existing municipal and industrial sources of pollutants and land use patterns. Also included should be municipal and industrial wasteloads, land use patterns, and 20-year demographic and economic growths.

4. Non-point source assessment - Each plan should include an assessment and identification of water quality problems associated with non-point sources of pollutants.

5. Water quality standards - Each plan should include applicable water quality standards.

6. Total maximum daily loads - Each plan should include the total allowable maximum daily load of relevant pollutants to be established at levels necessary to achieve compliance with applicable water quality standards; which takes into account provision for seasonal variation and lack of knowledge concerning the relationship between effluent limitation and water quality. Thermal loading should be established at levels necessary to assure the protection and propagation of aquatic life and wildlife.

7. Point-source load allocation - The total load allocation for all individual point sources should be coordinated with the National Pollutant Discharge Elimination System (NPDES). Such allocations should not exceed the total allocation for the five-year

period of the plan and should allow for anticipated economic and population growth during that period.

8. Municipal waste treatment system needs - Each plan should identify municipal waste treatment system needs (5-year increments for at least 20 years) by considering load reduction needs in order to attain and maintain applicable water quality standards and effluent limitation and population changes.

9. Industrial waste treatment system needs - Each plan shall include the anticipated (5-year increments for at least 20 years) industrial point source wasteload reduction required to attain and maintain applicable water quality standards and effluent limitations.

10. Non-point source control needs - Each plan should identify and evaluate all measures necessary to produce the desired level of control through application of Best Management Practices (BMP) for categories of non-point sources of pollutants established by EPA and state agreements. The evaluation shall include an assessment of non-point source control measures applied thus far and the time period required, the proposed regulatory program and the management agencies needed to achieve the desired controls.

11. Residual waste control needs; land disposal needs - Each plan should identify the necessary controls to be established over the disposal of residual wastes on land or in subsurface excavation which could affect water quality.

12. Urban and industrial stormwater system needs - Each plan should identify required improvements to existing urban and industrial stormwater systems, including combined sewer overflows, that are necessary to attain and maintain applicable water quality standards. Emphasis should be given to land use and non-structural techniques of controlling stormwater runoff.

13. Target abatement dates - Each plan should recognize target abatement dates for all significant dischargers, non-point source control measures, residual and land disposal controls and storm-water system needs. Major interim and final completion dates that are necessary to assure an adequate tracking of progress should be included.

14. Regulatory programs - Each plan should describe existing and future state-local regulatory programs for implementing the state water quality management plan. Existing programs shall include regulatory approaches to be employed, the statutory basis for the program and relevant administrative and financial program aspects. Future programs shall include the proposed regulatory approach, the necessary legislation, and anticipated administrative and financial capabilities.

15. Management agencies - Each plan should identify those agencies recommended for designation by the Governor to carry out each of the provisions of the water quality management plan. The agency must have adequate authority and capability to carry out its assigned portion of the water quality management plan.

16. Environmental, social, economic impact - Each plan should include an assessment of the environmental, social, and economic impacts resulting from the plan.

IV. PROBLEMS IN LARIMER AND WELD COUNTIES[13]

Larimer and Weld Counties contain approximately 250,000 people. The average person uses about 100 gallons of water per day, which becomes domestic sewage. Water is used to irrigate over one-half

million acres in the two counties. As growth and urbanization in the two counties continue, the demands on the limited supply of water will increase the difficult problems which are occurring presently. The increased usage of the water supply will further lower the water quality unless corrective steps are taken.

As the problems of improving water quality have grown, there has been a growing awareness of the complexity and the broad effects that water-related decisions have on life throughout the area. The people have discovered domestic sewage is not the only source of water pollution and there must be more than one solution to solve the problems.

Point sources of pollution in the area occur from domestic and industrial sewage treatment plants and large cattle feedlots. Non-point sources of pollution include runoff from agricultural fields, from mining, silvicultural and construction activities, and from streets and buildings in the urban areas.

There are many problems in the two-county area which are results of water-related decisions that have been made with very little coordination with other entities having decision-making responsibilities regarding water matters. As a result, many of their duties overlap; there is unwarranted competition where there should be cooperation; and water management capabilities vary greatly.

The Draft Plan is intended to solve many of the Region's water quality problems and to develop an efficient institutional strategy for regulating actions which affect water quality. The LWRCOG has written as follows:

> "Clearly, the Clean Water Act is of major significance to the Larimer-Weld Region. It is a big program to which the federal and state governments

> are firmly committed and as such, promises to impact the Region in a profound way. The Region's local governments must avail themselves of opportunities provided in Section 208 of the law to take the lead in the planning and program implementation. The path ultimately selected must enhance, not undermine, the regional economy and way of life. Proposed technical solutions, institutional change and financial programs absolutely must fit the Region's circumstances (as well as the clean water goals)."[12]

The Draft Plan recognizes that there are factors associated with this region which affect the attainability of national water quality goals.[12] Water management in Larimer and Weld counties must involve both water quality management and water quantity management. Since water in this area is a scarce resource, an extensive water quantity management system is required and has been in operation for over 100 years. There is an extreme variation in both stream flows and the quantity of water diverted from the streams--resulting in many streams drying up and in erosion and sedimentation problems.[12] Also, the Act includes a statement, as in much national legislation involving water, that nothing in the Act will affect the rights of the States to allocate quantities of water.[12] So it can be seen that the manner in which water is managed as a resource has a great affect on the attainment of water quality goals, and is reflected in the principles and concepts and planning strategies described in the Draft Plan.

V. THE LWRCOG 208 PLAN APPROACH

A. Principles and Concepts

The Draft Plan presents a three-phased implementation approach to the solution of water pollution problems in the region. Phase 1 involves problem definition, alternative solutions (including their

social, economic and environmental impact), priority setting, definition of institutional structures to deal with pollution problems and to meet financial requirements. Phase 2 refers to demonstration and public acceptance, and Phase 3 is essentially the delivery phase, where the solution and its mechanism for implementation are part of an established, institutionalized process.

Two basic pollutant groups are identified--point sources and non-point sources. Considerable knowledge with regard to regulation of point source pollution is available but the "methods for controlling non-point pollution sources are in a more primitive stage of development than the techniques for remedying point sources."[15] State guidelines for water quality management suggest that "the water quality problems that should receive greatest priority initially are municipal and industrial point source problems, and non-point source problems that can be dealt with through better management practices and future stormwater systems that can be better designed. Lower priority should be placed on non-point source and stormwater problems that require large capital investments for their solution."[23]

Mandatory compliance and program implementation for non-point sources of pollution are not possible, since all the facts on this pollution group are not presently known. Therefore, the state-of-the-art in dealing with non-point sources only justifies voluntary compliance activities. Current emphasis is on gradual implementation of programs that appear to be viable first in a demonstration setting, before applying such water quality management programs in a full implementation setting. Although the Draft Plan takes the position that "Mandatory compliance and program implementation can only be seriously considered when all the facts are known,"[12] the EPA guidelines specify that, "the requirement for a regulatory

program over point and non-point sources places a clear responsibility on areas developing State [Water Quality Management] Plans to establish regulation of non-point sources. It is EPA policy that the type of regulation appropriate for each non-point source category should be established by the State. Designated 208 planning agencies may also define non-point source regulatory measures for approval by the State."[23]

Even though the LWRCOG has made meaningful strides in defining agricultural related pollution problems and interrelationships with other pollution sources, studies concerning program testing and demonstration is still a relatively new field of endeavor. In its effort to develop an agricultural pollution control program, the LWRCOG initiated the formation of a special agricultural committee, for the purpose of addressing the institutional, financial and technical issues through preparation of pollution control principles, concepts and strategies for the Larimer-Weld Region.

B. Planning Strategies[12]

A brief summary of the four alternative technical strategies considered by the LWRCOG are provided below:

1. Strategy number one emphasizes control of municipal and industrial point source discharges. In order to meet water quality standards, municipal and industrial point source discharges for the Cache la Poudre River, the Loveland Wastewater Treatment Plant and the proposed Greeley Delta Plant would have to provide advanced waste treatment; the Great Western Plant at Loveland would have to provide tertiary treatment. Hydrology and stream habitat would not be altered; water quality would be improved but the type and quality of the existing fishery would not be improved.

2. Strategy number two includes advanced waste treatment for municipal and industrial discharges on the Lower Poudre, flow augmentation on the Poudre and on the Big Thompson, dredging of the Poudre and Thompson to expose channel substrate for fish propagation, recreational enhancement, fish stocking in the plains river reaches and stream engineering to provide fishery habitat.

3. Strategy number three was the recommended proposal selected by the LWRCOG. It requires secondary treatment of all existing plains area dischargers and also, fish stocking and stream engineering in the reach of the Poudre between the mouth of the canyon and Fort Collins Sewage Treatment Plant Number 1. In addition, a coordinated water quality, quantity and biological monitoring program would be implemented.

4. Strategy number four would require all dischargers to meet secondary treatment standards, control measures would be undertaken for non-point sources to maintain integrity of the existing fishery, and there would be no fish stocking or stream engineering in the plains area streams.

C. Institutional Strategy

The Draft Plan discusses the water management strategy for the Larimer-Weld Region. This strategy includes both a technical implementation strategy and an institutional strategy which identifies functional activities, organizational requirements, financial requirements, and policy and program requirements necessary to implement the technical strategy.

Regarding institutional strategy, the Draft Plan states that "Certain basic functional elements are essential to deal with the specific tasks required to implement the plan."[12] In conformance

with the Act and with EPA guidelines, the Draft Plan takes into consideration four functional tasks associated with the institutional strategy - areawide planning, management, operations and regulation.

Concerning the functional task of areawide planning, EPA Guidelines clearly stipulate that "Sections 303(e) and 208 of the Act require State and designated areawide planning agencies to have a continuing planning process which is consistent with the Act."[26] The Draft Plan assigns the areawide planning agency (the LWRCOG) the following responsibilities: approval of proposed changes to the plan; annual review and updating of the plan; completion of planning for non-point sources; the provision of technical assistance to management agencies; integration of the plan with adjoining 208 planning regions.

The primary responsibility of the management agency is to implement the 208 plan. In order to accomplish this task, management agencies must meet minimum capabilities as specified in Section 208 of the Act and possess land use control powers. Since the LWRCOG does not have any authority to enact or implement land use controls, it is essential that local governments which possess legal authority for land use planning and control be designated as management agencies to assure the implementation of the plan.

The functional task of "operations" may or may not be performed by a management agency. However, from a practical point of view, where general purpose government powers exist--such as in cities having treatment facilities--the dual functions of operations and management will usually be assigned to them. Conversely, where general purpose government powers do not exist--such as in agricultural or special district areas--the separation of both functions is more likely to occur.

The regulatory functions fall into two major categories: (1) administration of the Section 402 permit program for all point discharges; (2) land use and land management control. Details of the requirements for regulatory agencies are contained in 40 CFR 131 Regulations.

D. Institutional Assignments

The Draft Plan had two important findings with respect to non-point sources of pollution and the institutional arrangements they require. The LWRCOG has written as follows:

> "One [finding] is simply that we do not yet know enough to establish a highly structured program so we must first develop a planning process to see us through the applied research and development that is essential to a more structured approach. A second and corollary finding is that solutions should be gradual so that we can assess the broad implications..."[13]

The institutional arrangement for non-point sources (except agriculture) are basically the same as for point sources. The LWRCOG is designated as the planning agency and is responsible for establishing demonstration programs and completing the planning process. The cities and counties are designated as management agencies, and the Draft Plan does not designate any new operating agencies.

The institutional arrangements for agricultural non-point sources are divided into Phases 2 and 3. In Phase 2, continued study is required; and Phase 3 contains the full-scale implementation. In Phase 2 the LWRCOG is designated as the planning agency and the counties as management agencies. The Soil Conservation Districts are designated as operating agencies, and the State and County Health Departments are to perform the regulatory function.

For municipal and industrial point sources, the LWRCOG is designated as the planning agency. Qualified cities and the counties

are designated as management agencies, and the dischargers of pollutants are designated as operating agencies. The regulatory function is to be performed by the County and State Health Departments.

E. Implementation Strategy

Section 208 of the Act requires that each plan should be capable of implementation and that it identify the control techniques through which water quality management will be carried out. Implementation plans are defined by each category of pollution source and are briefly summarized below:

Municipal and Industrial Point Sources. Discharge from all municipal and industrial (30) treatment works were computed and modeled mathematically. It is felt that the region now does a good job of treating its municipal and industrial wastes. The LWRCOG has written that, "Two key factors will affect the demand on existing systems: (1) the location of growth and urbanization, and (2) stream classifications and treatment standards."[11]

A special study was conducted to determine if phosphate removal should be undertaken. The analysis showed that the two treatment facilities at Estes Park contribute less than 5 percent of the phosphate and that removal is not warranted.

The high cost of treatment works for municipal and industrial (M & I) wastes has become a major concern. A Utility Management Handbook has been developed to aid in planning these projects.

Another area of concern with respect to M & I waste is that of water conservation. Although no specific recommendations are made, the Draft Plan states, "Ongoing efforts to correct infiltration and inflow problems coupled with an aggressive water conservation program could substantially reduce hydraulic loading on the facilities

thereby extending reserved capacity." The Draft Plan assigns responsibility in this area to management agencies or part of ongoing studies.

The Draft Plan assigns the four institutional functions various tasks which constitute the implementation process to meet the stated objectives and solve the defined problems. The planning tasks are directed toward the following: water-based recreational opportunities; regulation of flows; fish stocking and stream engineering; and waste facility planning, management and operation.

1. Urban Stormwater.

> "The 208 study found that urban runoff may significantly lower water quality in certain parts of the region. This pollutant source is characterized by large, random discharges, and carries a great variety of pollutant types as well as large volumes of sediment. However, there appears to be insufficient justification for an aggressive and potentially expensive structural program to control the quality of urban runoff until the problem and possible solutions are better understood. It is clear that certain non-structural or design approaches could be cost-effective, such as controlling street sanding, ponding the runoff from construction sites or parking lots, and improving litter control, street sweeping, and stormwater management."[13]

The Draft Plan emphasizes housekeeping (for example, street sweeping) methods as a means of urban stormwater pollution control, but it also says that runoff attenuation is a preferred strategy to control not only volume but also sedimentation. The planning tasks involve the following: runoff monitoring, subdivision regulations investigation, and further study of the problem.

The Draft Plan requires management agencies to define a long-range program to manage stormwater. This program will include inventories of problem areas, planned budgets for stormwater management, technical assistance needs, and identification of activities which should be incorporated into a stormwater management program.

2. Silviculture. There is a near 2000 square mile area in this Region which is under jurisdiction of the Department of the Interior.[12] The area is the source of five river systems and potential water quality problems associated with silvicultural activities such as logging, construction, grazing, and recreation. The initial component of implementation is development of data that factually describes how silviculture activities affect water quality.

The Forest Service has proposed a study to evaluate the sediment impacts of mountain uses on water quality. Land uses associated with grazing, timber, private development, and recreation are addressed. The Forest Service Study will develop control requirements for silvicultural non-point source pollution.

The recommended implementation plan for silviculture involves implementation of the aforementioned Forest Service proposal, coordination of a water quality sampling and monitoring program for pollution due to silvicultural activities, and development of a public education program to reduce or mitigate water quality impacts by man in mountain areas.

3. Construction. Construction has a relatively minor impact on water quality in the region; however, this does not mean that controls should not be implemented. Current ordinances on construction do not specifically address sediment control. Attention will be given to land use controls which affect construction activity, such as subdivision regulations and erosion ordinances. The LWRCOG summarized the problem very well when they wrote:

> "Although the impact of construction on water quality is relatively insignificant compared to other non-point sources of pollution, there is still room for improvement, especially in terms of controlling erosion. The current high level of construction activity in the region is expected to continue, which strengthens

> the case for developing ordinances to improve water quality by such measures as collecting runoff from construction sites."[13]

4. Leachfields and Unlined Sewage Lagoons. The use of leachfields, unlined sewage lagoons and septic tanks as a means of sewage disposal has long been practiced, particularly in rural areas. In situations where such techniques did not produce a nuisance, they provided a satisfactory and least costly method of sewage disposal. Unfortunately, such practices are no longer exclusively independent. There is some concern that many septic systems are not operating properly, resulting in possible groundwater contamination. The Draft Plan recognizes that this is a speculative situation that could create serious health problems and that inadequate data now exists on the origin and impact of groundwater contaminants as a result of these sources. The present scheme of septic system regulation and designs rests with the County Health Departments which have no known standards and requirements for adequate operation and maintenance of septic systems.

As long-range objectives, the 208 study proposes to address the control of pollution from leachfields and unlined sewage lagoons by strengthening management and regulatory agencies, quantity groundwater contamination and developing a program for improved operation and maintenance of such systems. Because of the inadequacy of existing data, the Draft Plan has identified pertinent data requirements that would provide the necessary information to evaluate lagoon impacts on groundwater. The study has also alluded to chemical and biological techniques that can be used for generating needed data such as effluent characteristics, extent of treatment and sludge accumulation rates. The Draft Plan recognizes that

considerable field studies and field data gathering inventories will be needed to assess pollutants from septic sources. Critical review of existing septic systems and present regulations are pertinent tasks identified by the Draft Plan. The review will include soil conditions, groundwater quality, septic tank operation and maintenance, effectiveness of present regulations in protecting public health and usage of other wastewater treatment techniques.

5. Solid and Hazardous Wastes. The disposal of solid and hazardous wastes and their impact on water quality has been characterized in the Draft Plan as "a complex and difficult assignment which is beyond the scope of the initial planning program."[12] This is an understandable situation, since presently there is limited knowledge of solid waste management practices and even less knowledge of its interaction with water quality. The Draft Plan allows for a collection mechanism and flexibility so that policies, programs and appropriate regulatory measures can be established to address pollutant loadings from solid waste management. The development of a handbook for guidance in the location, design and operation and maintenance of solid waste management facilities is an excellent start. This will provide valuable information for solid waste disposal, especially if it is fully coordinated with water quality management. As part of the regulatory tasks, the Draft Plan has identified the County Health Department as providing certain information to the LWRCOG.

6. Concentrated Animal Feeding Operation. The Draft Plan found the ongoing animal program implemented by the State Department of Health to have insignificant impact on surface water quality within the Region. Impacts on groundwater were also found to be

negligible, except for localized areas. Potential programs could develop in areas where long-term manure loading was to continue. Site rotation may be a possible alternative to avoid high concentration of manure disposal in areas where groundwater may be contaminated. One other possibility may be the use of lined barrow pits for waste disposal. The Draft Plan emphasizes that guidance be provided area farmers to guarantee that manure and commercial fertilizers are utilized at rates commensurate with water quality and crop requirements.

7. Irrigated Agriculture. Long-range control objectives for irrigated agriculture, as described in the Draft Plan, present a comprehensive and extensive approach to water pollution abatement. They identify irrigated agriculture as the major water user in the Region and indicates that such use is the major cause of salinity, nitrate and sediment water quality degradation. Strategies for salinity control are aimed at reducing loss of good quality water to highly-saline groundwater by reducing conveyance losses and improving on-farm water use efficiency. Poor irrigation efficiencies also contribute to the nitrate problem, particularly on sandy soils and by excessive use of fertilizers. Strategies for nitrate control are aimed at improved fertilizer management and improved irrigation efficiencies. Similarly, sediment control is a function of irrigation methods, particularly tailwater control.

The two primary objectives set forth in the Draft Plan to address the irrigation situation are: (1) to determine the effectiveness of alternative management practices of the recommended BMP and (2) to estimate the costs for the program. It allows a flexibility that is a key element in general planning of this nature.

The implementation plan for irrigated agriculture recognizes that this is a new approach and not much is known in assigning technical tasks. The Draft Plan, therefore, proposes a phased implementation plan that considers, as the first phase, research, demonstration, monitoring and education.

Research needs will attempt to establish fertilizer guidelines for combined use of manure and chemical nitrogen, inventory areas of high seepage in the canal system and analyze the energy impacts of conversion to sprinkler irrigation.

A key element of the plan is the demonstration effort to define true effectiveness of selected BMP and demonstration to gain farmer acceptance. In addition to the potential BMP items listed for possible farmer acceptance are water savings, or more specifically, additional good water available for irrigation. Demonstration programs must be coupled with the monitoring phase. Most important is the education of everyone involved in using BMP, especially the farmers, since they will be the key to whether BMP can effectively be used as a management tool in achieving improved water quality.

8. Non-Irrigated Agriculture. The largest acreage of land use within the Region is non-irrigated cropland and rangeland. The reasons, as pointed out in the Draft Plan, are limited rainfall and inadequate ditch systems. As a result, a wheat-fallow system is used to store moisture in alternating years of wheat production. Because the fallow year is tilled repeatedly to reduce vegetation and thus conserve soil moisture, it creates conditions that are conducive to soil erosion in croplands. Rangeland, on the other hand, is less vulnerable to soil erosion because of native grass cover.

The Draft Plan recognizes that planning priorities did not permit the identification of water bodies and beneficial uses which may be impaired as a result of sediment pollution from non-irrigated agriculture sources. It does recommend, however, that studies be initiated to determine critical areas and that such studies lead to the development of watershed conservation plans within the non-irrigated areas.

F. Intergovernmental Agreements

Perhaps the key element in the successful implementation of the Draft Plan is the intergovernmental agreements that are required among the myriad of agencies. Water quality agencies operate in a confusing institutional arrangement consisting of many agencies of local, State and Federal governments; Regional planning bodies; and a wide-range of special-purpose authorities. Local government fragmentation has increased because of the many special districts for sewage treatment, water supply, fire protection, and other services; and this fragmentation has been stimulated by federal grants combined with local reluctance to reorganize to meet demands for regional services.[24] The water-related organizations operating within the Larimer-Weld Region consist of (1) most of the region's 34 cities which operate both water and wastewater systems, (2) more than 80 ditch companies with conveyance systems, (3) at least 16 domestic water and sanitation districts, and (4) 10 soil conservation districts involved in agricultural water use.[11] These service districts were established by political necessities and the desire to achieve economic efficiency. However, excessive fragmentation can produce inefficient and inequitable services and regulation. A town might pass along the costs of poor waste management to the

county, or vice-versa. These external diseconomies also occur when one service is provided to the detriment of other objectives.[24]

At present, the sole purpose of special district governments is to provide a specific service (water, sewer, etc.) for a designated area. To provide this service the special district government is authorized, by state law (see Appendix A for pertinent provisions), the power to levy a limited tax, to incur indebtedness and of eminent domain. General purpose governments are the more traditional type governments--towns, cities and counties that provide multi-purpose services. In addition, general purpose governments in Colorado have been delegated power for land use control. The situation may exist where one government entity (special district) is involved with water supply and/or waste water treatment and another entity (general purpose government) possesses the necessary land use controls to implement a 208 plan. It is essential that a communication mechanism be established between both governments to increase cooperation and to overcome problems of fragmentation. One method is to have the State set minimum standards and implementation guidelines and to impose land use controls; however, State land use controls have been strongly resisted in Colorado. Another arrangement is to have land use controls at the county or regional levels.[24]

In formulating the Draft Plan, the LWRCOG decided to utilize existing governmental structure to the greatest possible degree. This was done by developing two concepts which utilize intergovernmental agreements--the Urban Service Area concept and the Pass-Through concept.

The Urban Service Area concept assigns the responsibility of managing urban fringe areas, which are presently under county

jurisdiction, to the cities and towns. This is accomplished through intergovernmental agreements between the county and various municipalities. The Draft Plan describes the Urban Service Area concept as follows:

> "The purpose of creating an urban service area is to define the area of responsibility or area of domain for planning and service purposes. For these purposes, the legal division of responsibility which is determined by the city limit line is usually inappropriate. City limits are administrative boundaries with little permanence and no natural basis for their location. It is reasonable to assume that urban development and densities will locate in the vicinity of urban centers and their resultant need for urban level of services will continue to be met by cities and towns. In Colorado, the county's role traditionally has been to serve the minimal rural needs and to avoid the urban service business. Pressures to avoid tax increases, staff and new responsibilities argues for a continuation of this role. Every county which has allowed scattered urban development has been subject to increased budget, staff and service demands (from dog catchers to sheriff's patrols). Cities are also strongly opposed to counties entering the urban service business. Double taxation concerns drive this attitude.
>
> Because there are no laws in Colorado which permit extraterritorial land use controls to cities and towns, there is a natural area of conflict which develops around every growing community. The urban center provides the basis or attraction for new growth, most of which occurs inside the city limits. However, there is always a portion of development which locates in the fringe area outside the city limits but in close proximity. This occurs for a combination of reasons: cost of land, development standards, availability of land for development or desire of the buyer for a "rural" setting.
>
> Eventually, the growth of the city envelops most of this fringe development. When it does, conflicts occur over source of continued service, development standards, debt incurred for services prior to annexation, creation of limited purpose agencies which become self perpetuating, conflicting community goals, etc."[12]

The Pass-Through concept allows management agencies to pass certain powers to operating agencies. The Draft Plan describes the concept as follows:

"The relationships between management agencies and operating agencies is a complex, but significantly important one. Management agencies are responsible for the accomplishment of the assigned portions of the 208 Plan, including operations functions. However, operating agencies (if not the same agency as the management agency, as in Greeley's, Ft. Collins' and Loveland's case) may actually perform most of the tasks required of the management agency via an intergovernmental contract.

The reason that the distinction is so key in the Larimer-Weld Region is that management agencies must have land use powers to meet the objectives of the law and to meet the pollution abatement tasks that are assigned. Operations agencies do not need to possess land use powers so long as the responsible management agency for their area has that capacity. This distinction sets up the framework for an institutional structure that utilizes special districts, industrial and private wastewater treatment systems in an effective way, while not requiring them to perform a land use management role, or other general purpose government type of task, for which they possess inadequate powers.

Under this concept, sanitation districts such as those in and around Estes Park and Ft. Collins, would be assigned operations agency status. They would enter into an intergovernmental agreement with the management agency of their area to describe the details of their relationships. For example, this would be the Town of Estes Park and/or Larimer County for the Estes Park area, and the City of Ft. Collins and/or Larimer County for the Ft. Collins area. It is expected that the intergovernmental contract would have the following key elements:

Operating agencies would:

Possess in their own name a NPDES permit and be responsible for conforming with its requirements.

Be eligible for federal grants and loans to construct wastewater facilities called for in the 208 plan.

Establish their own schedule of rates and charges, subject to federal requirements for user fee structures and industrial cost recovery requirements.

Have complete control over operations and maintenance activities for district facilities.

Management agencies would:

Have review and approval responsibilities over any facility expansion. Certify compliance with 208 Plan or recommend amendments accordingly.

Make recommendations to the planning agency regarding priorities for construction grants within the management agency boundaries.

Be responsible for land use management decisions within the management agency boundaries.

Implement non-point source abatement activities called for in the 208 Plan.

Assume responsibility for overall pollution abatement activities within the management agency boundaries for the assigned elements contained in the 208 Plan, subject to the provisions of the contract with the operations agency.

Cooperate with the operations agency in every way possible to carry out the provisions of the 208 Plan.

Function in a regulatory or restraining way over the operating agencies in their area only when a clearly demonstrated water pollution concern exists or is emminent, that would be detrimental to the area's pollution abatement program as described in the 208 Plan."[12]

G. Public Involvement

"When trying to respond to public needs and requirements for public involvement the natural resource manager is hard pressed to determine the most effective means to obtain such input. Large-scale efforts to discover public sentiment may be expensive, time consuming and may yield little information. On the other hand, failure to involve the public may seriously misguide projects or lead to delays and increased costs if a project is halted by court or administrative action."[11]

Basically, public commitment toward the task of fulfilling requirements of the Act was accomplished through use of an 81-member Citizens' Advisory Committee and various subcommittees, which provided a flow of recommendations to the Areawide Planning Committee (APC) on such matters as population, land use, environmental impact, water quality, finances and agriculture. In addition to attempts at increasing public involvement to the maximum extent possible, through

the various forms of communication and information presented in Section 1.3 of the Draft Plan, it is important to note that efforts of influential citizens, highly respected in communities within the Larimer-Weld Region, played another key role in fostering public interest. It is very probable that through efforts of such "influentials," a number of people at the rural and urban "grass-roots" level were personally contacted to obtain views that otherwise may not have been expressed for consideration by the APC. Furthermore, it is also probable that personal contact of local publics by "influentials" helped provide an important contribution in explaining the program's purpose, innovative concepts, tasks and further studies, that would have to be accomplished in the next phase of the program, as well as informing local publics on a more personal basis of some of the potential future financial and social costs, new opportunities, and benefits that could be incurred on the community by plan implementation.

VI. LOOKING AHEAD - FACTORS FOR CONSIDERATION

Upon approval of the Areawide Water Quality Management Plan for the Larimer-Weld Region, implementation of the Plan will be the most important task remaining. The purpose of this section is to provide guidance for use in the implementation of the Plan. Factors for consideration are:

A. General

1. Generally, local land use policies and regulations are not used as tools for meeting the responsibility of achieving water quality standards. The LWRCOG should consider developing a set of

guidelines for assessing both land resources and local statutes so all jurisdictions within the Region can develop compatible policies and regulations to deal with non-point sources. Included in these guidelines should be (1) an exhaustive description of physical conditions which might significantly contribute to water pollution under certain uses, and (2) specific policies and statutory tools that would be effective in controlling such uses. Local entities would thus be provided with a wider range of options for dealing with water quality problems through their own policies and regulations. Point sources could also be controlled through regulation of land uses, although, it is recognized that this could limit the economic development potential of the area. However, by controlling the point sources, the amount and quality of wastewater can be controlled. Maintaining water quality in this manner would be particularly applicable where the degree of treatment required to meet minimum requirements under increased loads would not be economically feasible.[4] The development of these guidelines would reinforce the concept of local control and local responsibility.

2. The Draft Plan discusses the basic reasons why general purpose local governments are the preferred alternative for carrying out the water quality program in the Region. It is suggested that the LWRCOG investigate each agency to determine if that agency has the capability to carry out its responsibility. Some factors to consider are: (1) Many times small agencies such as municipalities are smaller than the hydrologic/economic region in which the pollution problem occurs and cannot select the best method to abate the problem, (2) Small agencies cannot control externalities that occur when the costs and benefits of a governmental program are not

contained within the same jurisdiction, (3) Economies of scale cannot be taken advantage of by small towns. Many smaller agencies lack money and technical expertise, and (4) Small agencies sometimes lack the political desire to adequately control a major local industry that is a major pollutor, or to impose pollution control costs on friends and neighbors.

Estes Park is an example of a smaller town that may experience difficulty in completing its assignments. Representatives of Estes Park have expressed concern over that city's ability to complete their assigned tasks in Urban Stormwater Management with their present manpower and capability.

3. The Draft Plan states that funding for continued planning should come from Federal or State levels. This would be an ideal situation, but if funds are not available is there a commitment from this Region to guarantee future funding? Since the Draft Plan states that Phase 2 should last about 3 years, or until 1981, it would be advisable to develop a contingency plan to insure continued financing of the plan implementation.

4. As part of the regulatory tasks for leachfields and unlined sewage lagoons, it recommended that a geology and soils map be included on the list of desirable data and information. This could provide valuable guidance in the site selection of septic tanks. One other regulatory measure for consideration would be to investigate the feasibility of extending the septic tank permit system to include annual inspection to insure proper operation and maintenance levels.

5. It still has to be investigated as to whether or not there is a better way to manage the water resource of the Poudre River. Total water resource management of the river should be studied. It

still has to be investigated as to whether or not there is a better way to manage the water resource of the Poudre River. An initial step towards total water resource management of the river basin would be a complete hydrologic study to determine, for example, low flow augmentation, firm yield, and flooding potential. Such a study would need to be coordinated with all agencies involved with hydrologic investigation in this area so that a common base can be used by all entities involved with water management resources of the river.

B. Public Involvement

1. Local personal contact emphasis, through utilization of key "influentials" at the community level, is a technique in fostering more public awareness, representation, and commitment as the 208 program progresses. This has been a useful strategy in the development of the Draft Plan, and it would be advisable to continue this approach through the implementation phases.

2. Investigate the feasibility of establishing a subcommittee that specifically evaluates "social impacts" of 208 planning decisions in depth. Since structural and/or non-structural solutions in water quality management and implementation could generate an extended chain of effects beyond primary and secondary impacts, beneficial and adverse impacts with regard to probable future social change, range of choice and established values of people in communities within the Region, needs to be very continually evaluated through a committee that is primarily concerned with social costs.

3. Another approach to help expand citizen participation in decision making would be to investigate the possibility of using appointed citizen boards in conjunction with the LWRCOG, management,

and regulatory agencies. These citizen boards exercise a variety of policy setting, budgetary, regulatory, adjudicatory, planning, and review powers, or act purely in an advisory capacity. Such boards can be useful in generating political support and voter acceptance for 208 programs and in expanding citizen participation in the decision making process. An advantage of these boards is that their business is usually conducted in public, opening up governmental decision making processes to the view and involvement of the public.

C. Principles and Concepts

1. It is suggested that assessment of social, economic and environmental impacts also be addressed in Phases 2 and 3 rather than only in Phase 1. This recommendation is made with the idea in mind that discussions and decisions arrived at in Phases 2 and 3 could possibly stimulate re-evaluation and revision of the aforementioned impact categories to some degree, prior to commitment of funds and resources to plan implementation.

D. Intergovernmental Agreements

1. The intergovernmental agreements required by these concepts are one of the major keys to the Areawide Water Quality Management Plan's successful implementation. There are many agreements required between counties and cities and between management and operation agencies and many disagreements are likely. The Draft Plan's unique approach to the institutional arrangements, and its strong reliance on intergovernmental agreements make it necessary that a provision be included to insure that these agreements come about. It is likely that some agencies will require guidance and encouragement to develop workable, responsive agreements.

At first glance, the LWRCOG would appear to be the ideal agency to develop guidelines and to use its powers to insure that intergovernmental agreements are formulated in line with the Draft Plan; however, the LWRCOG is composed of the same agencies that may be having difficulties in reaching agreements. Also, the LWRCOG can neither implement the Draft Plan nor insure its performance. However, the number and degree of conflicts that do arise between the agencies could probably be reduced if the LWRCOG 208 Planning Staff would develop guidelines and provide assistance to agencies formulating intergovernmental agreements.

It is recommended that a State agency with appropriate responsibilities be given the power to intervene in the disputes that evolve between agencies. Continuing Planning Process for Water Quality Management in Colorado describes two agencies with powers to intervene:

> "By State statute (Colorado Water Quality Control Act), the Water Quality Control Commission is charged with developing and maintaining a comprehensive and effective program for the prevention, control, and abatement of water pollution and for water quality protection throughout the State. In order to achieve these goals, the Commission establishes water quality standards and effluent limitations and classifies all State waters. Both Federal and State construction grants for wastewater treatment facilities require Commission approval. In conjunction with this, the Commission establishes priorities for Federal grants for municipal facilities. Further, all site location, construction, and expansion proposals for sewage treatment facilities require Commission approval.
>
> Other functions of the Commission relate directly to the 208 Program. The Commission formally reviews 208 Plans and recommends revisions consistent with state water quality standards and stream classifications. Finally, the Commission recommends a position with respect to certification of individual 208 Plans to the Governor."[17]

"The principle agency for implementing water quality control laws and regulations is the Water Quality Control Division of the State Department of Health. The Division receives policy guidance from the Water Quality Control Commission and provides technical assistance for 208 planning efforts.

Current functions of the Division are:

Planning: The Division fulfills the requirements for State involvement in 303(e), 208, and 201 related planning as outlined in the Federal Water Pollution Control Act Amendments of 1972. It reviews and comments on Environmental Impact Statements, A-95 funding requests, and subdivision proposals; it provides guidance to the NPDES permit program for facility sizes and sites and treatment levels through its stream modeling activities.

Monitoring and Enforcement: The Division routinely gathers a wide variety of data on water quality and effluent levels. It collects and analyzes effluent samples in order to enforce NPDES permit limitations and conducts specialized chemical and biological studies where required.

Technical Services: The Division is responsible for administering Federal and State grant programs, reviewing plans for treatment plants, inspecting and providing operational assistance for municipal treatment plants, overseeing the hazardous spill program and assisting in the technical aspects of industrial waste treatment.

NPDES Permit System: The Division issues permits for point source discharges in accordance with Federal and State regulations.

Legal Assistance: The Division provides legal assistance for enforcement of rules and regulations pertaining to water quality."[17]

It is suggested that the Water Quality Control Commission and/or the Water Quality Control Division use the power, just described, to settle disputes (1) by imposing sanctions on the agencies involved or (2) by arbitration or mediation.

2. Care must be used in implementing the urban service area concept because some cities, which would serve as core cities, may

lack the technical expertise to develop and/or implement the plans for the urban service area or may suffer incapacitating political pressures which prevent effective plan implementation and enforcement.

E. Coordination and Related Programs

The relationship between the Draft Plan and Federal, State and local programs which are impacted by the plan is not fully established by specific policies and implementing regulations. Much of the force for insuring coordination with other planning agencies will have to come from the LWRCOG. There are many Federal programs which can be used in the implementation of the plan and provisions for coordination with these programs must be established.

The Department of Housing and Urban Development (HUD) and EPA have entered into an inter-agency agreement which provides for coordination between the 701 land use element and 208 planning. The agreement encourages the use of HUD 701 monies for land use plans to regulate growth in keeping with 208 land use control objectives.

There are three programs in addition to the EPA facilities grant program (Section 201) with direct relevance to wastewater management. One is the EPA's State and Local Manpower Development program, which provides training for local operators of waste treatment facilities in advanced wastewater treatment technology. The second is a low-interest loan program to small businesses and is administered by the Small Business Administration. This program provides loans to small businesses for the construction of waste treatment facilities for industrial wastes. A second low-interest loan program--Water and Waste Disposal Systems for Rural Communities--is administered by the Farmers Home Administration (FmHA). This program assists

rural communities in meeting the 25 percent local share required for funding under the 201 waste treatment facilities grants program.

There are two federal programs, both operated by the FmHA which provides low-interest loans for the construction of water supply systems. These are the Water and Waste Disposal Systems for Rural Communities Program and the Soil and Water Loans Program.

Three Federal programs relate to flood plain management. The most important of these is the National Flood Insurance Program administered by HUD. Local communities are required to impose strict land use controls on development in flood plains. This includes the requirement for the proper siting and flood proofing, of wastewater treatment facilities constructed in flood plains.

Two other programs provide assistance to prevent and control flooding in rural areas. The Watershed Protection and Flood Prevention Program, administered by the Soil Conservation Service, provides technical assistance to landowners. The Watershed Protection and Flood Protection Loans Program, administered by the FmHA, provides financial assistance.

Additionally, there are many federal agencies involved in various aspects of planning in the Region. The Corps of Engineers, EPA, Bureau of Reclamation, Geological Survey, Bureau of Land Management, Fish and Wildlife Service, the Forest Service, and Soil Conservation Service.

1. Coordination must be developed with the numerous State agencies which are either directly involved in water quality management or involved in planning activities that influence water quality management. Revision of the A-95 process through legislation to improve coordination among State agencies may be needed. The

agencies are the Water Quality Control Commission, the Department of Public Health, the Division of Planning, the Land Use Commission, Division of Wildlife, Division of Parks and Outdoor Recreation, Geological Survey, and Soil Conservation Board.

2. The Draft Plan cautions that avoidance of duplication and conflict can best be achieved when Federal and State pollution planning and implementation programs are closely coordinated with the local water quality management effort. In fact, Section 3.11 helps to further reinforce this point by suggesting that 208 water quality planning is really a very unique opportunity for levels of government and the private sector to work cooperatively towards defining and achieving realizable objectives. In order to help reduce possible instances of confusion in coordination, it is suggested that consideration be given to establishing primary and secondary liaison contacts among administrative elements of all Federal, State and local agencies concerned. This procedure can include key citizen organizations, to help improve efficiency in communication and timeliness in dissemination of informational data and duties, during both the planning and implementation.

F. Water Conservation

The 1977 Clean Water Act brought into the law a concern for water conservation from the standpoint of not having to hydraulically oversize wastewater facilities based upon unacceptable potable water consumption practices.[16] Also, the Carter Administration's study of national water policy had water conservation at its cornerstone. In this semi-arid Region, the available water supplies must be conserved and the water must be used with the best possible efficiency. However, in many cases, water conservation from improved

efficiency might be offset by a larger detriment when all the impacts from that action are taken into account.[5]

The severe drought conditions throughout this Region have heightened the awareness for water conservation. The Draft Plan recognizes the need for water conservation practices with regard to waste treatment works. A study indicated that significant reduction in sanitary inflow into major waste treatment facilities may be achieved in the Region.[12]

The need to formulate a water conservation program within the Region does exist. Appendix C presents a structure to assist in the formulation of such a program and provides some of the backup data to assist in implementing it. The data presented is geared primarily towards those areas which have an impact on wastewater production.

An overall water conservation program must also include agricultural water conservation because the greatest water use in the Region occurs from irrigation practices.[6] There are many potential actions that can lower the total water use in agriculture and make the farming operation more efficient. Appendix D discusses various methods to use for potential implementation and the benefits and the detriments of the methods. Part I of this section discusses further the pro's and con's of irrigated agriculture.

G. Land Treatment and Successive Use

1. With regard to land treatment, Section 131.11(k) of the EPA regulations discusses residual waste control needs and land disposal needs. The section states that 208 plans should contain "(1) An identification of the necessary controls to be established over the disposition of residual wastes which could affect water

quality and a description of the proposed actions necessary to achieve such controls. (2) An identification of the necessary controls to be established over the disposal of pollutants on land or in subsurface excavations to protect ground and surface water quality and a description of the proposed actions necessary to achieve such controls."

Included in the discussion for both municipal and industrial waste treatment needs was the objective "To encourage the reclamation of residual wastes in point source discharges and sludge through direct land application systems." The LWRCOG is encouraged to give considerable thought to developing a land treatment and disposal plan for the Region.

In land treatment, the advanced treatment and disposal of both effluent and solids is accomplished in the same step, returning the water and the chemicals which they contain to the environment for re-use. Land treatment is based on the concept that wastes are resources out of place and by applying the wastewaters to the land, the nitrates, phosphates, and organic matter are directly recycled. This application can result in the water consistently exceeding effluent quality standards. Waterways are degraded by discharge of nutrient-rich effluents, while much money is spent on fertilizers for land application each year. Application of the wastewater to the land can return the nutrients to the soil as fertilizer, build up the soil's humus content, produce saleable crops, and possibly recharge the local ground water supply.

This method would be appropriate since there is a large quantity of irrigated lands in the Region. Care must be exercised because of the possible disadvantages of this application.

2. Another and more important possibility for investigation is successive water use. This concept is described as follows:

> "Much has been written and discussed about successive use of water, but the current state of the art does not support inexpensive, total recycling of water resources. Other options, almost as effective, are available, however.
>
> One such means is to use conventional water sources within the municipal system and, through the wastewater treatment process, treat effluent specifically to benefit agriculture and return the effluent to the stream. There are major advantages to be achieved.
>
> The city is able to "borrow" new water resources, owned by the farming community, to use in the municipal system. This avoids debt financing to purchase or condemn these water rights for municipal use. In the wastewater treatment process, bacteria, heavy metals, and other harmful chemicals are removed, but valuable nutrients are left intact. This process of wastewater treatment is less expensive and, therefore, of benefit to the citizen paying the bill.
>
> This process has two primary advantages to the farming community. First, when properly treated, municipal effluent is more valuable than raw ditch water. Because of the nutrients, fertilizer costs to the farmer are reduced. Secondly, the agricultural stream can be regulated concerning flow during dry years.
>
> In Colorado, 1977 was a classic example of the problem of stream regulation to the farmer. Ditch water, the lifeblood of Eastern Colorado farmland, was plentiful last year until about the middle of July. The year's supply of mountain runoff was then exhausted, with crops in the ground depending on more irrigation for successful harvest.
>
> Using properly treated effluent, stream discharges can be regulated throughout the irrigation season to provide sufficient dependable water from the beginning to the end of the season. (In 1977, the city of Westminster loaned 1,500 acre-feet of water to the Farmers' High Line Canal Company in September to bring in drought stricken crops.)
>
> The expansion of the city of Westminster's BIG DRY CREEK WASTEWATER PLAN, for which ground was broken December 13, 1977, is the first federally funded successive use project in the state of Colorado."

H. Prime and Unique Agricultural Lands

1. Relative to Larimer-Weld counties' regional objective to "Preserve an open space system which recognizes the importance of the Region's natural resources, reflects the natural physical characteristics of the Region's land, and prevents the adverse effects of urban sprawl," it is noteworthy to take into account the concept of prime and unique farmlands when considering future development and preservation planning in the area. Planning options open to the LWRCOG are somewhat constrained by the fact that prime and unique farmlands are not yet inventoried and put into an organized format that would be readily available for use by decision makers. The prime farmland definition includes areas that currently are irrigated or have proper drainage to provide the necessary water regime to meet the criteria. A brief background of the SCS's recent ruling, prescribing general guidelines for a national program of inventorying prime and unique farmland as well as other farmlands of statewide or local importance is contained in Appendix B.

I. Irrigated Agriculture

1. The Draft 208 Plan stresses that it is the intent of the LWRCOG to "encourage wise and efficient management and use of water resources available to the region." Among the adopted objectives toward attainment of this goal is the need to encourage and develop efficient irrigation practices, as well as the need to develop efficient delivery systems. Additionally, the plan also emphasizes another goal related to water use--"encourage maintenance and enhancement of surface and underground water quality consistent with the use of these waters".[12]

In relation to individual users, the water management system in the Region is considered to be inefficient. Therefore, the Draft

Plan emphasizes measures which lead to efficiency and conservation, such as lining canals and sprinkler irrigation systems. These measures are designed to decrease the amount of water used for irrigation, without significantly affecting the crops, and to reduce seepage losses from canals. Also, it is stated that much of the salinity problems in the streams comes from this excess irrigation water picking up salts and then making its way back to the streams via surface runoff or through groundwater.

However, the water management system is quite efficient when viewed from the Regional level. This is evidenced by the fact that the water in the region is used 2.2 times. Much of the excess irrigation water becomes groundwater which is then pumped and reused by others in the basin. In other words, much of the irrigation water is simply stored in the aquifer until withdrawn for other uses. This makes the water management system not only very efficient but also very interdependent among uses.

If these measures in the Draft Plan are carried out there will be an adverse affect on the amount of groundwater available. The increased amounts of water being returned to the streams would then need to be stored to replace the groundwater losses. It is doubtful any storage system could be as efficient as the aquifer because there are no evaporation losses from the aquifer. This is a point that merits early consideration by the planning agency.

As regards the salinity problem, early documentation is needed on the existing water quality in its aquifers and exactly where the salinity problem is located. There are natural salt deposits on tributaries to the Poudre, such as Box Elder Creek, which contribute to the salinity problem. Some investigation has been done (contained

in Water Quality Impacts of Irrigated Agriculture, Interim Report No. 3) but more is needed before implementation. More is contained on this subject in Appendix D.

2. Regarding economic equity in Best Management Practices for agricultural lands, the Draft 208 Plan recognizes that an equitable formula still needs to be worked out which recognizes distribution of costs and benefits. The question of who should pay--"he who benefits" or "he who pollutes"--is still under consideration by the LWRCOG. For future general guidance to the Region's planning staff, it is noteworthy to reference the National Water Commission's advice stated in its final report to the President and to the Congress in June 1973 on this issue. The report stated that

> "the most equitable and economically efficient association of cost with benefits over the long term will be produced by assigning the costs of preventing water pollution to those whose wastes cause pollution. Under such a 'polluter-pay' principle industries and municipalities would be expected to assume the economic burden of controlling their wastes. Under our economic system, costs thus incurred will be passed along to consumers in the form of higher prices for goods and services."

The report further points out that

> "the ultimate user of the products and services will pay the costs of preventing the pollution which his consumption would otherwise cause. In nearly all cases, the polluter-pay principle yields both the fairest and the least-cost results."[13]

APPENDIX A

SPECIAL DISTRICT CONTROL ACT

32-1-201. Short title. This part 2 shall be known and may be cited as the "Special District Control Act".

Source: L. 65, p. 887, § 1; C.R.S. 1963, § 89-18-1.

32-1-202. Legislative declaration. The general assembly hereby determines and declares that the procedures contained in this part 2 are necessary for the coordinated and orderly creation of special district governments and for the logical extension of special district services throughout the state. It is the purpose of this part 2 to prevent unnecessary proliferation and fragmentation of local government and to avoid excessive diffusion of local tax sources.

Source: L. 65, p. 887, § 2; C.R.S. 1963, § 89-18-2.

32-1-203. Special districts - definition - applicability. This part 2 shall be applicable to any petition for the formation of any proposed "special district" filed in any district court of competent jurisdiction. "Special district" means any water district, sanitation district, fire protection district, or other quasi-municipal corporation, as defined in section 32-1-101, organized under the local improvement and service district laws of this state but excluding all special service and local improvement districts as are confined exclusively within the boundaries of any existing city, city and county, or incorporated town.

Source: L. 64, p. 887, § 3; C.R.S. 1963, § 89-18-3.

Am. Jur. See 36 Am. Jur.2d, Municipal Corporations, Etc., § 13.
C.J.S. See 62 C.J.S., Municipal Corporations, § 5.

32-1-204. Filing of service plan. (1) The petitioners of any proposed special district shall file a service plan with the board of county commissioners of any county which has territory included within the boundaries of the proposed district. The service plan shall consist of a financial survey and a preliminary engineering or architectural survey showing how the proposed services are to be provided and financed. The service plan shall include a map of the proposed district boundaries and an estimate of the population and the valuation for assessment of the proposed district, and it shall describe the facilities to be constructed, the standards of such construction, an estimate of costs, including the cost of acquiring land, engineering services, legal services, proposed indebtedness, including proposed maximum interest rates and discounts, and other major expenses related to the formation and operation of the district. Such service plan shall also outline the details of any arrangement or proposed agreement; the form contract to be used, if available, shall be attached to the service plan, with any city, city and county, or incorporated town for the performance of any services between the proposed special district and such city, city and county, or incorporated town.

(2) Each service plan filed shall be accompanied by a processing fee set by the board of county commissioners not to exceed two hundred dollars which shall be deposited into the county general fund. Such processing fee shall be sufficient to cover the costs related to the hearing prescribed by section 32-1-208, including the costs of notice, publication, and recording of testimony.

Source: L. 65, p. 887, § 4; C.R.S. 1963, § 89-18-4.

32-1-205. Service plan criteria. (1) The board of county commissioners may disapprove the service plan submitted by the petitioners of a proposed special district upon satisfactory evidence that:

(a) There is insufficient existing and projected need for organized service in the area to be serviced by the proposed district; or

(b) The existing service in the area to be served by the proposed district is adequate for present and projected needs; or

(c) Adequate service is, or will be, available to the area through municipal annexation by other existing municipal or quasi-municipal corporations within a reasonable time and on a comparable basis; or

(d) The proposed special district is incapable of providing economical and sufficient service to the area within its proposed boundaries; or

(e) The area to be included in the proposed district does not have, or will not have, the financial ability to discharge the proposed indebtedness on a reasonable basis; or

(f) The facility and service standards of the proposed district are incompatible with the facility and service standards of adjacent municipalities and special districts.

(2) The board of county commissioners may conditionally approve the service plan of a proposed district upon satisfactory evidence that it does not comply with one or more of the criteria enumerated in subsection (1) of this section. Final approval shall be contingent upon modification of the service plan to include such changes or additional information as shall be specifically stated in the findings of the board of county commissioners.

(3) The findings of the board of county commissioners shall be based solely upon the service plan and evidence presented at the hearing by the petitioners, planning commission, and any interested party.

Source: L. 65, p. 889, § 7; C.R.S. 1963, § 89-18-7.

32-1-206. Resolution of approval required. A petition for the formation of a special district filed in any district court of competent jurisdiction shall be accompanied by a resolution approving the service plan of the proposed district by the board of county commissioners of the county where the territory of the proposed special district lies. In the event that the boundaries of a proposed special district include territory within two or more counties, a resolution approving the service plan for such special district shall be required from the board of county commissioners of each county which has territory included in the proposed special district; but the board of county commissioners of each of the respective counties may in their discretion hold a joint hearing on the proposed district in accordance with section 32-1-208.

Source: L. 65, p. 888, § 5; C.R.S. 1963, § 89-18-5.

32-1-207. Scope of authority. (1) The board of county commissioners of each county shall constitute the approving authority under this part 2 and shall review any service plan filed by the petitioners of any proposed special district. With reference to the review of any service plan, the board of county commissioners has the following authority:

(a) To approve without condition or modification the service plan submitted by the petitioners of a proposed special district;

(b) To disapprove the service plan submitted by the petitioners of a proposed special district as provided in section 32-1-205;

(c) To conditionally approve the service plan submitted by the petitioners of a proposed special district subject to the submission of additional information relating to, or modification of, the proposed service plan.

Source: L. 65, p. 888, § 6; C.R.S. 1963, § 89-18-6.

32-1-208. Public hearing - procedures - interested parties. (1) The petitioners of a proposed special district shall file a service plan with the board of county commissioners prior to filing a petition for the formation of the proposed special district in any district court. Such service plan shall be filed with the county clerk and recorder at least ten days prior to a regular meeting of the board of county commissioners. At the next regular meeting of the board of county commissioners immediately following the filing of a service plan with the county clerk and recorder, the board of county commissioners shall set a date for a public hearing on the service plan of the proposed district, which hearing date shall be within thirty days thereafter.

(2) The board of county commissioners shall provide written notice of the date, time, and location of the hearing to the petitioners and the governing body of any existing municipality or special district which has levied an ad valorem tax within the next preceding tax year and which has boundaries within a radius of three miles of the proposed district, which governmental units shall be interested parties for the purposes of this part 2. The board of county commissioners shall publish legal notice of the date, time, location, and purpose of such hearing in a newspaper of general circulation within the county once each week for a period of three successive weeks by three publications, the first of which shall be at least twenty days prior to the hearing date. Such publications shall constitute constructive notice to the residents and property owners within the proposed district who shall also be interested parties at the hearing.

(3) If there is a county planning commission or a regional county planning commission in lieu thereof, the service plan submitted by the petitioners for the formation of the proposed district shall be delivered by the county clerk and recorder to such planning commission. The county planning commission or regional county planning commission shall study such service plan and a representative thereof shall present its recommendations consistent with this part 2 to the board of county commissioners at said hearing.

(4) The hearing held by the board of county commissioners shall be open to the public and a transcript of proceedings shall be made. All interested parties as defined in this section shall be afforded an opportunity to be heard under such rules of procedure as may be established by the board of county commissioners. Any testimony or evidence which in the discretion of the board of county commissioners is relevant to the formation of the proposed district shall be considered.

(5) Within twenty days after the completion of the hearing, the board of county commissioners shall advise in writing the petitioners for the formation of the proposed special district of its action on the service plan. If the service plan is approved as submitted, a resolution of approval shall be issued to the petitioners. If the service plan is disapproved, the specific detailed reasons for such disapproval shall be set forth in writing. If the service plan is conditionally approved, the changes or modifications to be made in, or additional information relating to, the service plan, together with the reasons for such changes, modifications, or additional information, shall also be set forth in writing, and the proceeding shall be continued until such changes, modifications, or additional information is incorporated in the service plan. Upon the incorporation of such changes, modifications, or additional information in the service plan of the proposed district, the board of county commissioners shall issue a resolution of approval to the petitioners.

Source: L. 65, p. 890, § 8; C.R.S. 1963, § 89-18-8.

32-1-209. Judicial review - enforcement. (1) Except as provided in this part 2, no petition for the formation of a special district shall be approved by any district court in this state without the resolution of approval and the service plan required by this part 2. The approved service plan and the resolution of approval required by this part 2 shall be incorporated by reference in and appended to the order incorporating the district after all other legal procedures for the formation of the proposed district have been complied with. In the event that the petitioners for the formation of a proposed special district fail to secure such resolution of approval from any board of county commissioners, which action on the part of such board of county commissioners is determined by the court to be arbitrary, capricious, or unreasonable, the court may approve the formation of such district without such resolution of approval if the petitioners file with the court an acceptable service plan in accordance with the provisions of this part 2, which shall be approved by the court and incorporated by reference in and appended to the order incorporating the district after all other legal procedures for the formation of the proposed district have been complied with. If the service plan is approved by the board of county commissioners, any interested party as defined in section 32-1-208 (2), if such party had appeared and presented its objections before the board of county commissioners, shall have the right to appear and be heard at the hearing on the court petition for the organization of the district, and the district court may dismiss the court petition upon a determination that the decision of the board of county commissioners was arbitrary, capricious, or unreasonable.

(2) Upon final approval by the district court for the formation of the special district, the facilities, services, and financial arrangements of the district shall conform so far as practicable to the approved service plan.

(3) After the organization of a special district pursuant to the provisions of this part 2, material modifications of the service plan as originally approved may be made by the governing body of such special district only by petition to and approval by the board of county commissioners in substantially the same manner as is provided for the approval of an original service plan; except that the processing fee for such modification procedure shall not exceed one hundred dollars. Such modifications shall be required only with regard to changes of a basic or essential nature and shall not be required for changes of a mechanical type necessary only for the execution of the original service plan.

(4) Any unreasonable departure from the service plan as originally approved or, if the same has been modified, from the service plan as modified may be enjoined at any time prior to the date on which construction contracts are let for construction of all or any part of the departure sought to be enjoined by the district court approving the formation of such special district on its own motion, or upon motion of the board of county commissioners from which a resolution of approval is required by this article, or upon the motion of any interested party as defined in section 32-1-208 (2).

Source: L. 65, p. 891, § 9; C.R.S. 1963, § 89-18-9.

32-4-104. Petition. (1) The organization of a district shall be initiated by a petition filed in the office of the clerk of the court vested with jurisdiction in the county in which all or part of the real property in the proposed district is situated. The petition shall be signed by not less than ten percent or one hundred of the taxpaying electors of the district, whichever number is the smaller.

(2) The petition shall set forth:

(a) The name of the proposed district, consisting of a chosen name preceding the words "water district", or "sanitation district", or "water and sanitation district";

(b) A general description of the improvements to be constructed or installed for the district;

(c) The estimated cost of the proposed improvements;

(d) A general description of the boundaries of the district or the territory to be included therein, with such certainty as to enable a property owner to determine whether or not his property is within the district;

(e) A prayer for the organization of the district.

(3) No petition with the requisite signatures shall be declared void on account of alleged defects, but the court may at any time permit the petition to be amended to conform to the facts by correcting any errors in the description of the territory, or in any other particular. Similar petitions or duplicate copies of the same petition for the organization of the same district may be filed and shall together be regarded as one petition. All such petitions filed prior to the hearing on the first petition filed shall be considered by the court the same as though filed with the first petition.

Source: L. 49, p. 750, § 2; CSA, C. 173A, § 36; CRS 53, § 89-5-4; C.R.S. 1963, § 89-5-4; L. 70, p. 262, § 25.

C.J.S. See 63 C.J.S., Municipal Corporations, § 1364.

Law review. For note, "One Year Review of Constitutional Law", see 41 Den. L. Ctr. J. 77 (1964).

As to unconstitutionality of previous provision for exclusion of lands on a fixed acreage basis. See Colorado Interstate Gas Co. v. Sable Water Dist., 152 Colo. 89, 380 P.2d 569 (1963).

32-4-105. Bond of petitioners. At the time of filing the petition or at any time subsequent thereto, and prior to the time of hearing on said petition, a bond shall be filed, with security approved by the court, or a cash deposit made sufficient to pay all expenses connected with the proceedings in case the organization of the district is not effected. If at any time during the proceeding the court is satisfied that the bond first executed or the amount of cash deposited is insufficient in amount, it may require the execution of an additional bond or the deposit of additional cash within a time to be fixed, not less than ten days distant, and upon failure of the petitioner to execute or deposit the same, the petition shall be dismissed.

Source: L. 49, p. 751, § 2; CSA, C. 173A, § 37; CRS 53, § 89-5-5; C.R.S. 1963, § 89-5-5.

32-4-106. Notice of hearing. (1) Immediately after the filing of such petition, the court wherein such petition is filed, by order, shall fix a place and time, not less than twenty days nor more than forty days after the petition is filed, for hearing thereon. Thereupon the clerk of said court shall cause notice by publication to be made of the pendency of the petition, the purposes

and boundaries of the district, and the time and place of hearing thereon. The clerk of said court shall also forthwith cause a copy of said notice to be mailed by United States registered mail to the board of county commissioners of each of the several counties and to the governing body of each municipality having territory within the proposed district.

(2) The district court in and for the county in which the petition for the organization of a district has been filed shall thereafter, for all purposes of this part 1, except as otherwise provided, maintain and have original and exclusive jurisdiction, coextensive with the boundaries of the district, and of the property proposed to be included in said district or affected by said district without regard to the usual limits of its jurisdiction.

(3) No judge of such court wherein such petition is filed shall be disqualified to perform any duty imposed by this part 1 by reason of ownership of property within any proposed district.

Source: L. 49, p. 751, § 2; CSA, C. 173A, § 38; CRS 53, § 89-5-6; C.R.S. 1963, § 89-5-6.

C.J.S. See 63 C.J.S., Municipal Corporations, § 1366.

32-4-107. Hearings - organizational election. (1) Upon said hearing, if the court finds that no petition has been signed and presented in conformity with this article, it shall dismiss said proceedings and adjudge the costs against the signers of the petition in such proportion as it deems just and equitable. No appeal or other remedy shall lie from an order dismissing said proceedings. Nothing in this section shall be construed to prevent the filing of a subsequent petition for similar improvements or for a similar district, and the right so to renew such proceedings is hereby expressly granted and authorized.

(2) Anytime after the filing of the petition for the organization of a district and before the day fixed for the hearing thereon, the owner of any real property within the proposed district may file a petition with the court stating reasons why said property should not be included therein and praying that said real property be excluded therefrom. Such petition shall be duly verified and shall describe the property sought to be excluded. The court shall hear said petition and all objections thereto at the time of the hearing on the petition for organization and shall determine whether said property should be excluded or included in said district. The court shall exclude property located in any home rule municipal corporation in respect to which a petition for exclusion has been filed by such municipal corporation.

(3) Upon said hearing, if it appears that a petition for the organization of a district has been signed and presented in conformity with this part 1, and that the allegations of the petition are true, the court, by order duly entered of record, shall direct that the question of the organization of the district shall be submitted at an election to be held for that purpose in accordance with the provisions of part 8 of article 1 of this title. Such order shall appoint three electors of the district as judges of said election. The clerk of the court having jurisdiction shall give notice by publication of the time and place of said election as provided in said part 8. Said notice shall state the purposes and boundaries of the district.

32-4-112. Election of directors. (1) This section is subject to the provisions of part 8 of article 1 of this title. On the second Tuesday of August, in the second calendar year after the organization of any district, and on the second Tuesday of August in every second year thereafter, an election shall be held, which shall be known as the biennial election of the district.

(2) At the first biennial election and each sixth year thereafter, there shall be elected by the electors of the district one member of the board to serve for a term of six years. At the second biennial election and each sixth year thereafter, there shall be elected two members of the board to serve for terms of six years. At the third biennial election, and each sixth year thereafter, there shall be elected two members of the board to serve for terms of six years. Such biennial elections shall be held and conducted in the manner provided in part 8 of article 1 of this title.

(3) Not later than thirty days before any such election, written nominations may be filed with the secretary of the board. Such nominations shall be signed by not less than five electors, regardless of whether or not nominated therein, shall designate therein the name of each nominee and the term for which nominated, if there be more than one, and shall recite that the subscribers thereto and the nominee or nominees designated therein are electors of the district. No written nomination shall designate a qualified person as a candidate for more than one vacancy, nor shall it designate more than one nominee for any vacancy. No elector shall nominate more than one person for any vacancy. If a nominee does not withdraw his name before the first publication of the notice of election, his name shall be placed on the ballot. If he is nominated by petitions as a candidate for more than one term, his name shall appear only once on the ballot as a candidate for the longer or longest term so designated unless he files, not less than twenty-five days prior to said election with said secretary, a written designation of a term for which he was so nominated and for which he elects to be a candidate.

(4) The board shall provide for holding such election and shall appoint judges to conduct it. The secretary of the district shall give notice of election by publication and shall arrange such other details in connection therewith as the board may direct. The returns of the election shall be certified to and shall be canvassed and declared by the board. The candidates, according to the number of directors to be elected, receiving the most votes shall be elected and shall assume office on September first following. Any new member of the board shall qualify in the same manner as members of the first board qualify.

Source: L. 49, p. 755, § 2; CSA, C. 173A, § 44; CRS 53, § 89-5-12; L. 55, p. 541, § 3; C.R.S. 1963, § 89-5-12; L. 70, p. 263, § 27.

Cross reference. As to procedures for conduct of election, see § 32-1-801 et seq.

32-4-113. Powers of board. (1) For and on behalf of the district the board has the following powers:

(a) To have perpetual existence;

(b) To have and use a corporate seal;

(c) To sue and be sued, and be a party to suits, actions, and proceedings;

(d) Except as otherwise provided in this part 1, to enter into contracts and agreements affecting the affairs of the district, including contracts with the United States and any of its agencies or instrumentalities. Except in cases in which a district will receive aid from a governmental agency, a notice shall be published for bids on all construction contracts for work or material, or both, involving an expense of five thousand dollars or more. The districts may reject any and all bids, and if it appears that the district can perform the work or secure material for less than the lowest bid, it may proceed so to do.

(e) To borrow money and incur indebtedness and evidence the same by certificates, notes, or debentures, and to issue bonds, in accordance with the provisions of this part 1;

(f) To acquire, dispose of, and encumber real and personal property, water, water rights, water and sewer works and plants, and any interest therein, including leases and easements;

(g) To refund any bonded indebtedness as provided in sections 32-4-134 to 32-4-139;

(h) To have the management, control, and supervision of all the business and affairs of the district, and the construction, installation, operation, and maintenance of district improvements therein;

(i) To hire and retain agents, employees, engineers, and attorneys;

(j) To have and exercise the power of eminent domain and dominant eminent domain and, in the manner provided by law for the condemnation of private property for public use, to take any property necessary to the exercise of the powers granted, both within and without the district;

(k) (I) To construct and maintain works and establish and maintain facilities across or along any public street or highway, and in, upon, or over any vacant public lands, which public lands are the property of the state of Colorado, and to construct works and establish and maintain facilities across any stream of water or watercourse; but the board of county commissioners of any county in which any public streets or highways are situated which are to be cut into or excavated in the construction or maintenance of any such facilities has authority to make such rules as it deems necessary in regard to any such excavations and may require the payment of such reasonable fees against the district as may be fixed by it to insure proper restoration of such streets or highways;

(II) When such fee is paid, it is the responsibility of the board of county commissioners to promptly restore such street or highway to its former state. If the fee is not fixed and paid, the district shall promptly restore any such street or highway to its former state of usefulness as nearly as may be and shall not use the same in such manner as to completely or unnecessarily impair the usefulness thereof.

(l) (I) To fix and from time to time to increase or decrease water and sewer rates, tolls, or charges for services or facilities furnished by the district, and to pledge such revenue for the payment of any indebtedness of the district;

(II) To fix and from time to time increase or decrease minimum charges, and reasonable rates, tolls, or charges for making water or sewer services or facilities, or both, available and shall pledge such revenue for payment of any indebtedness of the district, but such rates, tolls, and charges for availability of services or facilities shall be made only where: The valuation for assessment of the district shall be less than three times the amount of all outstanding general obligation indebtedness of the district; the district shall have a mill levy assessed against all taxable property located within the district of not less than ten mills; and a notice, stating that such rates, tolls, and charges for availability of services or facilities are being considered and stating the date, time, and place of the meeting at which they are to be considered, shall be mailed by first class United States mail, postage prepaid, to each taxpaying owner of the district at his last known address, as disclosed by the tax records of the county or counties within which said district is located;

(III) Rates, tolls, or charges for making water or sewer services, or both water and sewer services, available shall be assessed solely for the purpose of paying principal of and interest on any outstanding indebtedness of the district and shall not be used to pay any operation or maintenance expenses of, nor capital improvements within or for, such district.

(IV) "Availability of service or facilities", for the purposes of this section, shall mean that water, or sewer, or both water and sewer lines are installed and ready for connection, within one hundred feet of any property line of the residential lot or residential lot equivalent to be assessed, but to one or both of which line or lines the particular lot or lot equivalent to be assessed is not connected.

(V) No rate, toll, or charge for making water or sewer services, or both, available shall exceed the total amount of principal of and interest on the outstanding indebtedness of the district to mature or accrue during the annual period within which said rate, toll, or charge is payable, less the amount produced or to be produced during such period by the mill levy then being levied and assessed by said district, divided by the total number of residential lots or residential lot equivalents in the assessing district. What constitutes a "residential lot" or a "residential lot equivalent" shall be determined by the board of directors of each such district in accordance with the custom in the particular district and area, or portion thereof, and taking into account the best engineering data available to the district at the time of the determination.

(VI) Until paid, all rates, tolls, or charges shall constitute a perpetual lien on and against the property served, and any such lien may be foreclosed in the same manner as provided by the laws of the state of Colorado for the foreclosure of mechanics' liens. The board shall shut off or discontinue service for delinquencies in the payment of such rates, tolls, or charges, or in the payment of taxes levied pursuant to this part 1, and prescribe and enforce rules and regulations for the connection with and the disconnection from properties of the facilities of the district.

(m) For health and sanitary purposes, to compel the owners of inhabited

property within a sanitation district to connect their property with the sewer system of such district, and, upon a failure so to connect within sixty days after written notice by the board so to do, the board may cause such connection to be made and a lien to be filed against the property for the expense incurred in making such connection. No owner shall be compelled to connect his property with such system unless a service line is brought, by the district, to a point within four hundred feet of his dwelling place.

(n) To adopt and amend bylaws not in conflict with the constitution and laws of the state for carrying on the business, objects, and affairs of the board and of the district;

(o) To have and exercise all rights and powers necessary or incidental to or implied from the specific powers granted in this part 1. Such specific powers shall not be considered as a limitation upon any power necessary or appropriate to carry out the purposes and intent of this part 1.

(p) When a district lies entirely within a city or town and when all of its indebtedness has been fully paid or satisfied, to convey to such city or town, with the consent of the governing authority thereof, all of the property of such district upon the condition that such city or town will operate and maintain such property. Upon such conveyance the district shall be dissolved, and a certificate to such effect shall be signed by the clerical officer of the city or town and filed with the county clerk and recorder of the counties in which the order establishing the district is filed.

(q) When two or more districts are using the same or joint facilities, and when the obligations of each district are fully paid or satisfied, to consolidate such districts into one. In such an event the consolidated district shall be under the control of a joint board consisting of the members of each board, until, by the occurrence of vacancies or expiration of terms of office, the board is reduced to five members. Thereafter the members of the board shall be elected as provided in section 32-4-112.

Source: L. 49, p. 756, § 2; CSA, C. 173A, § 45; CRS 53, § 89-5-13; L. 61, p. 523, § 1; L. 63, p. 694, § 1; C.R.S. 1963, § 89-5-13; L. 69, p. 704, § 1.

Cross references: For foreclosure of mechanics' liens, see article 22 of title 38; for the power of eminent domain, see article 1 of title 38.

I. General Consideration.
II. Eminent Domain.
III. Nature of Services.
IV. County Requirements.

I. GENERAL CONSIDERATION.

C.J.S. See 63 C.J.S., Municipal Corporations, § 1359.

Annotator's note. Cases material to § 32-4-113 decided prior to its earliest source, CSA, C. 173A, § 45, as amended, 1949, have also been included in the annotations to § 32-4-113.

Law review. For article, "One Year Review of Real Property", see 36 Dicta 57 (1959).

As to the constitutionality of subsection (1) of this section. See People ex rel. Rogers v. Letford, 102 Colo. 284, 79 P.2d 274 (1938).

Forcing property owners to connect with sewer system without hearing does not violate due process. This section is not contrary to the due process clause of § 25 of art. II, Colo. Const. on its face, in that it grants to the board power to compel property owners within a sanitation district to connect their property with the sewer system of such district without expressly requiring a hearing. Peri-Mack Civic Ass'n v. Board of Dirs. of Baker Metropolitan & San. Dist., 140 Colo. 371, 344 P.2d 685 (1959).

Districts do not have power to impose special assessments. By conferring the right to collect tolls and service charges as conferred by subsection (1), and, in addition, as supplemental to such income, to levy and collect ad

valorem taxes against property within the district, the general assembly did not attempt to confer upon such districts authority to impose special assessments. City of Aurora v. Aurora San. Dist., 112 Colo. 406, 149 P.2d 662 (1944).

Not illegal for sanitary district within city to provide services city is authorized to provide, but doesn't. Where the city did not provide facilities for sewage disposal within the area of a sanitary district organized within the city for purpose of sewage disposal, such district did not offend legally, although the laws under which city was incorporated permitted it directly, or through the medium of special improvement districts created by ordinance, to install and maintain sewers within its boundaries. City of Aurora v. Aurora San. Dist., 112 Colo. 406, 149 P.2d 662 (1944).

Express statutory authority permits a quasi-municipality to impose rates, tolls, or charges for use of its facilities. Brownbriar Enterprises, Inc. v. City & County of Denver, 177 Colo. 198, 493 P.2d 352 (1972).

II. EMINENT DOMAIN.

Districts created under this statute have power and authority to condemn land. Under the constitutional provisions establishing the right of eminent domain and the several statutes enacted pursuant thereto, a district has power and authority to condemn land. Town of Sheridan v. Valley San. Dist., 137 Colo. 315, 324 P.2d 1038 (1958).

Property acquired under the constitution and statutes by exercise of the power of eminent domain cannot be lost by operation of a municipal ordinance. Town of Sheridan v. Valley San. Dist., 137 Colo. 315, 324 P.2d 1038 (1958).

Thus, where a sanitary district exercised its power of condemnation to acquire a right-of-way for construction of a sanitary sewer through a municipality, the town may not constitutionally provide that all right, title, and interest in the sewer shall vest in the municipality at the expiration of five years. Town of Sheridan v. Valley San. Dist., 137 Colo. 315, 324 P.2d 1038 (1958).

Counsel fees are not allowable in eminent domain cases. Leadville Water Co. v. Parkville Water Dist., 164 Colo. 362, 436 P.2d 659 (1967).

III. NATURE OF SERVICES.

The services a water and sanitation district renders are proprietary in nature and may be contracted for as is provided by statutes dealing with the powers of the board created to administer the district. National Food Stores, Inc. v. North Wash. St. Water & San. Dist., 163 Colo. 178, 429 P.2d 283 (1967).

And no restrictions are placed upon boards as to the types of contracts into which they may enter. National Food Stores, Inc. v. North Wash. St. Water & San. Dist., 163 Colo. 178, 429 P.2d 283 (1967).

A contract to purchase a service for a stipulated period at a fixed annual rate is within the proper exercise of proprietary and business powers of a municipal corporation and not objectionable as a surrender of legislative power. National Food Stores, Inc. v. North Wash. St. Water & San. Dist., 163 Colo. 178, 429 P.2d 283 (1967).

And a water and sanitation district will be held to such a contract. Where a company complied with a contract to pay its agreed share of the construction costs of the sewage treatment facilities, the water and sanitation district could not be relieved of its obligation under the agreement concerning the fixed rate for sewage services. National Food Stores, Inc. v. North Wash. St. Water & San. Dist., 163 Colo. 178, 429 P.2d 283 (1967).

IV. COUNTY REQUIREMENTS.

Because a sanitation district has express legislative authority to undertake the construction of a sanitary sewer across or under roads. Board of County Comm'rs v. Cottingham, 134 Colo. 156, 301 P.2d 135 (1956).

A county has no authority to require a sanitary district to obtain a permit and pay a fixed fee prior to excavation of a road or highway for a sanitary sewer pursuant to the statutory duty of such district. Board of County Comm'rs v. Cottingham, 134 Colo. 156, 301 P.2d 135 (1956).

But may require bond. A county may require a bond from a sanitary district prior to excavation of a road or highway to insure proper restoration. Board of County Comm'rs v. Cottingham, 134 Colo. 156, 301 P.2d 135 (1956).

32-4-114. Power to levy taxes. In addition to the other means providing revenue for such districts, the board has power and authority to levy and collect ad valorem taxes on and against all taxable property within the district.

Source: L. 49, p. 758, § 2; CSA, C. 173A, § 46; CRS 53, § 89-5-14; C.R.S. 1963, § 89-5-14.

Cross reference: For procedure to increase tax levy beyond statutory limits, see part 3 of article 1 of title 29.

C.J.S. See 64 C.J.S., Municipal Corporations, § 1982.

This section confers upon the board of a water and sanitation district power and authority to levy and collect ad valorem taxes. Ruberoid Co. v. North Pecos Water & San. Dist., 158 Colo. 498, 408 P.2d 436 (1965).

Based on valuation and not special benefit. This power of general taxation upon all property is based upon its assessed valuation and not upon special benefit. Ruberoid Co. v. North Pecos Water & San. Dist., 158 Colo. 498, 408 P.2d 436 (1965).

Thus, lack of special benefit alone cannot be a ground for excluding property from a water and sanitation district. Ruberoid Co. v. North Pecos Water & San. Dist., 158 Colo. 498, 408 P.2d 436 (1965).

But the general assembly did not attempt to confer upon the water and sanitation district the authority to impose a special assessment. Ruberoid Co. v. North Pecos Water & San. Dist., 158 Colo. 498, 408 P.2d 436 (1965).

Because a water and sanitation district is directly concerned with public health and welfare and therefore does not depend on special assessments for its revenue or taxing authority. Ruberoid Co. v. North Pecos Water & San. Dist., 158 Colo. 498, 408 P.2d 436 (1965).

32-4-115. Levy and collection of taxes. (1) To levy and collect taxes, the board shall determine, in each year, the amount of money necessary to be raised by taxation, taking into consideration other sources of revenue of the district, and shall fix a rate of levy, which, when levied upon every dollar of valuation for assessment of taxable property within the district and, together with other revenues, will raise the amount required by the district annually to supply funds for paying expenses of organization and the costs of constructing, operating, and maintaining the works and equipment of the district, and promptly to pay in full, when due, all interest on and principal of bonds and other obligations of the district, and, in the event of accruing defaults or deficiencies, an additional levy may be made as provided in section 32-4-116.

(2) No later than the fifteenth day of October in each year, the board shall certify to the board of county commissioners of each county within the district, or having a portion of its territory within the district, the rate so fixed in order that at the time and in the manner required by law for the levying of taxes, such board of county commissioners shall levy such tax upon the valuation for assessment of all taxable property within the district.

Source: L. 49, p. 758, § 2; CSA, C. 173A, § 47; CRS 53, § 89-5-15; C.R.S. 1963, § 89-5-15; L. 67, p. 534, § 4.

Am. Jur. See 56 Am. Jur.2d, Municipal Corporations, Etc., § 13.

C.J.S. See 64 C.J.S., Municipal Corporations, § § 2030-2041.

Failure to adopt budget and pass appropriation resolution not corrected by certification of tax levy. Certification of the tax levy to the board of county commissioners does not correct a water and sanitation district's failure to adopt a budget and pass an appropriation resolution. Shannon Water & San. Dist. v. Norris & Sons Drilling Co., 29 Colo. App. 48, 477 P.2d 476 (1970).

32-4-116. Levies to cover deficiencies. The board, in certifying annual levies, shall take into account the maturing indebtedness for the ensuing year as provided in its contracts, maturing bonds and interest on bonds, and deficiencies and defaults of prior years and shall make ample provision for the payment thereof. In case the moneys produced from such levies, together with other revenues of the district, are not sufficient to pay punctually the annual installments on its contracts or bonds, and interest thereon, and to pay defaults and deficiencies, the board shall make such additional levies of taxes as may be necessary for such purposes, and notwithstanding any

limitations, such taxes shall be made and continue to be levied until the indebtedness of the district is fully paid.

Source: L. 39, p. 605, § 16; CSA, C. 173A, § 16; CRS 53, § 89-5-16; C.R.S. 1963, § 89-5-16.

Cross reference: For funding deficiencies, compare part 4 of article 1 of this title.

C.J.S. See 64 C.J.S., Municipal Corporations, § 2035.

32-4-117. County officers to levy and collect. It is the duty of the body having authority to levy taxes within each county to levy the taxes provided in this part 1. It is the duty of all officials charged with the duty of collecting taxes to collect such taxes at the time and in the form and manner and with like interest and penalties as other taxes are collected and when collected to pay the same to the district ordering its levy and collection. The payment of such collections shall be made monthly to the treasurer of the district and paid into the depository thereof to the credit of the district. All taxes levied under this part 1, together with interest thereon and penalties for default in payment thereof, and all costs of collecting the same shall constitute, until paid, a perpetual lien on and against the property taxed, and such lien shall be on a parity with the tax lien of other general taxes.

APPENDIX B

PRIME AND UNIQUE AGRICULTURAL LAND

Unique farmland, the second category of SCS's concern, is land other than prime farmland that is used for the production of specific high value food and fiber crops. It has the special combination of soil quality, location, growing season, and moisture supply needed to economically produce sustained high quality yields of a specific crop when treated and managed according to acceptable farming methods.

In addition to prime and unique farmlands, there are also farmlands of statewide importance. These lands include those that are nearly prime farmland and that economically produce high yields of crops when treated and managed according to acceptable farming methods. Criteria for defining and delineating this land are to be determined by the appropriate State agency or agencies.

APPENDIX C

Taken from Areawide Water Quality Management Plan for El Paso and Teller Counties First Annual Update[16]

The American Water Works Association in their June 1978 issue of Rumbles offered the following guidelines for establishing and maintaining a water conservation program.

"PROGRAM FACTS:

A program based upon facts is hard to dispute. Facts therefor are one of the necessities. Consumption records factually provide base line data, and follow-up measurements will show measured successes. The measurements may be system wide, or based upon a number of randomly selected metered customers to produce a statistically viable sample. If a program is already in effect, and meter records are available, an unbiased sample is still available by using records produced before any publicity about conservation was generated.

Another set of facts encompasses community attitude. This measuring technique (if also done randomly and periodically) provides the ability to measure awareness, understanding, change of attitude, and to receive open or structured comments from constituents regarding the program. Both problems (attitude and consumption measurement) require a minimum of expense to establish and routinely repeat. It is possible to conduct the samples by using trained volunteer forces.

PROGRAM DIRECTION:

Any viable program needs these four components to ensure success. They are Regulation, Technology, Education, Enforcement.

a. Regulation - Are the rules and regulations legally adequate to promote conservation? Regulations assign responsibility for preventing water waste wherever that product is used. Rules and regulations may be as simple as prohibiting sidewalk washing or as involved as zoning and building regulations stipulating use of conservation fixtures in new construction. Rules and regulations, and ordinances, need to be contemporary, and effective.

b. Technology - The use of the most recent and effective conservation hardware, or devices, is part of proper technology. Again, the involvement may be in varying degrees from retrofit flow restrictors to incorporation of industrial recycling processes. Technology also includes the promotion and use of low water demand vegetation, and software such as pricing structures.

c. Education - By far the strongest component for success of any conservation program is education. Education may involve development of school curriculum, public information programs, speakers and instructional 'consumer tips', but to remain successful the education must be ongoing. Education, when supported with proper technology and regulations, and other facts, becomes the strongest factor in altering customer awareness, attitude and behavior.

d. Enforcement - For the habitual few that are reluctant to adopt accepted conservation practices, enforcement may be the only effective motivational action. It is necessary to promote accepted, positive behavior, by penalizing negative habits and practices. Behavioral research has shown that 90% of all people will exhibit positive behavior if they fully understand what is required of them. This leaves only 10% to be dealt with through enforcement procedures, which incidentally, may also be thought of, or structured, as an educational system.

Whether conservation programs are mandated, as in restrictions, or are totally voluntary in nature, they require the support of people. Through people involvement activities, the conservation ethic will become more understood, more accepted, and more widely practiced as the acceptable positive norm of society."

William Sharpe, a Water Resources Extension Specialist located at Pennsylvania State University has written several documents pertaining to water conservation. Many of his reports have been funded by the U. S. Department of Interior, Office of Water Research and Technology. From his efforts, the following data pertaining to the nature of the utilization of water within the home is available.

"Most of the water that comes into our homes is used to remove wastes. Washing clothes, dishes and ourselves, plus flushing the toilet and washing the car account for most of the water used in the home. Drinking and cooking are really insignificant uses of water compared to the amount we use for waste removal. The following chart is an example of how water is used by a typical American family of four.

Use	Gallons Used Per Day	Percentage
1. Dishwashing	15	5.9
2. Cooking, drinking	12	4.7
3. Utility sink (washing hands, etc.)	5	2.0
4. Laundry	35	13.7
5. Bathing	80	31.4
6. Bathroom sink	100	39.2
	255	100.0

Several things are apparent from the chart. Toilet water usage is the largest of any of the items on the list. It accounts for more water than all other categories combined with the exception of bathing. Next to bathing, the most water is used for doing the laundry."

These numbers developed by Sharpe compare realistically to the consumption figures developed with the Project Aquarius planning area.

> The conservation of water used in the home, unlike other efforts to conserve electrical energy and save heating oil, does not require a change in life style or personal habits. Unlike expensive auto emission control equipment, the simplest water conservation measures cost only a few cents, and even the more expensive ones easily pay for themselves over time. All of these measures will actually save the customer money. Almost all the devices are designed to save water while resulting in a minimum of inconvenience to the water consumer."

Water conservation can be obtained by changes in procedures within the home, by the installation of water saving devices and through actual requirements or economic stimuli established by area governmental agencies.

An indepth study was conducted by Murray Milne on behalf of the California Water Resources Center, University of California/Davis. His efforts were also funded by the Office of Water Research and Technology, USDI. The resulting report is titled "Residential Water Conservation" (Report No. 35). The following is a listing of things that can be done easily within the home to reduce water consumption based upon Milne's findings. By adhering to the following conservation procedures, Milne predicts at least a 20 percent reduction in a family's water consumption.

TOILETS

- Do not flush facial tissues, spiders, cigarette butts, etc. down the toilet. Each flush uses 5-7 gallons of water. Use a waste basket instead.

- It may not be necessary to flush after every urination, unless there are health or aesthetic reasons.

- If the toilet has a built-in hydraulic odor vent (a water-consuming luxary feature found on some models), simply avoid using it.

BATHING

- Reduce your time in the shower. It is the second largest water consumer in the homes.

- Close the drain in the tub before turning on bath water. The water will soon be hot and the temperature can be adjusted as the tub fills.

- Use less water in the tub.

- Try soaping up with the shower off. It saves about 5-10 gallons of water for each shower.

- For shaving, fill the sink rather than use running water.

- While shampooing hair, turn off the water when it is not needed.

DRINKING AND COOKING

- Keep a bottle of water in the refrigerator instead of letting the water run to get a cool drink.

- Use a minimum of water for cooking vegetables. (Save this water in a jar in the refrigerator to use in soups, sauces, etc. It is high in flavor, minerals and vitamins.)

- Thaw frozen foods ahead of time. Don't use water to quick-thaw foods.

- Remove the ice tray from the freezer a few minutes ahead of time so running water will not be needed to release the ice cubes.

- Don't use the garbage disposal for items just as well thrown in the garbage can, such as orange peels, chicken bones, and other items requiring much water and grinding time.

- Wash vegetables in a pan of water, then use it for watering plants.

WASHING

- Run the dishwasher only when full. Each load uses 12-17 gallons of water.

- Don't use the long cycle on the dishwasher. If you experiment with shorter cycles and less detergent, you will find dishes come out just as clean.

- Don't rinse dishes before putting them in the dishwasher; just scrape off the scraps. Your dishwasher is designed to clean even very dirty dishes.

- If the dishwasher is not getting dishes clean, check for clogged pumps, sticking rotors, leaking hoses, etc.

- Do not use too much detergent in the dishwasher or laundry. Extra detergent means extra rinsing.

- Use low sudsing detergents. They require less water for rinsing. (Contrary to popular belief, foam has no effect on cleaning performance.)

- When hand-washing dishes, first soak them in a filled sink with detergent and then be stingy with the rinse water. Washing a whole stack of dishes and rinsing them all at once saves time and water.

- If hand-washing clothes, do not use running water. Wash them in batches of similar colors and in sequences of increasingly soiled items, so that the same wash water can be used over again.

- Use the variable load control if there is one on your dishwasher or washing machine. It was designed to save you water and energy.

- Use the suds saver on your washing machine. You will save 16-19 gallons of water per load, plus detergent and energy.

- Use the washing machine only when you have a full load. It uses 27-50 gallons of water per cycle.

- Soak dirty sneakers or other hard-to-clean items in wash water from machine or hand washing.

PLUMBING AND SEWAGE SYSTEM

- When you go on vacation, turn off the main valve for the house water. A leak while you are away could do a lot of damage as well as waste a lot of water.

OUTDOORS

- Water the lawn in the early morning to avoid losses due to evaporation.

- The key to successful lawn care is: slowly, deeply, and infrequently.

- Do not allow water to flow into a gutter. That is wasteful!!

- During the hot summer months, raise the blade on the lawn mower to about 1-1/2 inches in height. This provides shade for the roots and helps to reduce water loss.

- Use an alarm clock or a timer to remind you to turn off sprinklers.

- Do not use sprinklers on windy days.

- Keep sprinkler heads clean to prevent uneven watering, and make sure they are located correctly to cover the greenery instead of paved areas.

- Avoid sprinklers that produce a fine mist; too much water is lost to evaporation.

- Do not wash down driveways with a hose. Use a broom!

- Dig basins around the "drip line" of trees and shrubs to enable flood and soak irrigation. It not only saves water but is better for your plants.

- Spend less time washing the car. A 20-minute car wash uses between 200 and 600 gallons of water.

- Take the car to a commercial car wash. Most of them recycle their water.

EQUIPMENT REPAIR AND REPLACEMENT

- Test regularly for toilet tank leaks. If either the flapper valve or ballcock is defective, replace it with a leak proof or signaling type.

- Experiment with toilet tank inserts to reduce flush capacity to 3-4 gallons.

- Bend the float rod in the toilet tank so that the water level is at least 1/2 inch below the top of the overflow tube.

- Replace any defective faucet washers to eliminate all drips.

- Install a flow control insert in all shower heads that use more than 3 gallons per minute.

- Install aerators on all faucets.

- Replace worn out faucets with washerless faucets, spray taps, self-closing mixing valves, pressure-balancing mixing valves, or thermostatic mixing valves.

- Replace malfunctioning shower heads with low-flow models.

- Replace a malfunctioning dishwasher or washing machine with a water-saving model.

- Check the water system for leaks. At a time when there is no water use at the house, check the water meter, wait 15 minutes, then check it again. Any change in the reading indicates a leak.

- Have the water company adjust your water pressure to between 20-50 pounds per square inch (psi).

- Use a swimming pool cover to reduce evaporation.

- Install pistol grip spring closed nozzles on all hoses.

- Install automatic shut-offs on sprinklers.

- Plant native species that survive mostly on rainfall.

- Make any landscape changes just before the rainy season.

- Re-work the topography of landscaped areas to prevent runoff.

In light of the fact that it is frequently difficult to get people to change old, water wasting habits, water conservation devices can act as an efficient, effective means of reducing consumption. A multitude of various water saving devices have entered the market place. Present demand for their use is sporatic and inconsistent. Consequently, their availability may or may not exist

in local plumbing and hardware stores. Many of these devices have been shown to be ineffective for one reason or another. Many of the governmentally supported studies have recommended a thorough evaluation program to determine if all water saving devices will meet their manufacturers' claims.

Private enterprise is also realizing the values in knowing which devices are worthy of investment. This has resulted in such magazines as the Consumer Report carrying a report on both toilet and shower water devices in their May 1978 issue. More reports of this nature are sure to follow.

The Office of Water Research and Technology, U. S. Department of the Interior, has released a capsule report which itemizes the various types of water saving devices available on the market. The following is taken in part, from their report.

> "Design of plumbing fixtures and system has always been accomplished to ensure that a more than adequate flow of water would always be available to meet whatever demand was necessary. No thought was given to the design of fixtures and systems based more precisely on the needs of the water user. Consequently, pipe sizes and fixture sizes and designs have encouraged the use of water far in excess of that really necessary to do the job. Water conservation devices help eliminate this waste by allowing only the necessary amounts of water to be used at the plumbing fixture. In many cases the user does not even notice their presence. For example, toilets that look and work the same are available using 3.5 gallons every time they are flushed compared to the five gallons required by a conventional nonwater saving type. These water conservation devices are available to inexpensively and unobtrusively save the user money.
>
> - Plastic Bottles
>
> Plastic bottles can be used to save water in flush toilets that are designed to use more water than necessary for adequate flushing. The bottle, filled with water, is placed upright in the toilet reservoir where it will not interfere with the moving parts of the flushing mechanism. More than one bottle may be used depending upon the reservoir's size and design. The bottle should be weighted with a small stone or other object to keep it from floating in the reservoir. When the toilet is flushed, the plastic bottle holds back the volume

of water it displaces. Unlike bricks, the plastic bottles do not cost anything, will not deteriorate in water, and will not break the toilet reservoir if accidently dropped.

- Toilet Inserts

Plastic dams and other devices are being manufactured by several companies. These devices dam off a portion of the reservoir and retain that water when the toilet is flushed. Problems have been encountered with these devices where they are incompatible with the model of toilet being used. If proper adjustments cannot be made, inadequate flushing may result. However, substantial savings of approximately 18 to 20 percent in total home water can result from their use and they are relatively inexpensive.

- Dual Flush Cycle Modifications

A number of devices have been patented that can be incorporated into existing toilets to give them a dual flushing capability--one cycle for solids and one for liquids. The objective of these devices is to reduce the amount of water used to flush away liquid wastes. Tests of these devices indicate significant water savings can be obtained from their use. These devices were termed cost-effective by a U. S. Environmental Protection Agency study.

In the United Kingdom, a two-cycle wash down water closet is now in use. The difference between this toilet and the dual flush toilet is that there are two separate flush cycles, one for liquid wastes and the other one for solid wastes. These have a wash down type flushing action while U. S. toilets have the vortex siphon type. Less water is required for wash down units, but the toilet bowl requires more frequent cleaning. The solid waste flush cycle uses 2.5 gallons per flush while the liquid waste cycle uses only 1.25 gallons per flush. The flush cycles are initiated by a short pull on the flush handle for the smaller amount of water, and a longer more persistent pull for the larger amount of water.

- Improved Ballcocks

Ballcocks of improved design are now available at most hardware stores. These are easily installed in most conventional water closets and sell for about $5.00. Water savings are achieved using these devices by adjusting them to maintain a lower water level in the toilet reservoir and by improved leak detection features. Flushing efficiency is not impaired when water levels are lowered with one of these devices. The water level can be adjusted to use exactly the minimum amount of water necessary for proper flushing. It is not a good idea to bend the float arm down to save water because this decreases the force with which the water moves through the toilet bowl. Unsatisfactory cleansing of the bowl may result.

- Water Saving Toilets

Water saving toilets are being manufactured in this country. They are required by local plumbing codes in some areas and by state law in California. The principal feature of this type of toilet is a smaller water reservoir than that of a conventional toilet. These toilets use only 3.5 gallons per flush as compared to five gallons for a standard toilet. This amounts to a savings of 30 percent in toilet water usage. These toilets are economical in new construction or as replacements for unworkable toilets.

- Faucet Aerators

Faucet aerators are already in wide use. Faucets with aerators provide a nice even flow and reduce splashing. By mixing water with air they reduce the amount of water flowing from a faucet. Faucet aerators are easy to install, inexpensive, and will more than pay for themselves in a short time.

- Spray Taps

These taps are actually mini-showers designed for use in lavatory sinks and wash basins. Water is sprayed from the tap rather than in a single stream as is the case with conventional faucets. The spray allows for faster washing and rinsing with less water use as a consequence.

- Flow Control Devices

These are used to limit the rate of flow from shower heads and faucets. These devices are usually nothing more than orifice restrictors that fit into the supply lines for faucets or showers. Flow is usually limited to three gallons per minute for showers. Normal flow from showers is four gallons per minute and up. Water savings of up to 60 percent are claimed for flow-limited shower heads and up to 50 percent for faucets.

In addition, similar savings can be obtained for shower heads with built in flow controls. These shower heads eliminate any potential compatibility problems between the restrictor and the shower head. Inexpensive flow restrictors are available that restrict flow from two to 3.5 gallons per minute.

- Pressure Reducing Valves

Pressure reducing valves, when installed at the home water supply inlet, can effect considerable water savings in high pressure service areas. Water pressure need not exceed 50 to 60 pounds per square inch in residences.

- Water Conserving Appliances

Smaller automatic dishwashers and washing machines are available. Washing machines of the front loading type and those with suds-savers or that allow adjustment for load size use less water than conventional top loading equipment.

- Landscape Irrigation Equipment

Faucet flow controls on outside taps used for landscape watering allow precise calculation of the water being applied. Drip irrigation emitters and sprinklers on electric time clocks can also reduce water use significantly. Soil moisture tensiometers are expensive but they are useful in preventing unnecessary watering. Planting native vegetation with lower water requirements is the best method of reducing irrigation water use.

- Water Conservation Innovations

A variety of sophisticated new equipment including air assisted toilets and showers, vacuum toilets, composting toilets, incinerator toilets, water recycling systems, detergent flush toilets, mineral oil recycling toilets and lavatory-toilet combinations are also available. Many of these devices have potential application under special circumstances, but their relatively great initial costs will generally limit their use to cases where malfunction of on-lot sewage disposal systems require correction."

The following table was compiled by the State of California, Department of Water Resources in their May 1976 report entitled "Water Conservation in California." This table indicates the potential water savings that can be obtained by retrofitting or installing new water conserving fixtures in the home such as those described. As can be seen from the table, the average consumer can substantially reduce his water consumption through the utilization of such devices.

The ultimate worth of water conservation devices will be judged by their ability to return an adequate amount on the investment made to procure and install them. Little actual data is available to substantiate the economic returns from using water conservation devices; however, what is available indicates that very substantial economic returns are possible relative to the costs of purchasing and installing the necessary devices and fixtures. Some of the reported economic benefits are:

Place/ Organization	Device	Cost	Estimated Benefits
Pennsylvania State Univ.	Shower Flow Control	$15,000	$100,000/year
Gettysburg College	Shower Flow Control	5,000	13,000/year
EPA study of 8 San Diego homes	Shower Flow Control Toilet Inserts Dual Flush Cycle	1 4 5	2.62/yr/home 6.30/yr/home 7.65/yr/home
Gettysburg, Pennsylvania	Shower Flow Control and Toilet Inserts	--	2,920,000
Federal Energy Administration	Shower Flow Control	1	16.00/year

The economic benefits that have been reported are highly variable but in no case have they been negative. Actual amounts of these benefits will vary with the types of plumbing fixtures currently in use and the habits of the water user. Water conservation devices save the user money and conserve two of our most precious resources--water and energy.

Water conservation can be influenced by a variety of private and public institutions. Due to their influence, or their specific authority to grant approvals, these agencies can implement policies which encourage, or even discourage, water conservation. These institutions include local city councils, planning commissions, environmental protection agencies, public utilities, sewage treatment agencies, product testing agencies, state or county health departments, building trade unions, and product manufacturers. Also, the actions or policies of one of these agencies can influence the others. In one example, a change in government specifications induced product manufacturers to develop water saving technology, which helped bring about revisions in the model codes, resulting in an expected change in local codes.

TABLE VIII-4

POTENTIAL WATER SAVINGS FROM RESIDENTIAL INTERIOR FIXTURES

FIXTURE/ACTION	WATER USE		PERCENT SAVINGS TOTAL INTERIOR		INCREMENTAL COST		IN-HOUSE ENERGY SAVINGS
	Standard	Improved	New	Retro	New $	Retro $	
Tank toilet	5-7 gals (19 to 26 litres) per flush	3.5 gals (13 litres)	18	10-18	$0-$10	$0-$6	No
Shower	up to 12 gals (45 litres) per minute	3.0 gals (11 litres) per minute	9-12	9-12	$0-$5	$1-$5	Yes
Kitchen & lavatory faucets	up to 5 gals (20 litres) per minute	1.5 gals (5.7 litres) per minute [1]	2[2]	0-2[2]	$0-$5	$1-$5	Yes
Pressure reducing valve	80 pounds per square inch (550 kilopascals)	50 pounds per square inch (340 kilopascals)	0-10	0-10	$0-$25	$25	Yes
Hot water pipe insulation	Not insulated	Insulated	1-4[2]	0-1[2]	$0.50-$1.00 per foot	$0.50 per foot	Yes
Automatic clothes washer	27-54 gals 100-200 litres) per load	16-19 gals (61-72 litres) per load	0-5	--	$20-$30	Not practical	Yes
Automatic dishwasher	7.5-16 gals (28-61 litres) per load	7.5 gals (38 litres) per load	0-4[4]	--	0	Not practical	Yes
TOTAL			30-55[2]	19-43[5]			

1. Attachments marketed with 0.5 gal (2 litre) per minute flow. Residential acceptance unknown but commercially proven.
2. No field quantification.
3. Retrofitting may not always be practical.
4. Based on one load per day.
5. Educate to only wash full loads, turn off water faucets unless actually used, etc. could add another percent or two to the totals.
6. Insulation of certain continuously circulating hot water piping is already required.

Many revisions need to be made in building, plumbing, and health codes before water saving technology can be fully utilized. Presently, for instance, even though there are toilets available which use little or no water, many communities have codes requiring a flushing capacity of at least four gallons.

In the search for ways to reduce residential water consumption, economic means offer important possibilities. Changes in water demand, water price, or water rate structures may be able to bring about reductions in water consumption. Several other techniques may also influence water consumption, such as water or sewer hookup fee reductions, discounts on monthly bills, tax incentives, or product subsidies. However, it is important to remember the strong psychological aspect to consumer behavior. Decisions do not always appear to be logical from a purely economic point of view.

A great deal of variation in water prices exists, even within the same general area. Over 90 percent of municipalities in the United States have water meters. Significant decreases in water consumption may be achieved with the use of meters by making the consumer aware of being charged for each unit of water used.

There are six types of water rates:

SET PRICE RATE	No water meters; each consumer pays the same amount, no matter how much or how little is used.
FLAT RATE	Price per unit of water is constant; the cost increases in direct proportion to the amount used.
DECREASING BLOCK RATE	The most widely used rate structure price per unit of water used decreases as consumption increases.
INCREASING BLOCK RATE	Price per unit of water used increases with consumption.

LIFELINE RATE	A low, fixed rate for minimum needs.
PEAK DEMAND RATE	Designed to reduce water use by charging more for water delivered during periods of greatest demand.

Variations in household water consumption are strongly influenced by family size. The next most important factor is the family's socio-economic status. Families with higher income usually have larger landscaped areas, dishwashers, swimming pools, etc., and use more water than families without these amenities. Consumers do not necessarily reduce their water consumption in response to a price increase. A poor family may already be using water for little more than the essentials and therefore cannot reduce consumption. Since the cost of water usually represents a small percentage of an affluent family's expenses, it is unlikely to reduce consumption only because of a price increase.

The recommendations made by the California Department of Water Resources to initiate the wide scale use of water saving devices are:

1. In all new construction the following be required, either through state legislation or local building code changes:

   -- low-flow toilets (state legislation enacted in 1976)
   -- low-flow faucets
   -- low-flow showers
   -- pressure reducing valves where line pressure is above 50 psi
   -- insulated hot water lines

2. Local agencies encourage the following to be installed in existing housing, through education programs and by providing the water-saving devices free or at cost:

   -- weighted plastic bottles, water dams, or other devices in toilet reservoirs to reduce flush-flows
   -- low-flow showerheads or flow restrictors in the shower line
   -- low-flow aerators on faucets
   -- pressure reducing valves where line pressure is greater than 50 psi

3. Only low-water use clothes and dishwashers be sold in the state

4. Manufacturers of plumbing fixtures and water-using appliances be required to prominently display water use characteristics

5. Local governments adopt ordinances that require phasing out of home self-regenerating water softeners and replacement with centrally regenerated units

In addition, the Department of Water Resources recommended that:

1. Action recommended for the residential sector also be undertaken in the commercial and governmental sectors.

2. Water agencies use uniform, peak/seasonal, or increasing block rates in water pricing. Where possible, ad valorem taxes for water should be eliminated and sewage treatment costs included in the same billing system. Where appropriate, the lifeline rate concept should be included in the pricing system.

3. All water agencies institute effective delivery system leak detection programs.

4. All water agencies promote and assist in the detection and repair of household plumbing leaks.

The following policies were also outlined:

1. Assist local agencies in formulating necessary buildings and plumbing code changes to require water-saving devices.

2. In cooperation with local agencies, develop and submit specific recommendations to the International Association of Plumbing and Mechanical Officials on modifications to the Uniform Plumbing Code regarding requirements for water conservation considerations in the design of fixtures and in other aspects of plumbing.

3. Work with other state agencies to develop water conservation programs at state facilities.

4. Acquire the necessary expertise to provide technical assistance to local water agencies in their efforts to select effective pricing structures.

5. Examine the water systems throughout the state and recommend appropriate measures to ensure that actions are taken.

It would seem, then, that a community might consider the following as a list of steps to be taken in implementing a water conservation program. These should be viewed as some of the nut and bolt procedures which can be employed when following the general program direction discussed earlier.

1. Institute a leak survey and corrections program
2. Practice water treatment plant water conservation where appropriate
3. Initiate a public relations and education program
4. If the water supply is metered, institute pricing schemes that make water more expensive as use increases
5. If the supply is unmetered or after step 3 has been accomplished in metered systems, implement a water-saving device program
6. Make contacts with industrial, institutional, and commercial users and assist them in formulating water conservation plans.

The following methods could be utilized to implement water-saving device programs at both the local and national level.

1. Voluntary acceptance through education and/or the free distribution of devices (WSSC approach)
2. Voluntary retrofit of devices in existing dwellings with code requirements for devices in new construction (WSSC approach)
3. Mandatory for all customers served by the utility as a utility policy
4. Mandatory as a requirement for government assistance in water supply development
5. Mandatory as a requirement for government assistance in sewage facility development
6. Mandatory as a requirement for government assistance in housing development
7. Inclusion in government tax incentive packages for energy conservation programs.

Any or all of the preceding measures would serve to hasten progress in any water conservation effort. Water-saving devices and water usage changes will reduce water use. How, then, will this savings affect wastewater facilities? William E. Sharpe notes that most authors have tended to minimize the impact of water-saving devices on wasteflow volumes. When one considers the proportion of wastes treated at the

sewage treatment plant attributable to household wasteflows, the reasons for this are clear. With significant inputs of infiltration-inflow and industrial wastes the maximum theoretical reductions in sewage flow reaching the plant are about seven percent. However, C. A. Cole in his article entitled "Impact of Home Water Saving Devices on Collection Systems and Wate Treatment" has indicated that a substantial extension of the hydraulic life of a sewage treatment plant can be obtained if water-saving toilets are required in all new housing following that plant's construction. In the case of treatment plants servicing primarily residential areas, this impact would be significantly higher (20-40 percent).

In the case of on-lot sewage disposal systems the potential reductions for various water-saving devices are much higher. E. R. Bennett in his article "Impact of Flow Reduction on On-Lot Sewage Systems" reports that up to a 40 percent reduction in sewage flows reaching on-lot disposal systems is possible with current water-saving device technology. Such reductions have a tremendous potential impact on the sizing of such treatment systems and may also permit increased acceptability of marginally permeable soils for septic tank drainfields.

In a recent EPA demonstration project wastewater recycle systems were installed in three homes with septic tank systems. In two of the three homes, normally experienced septic tank problems were not evident during the testing period. These tests indicated a 26 percent reduction in sewage flows using this device.

The effect of water-saving devices on conventional sewage treatment and collection systems is not expected to be overly significant. However, problems could develop in collection lines that service a

population of fewer than 500 persons. In such cases, conventional design velocities may not be adequate for solids removal, resulting in blockages, odor problems and excessive pipe corrosion. The effects on sewage treatment should largely be confined to small increases in detention times and waste concentration, which would be beneficial. Where there is a significant infiltration-inflow problem, it is unlikely that these effects will be noticeable. In development where a widespread application of water-saving toilets is expected, house connections, laterals and submains should be evaluated to ensure that solids transport will be adequate.

Some very practical and beneficial results have been shown in the area of wastewater by some of the communities and organizations encouraging and practicing water conservation programs. The following cites a few of these benefits:

- Wasteflow reductions of 40 percent have been estimated for on-lot wastewater systems with currently available technology.

- Wasteflow reductions of seven percent to wastewater treatment plants have been estimated in one community whose water conservation program was only partially effective.

- A sewer connection moratorium was lifted in a town after a water conservation program proved to be successful.

- A large university showed estimated annual savings of $100,000 in water, wastewater treatment and energy costs after installation of water conservation devices.

- Potentially significant reductions in the initial costs of new dwellings may be realized by virtue of the smaller sized plumbing system components.

APPENDIX D

Taken from Water Use and Management In An Arid Region[6]

Whatever sanctions may be imposed from outside, there are many potential actions that can lower the total water use in agriculture and make far more efficient the farm. The following section discusses various methods, potential implementation and the benefits and detriments of the methods. With sufficient tax and subsidy incentives, many of these could be adopted in the immediate future.

Management Techniques

In the area of education and information, programs can be instituted to create an atmosphere for water conservation programs. Water conservation districts, county, state and federal groups, and educational institutions can promote attitude readjustment providing means and rationale towards conservation methods. News media, especially within the agricultural community, can provide technical, economic, and other information. Pamphlets, brochures, and other publications through extension services, departments of agriculture, and other sources, can provide specific action possibilities. Many of these programs can be underwritten or supported by government funds from various levels and from educational institutions. In the area of technology transfer, too, mechanisms are needed to meet with research the needs of the farmers, and then to pass this information on to them.

Incentives are needed in all the programs to be discussed so as to facilitate their implementation quickly where there is not immediate economic benefit to the farmer. Special financing, grants, tax breaks, supports, and other measures are possible.

Institutional changes include special large-scale programs for farmer assistance. There can be immediate efficiency gains by this, but the state and federal costs can be very high. Changing the pricing structure for water has legal and social difficulties, but

would enable use of the free market system or other allocation means to determine where the water goes. This may well encourage conservation due to outright need. Changing the water laws will entail state and federal law and often Constitutional changes. Recommendations in this area have been strongly promoted, however, and though the political process would be long, the long-range planning benefits will potentially benefit all competing forces.

As to direct conservation techniques, irrigation, which uses the greatest amount of water by far in agriculture, can be much more efficient. While more study is needed for specific site application, upgraded irrigation systems could reduce use by three to five percent (White House, 1977). More efficient sprinklers, drip systems, better design of gravity systems, and improved drainage can all contribute to better efficiency. Crop yield would also go up, percolation and evaporation losses would go down, and soil compaction and disease could be lessened. There is high capital cost for much of this, however; drip systems, for instance, can cost $700 to $1200 per acre to install. Drainage and gravity systems are less to upgrade, about $100 to $300 per acre. Another consideration is the tradeoff between possible increased energy costs and reduced water consumption. Proper maintenance of irrigation systems is less costly, but may be prohibitive without incentives where profits are currently marginal. Inspection, repair, and cleaning of sprinkler systems, ditches, and other structures will have small immediate gains, but are also least costly.

Management of the total farm system is another area to improve water conservation. Adjusting the acreage and crops on both a long and short range basis can cut farm losses at the same time water is conserved. The timing of such crops, the influence of the market,

and other factors do make such changes difficult. Study of exact moisture needs for certain periods can be studied and publicized. Evaporation data has been published this year (see Figure V-1) which aids the farmer in calculating the most effective irrigation scheduling. Finally, encouraging irrigation of only fertile fields can improve the crop/water use ratio. The determination of 'prime' lands, however, is fraught with legal and social problems.

Control of water loss in seepage and evapo-transpiration can be obtained by a variety of methods. Lining of canals and ditches can reduce withdrawals of water by at least three percent and consumption by one to two percent. Concrete lining is expensive, however, about $500 peracre, depending on irrigation distances and extent. There are natural linings, also, which may prove to be less expensive. Bentonite is a natural substance found locally which has been shown in research to be very effective. Other clays and similar materials can also be used. Seepage control of subsurface drainage can increase productivity, although it will probably show no net water conservation.

Crop Water Use Data

Weekly ET (inches)

DATE	DAY	CORN	SUGARBEETS	FIELD BEANS	ALFALFA
JULY	6-12	2.45	2.25	2.09	2.75

The tasseling-silking stage is here for some of the early corn. Moisture stress in the plant at this time will delay silking and cut yields drastically. Pinto beans can stand moisture stress at any early stage but moisture is needed at early bloom. Alfalfa and sugar beets will continue to use water at higher rates.

FIGURE V - 1

Anti-transpirants can be sprayed on crops to reduce water loss, but they are expensive, reduce photosynthesis, and may cause environmental and health problems. Water storage areas can be covered with a monolayer of chemicals such as hexadecannol and thereby reduce evaporation by up to ten percent. These techniques are, however, still low in reliability, high in cost ($10 to $40 per acre foot), and potential environmental and health hazards.

Control of weeds and phreatophytes in agricultural areas, in reservoirs and impoundments, and canals and ditches would provide small local gains immediately, and would reduce losses to nonessential plants. The long term effects on wildlife, erosion, and other systems makes such action of limited and local use only. Such activities are also very labor intensive, which can be benefit or disbenefit depending on the labor market.

Whichever of the above techniques may be undertaken, they must be conducted with the complete involvement of the farmers, and with a view to improving the agricultural situation as well as an improvement in the water conservation situation on farms. To the extent to which such programs are economically beneficial to the nation and/or less costly than the water conserved, they will be both acceptable and successful.

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