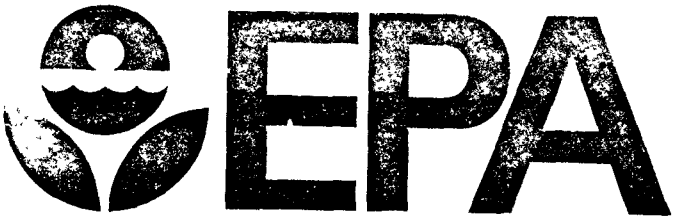
WATER QUALITY/WATER ALLOCATION COORDINATION STUDY

DRAFT

A REPORT TO CONGRESS IN RESPONSE TO
SECTION 102(D) OF THE CLEAN WATER ACT



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WATER PLANNING DIVISION
WASHINGTON, D.C. 20460

AUGUST, 1979

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D C 20460

Office of Water
and Waste Management

TO: Recipients of the Water Quality/Water Allocation Draft Report

Attached for your review and comment is a copy of the second draft of the Water Quality/Water Allocation Study, prepared in response to Section 102(d) of the Clean Water Act.

This draft incorporates, to the extent practicable, the numerous comments received from within EPA as well as from States, River Basin Commissions and others. I believe this revised draft is much improved as a result of these comments. The report now focuses more clearly on the identified existing and potential quality/quantity conflicts.

The report includes a discussion of the legislative background, a summary of the Clean Water Act, and a summary of the State and Federal water allocation programs. The analysis of quality/quantity relationships and conflicts focuses on four major areas: (1) instream flow; (2) irrigated agriculture; (3) consumptive waste treatment technologies; and (4) ground water and surface water relationships. Draft alternatives and recommendations to Congress are also presented which address problems and conflicts related to these issues.

Comments must be received no later than close of business November 1, 1979, to be incorporated into the final report. To facilitate completion of the final report, please forward your comments directly to the Project Officer, Jerry Kotas, Water Planning Division (WH-554), U.S. Environmental Protection Agency, 401 M Street, S.W., Washington, D.C. 20460, (202)426-2474.

I appreciate your assistance in helping to improve this report and I look forward to receiving your comments.

Sincerely yours,

Thomas C. Jorling
Assistant Administrator for
Water and Waste Management

Attachment

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CHAPTER I

EXECUTIVE SUMMARY

[reserved]

CHAPTER II

LEGISLATIVE BACKGROUND

This report is intended to meet the requirements of section 102(d) of the Clean Water Act. That section requires that the Administrator of the Environmental Protection Agency submit a report to the Congress which analyzes the relationship between the Act's water pollution control programs and programs by which State and Federal agencies allocate quantities of water. The section also requires EPA to consult with the States and River Basin Commissions. The report must also include recommendations concerning the policy in section 101(g) of the Act to improve coordination of efforts to reduce and eliminate pollution in concert with programs for managing water resources.

Section 101(g)

Section 101(g) was added to the Clean Water Act by section 5(a) of the 1977 Amendments (P.L. 95-217). It provides as follows:

> It is the policy of Congress that the authority of each State to allocate quantities of water within its jurisdiction shall not be superseded, abrogated or otherwise impaired by this Act. It is the further policy of Congress that nothing in this Act shall be construed to supersede or abrogate rights to quantities of water which have been established by any State. Federal agencies shall co-operate with State and local agencies to develop comprehensive solutions to prevent, reduce and eliminate pollution in concert with programs for managing water resources.

Section 101(g) was originally offered on the Senate floor as an amendment to section 510 of the Federal Water Pollution Control Act Amendments of 1972. It was co-sponsored by Senators Wallop and Hart and is referred to as the "Wallop Amendment." Section 510 states:

> Except as expressly provided in this Act, nothing in this Act shall . . . 2) be construed as impairing or in any manner affecting any right or jurisdiction of the States with respect to the water (including boundary waters) of such States.

As it was finally enacted, the Wallop Amendment was placed in section 101, the policy section of the Act, rather than in section 510. As explained in the Conference Report to the 1977 Amendments, section 101(g) is intended to "clarify existing law to assure its effective implementation. It is not intended to change existing law" (H. Rept. 95-830, December 6, 1977, p. 52). The existing law on this point is section 510(2), which was enacted in 1972 and was unchanged in the 1977 Amendments.

The only discussion of section 101(g) in the legislative history, other than the Conference Report cited above, is by Senator Wallop. It is useful to examine several portions of his floor statement:

> This amendment came immediately after the release of the Issue and Option Papers for the Water Resource Policy Study now being conducted by the Water Resources Council. Several of the options contained in that paper called for the use of Federal water quality legislation to effect Federal purposes that were not strictly related to water quality. Those other purposes might include, but were not limited to Federal land use planning, plant siting and production planning purposes. This "State's jurisdiction" amendment reaffirms that it is the policy of Congress that this Act is to be used for water quality purposes only.
>
> * * *
>
> It is not intended to change present law, for a similar prohibition is contained in section 510 of the Act. . . . Legitimate water quality measures authorized by this act may at times have some effect on the method of water usage. Water quality standards and their upgrading are legitimate and necessary under this Act. The requirements of section 402 and 404 permits may incidentally affect individual water rights. Management practices developed through State or local section 208 planning units may also incidentally effect [sic] the use of water

> under an individual water right. It is not the purpose of this amendment to prohibit those incidental effects. It is the purpose of this amendment to insure that State allocation systems are not subverted, and that effects on individual rights, if any, are prompted by legitimate and necessary water quality considerations.
>
> 123 Cong. Rec. S19677-78, (daily ed., Dec. 15, 1977).

EPA Understanding of Section 101(g)

Congress did not intend through Section 101(g) to prohibit EPA from taking such measures as may be legitimate and necessary to protect water quality. However, Congress did strongly assert that water allocation systems and water rights are not to be taken lightly. The 1977 Amendments left untouched both section 301(b)(1)(C), which requires without exception that point source discharges be controlled to meet water quality standards, and section 101(a)(2), which declares the national "fishable, swimmable" water quality goal.

Section 510(2), which Congress expressly declined to change, provides that States' water rights are not to be impaired "except as expressly provided in this Act." Thus, as Senator Wallop noted, the requirements of water quality standards, section 402 and section 404 permits, and section 208 plans may incidentally affect water rights and usages without running afoul of sections 101(g) and 510(2).

Purpose

The purpose of this report is to analyze the relationship between Clean Water Act programs and State and Federal water allocation programs. Its further purpose is to make recommendations, based on this analysis, for improving coordination of the management of water quantity and quality. Section 102(d) of the Clean Water Act states:

> The Administrator, after consultation with the States, and River Basin Commissions established under the Water Resources Planning Act, shall submit a report to Congress on or before July 1, 1978, which analyzes the relationship

> between programs under this Act, and the programs by which State and Federal agencies allocate quantities of water. Such report shall include recommendations concerning the policy in section 101(g) of the Act to improve coordination of efforts to reduce and eliminate pollution in concert with programs for managing water resources.

This report is in response to section 102(d). It will focus on the relationship between water resource and water quality programs, and will develop alternatives for coordination to help minimize conflicts between water resources and water quality programs.

Chapter III

CLEAN WATER ACT PROGRAMS

The objective of the Clean Water Act (hereafter, "the Act") is to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (section 101(a)). To accomplish this, the Act establishes two goals: the achievement, wherever attainable, of water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water by July 1, 1983 (section 101(a)(2)), and the elimination of the discharge of pollutants by 1985 (section 101(a)(1)). The Act establishes a comprehensive set of programs for research, planning, financial aid, regulation, and implementation to prevent and abate water pollution.

This chapter is a brief overview of the Act, focusing primarily on provisions that may affect State and Federal water allocations programs. It provides only the highlights of the programs, rather than a detailed analysis. No attempt is made to predict how courts might interpret section 101(g) in resolving any conflicts between water quality and water allocation programs.

Scope of Federal Regulatory Authority

The Clean Water Act generally prohibits the discharge of pollutants into navigable waters, except where the discharger has obtained a permit. A discharge is the addition of any pollutant to navigable waters from any point source. Point sources generally include pipes, conduits, and other discrete conveyances. The main categories of dischargers are industrial

and municipal sewage treatment plants, although some agricultural and mining activities are also included. Nonpoint sources of pollution, which include runoff from rainfall or irrigation, salt water intrusion, and groundwater pollution are not subject to the permit requirement.

The permit requirement applies to discharges into "navigable waters," which are defined in the Act as waters of the United States. The legislative history indicates that the term "navigable waters" should be given the broadest possible interpretation, "unencumbered by determinations which have been made or may have been made for administrative purposes." (Conf. Rep. No. 1236, 92d Congress, 2nd Session 144 (1972)). The definition therefore does not reflect traditional navigation concerns. It does, however, normally limit the permit requirement to dischargers into surface waters.

National Pollution Discharge Elimination System (NPDES)

Limitations on point sources are imposed primarily through the NPDES permit program (section 402). Permits generally consist of limitations on volumes, mass and/or concentrations of pollutants, and schedules of facility installation to assure compliance, although they may also include operating procedures. Permits may be issued for up to five years. Authority for administering the permit program can be transferred from EPA to the States. Thirty-two States now administer the program. EPA retains the authority to review individual permits issued by States for consistency with the Act.

Approaches for Determining Permit Conditions

The Act establishes three basic approaches for determining the level of point source pollution reduction required of dischargers, other than publicly-owned treatment works. First, all dischargers must, at a minimum, comply with technology-based effluent limitations. These are based on the degree of reduction of a pollutant that is attainable through the application of various levels of technology.

Second, when these limitations are not stringent enough to assure the desired quality of a body of water, then more stringent effluent limitations based on water quality standards are imposed.

Third, States are authorized to impose any more stringent limitations established pursuant to any State law or regulation.

Technology-based limitations: These limitations are generally based on guidelines developed by EPA for specific categories of industries. The Act sets forth a complex arrangement of requirements and deadlines for achieving effluent limitations based on these guidelines, and provides for variances in some circumstances. It defines the following levels of control technology:

- "Best practicable control technology current achievable" (BPT). This level of treatment represents the average of the best existing waste treatment performance. For the most part, it must be achieved by July 1, 1977.

- "Best available technology economically achievable (BAT)." This level of treatment will be based on the best control and treatment measures that have been developed or are capable of being developed.

- "Best available demonstrated control technology." This level of treatment is required by new source standards of performance, which apply to sources built after these standards are promulgated. These may require no discharge.

- "Best conventional treatment." For conventional pollutants, BAT has been modified to reflect, among other factors, a reasonable relationship between the costs of attaining a reduction in effluent and the benefits derived from reducing effluent, among other factors.

Dischargers are required to treat water to the extent achievable by these technologies, but are not required to use any specific technology.

Water Quality Standards: When technology-based effluent limitations are not stringent enough to protect water quality standards, more stringent effluent limitations based on these standards are imposed.

Water quality standards prescribe instream water quality. They generally consist of three elements: first, a designated use for a specific body of water, such as public water supply, recreation, or agriculture; second, criteria, which generally are instream numerical concentrations of the pollutants; and third, an antidegradation statement. The criteria must be sufficient to support the designated use. When technology-based

effluent limitations are not stringent enough to assure compliance with these water quality standards, section 301(b)(1)(C) of the Act requires the development of more stringent limitations to achieve them. EPA's present policy concerning use designation is based on section 101(a)(2) of the Clean Water Act, which provides that "wherever attainable, a goal 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 July 1, 1983." Fishable, swimmable use designations are therefore the norm, and less stringent designations are allowed only in limited circumstances.

Publicly-owned treatment works are subject to similar requirements. These are discussed in more detail in the section on construction grants.

State-Federal Relationships

Section 301(b)(1)(C) of the Act authorizes the imposition in permits of "any more stringent limitation, including those necessary to meet water quality standards, treatment requirements, or schedules of compliance, established pursuant to any State law or regulation, (under authority preserved by section 510) ...". Section 510 provides more generally that States are not preempted from imposing more stringent pollution control requirements.

Under section 401 of the Act, applicants for Federal licenses or permits to conduct any activity that may result in a discharge (including

but not limited to NPDES permits) must obtain a certification from the State that the discharge will comply with the applicable provisions of sections 301, 302, 303, 306, and 307 of the Act. These include technology-based limitations, water quality standards, and other limitations established under State authority preserved by the Act.

Federal agencies, facilities, and instrumentalities having jurisdiction over any property or facility, or engaged in activities that may result in discharge or runoff of pollutants are subject to Federal, State, local and interstate pollution control requirements to the same extent as non-governmental entities (section 313).

404 Permit Program

The Clean Water Act includes several other permit programs besides NPDES. The most important of these is the section 404 permit program for discharges of dredged or fill material. Activities regulated by this program include the construction of dams, diversions, and impoundments, the filling of wetlands, and the disposal of dredged spoil.

The section 404 permit program is presently administered by the Corps of Engineers, although the 1977 amendments to the Act authorize transfer of permitting responsibility to the States. Processing of many 404 permits is coordinated with processing of permits under the Rivers and Harbors Act of 1899. Section 404 permit applications are evaluated on the basis of compliance with environmental evaluation gudelines developed by EPA, in

conjunction with the Corps, under section 404(b)(1) of the Act. Permits issued by the Corps are also subject to the public interest review, based on the National Environmental Policy Act (NEPA), the Fish and Wildlife Coordination Act, and several other Federal statutes. The Corps determines whether permit issuance would be in the public interest, taking into account all factors relevant to the proposal. Factors specified in Corps regulations include conservation, economics, aesthetics, and energy needs. EPA can veto the issuance of Corps permits on the basis of unacceptable adverse effects on municipal water supplies, shellfish beds, and fishery areas.

Flow Augmentation

The term "flow augmentation" as used here refers to several pollution control techniques, including increasing stream flow from impoundments and dilution of wastes from point sources. Section 102(b) of the Clean Water Act governs flow augmentation by Federal projects for water quality purposes. This generally involves the release of water from reservoirs to maintain the assimilative capacity of a downstream body of water. Section 102(b) requires Federal agencies that are planning reservoirs to consider storage for control of stream flow for water quality purposes. The Administrator of EPA is authorized to determine the need for, and value of, storage for water quality purposes. The legislative history specifically bans pollution dilution as a substitute for waste treatment. Flow augmentation can be considered only as a supplement to adequate waste treatment.

This policy also governs flow augmentation by dischargers of pollutants who impound water for subsequent release during low flow periods, or who

transfer water from one body to another to increase stream flow. Flow augmentation is acceptable only where adequate treatment is insufficient to achieve water quality standards, and where a discharger can demonstrate from both environmental and economic standpoints that flow augmentation is the preferred method to achieve water quality standards.

Construction Grants

Section 201 of the Clean Water Act authorizes Federal grants for planning, building and improving sewage treatment works and sewers. The program is for the most part jointly administered by EPA and the States; EPA is authorized to delegate many of its responsibilities for administration of the program to the States. Federal financial assistance is available for three steps: 1) facilities planning, 2) design specifications, and 3) actual construction.

The levels of pollutant reduction required of municipalities are analogous to those for industries. By July 1, 1977, publicly-owned treatment works must achieve effluent limitations based on secondary treatment. By July 1, 1983, they must achieve effluent limitations based on the "best practicable waste treatment technology over the life of the work" (BPWTT). More stringent requirements based on water quality standards or State authority may also be imposed

EPA defines secondary treatment as numerical values for BOD, suspended solids, fecal coliform and acidity. BPWTT involves an analysis of

alternatives, including land disposal and water reuse, as well as a requirement for secondary treatment. The evaluation of alternatives takes place in the course of facilities planning. EPA's actions in funding construction based on these plans are subject to the environmental impact analysis requirements of NEPA.

Water Quality Management Planning

The Clean Water Act established a number of planning programs. Section 303(e) requires each State to develop a Continuing Planning Process, which provides for implementation of water quality standards. Section 208 establishes areawide waste treatment management planning, which provides for control of all sources of pollution, point and nonpoint, to the extent practicable. 208 plans are developed either by areawide agencies designated by the State, or by the State itself in areas which have not been designated. Section 106 provides for grants to the States for carrying out programs under the Act. EPA has recently issued regulations integrating these planning programs. Planning is also required for construction of municipal waste treatment facilities, as discussed in the section on construction grants.

Section 209 provides for the development of Level B studies for all basins in the United States under the Water Resources Planning Act. Level B plans are evaluations of resources in a selected area. They are designed to resolve complex long range problems by identifying and recommending actions to be taken by individual areas of government.

Nonpoint Sources

Section 208 provides for States and local governments to establish programs to control nonpoint as well as point sources of pollution. Nonpoint sources include runoff from activities such as agriculture, forestry, mining, construction, saltwater intrusion, urban stormwater, and residual wastes. These programs must be regulatory, unless nonregulatory programs will be adequate to attain the goals of the Act. The federal government has no direct enforcement authority over nonpoint sources under the Clean Water Act.

Ground Water

EPA has three programs affecting ground water under the Clean Water Act. First, under section 208, States and areawide agencies are to develop and implement management programs for ground water protection. Specifically, section 208(b)(2)(K) provides for 208 planning agencies to develop a "process to control the disposal of pollutants on land or in subsurface excavations to protect ground and surface water quality." Second, under section 402(b), States must have authority to control the disposal of pollutants into wells in order to have an approved NPDES permit program. Third, alternative waste management techniques must be considered before grants for construction of publicly-owned treatment works can be made. On site and land disposal, which may affect ground water quality, are major alternatives.

CHAPTER IV

STATE AND FEDERAL SURFACE WATER ALLOCATION SYSTEMS

Traditionally, water quantity allocation has been primarily the responsibility of the States. Congress reaffirmed this State role in section 101(g) of the Clean Water Act as did President Carter in his national water policy. In order to understand the nature of the States' responsibility in water quantity allocation, it is necessary to understand the legal systems pursuant to which water is allocated by the States, including the reasons for their evolution and their basic tenets. Two basic systems of law, the riparian doctrine and the prior appropriation doctrine, govern allocation of surface water by the States. The following is a discussion of these two systems. A brief review of water allocation law as it applies in each State can be found in Appendix A of this report.

Riparian System

The riparian system is applied in all States east of the 100th meridian except Mississippi, and in combination with the prior appropriation system in several of the western States. Historically, the concept of riparian rights is derived from English common law. In England the Crown owned the navigable (public) waters and their banks and beds, holding them in trust for public use. Private waters were owned and controlled by those who owned riparian land, defined as land adjacent to the stream or upon which the stream flowed. The bed of the stream was owned by the riparian landowner. Riparian rights also attached to public

waters, but they were more restricted than in private waters, because they were subordinate to the public's right of navigation and fishing, and because the Crown owned the beds and tidelands.

When the colonists arrived in America they brought the English common law riparian system with them. It was well suited to the humid climate in the eastern States which was similar to the English climate. Water supply was abundant. The basic concept of the English riparian system is that riparian landowners are entitled to use the water as long as their use does not substantially reduce the quantity or quality of the water available to other riparians. The two basic principles of the doctrine are: (1) that ownership of land along a stream is essential to the existence of a water right, and (2) each riparian owner has an equal right to make use of the stream, even if that right remains unexercised. These rights cannot be lost through non-use. Further, it is a correlative right, and each landowner must consider the rights of other riparians. In times of shortage, theoretically, under a pure riparian system each riparian would be required to cut back water use to the same degree, although in practice this may not be the case.

Some changes were made to the English riparian system as it was applied to the eastern United States. The definition of navigability was expanded to include all navigable inland waters. Another change made in several of the riparian States regarded consumptive rights to water. Under the English rule, known as the natural flow doctrine, each riparian proprietor on a watercourse is entitled to have the

stream flow through his land in its natural condition, not perceptibly retarded, diminished, or polluted by others. Several eastern States still follow this doctrine. Most, however, either have abandoned it for the reasonable use doctrine or use a combination of the two doctrines. The natural flow doctrine allows diversions for consumptive uses which are considered to be natural uses such as drinking, bathing, household purposes, and watering household and farm animals. A riparian owner, under the natural flow doctrine, may withdraw as much water as he needs for such natural uses, even if this drains the entire stream. Artificial uses include irrigation, manufacturing, power generation, mining operations, and large-scale stock watering. Water may be diverted by riparians for these artificial uses as long as there is no material interference with the natural flow of the watercouse. Such a use is actionable by a downstream owner even though he is not using the stream and suffers no actual damages. The natural flow doctrine was effective in the early days of the industrial revolution because it ensured that mills and factories powered by water would have sufficient flow to operate. Since water flow is no longer used as the primary source of energy, the natural flow doctrine has been rejected in all but a few States because it prohibits many beneficial consumptive uses.

The reasonable use doctrine gives each riparian proprietor a right to use the water for any beneficial purpose provided that the intended use does not unreasonably interfere with legitimate water uses by other proprietors on the stream. The determination of reasonableness is made on a case-by-case basis. Priority of use or extent of riparian frontage are not necessarily determinative in considering what is a reasonable use. In spite of the correlative nature of their rights, each riparian is not necessarily entitled to a proportionate share

of the available water. Where water supply is insufficient to satisfy all users, an otherwise reasonable use may be determined to be unreasonable under the circumstances and be prohibited.

The reasonableness of a use will be determined according to factors such as rainfall; climate; season of the year; customs and usages; size, velocity, and capacity of the watercouse; nature and extent of improvements on the watercourse; amount of water taken; place and method of diversion; place of use; previous uses; the object, extent and type of use; its necessity and importance to society; the uses, rights, and reasonable needs of other riparians; and the use's location on a stream. The reasonable use doctrine gives preference to natural uses over artificial uses. A determination of reasonableness is based on present conditions rather than future circumstances. Both the natural flow and reasonable use rules govern water quality. The riparian system generally does not allow for use of the water on nonriparian land, including both diversions by riparian owners to nonriparian land and diversions by nonriparian owners. However, in jurisdictions which follow the reasonable use rule, a plaintiff will usually have to show actual damage before he can enjoin a nonriparian use. In a few States nonriparian uses which harm downstream riparians may be allowed if they meet the test of reasonableness. In most riparian States riparian rights are not transferable apart from the riparian land from which they stem. In the few cases where they are severable, the right of the nonriparian grantee is effective against the riparian grantor but is usually inferior to the rights of other riparians.

Under a strict interpretation of the riparian theory, a municipality, even where it is a riparian owner, cannot divert water for purposes of public water supply. In practice, however, courts allow the municipalities to make such diversions. Some States have expressly recognized riparian rights for municipalities. Of course, municipalities have the power to acquire water rights by eminent domain. Once such rights are so acquired, the municipality is not bound by the riparian doctrine and may sell water to nonriparians.

Many water uses in the eastern States are not based on riparian rights but are permit rights administered by a State agency. In some respects these permit systems are similar to prior appropriation systems, but there are also major differences. One difference is that eastern permits are often for fixed terms subject to imposition of conditions and limitations and are frequently revocable. Also, the date a permit was acquired usually does not affect the adjudication of conflicts between water users, which are generally resolved through private litigation following the rule of reasonable use. The permits generally function as a record-keeping device allowing the State to determine how much water is being used. In some States the permit requirement only extends to large water users or to certain geographic areas. In some States certain uses, such as agriculture, are exempt from the permits. As a general rule these permit systems do not address all of the shortcomings of the riparian system, particularly in the resolution of conflicts. See Appendix B for a review by State of these permit systems.

Prior Appropriation System

In the American West conditions at the time of settlement were quite different than in the East. Water was initially used for mining and later for irrigation.

Both of these uses required conveyance of water substantial distances from the stream and both consumed large quantities of scarce water. In a setting where there was often not enough water to go around, the riparian system would not work. To encourage development, the West needed a system which imparted certainty as to the amount of water available. The concept of prior appropriation developed from the miner's rule of "First in time, first in right." As early as 1855 this rule was recognized in California. It was developed into a full-fledged legal doctrine in the case of Coffin v. Left Hand Ditch, decided by the Colorado Supreme Court in 1882. Consequently, the prior appropriation doctrine is sometimes called the Colorado Doctrine.

California was an early leader in recognizing the prior appropriation doctrine, but later it also recognized riparian rights. This California Doctrine, recognizing both prior appropriation and riparian rights, was later adopted by Nebraska, Kansas, Mississippi, North Dakota, South Dakota, Oklahoma, Oregon, Texas, and Washington. The combination of the two doctrines did not work well, and most of the States, except California, have since abandoned the riparian doctrine for the prior appropriation doctrine.

The fundamental principles of the prior appropriation doctrine are (1) beneficial use of water is the basis, measure and limit of the right and (2) first in time, first in right (i.e., priority). In contrast to the riparian doctrine, beneficial use and not ownership of land is the basis of the right; likewise, priority in time and not equality of right governs when there are conflicting demands for water. The effect of the priority rule is that water shortages fall entirely on those who last commenced use, rather than being borne by all users. This allows each potential user to examine the remaining supply and determine whether there is sufficient water to justify making an investment. The portion of an appropriative right which is not used can be lost either by abandonment, or statutory forfeiture for nonuse usually over a period of three to five years. This is often called the "use it or lose it" rule.

Traditionally, five steps were necessary to initiate an appropriative water right:

(1) The intent to appropriate water.

(2) Notice to others of the appropriation.

(3) Compliance with State prescribed formalities.

(4) A diversion of water.

(5) Application of the water to a beneficial use.

Modern permit systems, which exist in all appropriation States except Colorado, satisfy the first two requirements. The third is simply a matter of following prescribed procedures, including obtaining a State permit. The last two requirements will be discussed later in this chapter.

Under the prior appropriation system, a junior appropriator is entitled to water whenever it is not needed by a senior appropriator. He can insist that a senior appropriator not take more than his appropriation allows. He also has the right to prohibit any change in the stream conditions existing at the time his appropriation was initiated if the change would damage his appropriation. This right applies to changes in place of use (either point of diversion, point of return, or both) and manner of use.

Statutory exceptions have been enacted in some States which modify the strict priority rule. These include authority to reject an application if a proposed appropriation is deemed to be against the public interest, preferences to certain water uses regardless of priority, preferences and reservations in favor of municipalities, and withdrawal of waters from general appropriation in favor of existing or proposed public projects. Modifications affecting priorities in periods of water shortage take the form of preferences.

The following sections discuss some of the basic principles of appropriative water law in more detail. It is important to note that the following discussion presents theory and that, in real application, these principles are applied with differing degrees of firmness in the different States due to difficulties of proof or the practicalities of enforcement.

Beneficial Use

The prior appropriation system requires that all water appropriated must be put to a beneficial use. The corollary to that is that water may not be wasted. Appropriative law supports the concept of "maximum utilization" of the water resource. The amount of water an appropriator may take is always limited by the amount he can put to beneficial use. This included the amount consumed as well as the quantity used to transport the water from the point of diversion to the point of use. The requirement for beneficial use will result in the loss of a water right (be abandonment or forfeiture) if the right remains unused for too long. Different States define beneficial use differently. The determination of whether a use is beneficial is initially an administrative determination and ultimately a judicial function although in certain States statutes have listed uses which may be beneficial.

The concept of beneficial use is not static; it has changed as needs, policies, priorities and circumstances have changed. For example, during the period of time in which the West was being settled, the primary criterion for determining whether a use was beneficial was economic. Thus, such uses as irrigation, public water supply, stock watering, mining, and industry power (including electrical generation) have traditionally been considered beneficial. In all jurisdictions domestic (household) use is beneficial and is given a preference over other uses. In recent years instream values have begun to be recognized. Future energy development may further impact the determination of what is a beneficial use.

Even if a use is beneficial, the means of diversion by which it is effected may be wasteful as is illustrated by the case of Empire Water and Power Co. v. Cascade Town Co. 205 F. 123 (8th Cir. 1913) in which the Court held that while use of water to enhance a profitable resort was beneficial, the means of diversion involved was wasteful in view of competing demands. The beneficial use and waste concepts will be addressed in further detail in Chapters V, VI, and VII with particular emphasis on their relevance to maintenance of instream flows, irrigation efficiency, and consumptive waste treatment technologies.

Diversion Requirements

A diversion of water has traditionally been considered an essential element to perfect an appropriative right. Although many legal scholars believe that there is no necessity for the diversion requirement under modern permit systems in prior appropriation States, the requirement still exists in several States. The scholars' reasoning is that the original purpose of the requirement was to provide physical evidence of the intent to appropriate and notice that an appropriation was being made. The permit system provides a superior means of satisfying the requirements for notice and intent. Nonetheless, most prior appropriation States still maintain the diversion requirement, except for certain statutory exceptions relating to State appropriations. The diversion requirement will be addressed in Chapter V as it relates to maintenance of instream flows.

Loss of Water Rights

Under riparian common law, water rights are not lost through non-use. However, in theory, under prior appropriation systems if appropriated water is not used for a certain period of time rights to that water can be lost, either through abandonment or statutory forfeiture (usually non-use for 3 to 5 years). Only that portion of the water right not used would be lost. The purpose for abandonment or forfeiture of unused water, often referred to as the "use it or lost it" doctrine, is to ensure that the available water supply picture is not distorted, that certainty is fostered and that speculation in paper water rights is discouraged. "Use it or lose it" and related concept of "saved" waters, waste and the duty of water will be analyzed in Chapter V and VI in relation to CWA requirements regarding maintenance of instream flows and irrigated agriculture.

Change of Use

In most prior appropriation States appropriators are allowed to apply to the permitting authority for a change of use. Such a change of use will be granted if it does not change the stream conditions that existed at the time the junior appropriation was made. A change of use which harms a junior appropriation may result in a suit for damages or an injunction against the change of use. When the action is considered a reuse rather than a change of use, an action for damages or equitable relief will not lie. Change of use and reuse will be discussed in more detail in Chapter VIII.

Appropriations on the Return Flow

In most prior appropriation States appropriators of stream flow are in fact largely appropriating irrigation return flows and treated effluent. These appropriations vest rights in the appropriator. Chapters VI and VII will address these rights in regard to nonpoint source control requirements and consumptive waste treatment technologies.

Preferences

Several of the Western States set forth in their statutes preferences to be utilized generally either in granting initial appropriations or in distributing water during times of shortage. In a 1955 article in the Rocky Mountain Law Review, Dean Frank Trelease made the following statement about preferences: "Preference is a generic term, and a preferential right may have one of a number of different effects. It may give persons who use waters for some purposes a right to the water that is superior to prior rights for other purposes, or it may give certain water users a better right than others using the water for the same purposes. Some preferences permit a preferred user to condemn and pay for non-preferred water rights; others withdraw water from general appropriation and reserve it for future preferred uses; still others amount to rules for choosing between substantially simultaneous applications for permits to appropriate the same water. In addition, policies governing the actions of planning agencies may require that certain uses must be given preference over others in the

formulation of projects for the development and use of water." Ordinarily first preference is given to domestic use and second to agriculture regardless of priority in time. Instream uses are either not mentioned or are at the bottom of the list, because historically they were considered to be of limited economic value.

Special Rules for Municipalities

In prior appropriation States, municipalities often have more flexibility in water usage than in riparian States. In several riparian States municipalities, in addition to their power of eminent domain, are usually allowed to divert water for public supply. A water usage may be held reasonable for a municipality which would not be reasonable for a private user. In prior appropriation States municipalities may have leeway to dispose of surplus water up to the amount of their diversion even though no water is returned to junior appropriators. Municipalities are usually not limited in their appropriations to the amount needed at the time their rights are adjudicated, but are entitled to appropriate sufficient water for probable future uses. See City and County of Denver v. Sheriff, 105 Colo. 193,96 P2d 836, 842 (1939). Chapter VII contains a more detailed discussion of special rules for municipalities.

Legal Aspects of Federal-State Relations in Water Resources Management

Federal land management agencies such as the Bureau of Land Management and the U.S. Forest Service, and Federal water resource development agencies such as

the Bureau of Reclamation, the Corps of Engineers, the Federal Energy Regulatory Commission, the Soil Conservation Service and the Tennessee Valley Authority, have programs that affect the allocation of water.

The activities of the Federal government with respect to water quantity allocation are:

(1) The Federal government builds projects all or a portion of the costs of which are to be repaid by beneficiaries (e.g., Bureau of Reclamation, Corps of Engineers, Tennessee Valley Authority).

(2) The Federal government builds projects and manages them for multi-purpose uses, allowing profitable uses (e.g., power generation) to pay for less profitable uses.

(3) The Federal government has reserved water rights to support specific Federal purposes on lands withdrawn from entry (e.g., U.S. Forest Service, Bureau of Land Management).

While the importance of Indian water rights in regard to Federal-State relations is recognized, the complexity of the issues involved has resulted in a decision not to address Indian water rights in this report.

1. Specific Federal-State Conflicts

A. Reclamation Act of 1902, Federal Power Act

A series of court cases have addressed the interpretation of section 8 of the Reclamation Act of 1902, which is substantially the same as section 27 of the Federal Power Act. Section 8 provides:

> That nothing in this Act shall be construed as affecting or intending to affect or in any way to interfere with the laws of any State or territory relating to control, appropriation, use, or distribution of water used in irrigation or any vested rights acquired thereunder, and the Secretary of the Interior, in carrying out the provisions of this Act, shall proceed in conformity with such laws, and nothing herein shall in any way affect any right of any State or Federal government or of any land owner, appropriator, or user of water in, to, or from any interstate stream or the waters thereof.

From 1946 to 1963, section 8 and section 27 were construed in four major Supreme Court decisions. These decisions held that the statutes did not allow the States to veto a Federal project which was inconsistent with State law. Section 27, in First Iowa Hydro-Electric Co-op v. Federal Power Commission, 328 U.S. 152 (1946), was interpreted as not requiring compliance with State laws but only as being "by way of suggestion" to the FPC on matters on which it "may wish proof submitted to it on the applicant's progress." The

section 8 cases, most notably Ivanhoe Irrigation District v. McCracken, 357 U.S. 275 (1958), in dictum suggest that section 8 is merely a property rule and that section 8 has no State influence even in cases of clear Federal-State conflict, although in Ivanhoe there was such a conflict. Under Ivanhoe the Federal government may choose to ignore State law, but if it takes water rights vested under State law, State water law defines the right taken and thus the measure of damages.

The issue was recently before the Supreme Court in a case where there was no clear conflict. In California v. U.S., 46 U.S.L.W. 4997 (U.S. July 3, 1978), the Supreme Court reversed the dictum in the Ivanhoe case and held that a State may impose any condition on "control, appropriation, use or distribution of water" in a Federal reclamation project that is not inconsistent with clear congressional directives respecting the project. In that case the Bureau of Reclamation was planning to build the New Melones Dam, a Congressionally authorized multi-purpose dam which is part of the Central Valley Project in California. The Bureau applied to California for a permit to appropriate the water that would be impounded by the dam and later used for reclamation. California, as it is allowed to do under State law, granted the permit but placed several conditions on it, the most important of which prohibited full impoundment until the Bureau was able to show firm commitments or at least a specific plan for the use of the water. The purpose of this condition was to protect for as long as possible a white water area on the Stanislaus River. The Federal government argued that California did not have the authority to impose such conditions based on the earlier line of cases defining section 8. The Court rejected the earlier cases and held for California.

The specific impact of the New Melones decision on future Federal developmental projects is as yet undetermined; however, it is obvious that without a clear conflict the effective level of State control has increased significantly.

2. Federal Reserved Rights

On the same day as the New Melones decision, the Supreme Court also decided the Rio Mimbres case in U.S. V. New Mexico, No 77-510, (July 3, 1978). The issue in that case was the quantity of water which the United States reserved out of the Mimbres River when it set aside the Gila National Forest in 1899. In 1908, in Winters v. U.S., 207 U.S. 564 (1908), the Supreme Court held that the Federal government could create water rights as a proprietor as well as a sovereign, thus recognizing the concept of Federal reserved rights. Where private rights have been established, the Federal government retains a proprietary interest, sufficient at least to enable Congress to withdraw such water from further appropriation under State law and to reserve it for Federal use in connection with Federal lands. This proprietary interest arises from prior Federal ownership in Western lands. In the eastern States where there was no original Federal land ownership, water rights of the Federal government are based on riparian theory, as with any other land owner. Under the reserved rights doctrine when Federal lands are withdrawn or reserved for specific purposes, either by legislation or Executive Order, without any mention of water, unappropriated water will implicitly be reserved in an amount sufficient to satisfy the purposes of the withdrawal or reservation. In general, these Federal reserved rights have not been quantified,

which has inhibited the ability of States, where such rights exist, to manage their water resources.

Those water rights which vested before Federal reservation remain intact and have a higher priority than the Federal rights. However, future State allocations of water rights on Federal land are junior to the Federal reserved rights. Federal reserved rights are based on the purpose for which the reservation or withdrawal was made. The Winters case involved reserved rights on an Indian reservation as did another leading case, Arizona v. California, 373 U.S. 546, (1963). In Cappaert v. U.S., 426 U.S. 128 (1976), the Court interpreted the reserved rights doctrine to include sufficient groundwater to maintain minimal lake levels at Devil's Hole National Monument, finding that such water was necessary to fulfill the purpose of the reservation.

In the Rio Mimbres case the water reservation in question was implied rather than express. The United States claimed sufficient water to maintain a minimum instream flow for aesthetic, environmental, recreational, and fish purposes. The Court held that maintenance of instream flow was not a purpose for which the National Forests were reserved. This ruling apparently applies to all National Forests reserved prior to the enactment of the Multiple-Use Sustained-Yield Act of 1960 unless express reservations of water for instream flow purpose were made at the time of reservation. Specifically, the Court said that "(t)he Multiple-Use Sustained-Yield Act of 1960 does not have a retroactive effect nor can it broaden the purposes for which the Gila National Forest was established under the Organic Act of 1897."

The impact of the Rio Mimbres case is as yet untested. It is clear, however, that the reserved rights of the Federal government are substantially less than had been thought prior to the Court's decision. When Rio Mimbres and New Melones are read together with section 313 of the Clean Water Act, which requires compliance by the Federal government with State procedural and substantive requirements for water pollution control, the authority of the States over total water resource management has been effectively expanded through clarification of the law.

Interstate Relationships

The main vehicle for determining the amount of water available to States which share interstate streams has been the interstate compact. These compacts fix the share to which each State is entitled. Compacts are more than contracts among the States since the Federal government must consent to a compact, although the effect of Federal consent is unclear. The major issue, as yet unanswered, is whether a compact can bind the Federal government if Congress has consented to it. Generally individual holders of water rights are subject to the compact and their rights may be curtailed by the State in furtherance of its compact duties.

A compact generally makes gross allocations among the States and fixes the rights and duties of the individual States. For example, in the Upper Colorado River Basin Compact, Utah bears most of the evaporative losses but contributes a relatively small share of the supply, so it would be unfair to charge Utah's share with all evaporation losses. Thus, the compact fixes a formula whereby the Upper Basin States share reservoir evaporation losses in their common duty

toward Arizona, California, and Mexico. There is persuasive evidence that the Colorado River Compact was based on above average runoff. Consequently, allocations to States may exceed the long-term average flow.

In the East the allocation of the Delaware River is controlled in part by the Delaware Basin Compact. The compact procedure has been used for ad hoc apportionment. In New Jersey v. New York, 357 U.S. 955 (1954) the Supreme Court imposed minimum flow release obligations in New York to protect the downstream States of New Jersey and Pennsylvania. The releases limit New York's right to withdraw water from the Delaware watershed to prevent, among other things, salt water intrusion in the Delaware. The Court's decree is supplemented by the Delaware Basin Compact which gives a commission discretionary apportionment powers in times of drought. This power was invoked during the 1965 drought to limit New York City's diversion and to require reservoir releases.

Interstate water compacts raise complex issues of water management efficiency and use in Western States. In some cases they promote the "use it or lose it" policy since each State is reluctant to release any of its entitled water flows to downstream States. In other cases the compacts promote maintenance of instream flows because they require significant amounts of flow to be left in streams for downstream States, thereby limiting the amount of diversion and consumption that can occur in some States. Interstate compacts can allocate more water than actually exists, thus creating both quantity and quality problems.

Federal Programs Impacting Water Allocation

Direct responsibility for allocating quantities of water is at the State level. The Federal interest in water is twofold -- economic and environmental. The economic interest has been expressed historically through Federally built water resource development projects. The environmental interest is more recent and is expressed through legislation administered by agencies such as EPA, the Fish and Wildlife Service and the Office of Surface Mining. The two interests have not been well coordinated with each other and, in many instances, have been in direct conflict. However, recently strong efforts have been made to integrate the two interests and achieve a cohesive national policy.

The following discussion of Federal programs which impact water allocation will address surface water. Chapter VIII of this report will address Federal activities relating to groundwater management. The authorities of the Federal government in regard to surface water allocation vary greatly. The Federal government does not directly allocate water in the sense that States allocate quantities of water. However, various Federal programs can significantly impact the amount and location of water available for allocation and what it is used for. Federal authorities fall into several broad classes.

- Water resource development programs.
- Federal land management authorities.
- Federal water resource planning programs.
- Federal policy development.
- Coordination.
- Service and Technical Assistance programs.

Water Resource Development Programs

The Bureau of Reclamation, the Corps of Engineers, the Tennessee Valley Authority and the Soil Conservation Service are the Federal agencies primarily involved in water development projects. Such projects are often initiated at the request of the States. The State is responsible for allocating water developed by Federal projects and controls the extent to which that water is left in the stream. The Federal government must obtain both flow rights and storage rights from the States. However, the Federal agencies can have significant impacts on the amount and timing of water available in a stream because they control the scheduling of releases from reservoirs.

While the Federal Energy Regulatory Commission licenses rather than develops water resources projects, the conditions contained in its licenses may have a significant impact on water quality available in a stream through scheduling of releases.

The specific relationship between Federal development programs and maintenance of instream flow is analyzed in Chapter V. Chapter VI discusses the impact of these programs on irrigated agriculture, with particular emphasis on the price of Federally developed water.

Federal Land Management Authorities

Federal land management agencies, including the Bureau of Land Management (BLM), U.S. Forest Service and the National Park Service, have certain rights to use water flowing on Federal lands. The BLM is in the process of developing a position regarding its authorities over water on BLM lands. The U.S. Forest Service has Federal reserved rights which have been defined in the Rio Mimbres case discussed earlier in this Chapter. The issue of Federal reserved rights has been of particular interest to the States, which desire their quantification in order to know the amount of water which is available for them to allocate. Indian reserved rights are not addressed in this report.

Federal Water Resource Planning Programs

The Water Resources Planning Act of 1965 (P.L. 89-90) created the Water Resources Council, and was enacted "to encourage the conservation, development, and utilization of water and related land resources of the United States on a comprehensive and coordinated basis by the Federal Government, States, localities and private enterprise." The Water Resources Council, composed of heads of various Federal departments and agencies, was directed by the Act to establish principles, standards and procedures for preparation of basin plans, and for formulation and evaluation of Federal water and related land resource projects. The basic planning objectives are national economic development and environmental quality. The WRC has specified three (3) levels of planning:

° Level A: Framework Studies and Assessments, which are general inventory and evaluation studies of water resource programs and problems.

° Level B: Regional or River Basin plans, which are reconnaissance level evaluations of resources in a selected area. They are designed to resolve complex long-range problems by identifying and recommending actions to be taken by individual areas of government.

° Level C: Implementation Studies, which are specific water development project plans for the purpose of project authorization and funding.

This planning is carried out by River Basin Commissions provided for in the Act. Six basin commissions are presently operating: The Ohio, Great Lakes, Missouri, Upper Mississippi, New England and Pacific Northwest. Section 209 of the Clean Water Act requires the preparation of Level B plans for all basins by 1980. Priority is to be given to basins which overlap with designated 208 planning areas.

Federal Policy Development

In June 1978, the President's Water Policy Message was delivered. The Water Policy is an attempt to address some of the inefficiencies associated with water resource development, for example, by giving a higher priority to projects which the States support, or by revising the guidelines for water resource project planning. On July 12, 1978, a series of directives was issued to implement the policy. Interagency task forces were established under the direction of the

Secretary of the Interior to develop the specific elements necessary to insure effective implementation of the policy. The President reaffirmed existing Federal policy that the primary responsibility for water resource management is at the State level.

Of particular interest to this report are the proposed revisions of WRC Principles and Standards to ensure adequate consideration of environmental values in Federal water resource development planning, and increased emphasis on maintenance of instream flows and groundwater management. Since the effort is still on-going the specific impact of the policy implementation effort on water resource and water quality management cannot yet be assessed.

Coordination

Among the existing mechanisms and legislation available for coordination of Federal water resource programs and Federal environmental protection programs are the River Basin Commissions, the Fish and Wildlife Coordination Act, and the National Environmental Policy Act.

The Water Resources Planning Act provides for the function of River Basin Commissions. These commissions are designed to serve as the principal agency in the multi-State river basin for coordination of water resources planning, and to prepare comprehensive coordinated joint plans for water and related land management.

However, as currently constituted the Water Resources Council can at best play only a limited coordination role between water quantity and water quality considerations because the Water Resources Planning Act emphasizes water resource development and places water quality as a secondary priority.

The Fish and Wildlife Coordination Act requires that fish and wildlife values be considered in advance of project construction licensed or funded by the Federal government. It requires that fish and wildlife receive equal consideration with other project purposes, provides for enhancing these values where possible, and authorizes compensatory features where some damage is inevitable. The July 12 directive on Environmental Quality and Water Resources requires that the Interior Department, in consultation with the Commerce Department, promulgate regulations defining requirements and procedures for compliance with the Fish and Wildlife Coordination Act. Within three months after promulgation, Federal agencies that consult with the Fish and Wildlife Service will publish the procedures that they will follow in implementing these regulations.

The National Environmental Policy Act (NEPA) requires that Environmental Assessments (EA) and, in certain instances, Environmental Impact Statements (EIS) be prepared for proposed Federal activities to determine their possible impact on the environment. NEPA has the potential for coordinating water quality and water quantity concerns through the EA, EIS, and citizen suit provisions.

Coordination between Level B (WRC) and Water Quality Management planning is one of several potentially useful tools for identifying and minimizing quality/ quantity conflicts. Level B plans can provide a variety of data, project future uses, and identify and screen potential solutions and the impacts of these solutions on flow levels. The River Basin Commisions provide one forum for achieving coordination and addressing conflicts. However River Basin Commissions have not been established for many parts of the county.

The Water Quality Management planning process also provides several other measures for identifying and resolving conflicts. They include:

- Bi-lateral interagency agreements between EPA and eleven (11) different Federal departments and agencies, for coordination of 208 plans with these other programs;

- Policy advisory committees for each 208 planning process. These are composed of local officials and representatives of interested State and Federal agencies.

- EPA's Regional review and approval process, which should identify failures of coordination on the part of the 208 plans.

- State/EPA Agreements.

Service and Technical Assistance Programs

There are numerous Federal programs which provide financial and technical assistance in areas related to water resources management. These include loan and cost sharing programs under the Department of Agriculture, HUD, and the Department of Commerce, and technical assistance programs under such agencies as the Soil Conservation Service, Army Corps of Engineers, and U.S. Geological Survey. The loan and grant programs can influence water resource management by encouraging or discouraging certain types of developement in specific geographical areas. The technical assistance programs have potential for assisting in better coordination of water development and water quality interests through providing information and assistance where it is most needed.

CHAPTER V

INSTREAM FLOWS

Minimum stream flows are frequently necessary to protect water supply, fish and wildlife habitat, public health, recreation, navigation, ground water recharge and other uses. Historically, State and Federal programs for the allocation of water have tended, for socio-economic reasons, to give a higher priority to offstream uses that are incompatible with the maintenance of instream flows. Clean Water Act programs are intended to protect water quality for both instream and offstream use. However, they often depend on the existence of minimum flows, both because treatment required for pollutant discharges are frequently designed with specific flow levels in mind, and because minimum flows in themselves may be necessary to meet the objectives of the Clean Water Act.

Section 101(g) of the Clean Water Act recognizes the need for cooperation between the States and Federal agencies in order to better resolve conflicts when they arise. This chapter discusses how existing programs deal with instreams flows, and how they deal with conflicts between instream and offstream uses. The chapter is divided into three parts:

- o a brief list of some situations that lead to conflicts between instream and offstream uses
- o a description of aspects of Federal and State allocation programs that promote or prevent the maintenance of instream flows.
- o an analysis of relationships between allocation programs and Clean Water programs.

Characteristic Problems

The problems discussed below are conflicts between programs, rather than simply water quality problems. Depleted flows are not necessarily problems in themselves, since the primary responsibility for allocating water between instream and offstream uses rests with the States, and instream uses are not inherently more valuable than offstream uses. However, Clean Water Act programs in many instances depend on the existence of instream flows, and in some cases Clean Water Act programs and water allocation programs unnecessarily defeat each others purposes, rather than supporting each other, or at least reaching accommodations. The following discussion briefly identifies a few of these conflicts that center around the maintenance of instream flows.

Offstream diversions for irrigated agriculture, municipal water supply, industrial and other purposes may impair or preclude the use of water for a number of purposes or uses that require instream flows, including fisheries, recreation, navigation, hydropower, aesthetics and ground water recharge. (Pollution problems resulting from irrigation are discussed in Chapter VI, but irrigation is also a significant contributor to the general flow depletion conflicts discussed in this chapter).

Waste treatment requirements contained in NPDES permits are often determined on the basis of particular stream flow levels. When diversions and/or consumptive uses reduce flow below these levels, higher concentrations of pollutants result, and treatment requirements may no longer be sufficient to protect water quality. For example, inadequate instream flows may result in significant instream temperature rises which can adversely affect the instream environment. On the other hand, maintenance of stream flow might limit the ability of water right holders to change their points of diversion or return or to perfect their water rights.

Impoundments can create the same problems of impaired or precluded instream uses and ineffective waste treatment requirements. Flow regulation to assure minimum instream flows may conflict with other purposes of the project, or State allocation law. For example, operation of hydropower projects to maximize electric power generation may result in flow reductions that are incompatible with the maintenance of downstream fisheries.

Not only depletion of flow but changes in flow patterns can lead to conflicts. Impoundments for hydropower, or to provide water for irrigation, water supply or other purposes during dry seasons will cause changes in flow patterns, which may impair the biological productivity of streams, lakes or estuaries. Both reductions of flow and changes in flow patterns may lead in some instances to salt water intrusion that disrupts existing ecosytems.

Consumptive waste water treatment may reduce flow levels and thereby preclude instream uses. Regionalization of sewage treatment works may change the location of flows and thereby cause flow depletion in specific areas. These problems differ from the others discussed in this Chapter because they address the effects of one Clean Water Act program on another in regard to instream flow maintenance. This Chapter briefly discusses these instream flow conflicts, while Chapter VII addresses conflicts between consumptive waste treatment and water allocation programs generally in greater detail.

Of course, the water quality and water allocation programs often complement each other. For example, water projects often maintain minimum flow levels by regulating flow. Some stream flows in water-poor areas consist primarily of releases from impoundments during the dry season.

STATE AND FEDERAL ALLOCATION PROGRAMS AFFECTING INSTREAM FLOW

This section briefly describes aspects of the State and Federal allocation laws and programs that specifically refer to instream flows. Chapter IV includes a more general description of these programs and laws. The appendix to this Chapter discusses specific permit laws in riparian States that support the maintenance of minimum stream flows. (See Appendix C.)

Riparian States

1. Natural Flow Jurisdictions - Under the natural flow doctrine, each riparian proprietor on a water course is entitled to have the stream flow through his land in its natural condition, not perceptibly retarded, diminished or polluted by others. Five States adhere to this doctrine in most respects.

The natural flow doctrine theoretically encourages the maintenance of instream flows. However, the only way to resolve conflicts among water users is costly, time-consuming litigation between private parties. In practice, impoundments and diversions still can result in considerable reductions in flow.

2. Reasonable Use Jurisdictions - The reasonable use doctrine gives each riparian land owner the right to use the water for any beneficial purpose, provided that the intended use does not unreasonably interfere with legitimate uses by other proprietors on the stream. Most riparian States apply the reasonable use rule to determine the validity of a particular use.

In time of abundant flow, the reasonable use doctrine works well to assure maintenance of minimum instream flows. It is less dependable in times of low flow. A series of riparian owners might all be making a reasonable use of the water, but their cumulative withdrawals may reduce the flow below the minimum needed to protect water quality. The remedy to resolve conflicts among water uses in this situation is costly, protracted private litigation to determine which uses remain reasonable and which ones do not. Minimum flows will not necessarily be maintained in these situations.

3. Riparian Permit Jurisdictions - Eleven riparian States have enacted statutes that use permit systems to determine rights to water. Generally, these permit systems exempt certain water uses, or only apply to certain areas within the States. Resolution of water use conflict is left to the courts, as in traditional riparian jurisdictions. Several permit States include specific requirements for maintenance of minimum stream flows. (See Appendix C.)

Prior Appropriation States

Water law in prior appropriation States is less likely to support maintenance of minimum stream flows. Appropriation States are for the most part arid or semi-arid and there are more conflicts over scarce waters. Prior appropriation law has also been traditionally oriented towards offstream, consumptive uses. Several traditional legal doctrines may bar appropriations for instream uses. (See Chapter 4 for a more detailed discussion of these doctrines).

1. Beneficial Use - The holder of a water right must put the water to beneficial use, or the water right will be lost. The traditional definition of beneficial use has been in terms of private economic benefit. Since maintenance of stream flow is difficult to define in these terms, it is very possible that attempted instream appropriations may be denied as non-beneficial uses. In recent years there has been a trend toward recognizing instream uses as beneficial. By statute, Colorado has classified instream uses as beneficial when the appropriation is made by the State.

2. Diversion Requirement - In some States, a user must divert the water out of the stream in order to make a valid appropriation. Instream uses do not involve such a diversion, so this requirement would automatically require denial of an attempted instream appropriation. As recently as 1972 the New Mexico Supreme Court refused to recognize an intended appropriation based on natural irrigation, because there had been no man-made diversion. A California trial court recently held that a public instream use appropriation may be rejected because the appropriator lacks possession of the water. In 1973 the Colorado legislature overturned a 1965 Court decision which involved an attempt to appropriate for minimum flows. The Court held a diversion was required; subsequently a statute was enacted which authorized instream appropriations by the Colorado Water Conservation Board.

Instream appropriations may still be effective, even though most streams in prior appropriation states are already over appropriated. Many senior appropriators are downstream, and substantial flow remains in the stream for these downstream users. Instream appropriators, even if they are junior to the downstream users, have the right to challenge changes in the place of diversion that would affect these flows.

Federal Agency Programs

Federal agencies do not directly allocate quantities of water, but Federal water projects have impact on the amount, timing and location of water available for instream flows. The authority of Federal agencies to make decisions on the basis of instream flows is determined by the project's authorizations and a number of more general statutes. The President's Water Policy Initiative emphasized the importance of considering instream impacts in Federal water project planning and management.

1. Specific Project Authorizations - The authority of Federal agencies to operate existing projects under their authorizing legislation for instream flow purposes is uncertain. In general, Federal agencies claim to have this authority for future projects, but frequently not for existing projects. Studies of authorizing legislation in certain regions have indicated that most authorizations include a catch-all phrase such as "other purposes," and that the projects were frequently operated for other purposes, which were not explicity mentioned in the authorizing legislation. (See Anadramous Fish Law Memo, June 1979, National Resources Law Institute, Lewis and Clark Law School, p. 4).

2. General Statutory Authorizations - Several dozen statutory provisions can potentially be used by Federal projects to maintain and protect stream flows. (See Federal Legislation for the Protection and Maintenance of Instream Flows prepared by Instream Flows Working Group of the President's Water Policy Task Force). In addition to the statutes of broad applicability discussed in Chapter 4, the most important are the Fish and Wildlife Coordination Act, the Endangered Species Act, The Wild and Scenic Rivers Act, and Clean Water Act Sections 102(b) and 404 (discussed later in the chapter).

The Fish and Wildlife Coordination Act has been used to assure minimum flows in both Federal and non-Federal water resource projects. The Act requires that fish and wildlife values be considered in advance of project construction licensed or funded by the Federal government. It requires that fish and wildlife receive equal consideration with other project purposes, provides for enhancing these values where possible, and authorizes compensatory features where some damage is inevitable.

Under the Endangered Species Act, Federal agencies must not carry out activities which jeopardize the continued existence of any endangered and threatened species or result in the destruction or adverse modification of such species. Instream flow necessary to fully protect designated species could be required below any future reservoir project.

Under the Wild and Scenic River Act, designation as a wild and scenic river has the effect of reserving historical flows since new stream diversions and Federally funded water resource developments are prohibited and may be restricted below or above the designated river segment.

Section 102(b)(1) of the Clean Water Act requires consideration of storage for regulation of stream flow in planning of reservoirs by Federal agencies. EPA has the authority to determine the need for stream flow regulation for water quality purposes, and to determine the proportion of project costs that can be attributed to water quality. Other agencies determine the need for instream flow regulation for other purposes, including navigation, salt water intrusion, recreation, aesthetics, and fish and wildlife.

Water Policy Initiatives - The approach of Federal agencies to maintenance of instream flows will be changing in response to the President's Water Policy

message, and his directive on Environmental Quality and Water Resources management. The Water Policy message directed Federal agency heads to cooperate with the States and provide leadership in maintaining instream flows through joint assessment of needs, increased assistance in gathering and sharing of data, appropriate design and operation of Federal water facilities, and other means. The message also stated: "New and existing projects should be planned and operated to protect instream flows, consistent with State law and in close consultation with State."

The Environmental Quality and Water Resources directive of July 12, 1978 acknowledges that the States have the principal responsibility for protection of instream flows, and that the Federal government has the following responsibilities:

- to reduce the extent to which Federal actions contribute to and exacerbate (instream flow) problems

- to exercise existing Federal authority, consistent with State laws, to remedy these problems

- to cooperate affirmatively with States in developing programs to solve these problems

The July 12 directive also will change implementation of the Fish and Wildlife Coordination Act. The Interior Department, in consultation with the Commerce Department, will promulgate regulations defining requirements and procedures for compliance with the Fish and Wildlife Coordination Act. These regulations were proposed on Friday, May 18, 1979 (40 CFR 29300). Within three months after promulgation, Federal agencies that consult with the Fish and Wildlife Service will publish the procedures that they will follow in implementing these regulations.

RELATIONSHIP WITH CLEAN WATER ACT PROGRAMS

The most significant Clean Water Act programs affecting instream flows are the water quality standards program, the water quality management planning program, the permit program for discharges of dredged and fill material, and programs requiring consumptive waste treatment. These programs are briefly described in Chapter 3. The remainder of this chapter addresses the relationship between these programs and State and Federal water allocation programs.

The most complex problems involve attainment of water quality standards in low flow conditions. Most of the discussion addresses the basic alternatives for dealing with water quality standards problems and policy and legal constraints on these approaches. Institutional arrangements for resolving these problems are discussed in the section on Water Quality Management planning. Other problems are discussed more briefly.

Water Quality Standards

The water quality standards for a body of water include: designated uses such as fishing or public water supply; criteria which are generally instream concentrations of pollutants which must be stringent enough to protect the designated use; and an antidegradation statement. Reduction in flow can result in violations of water quality standards, because pollutant discharge limitations that implement water quality standards are generally based on minimum stream flows.

Assumptions about flow are often essential to developing controls for discharges of pollutants. Water quality standards frequently serve as the basis for developing enforceable discharge limitations for municipal and industrial discharges. The precise numerical limitations for individual discharges are developed by determining the capacity of a stream to assimilate waste, and allocating this wasteload among existing and potential dischargers on the stream. The assimilative capacity of a stream will vary with the flow level.

Water quality standards generally include a minimum stream flow on which wasteload allocations are based on. Frequently, this is the 7-day average low flow expected to occur during any 10-year period (7Q10). Effluent limitations for dischargers of pollutants are established to protect standards at these low flow levels. Standards for the most part do not require that any specific minimum flow level be maintained at all times, although States do have authority to establish such standards.

Diversions and impoundments may reduce flow below the levels upon which the wasteload allocations are based. Discharges from point sources may then lead to violations of water quality standards. Under existing law, planners theoretically have four options for addressing these problems: 1) increasing levels of treatment, 2) requiring minimum flows by limiting diversions or consumptive uses, 3) augmenting stream flows, and 4) relaxing water quality standards. The following section discusses the problems with these approaches in greater detail. It focuses on what can be done under existing laws and policies. The alternatives chapter discusses changes that might be made to existing policies that might result in better decisions.

1) Increased Levels of Treatment

Increasing levels of treatment will be difficult. First of all, development of wasteload allocations is frequently expensive and time consuming, and planning funds for developing them and revising them are limited. In addition, wasteload allocations are generally devised as NPDES permit conditions. These permits are almost always issued for five year periods, and it is difficult to re-open them on the basis of revised allocations. Finally, Congress is requiring more and more stringent technical justifications before it will fund plants using expensive advanced waste treatment to meet water quality standards.

There are other possible complications. Because wasteload allocations are generally designed on the basis of the 7-day/10-year low flow, they may require levels of treatment in excess of those needed to meet water quality standards much of the time. Flow and temperature related permits allow less stringent levels of treatment when stream flow is above criteria low flow levels, although they are difficult to develop.

2) Minimum Flow Requirements

Requiring the maintenance of minimum stream flows might be equally difficult, because of both State water laws and Clean Water Act programs. Existing water rights for offstream uses may prevent water from being kept in the stream. State laws that treat instream uses as nonbeneficial uses, or that require diversions in order to obtain water rights, may make it impossible to assure that water is left in the stream even if there is an attempted instream appropriation.

Existing Clean Water Act programs have not frequently been used to establish minimum flow requirements, and their use has generally been limited to conditioning future diversions and impoundments to prevent further reductions in flow, rather than requiring restoration of historic flows. Section 404 authorizes the inclusion of minimum flow requirements as conditions of permits for the discharge of dredged or fill material, and Section 401 authorizes the inclusion of conditions to protect water quality in Federal licenses for activities that may result in the discharge of pollutants. Under Section 313, Federal projects must comply with State water quality standards, which can contain minimum flow requirements.

3) Flow Augmentation

Flow augmentation by other sources to meet the base flows assumed in the wasteload allocations may be possible only in limited situations. The largest obstacle is likely to be the availability of water, although both State water law and laws governing the operation of Federal projects also limit the applicability of flow augmentation.

Particularly in arid regions and dry seasons, water is not likely to be available for stream flow maintenance. It may not be possible for State governments or anyone else to acquire enough water rights to assure minimum flows.

It is not clear who would own instream rights, or pay for them. Instream flow rights are increasingly being recognized under State law (see appendix to this chapter), but actual purchase or appropriation by States or private parties has not occured on a widespread basis. Purchase of water rights is not an eligible cost for Clean Water Act grants for construction of publicly owned waste treatment works. In any case, water might not be available except at considerable cost.

State and Federal laws governing the operation of water projects are less likely to be obstacles to the maintenance of flow levels than the economics of operating these projects. Authorizing statutes do not necessarily preclude projects from releasing water to maintain minimum flows, but releases to maintain stream flows might interfere with other uses of a project, such as hydropower. The portion of a Federal project's cost that can be attributed to flow augmentation is determined by EPA under Section 102(b) of the Clean Water Act. That section provides that ". . . storage and water releases should not be provided as a substitute for adequate treatment or other methods of controlling waste at the source."

4) Downgrading Water Quality Standards

Relaxation of water quality standards might not be justified. EPA regulations allow for downgrading of standards only in limited situations. A State must demonstrate that the existing designated use is not available because of

natural background or irretrievable man-induced conditions, or it must be able to show that compliance by dischargers with effluent limitations necessary to meet the standards would result in "substantial and widespread adverse social and economic impact." Of course, minimum flow requirements may be irrelevant in some situations, as in some naturally intermittent streams, and some streams consisting primarily of waste water effluent.

Case Studies

Case studies conducted for EPA illustrate some of the problems involved in chosing among these approaches. On the Winooski River in Vermont the economics of producing power often leads utilities to severely restrict stream flow, particularly during summer months when natural flows are already low.

The primary alternatives for protecting water quality standards in this situation are: advanced waste water treatment by municipalities and regulation of the dam operation. Under the first alternative, costs are borne by the water-using communities that must pay higher construction and operation and maintenance costs. Under the second, costs are borne by power users. Existing institutional arrangements were not designed to balance the cost between these two types of water users.

The principal agencies involved are the State Agency of Environmental Conservation, the State Public Service Board, and the Federal Energy Regulatory Commission. The State Agency of Environmental Conservation develops the waste-load allocations that determine the level of pollutant reduction that dischargers

must meet in order to comply with water quality standards. The wasteload allocations will be adopted by the State after formal rulemaking hearings.

The State water quality standards require that 7-day/10-year low flows be used in determining wasteload allocations. Requiring flow maintenance at this level would benefit the local communities paying for waste treatment, while allowing reduced flows would benefit utility rate payers. The administrative procedures are designed to involve members of communities affected by dischargers, rather than all utilities customers.

The Public Service Board (PSB) also lacks a specific mandate to address the problem. However, new dams require a certificate of public good that entails a finding that proposed construction will not have an undue adverse effect on water purity, and these issues can be addressed in hearings. The PSB also has ongoing jurisdiction over existing dams, but the authorizing statute does not make any direct reference to water quality.

Public Service Board decisions are subject to the supervisory authority of the Federal Energy Regulatory Commission (FERC), which regulates non-Federal hydroelectric projects. Existing licenses are not routinely reopened, but in at least some instances FERC retains the authority to reopen them. However, FERC currently is not required to reopen licenses, and it might be reluctant to in light of the impact of increased stream flow on its principal mission, the promotion of power generation.

Conflicts involving hydroelectric dams may arise more frequently in the future, as hydroelectric power is considered more frequently as an alternative to expensive and uncertain supplies of power from oil and nuclear plants.

The Willamette River in Oregon has been cited as an example of the use of reservoir releases to meet base flows included in water quality standards. Reservoirs on the Willamette were constructed for the purposes of flood control, navigation, irrigation, and hydroelectric power generation, but not specifically for water quality enhancement. In summer months, the risks of floods are small, and low flows have required the release of stored water for irrigation and navigation. Water quality standards were met during some critical low flow periods because of these storage releases for other uses.

The State also requires compliance with water quality standards by waste treatment at the source. State pollution authorities regarded the flow augmentation as a supplement to and not a substitute for waste treatment. Compliance with water quality standards in the Willamette thus depends on both waste treatment, and flow releases, since no practicable amount of flow released from existing reservoirs would assure compliance with standards. Furthermore, costs of treatment would be greatly increased without augmentation.

Minimum Flow Requirements

Water quality standards are established to achieve the goal in Section 101(a)(2) of the Clean Water Act, which is a level of water quality that provides for the protection and propagation of fish, shellfish, and wildlife, and provides for recreation in and on the water. Clearly, some minimum flow will be necessary

to attain these goals, where they are attainable. Minimum stream flows in water quality standards thus not only serve as the basis of waste treatment requirements, minimum flows may be necessary in themselves to meet the goals of the Act.

As discussed earlier, the flow level generally included in water quality standards is the 7Q10, or some other flow that represents a drought level. This flow is the level at which wasteload allocations are established. Water quality standards do not generally require that flows be maintained at any particular level. Thus, flow levels in water quality standards are not necessarily based on the amount of water actually needed to protect instream use.

The amount of water necessary to maintain, for example, an adequate aquatic habitat will vary with the location and the species involved. Factors include the ability of the stream to cleanse the bed of deposited silts; velocity; depth; channel characteristics; temperatures; supportive species of vegetation; and the rate of change of the flow level within the channel.

EPA does not require that standards include flow criteria to protect the use included in the standards although States have the authority to establish such criteria. In June 1978, EPA published an advanced notice of proposed rule-making that raised the possibility of a change in this policy, while ruling out the option of promulgating flow criteria when the States choose not to do so.

As the earlier discussion of waste treatment requirements indicates, State water allocation laws may not always be hospitable to instream flow maintenance.

Interpretations of beneficial use and diversion requirements may prevent instream appropriations. On the other hand, many State water laws are compatible with instream flow and a number of States have programs for protecting instream flow. In any case, the decision between instream and offstream uses is primarily the States' responsibility. The water quality standards setting process is potentially useful for identifying stream segments where instream flow protection is feasible.

Water Quality Management Planning

The Clean Water Act established several planning programs, which EPA has consolidated to a large extent under the title of Water Quality Management planning. These potentially provide a vehicle for identifying and resolving quality/quantity conflicts. Studies conducted for EPA indicate that, while WQM planning has been useful in identifying problems, it has not generally been as helpful in resolving them.

A number of 208 agencies addressed problems with water quality standards violations attributable to flow depletion. In one case, 208 studies led to water quality standards revisions and relaxation of permit requirements for municipalities, resulting in cost savings in waste treatment. In another, the agency succeeded in obtaining conditions to protect flow levels from withdrawals. In both instances, 208 planning provided the vehicle for studying the conflict and developing solutions, but the actual resolution of the conflict required changes under other provisions of the Clean Water Act.

Historically, planning for water quality and planning for water resources have been conducted separately. This is due in part to fundamental differences in the objectives and methods of these programs.

Water quality management planning (see Chapter III) is designed to reduce pollution to protect both instream and offstream uses, while water resource plans have traditionally been oriented towards the economic benefits of water development, particularly irrigated agriculture, energy, navigation, flood control and recreation. Water quality management planning has been on an areawide or basin-wide basis, while water resource plans are generally prepared on a project-specific basis. Water quality management planning for waste treatment projects is conducted to determine the most cost-effective method of attaining water quality or technology based standards. Under the Water Resources Council's Principles and Standards, Federal water resource development projects must be justified on the basis of cost benefit analysis. Water quality management planning is primarily conducted by States, subject to EPA review and approval, while planning for water resource projects is conducted primarily by Federal agencies.

Level B studies under the Water Resources Planning Act are exceptions to these generalizations in some respects. They are conducted on a basin-wide basis, with substantial State and local involvement. Section 209 of the Clean Water Act requires the preparation of Level B plans for all basins by 1980 (See Chapter IV, for extensive discussion of Level B planning). Priority is to be given to basins which overlap with designated 208 planning areas. 35% of the nation has been subject to this planning process. Funds have not been appropriated under Section 209.

Dredged or Fill Permit Program

A holder of water rights under State law may find it necessary to construct impoundments and diversions works in order to make use of water to which the user is entitled. The construction may, in some instances, be prevented or regulated by the permitting requirements of Section 404 of the Clean Water Act. Section 404 requires permits for discharges for dredged and fill material, with some limited exceptions. This amounts to a requirement for a permit where a hydrologic modification is involved, and in many situations where a structure is put into a stream to divert water.

The Corps of Engineers is authorized in several places to require the maintenance of minimum stream flows as conditions of these permits.

EPA's guidelines for evaluation of proposed discharges of dredged and fill material (CWA 404 (b)(1)) include the following objectives:

> Avoid discharge of activities that significantly disrupt the chemical, physical, and biological integrity of the ecosystem of which . . . the normal fluctuations of water level are integral components. !40 CFR 230.5(a)(1)1

The regulations governing issuance of dredged or fill permits by the Corps of Engineers provide for conditioning of permits to comply with the Fish and Wildlife Coordination Act (33 CFR 320.4(c)). These regulations also provide that any permit issued may be conditioned to implement water quality protection measures (33 CFR 320.4(d)).

These regulations will soon be revised to implement the 1977 amendments to the Clean Water Act.

Consumptive Wastewater Treatment and Regionalization

Effluent guidelines for waste treatment for some industrial sub-categories require zero discharge of pollutants. Land disposal may be the most practicable method for complying with this requirement and zero discharge must also be considered in planning for publicly owned treatment works. In some cases these requirements may interfere with the water rights of downstream users, since land disposal might deplete flows below levels necessary to protect downstream uses.

Regionalization involves replacing several small treatment plants that discharge treated wastes to upstream points or smaller tributaries with a large centralized plant discharging to a downstream point on a bay or stream. It is usually undertaken for reasons of cost effectiveness. It may result in severe reduction of instream flow below the original point of discharge. These problems differ from the others discussed in this chapter, because Clean Water Act programs may be in conflict with instream flow maintenance, rather than dependent on instream flow maintenance. Problems with consumptive waste treatment are discussed in more detail in Chapter VII.

CONCLUSIONS

Water allocation and water quality programs have been involved in conflicts over maintenance of instream flow levels, in the face of demands for offstream uses of water for agricultural, industrial, municipal and other uses.

- State water law and water rights may be in conflict with pollution control requirements based on water quality standards. Limitations on discharges of pollutants are frequently determined on the basis of minimum stream flows included in water quality standards. When flow levels are reduced below these minimums, treatment requirements are no longer adequate to protect the standards. In many circumstances, the only alternatives for maintaining or achieving the water quality standards may be increased levels of treatment for existing and future dischargers, flow augmentation, or limitations on withdrawals. In some circumstances, restrictions on discharges may result in conflicts with State allocation systems.

- Depleted flows may reduce water quality to such an extent that both offstream uses, like agriculture and municipal water supply, and instream uses, like fishing and recreation, may be impaired.

- Conflicts over maintenance of instream flows may result from applications for permits for discharges of dredged or fill material under Section 404 of the Clean Water Act. Minimum stream flows may be based on a number of authorities in addition to water quality standards.

- Four options are available to address water quality problems relating to reduced stream flows: 1) increased treatment levels; 2) limiting diversions and consumptive uses; 3) augmenting stream flows and 4) relaxing water quality standards.

- Instream uses are often not recognized in prior appropriation States as beneficial uses upon which appropriations can be made.

- Some prior appropriation States require a physical diversion to perfect an appropriation; instream uses do not entail physical diversion.

- Federal water development projects may impact the amount of water available through scheduling of releases.

- Often existing projects can not be depended on to provide instream flow levels for water quality purposes because it is outside the scope of their authorization.

- Consumptive waste treatment requirements and regionalization of sewer systems to comply with the Clean Water Act may lead to reduction in instream flow levels.

CHAPTER VI

IRRIGATED AGRICULTURE

Control of nonpoint source pollution from irrigated agriculture is a politically sensitive issue, especially because irrigated agriculture is central to the economy of many States, and especially those in the west where water is scarce. Thus, mandatory land management practices to reduce nonpoint source pollution generally have not been required by the States pursuant to the CWA and are unlikely to be required on a large scale basis in the foreseeable future. However, the absence of regulatory programs means that voluntary programs must be developed to meet the goals of the CWA in Section 101, the nonpoint source control requirements in Section 208, and to attain and maintain applicable water quality standards. The relationship between State and Federal allocation systems as they address irrigated agriculture and CWA requirements is less one of head-on conflict than of a failure of each system to accommodate the needs of the other.

Implementation of CWA requirements as they relate to irrigated agriculture may be costly and would require some irrigators to change the way they have been managing their land. The results in terms of cleaner water for other users on the stream, including other irrigators, and increased water made available for others through more efficient irrigation practices provide important environmental and economic reasons to make the changes. However, the willingness of irrigators to make changes will depend on the extent to which the Federal government implements policies regarding both water quality and quantity management which are supportive of needed change. The State allocation systems also will have to be flexible enough to accommodate to such change.

Water quality problems associated with irrigated agriculture include both those directly and immediately caused by the practice of irrigated agriculture (i.e., the discharge and concentration of pollutants caused by irrigation itself) and those indirectly caused by irrigated agriculture, such as overdraft of aquifers resulting in saline intrusion and overdraft of surface waters creating problems with the adequate treatment of wastes from other types of sources. Inasmuch as the indirect effects are discussed in other sections of this report, this chapter considers only direct effects with specific references to salinity, fertilizers, and sediments. This chapter will describe the water quality and quantity problems associated with irrigated agriculture, describe the Clean Water Act requirements, basic tenets of State allocation systems and the role of the Federal government.

GENERAL PROBLEM DESCRIPTION

Irrigation can have a significant effect in modifying the natural environment. In many cases, the use of water for irrigation purposes may cause degradation of ground and surface water quality by increasing pollutant content, depleting streamflow, and/or over-drafting ground water basins. In 1975, according to the Water Resources Council Second National Water Assessment, water withdrawals for irrigated agriculture comprised 158.7 of the 398.2 billion gallons of water per day withdrawn from surface and ground sources in the United States. Although irrigation accounts for only 40 percent of this total quantity withdrawn, it consumes over 83 percent of the amount of fresh water consumed in the United States. "Consumed" water is no longer available because it has been evaporated, transpired, incorporated into crops or products, consumed by animals or people,

and otherwise removed from the immediate surface-ground water system. In the 17 western States, irrigated agriculture is the major diverter (74%) of water from streams as well as the principal consumer (91%) of both ground and surface water supplies.

Irrigation in the humid areas of the United States is a relatively recent development. These areas include 31 eastern States, Hawaii, Alaska, and the Caribbean area. As approximately 78 percent of the 8.5 million acres of land under irrigation in humid areas is in the coastal regions of the States and the lower Mississippi Valley, irrigation contributes to the intrusion of saline waters which has degraded the quality of surface and ground water bodies in several areas. Return flows from irrigation also have caused significant fertilizer, pesticide, and sediment loadings in various receiving waters. The potential for pollution problems will increase as irrigation increases in humid areas.

POLLUTION FROM IRRIGATED AGRICULTURE

There are three general types of pollutants associated with irrigated agriculture which Sections 208 and 303(e) seek to address: salinity or total dissolved solids, fertilizers, and sediments.

Salinity or Total Dissolved Solids

The term "salinity" is commonly used to refer to the presence in water of a large variety of dissolved materials, or "salts" (typically sulfate, chloride, or bicarbonate of calcium, magnesium, or sodium).

Salinity is the result of two basic processes: salt-loading and salt-concentrating. Salt-loading is the addition of mineral salts from various natural and man-made sources which increases the total salt burden of the river. Salt-concentrating is caused by consumptive uses, evaporation, channel leakage, and other losses of water which concentrate the salt in a smaller volume of the river.

The degradation of water quality by increasing salinity has significant impacts on other uses--principally on municipal, industrial and subsequent agricultural use. When such uses are designated in Water Quality Standards they are protected under Section 303(c)(2) of the CWA.

From a public water supply perspective, the concern relates to the palatability of drinking water and potential health impacts of excessively saline drinking water on people on low sodium diets and those with heart disease. In addition, the corrosive effect of salinity on piping and appliances can be extremely costly. Excessive salinity may cause municipalities to incur high costs by importing less saline water for public use.

Certain industries, such as pharmaceuticals, food processing, textile manufacturing, and laundering are particularly sensitive to specific dissolved elements in water.

Agriculture bears a major economic impact because of increased salinity which may decrease crop production because certain crops are affected by salinity or because it may damage certain soils. For example, clay soils

affected by salts with a high sodium ion content may form "black alkali", which is impermeable and a poor crop producer.

Although, the environmental effects of excessive salinity are less well identified than the impacts on subsequent beneficial uses just described, it is known that the spawning of certain fish species may be impaired by salinities in the range of 5000 mg/l or less.

Agricultural Fertilizers

Agricultural fertilizers contain large quantities of nitrogenous and phosphorous compounds which may enter the surface or ground water through percolation, runoff or return flows. These compounds are not biodegradable and go through various biochemical changes which leave them available for use within the stream's ecological system. When introduced into a stream in excessive quantities, these nutrients can produce eutrophication and certain harmful health effects, especially those caused by nitrates in drinking water.

Although application ratios for agricultural fertilizers are decreasing, they are still often higher than desirable. There are several reasons for high application rates: (1) the unpredictability of the occurrence of heavy rainfall, (2) a lack of certainty as to the amount which must practically be applied, and (3) the necessity to maintain an adequate residual supply in the fields, after leaching to the ground water and runoff losses to surface streams.

Sediments

Sediment is the largest single nonpoint source pollutant. The practice of irrigated agriculture, like all other crop agriculture, may result in erosion of sediments in varying degrees from the fields -- a large portion of which eventually reaches streams to become excess loads. Natural sediment loads are essential to maintaining a stream's regimen. Unfortunately, excess sediment contributions from all sources not only create turbidity problems in streams but, in more quiescent reaches, may settle in great quantity, occluding the bottom to the point where some forms of bottom life cannot exist.

This soil erosion and consequent creation of excess sediment loads may also lead to chemical pollution of the streams. A significant portion of agricultural chemicals actually reaches the streams adsorbed to and transported by soil particles.

CLEAN WATER ACT REQUIREMENTS RELATED TO IRRIGATED AGRICULTURE

Section 208 provides the basis for control of nonpoint sources of pollution. Because of the diffuse nature of nonpoint sources and the cost of applying treatment measures, the accepted approach for controlling them is through the application of preventative practices known as Best Management Practices (BMPs). In the case of irrigated agriculture, which was defined as a nonpoint source in the 1977 Clean Water Act, an EPA recommended BMP calls for increased irrigation efficiency to reduce the amount of water applied to land and thus reduce the amount of runoff and return flow which carry pollutants to the stream. Appendix D contains a more detailed discussion of the suggested increased irrigation

efficiency BMP (which concerns only the amount of water required for plant growth vs. the amount supplied, and does not include economic considerations). In Section 208(b)(2)(F) the Act requires that water quality management plans include "a process to (i) identify, if appropriate, agriculturally. . related nonpoint sources of pollution, including return flows from irrigated agriculture and their cumulative effect. . . and set forth procedures and methods for their control to the extent feasible." Prior to 1977, irrigation return flows had been judicially interpreted as point sources and thus were subject to the NPDES permit system.

Implementation of the irrigated agriculture BMP may be costly, although some funding will be available under the Rural Clean Water Program. However, treatment alternatives such as de-salting plants may well be more costly in the long run due to capital, operating, and energy costs. One of the major issues being raised concerns who should bear the cost - the irrigators or all Federal taxpayers. This question has been asked in regard to the recent request to Congress for additional funds ($83 million) to build a large de-salting plant in Arizona authorized by Congress five years ago (for $62 million) to meet water quality commitments made in a treaty with Mexico for the Colorado River. Total project costs are projected to be $1 billion. The director of the Agriculture Department's salinity laboratory believes that irrigation management and social solutions will solve the problem. However, the manager of the Wellton-Mohawk Irrigation District feels it is the Federal government's obligation, and not that of irrigators at the bottom of the pool, to meet the Treaty obligations, especially since farmers along 1400 miles of the Colorado are contributing to the severe

salinity problem in the Colorado River near Mexico. The salinity laboratory director indicated that recent improvements in irrigation technology, including use of laser beams to level fields, have resulted in the same amount of irrigation water doing three times the work. However, political problems often militate for the treatment approach.

Section 303 of the Clean Water Act requires States to adopt water quality standards. The standards identify the uses of navigable waters and establish water quality criteria based on these uses. Specifically, Section 303(c)(2) requires that standards take into consideration the water's use and value for "public water supplies, propagation of fish and wildfish, recreational purposes, and agricultural, and other purposes. . ." Generally, the States have established narrative criteria for nonpoint source pollutants but have developed few numerical criteria for the nonpoint source related pollutants which will be discussed on the following pages (salinity, nitrates, phosphorus, and sediment). However, the directive in 303(c)(2) that the standards shall protect existing agricultural and other uses, along with the directives in Section 208, provide a firm basis for control of pollution from irrigated agriculture.

IRRIGATED AGRICULTURE AND STATE WATER QUALITY ALLOCATION LAW

The quantity, and consequently, the quality of water in irrigation return flows is tied closely to the water rights system, especially in the western States where irrigation is most common. All of the western States allocate water under the doctrine of prior appropriation, although a few, notably California, have a mixed riparian-appropriative system. The eastern States operate under either a pure riparian system or a statutorily modified permit system. See Chapter IV for a more detailed discussion of State allocation systems.

Riparian States

Under the riparian system it is generally required that water be put to a reasonable use, and be returned to the stream with quality adequate to meet the requirements of downstream uses. This requirement in theory limits waste of water and water pollution when they interfere with the rights of another riparian user. Riparian water rights are not lost through non-use. Thus, a user is not penalized with partial loss of his water right if he adopts more efficient water use practices. As is the case with the requirements for instream flow levels, the riparian doctrine is in theory supportive of efficient irrigation practices which will lead to improved water quality in irrigation return flows. However, because the riparian States generally lack an administrative structure for conflict resolution, the reasonable use concept is enforced only through costly and time-consuming private litigation. Riparian States which have instituted permit systems have, to varying degrees, remedied some of the potential problems in traditional riparian jurisdictions through such concepts as time-limited permits, conditions in permits, and reporting requirements. However, these statutory permit systems do little to address the conflict resolution problem.

Prior Appropriation System

The right to water under prior appropriation systems is a right of use rather than a right of ownership of the body of the water itself. Prior to diversion the water is still a public resource, and, if the right holder cannot put it to beneficial use, he must allow it to flow past his point of diversion to other appropriators. When he diverts the water which has been appropriated

to him for a beneficial use, the water is his personal property until it returns to the stream or escapes his control. Following is a discussion of several elements of appropriative legal systems relating to irrigated agriculture which may impact water quality requirements under the Clean Water Act. These include: quantity of water appropriated; loss of water rights; restrictions on transfers; conserved, salvaged, and developed waters; rights and duties of return flows; and rights to a given quality of water.

Quantity of Water Appropriated

Beneficial use is the basis, limit, and measure of an appropriative water right. This means that water must be used for a beneficial purpose and the use of the water itself must be beneficial and carried out in a beneficial manner. The criteria for determining when a use is wasteful differ in the various States.

In addition to the general definition of beneficial use, appropriative States have employed three approaches to determining the specific amount of water which can be used beneficially. One approach has been to establish statutory limitations on the quantity of water that may be used per acre of land devoted to agriculture under irrigation (e.g., Wyoming). The statutory standards reflect the irrigation practices of the period of their enactment and do not reflect quantities of water needed if more efficient irrigation practices were to be used.

The "duty of water" defines a reasonable quantity for beneficial uses -- the extent to which and the manner in which the water should be used by the appropriator. The Colorado court in Farmers Highline Canal and Reservoir Co. v. Golden, 129 Colo. 575, 270 P. 2d 629, (1954), said the statutory duty of

water is "that measure of water, which by careful management and use, without wastage, is reasonably required to be applied to any given tract of land for such a period of time as may be adequate to produce therefrom a maximum amount of such crops as ordinarily are grown thereon." The majority of States incorporate this concept into their determination of the amount to be granted to a water right applicant. Several States have quantified the amount, although little uniformity exists in the numbers used.

A second approach is exemplified by California, which applies the concept of "common custom" as one method for determining when a use is wasteful. Under the concept of "common custom" an appropriator need not take extraordinary precautions to prevent waste if a use is reasonable according to the customs of the community and so long as the custom does not involve "unnecessary waste" of water. In other words, if the local custom of irrigators in an area is to follow irrigation practices of eighty years ago, the practice is not wasteful even if the practice requires twice as much water as would be needed if more efficient practices were followed. "Unnecessary waste" would be practices which would have been considered wasteful eighty years ago, i.e., grossly wasteful techniques. Thus, there is a wide divergence between the theory of requiring beneficial use and the practice of tolerating relatively inefficient irrigation practices.

A third approach is to provide criteria in directives to administrators. This approach has the advantage of not requiring statutory revision as the efficiency of irrigation technology improves. In Nevada the State Engineer is to consider the duties of water established by court decrees or by experimentation in the area where water is to be used. He is also instructed to consider the growing season, type of culture, and reasonable transporation losses.

New Mexico law instructs the State Engineer not to allow the diversion of more water for irrigation than can be used consistently with good agricultural practices to produce the most effective use of water. In Washington the law provides that an appropriator will be provided that quantity of water reasonably necessary to irrigate his land, but his irrigation is to be accomplished by the most economical method of artificial irrigation according to the methods employed in the vicinity where the land is situated. The court determines the most economical method.

Loss of Water Rights

As the Montana Supreme Court said in 1924 in the case of Allen v. Patrick, 222 Pac. 451, "In Montana, as elsewhere, when the early settlers made their original appropriations they had little knowledge of the quantity of water necessary to irrigate their lands to good advantage. Ample quantities of water being available in the streams the settlers claimed extravagant amounts." Of course, as settlement proceeded and knowledge advanced, many landowners realized that the use of excessive quantities of water was detrimental rather than beneficial to the land. However, to some degree the attitude of getting and using as much water as one can has persisted, and to the extent that it persists, it can act as a deterrent to implementation of more water efficient irrigation practices.

Enforcement of the concept of "waste" by the States has been limited, reducing the incentive for efficient water use in irrigated agriculture. An additional disincentive to more efficient water use is the concept of "use it or lose it,"

under which water made available under a water right will be lost to the right-holder either through abandonment or forfeiture if it is not used. Water which is conserved or saved through more efficient practices often is not made available to the conserver but is left in the stream to satisfy junior appropriations. Since the conserver, under the allocation law in some States, may not be able to apply the "saved" water to other lands or sell it, there is little economic incentive to conserve water through more efficient but costly irrigation practices.

Restrictions on Transfers

In all western States when a water right is granted for irrigation use, that right attaches to or is appurtenant to the land(s) described in the permit. This means the water cannot be used elsewhere without approval of the State permitting agency (or Water Court in Colorado). This stems from attempts by the States at the turn of the century to prevent some of the fraudulent land and water sale practices that had gone on under earlier Federal settlement schemes in the West. However, many variations exist as to the restrictions on transfer of water rights. In most States water rights' transfers only require State agency approval when proper measures and adjustments are made to prevent impairment of other users' rights. In a minority of other States the appurtenancy rule is more restrictive. The transfer can be approved for uses other than irrigation only if it becomes impracticable to use the water economically or beneficially on the original lands. This is a virtual prohibition on transfers. States with strict provisions on transfer are Oklahoma, Oregon, Nebraska, and South Dakota.

The restriction on transfers of water for use on other land or by other users, coupled with the loss of water rights if water is saved by conservation, creates a powerful disincentive to more efficient water use.

Typical is the decision in Salt River Valley Water Users Association v. Kovacovich, 411 P.2d 201 (Ariz., 1966). In that case, the Court had to decide whether a landowner having a valid water right may, through water saving practices, apply the water thus saved to immediately adjacent lands in his ownership. The Court held against the landowner in saying that such saved or salvaged waters inure to the benefit of other water users.

Conserved, Salvaged, and Developed Waters

The Kovacovich case highlights the legal distinctions between conserved water, salvaged water, and developed water. Salvaged water is water that would have otherwise been lost to the water supply system and not be available for use by others if it had not been salvaged by artificial improvements. Developed water is new water which prior to its development was not a part of the water supply, such as water from another watershed. The person who salvages or develops the water has the right to use that water. Unfortunately, the courts have not carefully distinguished between water conservation practices and water salvage practices, which can serve to deter implementation of more efficient irrigation practices.

Rights and Duties of Return Flows

Relevant to this discussion are the rights and duties of return flows. Since water rights are granted on return flows, the courts have generally held that junior appropriators can rely on these return flows and have protected

their rights in this source. Also, as a general rule irrigation districts can recapture flows before they leave their boundaries and reuse these waters (Ide v. United States, 263 U.S. 297, 1924). This rule normally does not extend to individuals, as return flows are considered by the Court to be nonconsumptive uses of water that returns to the stream from the proper and beneficial application of water. This rule allows for individual reuse of waste water on the user's property. Some jurisdictions have stated that a downstream user can appropriate waste water but cannot compel the person committing the waste to continue to discharge, nor prevent him from adopting improved practices that eliminate the waste.

Rights to a Given Quality of Water

Recently the Colorado Supreme Court decided a case which exemplifies one type of conflict which can arise between nonpoint source pollution control requirements and the water allocation system. In United States v. Bessemer Irrigation Ditch Co., the United States Court of Claims was faced with deciding whether an appropriator has a vested right to water of a given quality, including the impurities contained therein. The issue arose because the Bureau of Reclamation constructed a dam project on the Arkansas River which destroyed a portion of an irrigation ditch belonging to Bessemer. As compensation the Bureau proposed to deliver water directly from the reservoir to the irrigation company to satisfy its water right. The company objected on the ground that the water it historically diverted had a high silt content which helped seal the ditch and made the water easier to spread on the land. The effect of having cleaner water supplied

was that the irrigation company could only irrigate half the land it had historically irrigated because of increased seepage losses and reduced irrigative capacity. The U.S. Court Claims held for the irrigation company on the basis that an appropriator has a right to rely on a certain quality of water. In August 1978, in response to a question certified to it by the U.S. Court of Claims (under the title A.B. Cattle Co. v United States), the U.S. Court of Claim's decision was upheld on the basis that the company's rights were impaired because of the reduction in acreage which it could irrigated. However, on December 13, 1978 the Colorado Supreme Court issued its decision on rehearing and reversed itself, holding that water users are not entitled to silty water. However, the Court refused to render an opinion as to whether the appropriator's right to receive water containing silt is abrogated by State or Federal water quality statutes. Irrigators using water from the Bureau of Reclamation dam at Guernsey, Wyoming are raising similar questions regarding the right to receive silty waters and it can be anticipated that the question will arise in other areas as nonpoint source control programs are implemented.

Federal Water Resource Programs

While Federal agencies do not directly allocate quantities of water to water rights holders, they impact the amount, timing, and location of water available for allocation for irrigated agriculture through Federal water projects. These agencies may be said to indirectly allocate water by deciding the total amount or percentage available for a given project purpose (e.g., irrigation, power) when planning and seeking Congressional authorization of the project. Further, the location of a project on a stream will affect the amount of water available for particular uses, as will the timing of releases.

The Bureau of Reclamation and the Soil Conservation Service are the Federal agencies primarily involved in water development projects for irrigation. The Bureau's activities have a greater impact, since the SCS is limited to the development of small watersheds.

As mentioned in the chapter on Instream Flow Maintenance (Chapter V) and in the discussion of Federal/State relationships in Chapter IV, the State is responsible for allocating water developed by Federal projects and controls the extent to which that water is left in the stream to reduce concentrations of pollutants and to insure minimum flows for fish. The Federal government must obtain both flow rights and storage rights from the States. Such rights, especially in newer projects, are usually junior water rights and therefore cannot be used to maintain flow levels for environmental purposes.

Federal and State water resource programs have provided substantial benefits to the Nation. When they were initiated, the emphasis of the programs was on resource development. To this end, the water marketing policies of the Federal water development agencies have provided substantial subsidies to users. Federal water projects provide about 20% of the water used for western irrigation. The project costs allocated to irrigation water supply are required by law to be scaled to the estimated ability to pay of the prospective users. A major additional subsidy arises through the fact that the irrigation costs are repaid interest-free over a period of up to 60 years, equivalent to an 80 percent subsidy under current conditions. On multi-purpose projects, water used to generate power may also be used to irrigate; however, if power generation is the primary use, the power account will be charged rather than the irrigation acount.

While it is possible and in fact encouraged by the President's water policy to negotiate water use contracts which better reflect the value of water and provide flexibility for future price changes for new projects, there is less flexibility in renegotiating old, long term contracts. On existing projects, the desired effect of increasing irrigation efficiency can be brought about in other ways. In particular, by making the rights to project water supplies more readily transferable, the real value of water would be brought home to irrigators. The press of events may encourage change in this direction. During the California drought of 1975, for example, the Bureau of Reclamation made a start toward acting as a middleman in the temporary transfer of water supplies from users with surpluses to those with urgent needs. Complementary State actions, such as a bill before the Idaho legislature (House Bill No. 165), providing for a State water supply bank, and any other steps toward facilitating the transferability of project supplies encourage irrigators to evaluate their practices in terms of the value of water and, in particular, encourage the adoption of water-conserving techniques.

Conclusions

- o CWA requirements related to or affecting irrigated agriculture require control of nonpoint source pollutants through BMP's (Section 208). These BMP's should protect various uses, including agriculture, identified in the Water Quality Standards (Section 303(c)(2) and (e)). The suggested BMP generally involves more efficient application of irrigation water, resulting in fewer pollutants reaching the stream or ground water through leaching, run-off, and return flows.

- o Implementation of CWA requirements for nonpoint sources may result in economic hardship and loss of valuable water rights.

- o Large scale implementation of increased efficiency BMP's may be costly and is unlikely to occur unless the State allocation system and associated Federal programs provide incentives (or fail to provide disincentives) to their implementation.

- o Federal policy, as expressed through the Federal subsidy of the cost of water, has resulted in increased agricultural development in water-short areas but has failed to provide an incentive to use irrigation water more efficiently so as to protect water quality.

- o While riparian systems are theoretically supportive of nonpoint source controls through implementation of increased efficiency BMP's because water is not lost through non-use and waste is discouraged, the lack of an administrative structure to resolve conflicts may make such a requirement difficult to enforce through the allocation system.

- o The prohibition against "waste" in prior appropriation States provides a vehicle to ensure implementation of water quality requirements for more efficient water use.

- o Lack of clear definition of the amount of water which can be beneficially used, outdated criteria to determine the "duty of water" and cumbersome procedures to revise these criteria restrict the prior appropriation States' ability to enforce prohibitions against "waste" and enforce water quality requirements entailing efficient use of water through the allocation system.

- o The potential loss of valuable water rights in prior appropriation States through non-use may be a disincentive to implementation of more efficient irrigation technologies.

- o Limitations on transferability of water rights to other uses may serve as an economic disincentive to implementation of more water efficient practices.

- o The lack of clear distinction, in some prior appropriation States, among conserved, saved, and developed waters has led to confusion as to the impacts of using more efficient irrigation practices.

CHAPTER VII

CONSUMPTIVE WASTE TREATMENT TECHNOLOGIES

INTRODUCTION

Attainment of the 1983 interim national goal for the reduction of pollutants into navigable waters will require stringent levels of waste treatment. In some circumstances, the only feasible method of meeting nationally mandated best practicable waste treatment technology level for publicly owned treatment works (POTWs), best available treatment levels (BAT) or best conventional pollution control technologies required for industrial dischargers is the disposal or retention of part or all of the waste stream on land or in containment. More stringent limitations necessary to meet water quality standards may also require consumptive waste water treatment. Approximately 50 percent or 8918 of the nation's POTWs now discharge into water quality limited segments (waters requiring treatment more stringent than secondary (municipalities) and Best Available Technology (industry)).

Current technological solutions for POTW pollutant discharge reductions and for treatment of industrial discharges include advanced secondary treatment (that is, treatment resulting in effluents containing less than 30 mg/l of biochemical oxygen demand and suspended solids for POTW's); advanced waste water treatment; deep well injection; disposal on land; and reuse or recycling.

When water is withdrawn from surface or underground sources and not returned after use, i.e., lost through evaporation, transpiration, or other processes, such a use is classified as consumptive. Consumptive waste treatment may diminish the amount of water available for instream and offstream users who may be entitled to this water under State allocation systems. As the data in Table 1 indicate, although the Water Resources Council's projections indicate a decline in

Table I.

Total withdrawals and consumption, by functional use, for the 21 water resources regions—"1975," 1985, 2000

[million gallons per day]

Functional use	Total withdrawals			Total consumption		
	"1975"	1985	2000	"1975"	1985	2000
Fresh water:						
Domestic:						
Central (municipal)	21,164	23,983	27,918	4,976	5,665	6,638
Noncentral (rural)	2,092	2,320	2,400	1,292	1,408	1,436
Commercial	5,530	6,048	6,732	1,109	1,216	1,369
Manufacturing	51,222	23,687	19,669	6,059	8,903	14,699
Agriculture:						
Irrigation	158,743	166,252	153,846	86,391	92,820	92,506
Livestock	1,912	2,233	2,551	1,912	2,233	2,551
Steam electric generation	88,916	94,858	79,492	1,419	4,062	10,541
Minerals industry	7,055	8,832	11,328	2,196	2,777	3,609
Public lands and others[1]	1,866	2,162	2,461	1,236	1,461	1,731
Total fresh water	338,500	330,375	306,397	106,590	120,545	135,080
Saline water,[2] total	59,737	91,236	118,815			
Total withdrawals	398,237	421,611	425,212			

[1] Includes water for fish hatcheries and miscellaneous uses.

[2] Saline water is used mainly in manufacturing and steam electric generation.

Source: U.S. Water Resources Council, Second National Water Assessment, Summmary, 1978

total fresh water withdrawals between now and the year 2000, a significant increase in consumptive use is projected for the same period, probably primarily due to increases in users with some increased consumption by existing users.

However, there are currently few specific examples of conflicts between State water allocation systems and municipal/industrial consumptive waste treatment technologies required for water quality purposes. Yet in several circumstances, there is potential for conflict. This Chapter examines areas where the potential for conflict is greatest.

Clean Water Act Requirements

Many waste treatment techniques encouraged or required by the Clean Water Act may involve consumption of all or a portion of the waste water, rather than its discharge to the navigable waters.

- Section 201(g) requires that construction grant recipients study and evaluate innovative and alternative wastewater treatment processes which provide for reclaiming and reuse of water, otherwise eliminating the discharge of pollutants, and utilizing recycling techniques, land application, new or improved methods of waste treatment management for municipal and industrial waste, and the confined disposal of pollutants.

- Effluent guidelines established for point sources under sections 301 and 304 of the Act may require elimination of the discharge of pollutants for some categories of industries.

- Section 316(a) provides the authority to impose effluent limitations for thermal discharge from a point source; and section 316(b) requires that the location, design, construction, and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impacts.

- Section 208 requires States and areawide agencies to develop best management practices (BMPs) to control nonpoint sources of pollution. BMP's for irrigated agriculture often involve the more efficient (i.e., reduced volume) application of water.
- Section 101(a) of the Clean Water Act established the national goal that the discharge of pollutants into navigable waters be eliminated by 1985. Land application or other consumptive techniques are important alternatives for addressing the discharge goal.

LAND APPLICATION SYSTEMS

For conventional municipal and industrial wastes (those creating oxygen demands in receiving waters and composed primarily of organic suspended solids), land application systems provide excellent treatment, as shown in Table 2.

The application of waste water is attractive for several reasons:

(1) The soil column and surficial materials often act as an excellent filter for nutrients and some heavy metals.

(2) It presents a positive (and sometimes cheaper) alternative to advanced waste treatment and surface water discharge.

(3) It can result in economic return on sale of crops.

(4) It can be incorporated as part of a water conservation and reuse program where, from a given use, the treated effluent may replace the need for an existing high quality withdrawal.

(5) Land application often will actually remove more pollution than a permit requires. This additional removal reduces the burden on other discharges.

TABLE 2

COMPARISON OF AVERAGE EFFLUENT QUALITY FOR SECONDARY TREATMENT, ADVANCED WASTEWATER TREATMENT AND LAND TREATMENT

System	EFFLUENT QUALITY PARAMETER, mg/l					
	Biological Oxygen Demand (BOD)	Suspended Solids SS	NH_3-N	NO_3-N	Total N	P
Secondary	30	30	--	--	--	--
Aerated Lagoon	35	40	10	20	30	8
Activated Sludge	20	25	20	10	30	8
AWT-1	12	15	1	29	30	8
AWT-2	15	15	--	--	3	8
AWT-3	5	5	20	10	30	0.5
AWT-4	5	5	--	--	3	0.5
Slow Rate Land	1	1	0.5	2.5	3	0.1
Rapid Rate Land	5	1	--	10	10	2
Overland Flow	5	5	0.5	2.5	3	5

(6) Land application is only a new consumptive loss when it is applied to land not presently being irrigated.

Wastewater is generally used for irrigation of non-food crops, e.g., pasture. When wastewater is used to irrigate food crops, it is only used for those that do not come in direct contact with irrigation water, such as tree crops.

Land treatment may provide the only effective means to provide or protect desired water quality in some situations, and in numerous others it may be the most cost-effective. For small communities with population less than 10,000 or 20,000 and for many industrial plants, these processes may be the only economically feasible means of meeting the goals and requirements of the Clean Water Act.

There may be diseconomies of scale in land application; for larger municipalities it would generally require either longer conveyance facilities or the use of higher cost land, as compared to smaller communities. In addition, the cost of land application can vary from place to place because of differences in the value of the land and of the water consumed. There also may be objection to taking land for effluent application out of private ownership and placing it in public ownership, thus taking it off local tax rolls (although this is often unnecessary).

Publicly Owned Treatment Works

Under section 201(g)(5) of the CWA, construction grant recipients are required to analyze innovative and alternative treatment processes and techniques for use in wastewater treatment works. Alternative practices are those that have been proven through actual use; innovative practices have not been fully proven. Innovative and alternative technologies include process redesign, land application and total containment. The Act provides an incentive in the

form of Federal grants for 85 percent of allowable construction costs for treatment works using innovative and alternative technologies (rather than 75 percent for conventional systems). In order to further encourage the use of these technologies the cost-effective guidelines permit a 15 percent cost preference and treatment works proposing to utilize them can be given higher priority for funding. The intent of the provisions regarding innovative and alternative technologies is to achieve greater reclamation and reuse. Innovative and alternative systems are desirable because they are simpler, often use less energy, recycle nutrients into the land, may be less expensive and have lower operating and maintenance costs than conventional systems.

Each proposal for waste water treatment facilities must undergo a cost-effectiveness analysis prior to funding. All costs are considered in the cost-effectiveness analysis including cost of purchase of water rights, off-set water, land costs, transportation costs and any damages which might be incurred. There is also a qualitative analysis which considers socio-economic and legal impacts. In general, such technologies will not meet the cost-effectiveness criteria if their implementation will violate State water law or will result in major socio-economic dislocations. EPA funding policy specifies that the costs of purchase of water rights, purchase of offset water and payment of damages are not eligible costs for Federal funding.

At the current time the system for cost-effectiveness analysis provides sufficient flexibility to address potential conflicts between implementation of innovative and alternative technologies and State water allocation law. The State/EPA Agreement is another vehicle available to address potential conflicts.

Water-Consumptive Industrial Requirements

Zero discharge of pollutants is the effluent guideline required for a number of industrial sub-categories, either under BPT (Best Practicable Technology, the standard for 1977 compliance), BAT (Best Available Technology, the standard for 1983 compliance) or BCT (Best Conventional Treatment, the 1983 standard for designated pollutants). Since guidelines for the last two headings are still in the process of development, the best data are for BPT, for which 118 out of 1138 industrial subcategories (10 percent) are required to achieve zero discharge of pollutants.

The rationale for zero discharge as a water pollution control regulation is cost-effectiveness in comparison with alternative discharge technologies and the availability and use of the technology to implement zero discharge by a specific industry. However, zero discharge does not necessarily result in greater consumptive losses because, in some instances, industry can redesign processes to recover and recycle pollutants or to reduce water usage.

EPA has not gone far beyond existing practice in its requirements for zero discharge. Zero discharge makes sense where the water and residuals have some value on land (as in food processing); where the pollutants are too hazardous to discharge, but not dangerous in containment (as in uranium and vanadium milling); where evaporation or seepage rates are high; and where the impact of water lost through land application or containment is not great. The number of subcategories requiring zero discharge is high in the following industries: inorganic chemicals; nonferrous metal manufacturing; glass manufacturing; grain milling; and sugar processing.

The twenty-two zero discharge industries consumed at maximum 1.4 percent of total water withdrawals in the U.S. (1,988 billion gallons a year (BGY) of 146,000 BGY in the U.S.). This percentage, however, can be much greater in specific geographic areas and have significant impacts on water use by depleting water sources and increasing in-stream pollutant levels.

The Colorado River Basin is a case in point. Water users in the Basin are withdrawing surface waters at a per capita rate of 20,000 gallons per day (gpd), a rate 50 times greater than in the New England and Mid-Atlantic Regions. Hence any consumptive withdrawal, such as is represented by water subject to zero discharge, has a greater impact on total availability of water than a diversionary withdrawal which permits water to be returned to the River after use.

Problems raised by water-consumptive pollution control requirements for industry have been most apparent in the case of the steam-electric generating industry. The power industry uses 80 percent of the total water used for all industrial cooling purposes. The problems in that industry fall into two categories--those related to water-consumptive techniques for cooling, and those for salinity control.

Thermal controls. Steam-electric plants generate large amounts of waste heat as part of the thermodynamic cycle. The industrial cooling process involves cooling the water by some technique and subsequently reusing the water or returning it to the source (lake or stream). Generally, the techniques are of two types:

(1) Once through or open-cycle cooling where water is diverted from the source (stream or lake), run through the condensors, and then either directly returned to the source or returned after cooling in a cooling pond.

(2) Closed cyle cooling where the cooling water is not returned to the source but is cooled (by either wet or dry cooling towers or by cooling lakes or ponds) and then recirculated through the condensors.

The closed-cycle techniques often involve considerable evaporation and therefore result in more consumptive use than once-through cooling.

Heated water discharged to surface waters can have an adverse effect on the ecosystem. Under the Clean Water Act, heat is defined as a pollutant, and effluent limitations were issued by the Agency in 1974 requiring in many cases the use of cooling towers as an abatement technique.

However, a number of utilities and the State of Texas sued EPA, in 1976, on the grounds that the benefits of the abatement requirements had not been demonstrated and that they involved excessive cost and water consumption. The Fourth Circuit, in Appalachian Power Company v. Train, 545 F.2d 1351 (1976), sustained the challenges to the regulations on a variety of grounds, emphasizing the consumptive use impacts of the 1974 thermal guidelines, particularly in the arid western States. The court disagreed with EPA's restrictions on the use of cooling lakes and remanded the guidelines to EPA for further consideration.

The use of cooling lakes and ponds still remains an issue. In water short areas, many plants have been built with lakes or ponds to store water over the year and to use as part of the cooling process--with water being recycled between the generating system and the reservoir. In such cases, water users have objected to requirements for evaporative cooling towers as being wasteful, so long as the cooling potential of the lakes is available. On the other hand, since many of the impoundments are on navigable rivers, EPA has been concerned with the environmental effects of the thermal loadings.

Currently, the issue is in a state of abeyance. The Agency is attempting to develop a national policy which will take account of environmental effects as well as deal with the matter of water scarcity, to meet the court's finding that EPA had not weighed the costs and benefits of thermal controls. In the meantime, in writing permits, EPA is proceeding on a case-by-case basis. For example, in States where thermal water quality standards exist for lakes, EPA thermal criteria are being used to develop effluent limitations for the plants.

Salinity control. In the Colorado River Basin, where salinity is a significant pollutant, the States, working through the Salinity Forum, have adopted a "no-salt-discharge" policy for industry. Under this policy, a plant, as a condition of its NPDES permit, is not allowed to discharge saline waste water to receiving waters, thus often forcing more consumptive treatment techniques which result in less return flows which can lead to increased instream concentrations of salinity.

A Salinity Forum has been established for the consideration of this issue. EPA and the Basin States have recently adopted guidelines on writing permits for industry which require submission of data on the cost of salt removal under the no-salt-discharge policy and which would require no salt discharge technique whenever practicable.*

Other industrial cases. Beet-sugar processing is another industry in which no-discharge requirements have become an issue. Most plants in the industry have adopted zero-discharge for the heavily polluted process water, which comes from beet washing and other operations. The main concern is with the Best Available Technology (BAT) requirement that large plants should also adopt zero discharge for the relatively clean condensing water. When the costs of land application are high, industry might adapt to the requirement by installing systems for recycling condensing water through the use of cooling towers and cooling lagoons. Therefore, the total costs of zero-discharge may be high in terms of the capital costs of the facilities in addition to the value of the water consumed.

State Water Allocation Systems

Following is a discussion of allocation law, at the State level, examining the likelihood of conflicts and areas where there is compatibility.**

*Colorado River Basin Salinity Control Forum, "Policy for Implementation of the Colorado River Salinity Standards through the NPDES Permit Program," February 28, 1977.

**See Appendix A for a discussion of a case which addresses Federal-State quality/quantity relationships.

Land Application Systems

Riparian States

The reasonable use rule is followed in most riparian States in determining the acceptability of a particular water use. Land application systems can have adverse effects on natural water courses by alteration of the flow of the water body into which the wastes would have been discharged in the absence of the land application system.

In general, riparian law has favorable implications for land application. Land application would ordinarily be irrigation, which is a reasonable use. In those riparian States which distinguish between consumptive and nonconsumptive uses, the application of wastes would probably be considered nonconsumptive and thus generally allowable, since it involves the diversion of wastes rather than the stream's natural flow. For intermittent streams, where effluent may make up the entire base flow, this distinction is less clear. Decisions regarding the reasonableness of a particular land application will, of course, be made on a case-by-case basis. Where a downstream landowner is affected by the loss of flow, he may challenge the operator of the land application system. While under the natural flow doctrine actual damages need not be proved, under the reasonable use theory they must be. There might also be challenges regarding drainage of trace pollutants.

Prior Appropriation States

In order to perfect a right to use water for land application, such a use must be considered beneficial. As a corollary, the use must not be wasteful. The prior appropriation doctrine applies only to waters, and not to wastes added to the water. In most prior appropriation States land application will be considered irrigation, which is a beneficial use and which has preference over most other uses except domestic use. However, the concept of priority will impose limitations on the quantity of water which can be consumptively used without paying compensation to other appropriators. A downstream appropriator might challenge a reduction of return flow upon which his appropriation is based under State law. The results will depend in part on the priority relationship of the parties and the preference placed (by the State) on either of the two appropriations. If the land application diversion is senior to the downstream appropriation, or if the land application diversion has a higher preference, a challenge is unlikely. Special preferences for municipalities are discussed below.

The viability of a land application system may also be affected by the drainage of trace pollutants from such a system. Conflicts on these grounds are unlikely since the impacts of trace pollutants is not likely to be substantial.

Total Containment Systems

Riparian States

In most riparian States, total containment systems are generally not a viable alternative for metropolitan areas because of the large amount of land required. There might be challenges to attempt to put total containment systems

on non-riparian lands, since riparian rights generally must be exercised on riparian lands. In rural areas and in metropolitan areas which try to use total containment systems, the reasonable use test will generally apply. A currently reasonable consumptive use could at a later date be judged unreasonable in light of other demands on the water body. The considerations would generally be the same as in the discussion on land application systems in riparian jurisdictions.

Prior Appropriation States

The key State water law issue regarding total containment systems in prior appropriation States is whether the use is beneficial. The corollary issue is whether such a use is wasteful. Generally, the concept of beneficial use is not clearly defined, and it is also a changing concept.

The general water management goal in the arid prior appropriation States is maximum utilization of the water. Thus, whether such a use is beneficial depends not only on the relative benefits which can be produced but on the availability of less consumptive means of accomplishing them.

The likelihood of challenge by junior appropriators will generally be affected by whether the system is regarded to be a change of use or reuse. A change of use might result in a lawsuit against the no-discharge user by junior appropriators. A claim that it is reuse, or a more efficient use, is likely to be an effective defense.

Change of use can refer to change in point of diversion or place or manner of use. The burden is on the person proposing the change to prove it will not harm junior appropriators (upstream as well as downstream) who have vested rights in the continuation of stream conditions as they existed at the time their appropriations were made. Western courts have specifically denied senior appropriators the right to change direct flow rights to storage rights where such change would hurt junior appropriators. The change of use rules have not been subject to exception, even for municipalities. A no discharge user might be challenged if the land application causes the cessation of all return flow, if junior appropriators have relied on the return flow for their appropriations.

A total containment system may also be regarded as a reuse or more efficient use, which is permitted and encouraged by some State water laws. The concept behind reuse is that the appropriator owns the water and is entitled to its possession after diversion for as long as the water remains on his property or under his control. Some courts have said the water is in public ownership but that the State cedes control during periods of beneficial use by the appropriator. Before the water leaves his control, the user can recapture it and reuse it as he wishes. However, where an appropriator has allowed water to return to the stream, it once again becomes the property of the State and available for subsequent use. When the operator of a containment system has allowed the water to return for a considerable period of time, a subsequent appropriator may challenge improvements in the initial appropriator's system that reduces the amount of water available downstream. Such challenges will not necessarily arise, since land disposal may entail reuse of the water for irrigation.

Special Rules for Municipalities

In some jurisidictions the rights of cities to dispose of waste water are greater than rights of private entities. Municipalities often are not limited in the amount of water they can divert to meet current needs; they can appropriate sufficient water for probable future demands. Courts in Wyoming have held that a city can dispose of surplus water up to the amount of its diversion even though it returns no water to junior appropriators. Wyoming courts also have held that a city can impound water for emergencies against the claim of junior appropriators that it is not a beneficial use. However, other courts have held that the rights of a city are no greater than the right of any other appropriator, and have limited the right of a city to dispose of its surplus water (Colorado), and denied the city a right to impound water in excess of its actual needs (Montana).

Where special rights for municipalities exist, they may extend so far as to permit a city to consume its entire appropriation by evaporation when a private entity would have no such right. This possibility was recognized by the Wyoming Supreme Court in Wyoming Hereford Ranch v. Hammond Packing Co. 33 Wyoming 14, 236 P. 764 (1925), in which the court held that the City of Cheyenne could dispose of its sewage effluent by sale and deposit the water directly in the ditch of the buyer despite the claims of downstream appropriators. Colorado, in Pulaski Irrigation Co. v. City of Trinidad, 70 Colorado 565, 203 P. 681 (1922), with facts similar to the Wyoming Hereford case, held the City of Trinidad had no right to sell its purified water in lieu of returning it to the stream. However, in dictum, the court recognized that disposal by evaporation might be recognized as a rightful disposition of water in the proper circumstances.

While the weight of authority appears to recognize special municipal rights for which the reasonable use concept in riparian States and beneficial use concept in prior appropriation States is construed more liberally, it is unclear whether States other than Wyoming, and possibly Colorado, would extend these concepts to allow municipalities the right not to return surplus water to the detriment of junior appropriators.

Conclusions

- Currently, few specific examples of conflicts have been identified between water quality requirements for consumptive technologies and State allocation systems. However there is potential for conflict in several areas.

- If a proposed consumptive use replaces a current consumptive use it will generally be more legally feasible than if proposing a new consumptive use.

Publicly Owned Treatment Works

- EPA encourages land application as an innovative and alternative waste treatment technology.

- Each proposal for funding must undergo a cost-effectiveness analysis. All costs are considered in C-E analysis including: purchase of water rights, off-set water, land costs, transportation costs, and any damages which might be incurred. C-E analysis also requires a qualitative analysis of socio-economic and legal impacts.

- Current EPA policy: purchase of water rights, offset water, and payment of damages are not eligible costs.

- Therefore C-E analysis serves to resolve conflicts before they occur.

- Although riparian law has favorable implications for land application, the priority concept in prior appropriation States will impose limitations on the quantity of water which can be consumptively used without paying compensation to other appropriators.

- There is uncertainty regarding the ability of municipalities to consume their appropriations through land disposal or to sell treated effluent.

Industrial Dischargers

- Zero discharge of waste water is required as the effluent standard for twenty-two industrial subcategories (sugar processing, inorganic chemicals. . .).

- Although, currently, no significant quantity/quality conflicts have been identified, steam-electric plants are one area where there may be potential conflicts, where much water consumption is concentrated at one point.

- There is some potential for conflict for new steam-electric facilities. New Source Performance Standards apply.

- In areas such as the Colorado River Basin, water rights are either consumptive or diversionary. Zero discharge imposed on water users with only diversionary rights at present will necessitate their acquisition of consumptive water rights.

° Water consumption is limited by inter-state agreements and international treaties in the Colorado River Basin; salinity levels are also limited. Zero discharge, by increasing water consumption, will exacerbate the water resources situation.

° Total containment systems often require large land areas. In riparian States there may be challenges where these systems are located outside riparian lands.

° In many prior appropriation States, some consumptive technologies would be considered wasteful and therefore not beneficial uses. If the no discharge system is found to be a change of use (possibly a total evaporation system with no reuse) rather than a reuse of the water, it could result in a lawsuit against the no discharge user. Junior appropriators may demand costly purchases of water rights or payment of damages if consumptive waste treatment techniques are used, or they may deny the change of use request.

AMERICAN IRON AND STEEL INSTITUTE v. EPA,
8 ERC 1321 (U.S. COURT OF APPEALS, 3rd CIRCUIT)
November 7, 1975

In this case petitioners challenged EPA effluent limitations designed to be applied on a national basis to the steel industry. In particular, CF&I Steel Corporation claimed that installation of anti-pollution control devices in its Colorado plant would cause significant net loss of water through evaporation. It was seeking locally developed single source effluent limitations. The Court held that EPA has the authority to promulgate national effluent limitations under section 301 of the CWA. It further held that this does not preclude some flexibility at the local level. The case was remanded for reconsideration of the single number limitations and the promulgation of guidelines by EPA. In a footnote the Court said, "(w)e also reject CF&I's contention that the regulations are invalid because they conflict with State laws requiring water conservation. To the extent that these Federal regulations are valid and are in conflict with State law, they take precedence under the Supremacy Clause of the Constitution."

CHAPTER VIII

GROUND WATER AND RELATED SURFACE FLOW PROBLEMS

INTRODUCTION

This chapter examines the extensive use of ground water in the United States and illustrates where ground water is being overused, resulting in water quality problems, and where water quality degradation has effectively limited the usable supply of ground water. Specifically, three areas of relationship among ground and surface water and quality and quantity are identified. The Federal role in ground water management and State ground water allocation laws are examined and conclusions are set forth.

BACKGROUND

Until recently, the Federal government has not expressed any strong interest in ground water policy or management, leaving that responsibility almost entirely to State government. States have independently developed ground water policies which reflect varying attitudes on resource conservation and use. Rights to use ground water generally have been based on the attitude that a land owner should be able to use his or her property (in this case the water underlying the land) with a minimum of governmental restriction--except where the public health would be endangered. Environmental concerns are now leading to increased private and public action to protect both the quality and quantity of ground water and the related surface water flow.

As water quality efforts have progressed at all levels of government, conflicts between established ground water allocation policies and water quality objectives have become more apparent. Allocation policies for ground water generally have developed without regard for their impacts

on ground or surface water quality or quantity. In the same manner, water quality objectives for ground water have been established without careful consideration of current water use policies and the potentially severe socio-economic impacts of changes in those policies which might be required to accommodate expressed water quality goals.

At least one half of the population of the United States depends on ground water as a source of drinking water. Dependence on ground water as a supply source varies locally. For example, ground water provides 62 percent of the supply in Arizona, 2 percent in Montana, and is the sole source of supply on Long Island, New York and in San Antonio, Texas. Nationwide, ground water supplies about 80 percent of all municipal water systems, numerous industrial installations, approximately 10 million rural families, and much of the demand for irrigated agriculture. The widespread preference for ground water as a supply source is usually due to its abundance and low cost, or to the lack of an economically competitive surface water source. Overall for the U.S., ground water supplied 24 percent of freshwater withdrawals in 1975, up from 18 percent in 1950. The use of ground water is increasing at 3 or 4 percent per year--from an estimated 34 billion gallons per day in 1950 to 82 billion gallons per day in 1975.*

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* Murray and Reeves, Estimated Use of Water in the U.S. in 1975. Geological Survey Circular 765.

The U.S. Geological Survey has estimated that 180 billion acre-feet of ground water, roughly equivalent to 10 years of precipitation, is actually available for use under present technology and costs of production. This amount is not uniformly distributed throughout the Nation. Good quality ground water often is not available or is in limited supply in arid areas which have an inadequate surface water supply to attain desired growth or to sustain use at existing levels in many places.

GROUND WATER QUALITY/QUANTITY CONFLICTS

In some parts of the United States, specific ground and surface water quality problems are related to ground water allocation policies. These problems can be divided into three categories (1) saline intrusion caused by aquifer overdrafts, (2) polluting uses of ground water adversely affecting ground waters, and (3) degradation caused by excessive withdrawals from interdependent ground/surface water systems.

The first category, salt water intrusion into fresh water aquifers, has become a problem of national significance. The saline water may come from the sea or inland saline aquifers. Overdraft of a fresh water aquifer can cause reversal or reduction of the hydraulic gradient which keeps the saline water in place. Salt water can then move into the remaining fresh water body. The disposal of salt water on or under the ground surface also can cause saline contamination of aquifers.

Coastal areas with intrusion problems of varying magnitude include Baltimore, Maryland; Savannah, Georgia; Mobile, Alabama; Takoma, Washington;

and coastal areas of California. Examples of saline intrusion in inland States include various locations in New Mexico and the Red River Valley of North Dakota, where vertical intrusion of deeper saline waters into the producing aquifer occurs as a result of heavy pumping. Similar problems exist in northwest Minnesota, various locations in Michigan, and the Mount Vernon-West Franklin area of Indiana. In a number of cases, the increases in salinity of the aquifer have necessitated the development of new sources for public water supply.

Many States, especially California, have dealt effectively with saline intrusion through artificial recharge programs to raise the water level and force out salt water, and through limits on ground water withdrawals which result in saline intrusion.

The second major type of ground water degradation results from extensive agricultural, industrial, and urban use of ground water. For example, extensive use of ground water for irrigation may result in degradation of the aquifer by movement of applied agricultural nutrients, pesticides, and salts from the soil directly downward into the source aquifer. Possibly the most graphic examples of this type of pollution are found in Arizona and Nebraska where irrigators use and reuse ground water, which is degraded during each cycle of use.

The third type of conflict between water allocation systems and water quality requirements arises when surface/ground hydrologic relationships are inadequately recognized in the overall management

system. The result can be degradation of either surface or ground waters or both caused by excessive ground water withdrawals.

In many places, maintenance of stream flows essential to water quality depends on ground water which feeds streams. Studies of Long Island, for example, report that the uncontrolled overdraft of ground water and the rerouting of potential recharge water into the ocean by the installation of storm sewers have reduced not only instream flow but also outflow to the estuaries, changing the fresh-salt balance and the general ecosystem in those estuaries.

The reverse situation may also occur, where excessive withdrawals of water from surface streams affect ground water quality and quantity. Stream reaches often serve to recharge aquifers by percolation through porous stream bottoms. When surface allocation systems allow salinization or other degradation of streams, ground water may be degraded by the recharge water.

The more general relationship is set forth in the following quote from a letter written by Mr. C. H. McConnell, Deputy Secretary, Resources Management of the Pennsylvania Department of Environmental Resources and addressed to Mr. Gerald Meyer (USGS), Chairman of the Ground Water Task Force for Implementation of the President's Water Policy.

"In Pennsylvania, our main groundwater shortcoming is the lack of basic data. Pennsylvania groundwater is primarily shallow and under water table conditions. This means that groundwater and surface water are intimately associated and one cannot be used without affecting the other. For example, surface water quality standards are based on the quality at seven-day, ten-year low flow, and this low flow is 100 percent groundwater. Polluted groundwater defeats the goals of surface water standards, and groundwater overdrafts can severely restrict surface water flows. To adequately protect ground and surface water quality, ground and surface water uses, and instream flow needs, we must consider conjunctive use planning."

In order to fully understand the present status of problems related to ground water quality/water allocation relationships, it is necessary to examine the specific water quality requirements under the Clean Water Act, related Federal legislation, programs and policies, and State allocation systems related to ground water.

ECONOMIC IMPACTS OF GROUND WATER DEPLETION

While ground water depletion through overdraft is in one sense strictly a quantity problem, when the effect of excessive ground water withdrawals on surface flow is understood, it becomes appropriate for this report to address the economic impacts of such excessive withdrawals. As stated in the June 4, 1979, report of Task Force 2b responding to its assignment relating to Ground Water Supply--Federal/State Cooperation (Federal Water Policy Initiatives), "(t)he resource (ground water) is intimately interrelated with streamflow, the environment, and the land--physically, economically, and politically." Unconstrained use of the aquifer sometimes has led to localized supply and quality related problems. State laws governing ground water often do not discourage over draft of an aquifer. An individual operator will be guided primarily by the cost of drilling a well and raising the water and not by the effect that his pumpage may have on increasing the pumping lifts of other operators, the "common pool" problem.

Development based on ground water resources has resulted in major social and economic commitments--the expansion of irrigated agriculture or urban and industrial development--in such areas as the west Texas

highplains, California, Arizona, Georgia, and New York. Often these commitments were made with inadequate recognition of the limits of the resource upon which they were dependent. In the absence of common management of the pool, water in the aquifer may be overdrafted or "mined," eventually requiring the development of more expensive water supplies or the abandonment of farming operations or other uses.

FEDERAL INVOLVEMENT

As previously indicated, clear Federal policy regarding ground water has been slow to develop. In recent years, four major pieces of environmental legislation, Section 208 of the Clean Water Act, the Safe Drinking Water Act, the Resources Conservation and Recovery Act, and the Surface Mining Act, have shown major concern with the quality of ground water.

Numerous other Federal programs are related directly or indirectly to ground water quality protection. In recognition of the effect of the Federal programs upon the management of the total water resources, the President issued a series of directives addressing ground water and instream flow. One of the July 12, 1978, directives requires Federal agencies to assess any ground water problems which would be associated with a water resources project to be constructed and set forth actions to avoid or minimize such effects, whether related to quality or quantity. The directive further requires such agencies to work closely with State and local governments to seek resolution of such problems. There was no change in the Federal policy that the States have the primary responsibility for the management of ground water, including allocation, within their respective jurisdictions.

The authority of the Federal agencies in the field of ground water management varies greatly, from direct regulatory authority to non-regulatory authorities based primarily upon the National Environmental Policy Act. These authorities fall into several broad classes:

- o Direct regulatory authority
- o Limited regulatory or quasi-regulatory authority
- o Water resources management authority in connection with management of Federal lands
- o Service program authority
- o Indirect program authority.

The direct regulatory authorities are found only in environmental legislation, and the resultant programs are managed, for the most part by the States. These programs and authorities include:

- o Safe Drinking Water Act
  - Establishes minimum quality standards for public water supplies for all ground water for human potable use.
  - Requires controlling underground injection of wastes.
  - Designation of aquifers as the sole sources of potable supplies leading to protection from pollution through Federal activities.
- o Resource Conservation and Recovery Act
  - Requires protection of ground water quality from pollution caused by surface and subsurface disposal of waste materials.
- o Surface Mining Act
  - Requires protection of ground water quality from pollution caused by mining operations.
- o Clean Water Act of 1977

- Section 104

  -- Requires, among other things, the Administrator to establish national programs for the prevention, reduction, and elimination of pollution which shall include a "water quality surveillance system for the purpose of monitoring the quality of the navigable waters and ground waters ...."

- Section 106

  -- Prohibits the Administrator from making grants for pollution control programs to any State which does not have a satisfactory program for monitoring "the quality of navigable waters and, to the extent practicable, ground waters including biologic monitoring."

- Section 208

  -- Requires State and areawide agencies to development plans to protect ground or surface water quality from both point and nonpoint sources. While all sources are covered, specific direct reference is made to:

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

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

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

- Section 402

  -- Establishes the National Pollution Discharge Elimination System, which is a program for issuing permits for point sources of water pollution of navigable waters. One requirement for State approval by EPA to issue permits is that the State must issue permits which control disposal of pollutants into wells. This has been interpreted to mean "deep" waste injection wells, of which there are only about 350 in the U.S. Further, EPA has said that permits will only be given to cover these wells if there is an associated surface water discharge of pollutants. While many States are not placing these same restrictions on the definition of wells, most States are covering only a very small number of wells. One reason for this narrow coverage is that the definition of "pollutant" in section 502 does not mean water,

gas or other material which is injected into a well to facilitate production of oil or gas, or water derived in association with oil or gas production and disposed of in a well if the well is approved by authority of the State in which it is located.

The requirements of the above legislation are generally not coordinated with the requirements of State ground water allocation programs, and in many cases may actually conflict with State allocation programs, since the latter generally were not designed to take cognizance of the need for protection of water quality.

In addition, EPA has indirect ground water quality related authorities in the Clean Water Act pursuant to the National Pollution Discharge Elimination System Program (Permits) and in the administration of its Municipal Construction Grants Program (controlling land disposal of wastes), where certain requirements may conflict with State allocation policy in specific situations. One such example is the requirement for water conservation which may differ markedly from State attitudes and policy.

The limited regulatory or quasi-regulatory programs include the hydroelectric licensing program of the Federal Energy Regulatory Commission and the requirements of the National Environmental Policy Act. The requirements under both authorities have not always been effective in protecting ground water quality in consideration of surface water projects.

The only Federal agencies with direct responsibilities for ground water allocation are those that manage Federal lands, such as the Bureau

of Land Management and the U.S. Forest Service. The land management agencies claim the right to manage the ground water underlying public lands by virtue of land ownership. Since aquifers often extend beyond the Federal boundary, difficult situations arise concerning management of the ground and surface water resources.

Federal service programs include those which provide technical and financial assistance to State and local governments and private individuals. Such programs are conducted by the U.S. Geological Survey, the Bureau of Reclamation, the Office of Water Research Technology, the Environmental Protection Agency, the Soil Conservation Service, the Farmers Home Loan Program and others. Some of the programs may impact ground water usage by encouraging or discouraging agricultural development in areas dependent on ground water supplies.

While the primary programs to implement the mission of the traditional developmental agencies, such as the Bureau of Reclamation and the Corps of Engineers, are not directly involved in ground water development, management decisions regarding surface flow may impact ground water quality and quantity, because of the close hydrologic relationship between ground and surface waters.

LEGAL ISSUES IN STATE ALLOCATION SYSTEMS

The law governing ground water in the United States generally follows one of the five doctrines discussed below. However, the traditional legal classifications of ground water often do not reflect a modern understanding of ground water hydrology. Court decisions based on these misleading classifications add to the complexity of ground water management.

ABSOLUTE OWNERSHIP (ENGLISH RULE)

The English or common law rule of absolute ownership is based upon two principles: (1) a landowner owns everything from the center of the earth to the heavens, and (2) because its movement is not easily discernable, ground water cannot be apportioned among overlying landowners. Under the rule of absolute ownership, the right to use water is based solely on land ownership. A landowner is unrestricted in his use of ground water, except that he cannot act maliciously or negligently. A landowner is not liable if his use of ground water interferes with the ground water use of another. Under the rule of absolute ownership, a landowner may waste ground water, use it on lands not overlying the aquifer, or sell the water.

While the English rule is called the "rule of absolute ownership," a landowner has little actual protection of the ground water under his land in the face of a neighboring landowner with a deeper well or more powerful pump. The rule of absolute ownership is essentially the law of capture, under which every landowner has the right to pump as much ground water as he can without regard to the rights of others.

Texas, Louisiana, Arkansas, Missouri, Minnesota, Indiana, Ohio, Pennsylvania, Vermont, Massachusetts, Connecticut, Maine, New Jersey, Rhode Island, South Carolina, Georgia, Alabama, Mississippi, and in part California follow the absolute ownership rule.

REASONABLE USE (AMERICAN RULE)

Under the American rule of reasonable use, the right to use ground water is also based on land ownership. It differs from the absolute ownership rule on two significant points: the amount of ground water that can be used, and where it can be used.

Under the reasonable use doctrine, every landowner is entitled to the reasonable (i.e., not wasteful) use of ground water. The concept of reasonableness is different from that of riparian law, in that it does not involve comparison of the relative utility of competing uses.

Under the reasonable use rule, reasonableness is based on the relationship between the ground water use and the use of the land where the well is located. Uses on distant lands are unreasonable per se as they bear no relationship to the land under which the water is located. This restriction on ground water transfers significantly differs from the absolute ownership rule.

A landowner's use of ground water must be interfered with before the issue of reasonableness can be raised. This applies both to waste of ground water and use on distant lands. The reasonable use rule is followed in Arizona, Nebraska, Iowa, Illinois, Michigan, Kentucky, Tennessee, Florida, North Carolina, Virginia, Delaware, West Virginia, Maryland, New York, New Hampshire and Wisconsin.

RESTATEMENT OF TORTS RULE

Tentative Draft No. 17 of the Restatement (2d) of Torts is essentially a modification of the American rule of reasonable use: the Restatement rule suggests that disputes among ground water users be resolved on a basis similar to resolution of surface water disputes among riparians. The Restatement rule preserves the rights of landowners to use water for any beneficial purpose, including the sale of water. Liability for interfering with the ground water use of another is imposed only when the interference causes unreasonable harm. A finding of liability would not result in determining who can use the water, but rather whether damages should be awarded, if pumps must be installed or lowered or a new well drilled.

CORRELATIVE RIGHTS (CALIFORNIA RULE)

The correlative rights doctrine is basically a judicial extension of the reasonable use rule to resolve ground water disputes among landowners. Fashioned by California courts in dealing with ground water depletions, the doctrine of "correlative rights" has a rather specific meaning under California law. Under the doctrine if there is sufficient water supply, overlying landowners share the supply with ground water appropriators. However, if the supply is not sufficient, appropriators get nothing and the overlying landowners share the supply on the basis of reasonable use.

PRIOR APPROPRIATION

In most western States, the doctrine of prior appropriation has been applied to ground water. The right to use ground water is based on obtaining a State permit, which may limit the amount of water withdrawn. Conflicts among ground water users are usually resolved on the basis of priority (first in time is first in right). In some appropriation States, the right to appropriate ground water may be denied if it is determined that the ground water basin is overappropriated, or that the rights of senior ground water users would be impaired. States following the prior appropriation doctrine include Washington, Oregon, Idaho, Nevada, Montana, Wyoming, Utah, Colorado, New Mexico, North Dakota, South Dakota, Kansas, Alaska, and in part, California.

THE EFFECTS OF EXISTING LEGAL DOCTRINES AND INSTITUTIONAL ARRANGEMENTS

The absolute ownership rule, reasonable use rule, and the Restatement rule fail to address the issue of depletion of a ground water reservoir.

Under the absolute ownership rule, a landowner may withdraw ground water without regard to either the impact on neighboring landowners or the depletion of the ground water reservoir. Under the reasonable use rule, a landowner's right to withdraw ground water will be restricted only if it is wasteful, is located on distant or non-overlying lands, or both. Otherwise, a landowner may withdraw ground water without regard to ground water depletions. The Restatement rule makes landowners liable for their unreasonable interference with other ground water uses, but deliberately leaves the issue of ground water reservoir depletions for legislative resolution.

Another problem not addressed by the absolute ownership, reasonable use, Restatement, or correlative rights doctrines is how to resolve conflicts between ground and surface water users. This issue is important, not only in determining and maintaining surface water supplies, but also for maintaining stream flows for water quality, fish and wildlife habitat, and other instream purposes. Where ground water levels are declining, the ground water contribution to surface stream flow may be reduced, eventually inducing aquifer recharge from stream flow. If ground water levels continue to decrease, stream flow may be reduced until, eventually, the surface flow would be completely depleted.

In both eastern and western States, disputes among individual ground and surface water users have been resolved by the courts. In the eastern States the decisions show a slight tendency to favor the ground water user. In the western States, the courts have almost always followed prior appropriation, protecting the senior right of surface appropriators from interference by subsequent ground and surface water users.

In western States which apply prior appropriation to both ground and surface water, ground water appropriations may be denied where they interfere with prior surface appropriations. Colorado has gone the farthest of any State in integrating ground and surface water allocation and administration. Colorado law has defined tributary ground water as ground water that would reach a stream if not intercepted by a well. Ground water appropriators who intercept tributary ground water have two options: they may supply water to the stream replacing the amount of tributary ground water they intercept, or they must stop pumping when it interferes with the withdrawals of senior surface appropriators.

The conflicts in policies and legislation, both at any level of government and among the levels of government, are reflected in the institutions created to administer the legislation affecting ground water.

As discussed previously, ground water quality and quantity are often intimately connected to surface water quality. Unfortunately, it is common to find water quality and water quantity administered by separate units of government, each with authority only in one field, and both lacking any effective legislative authority which would enable the gap to be bridged. For example, it is typical to have authority for various aspects of ground water vested in the State Engineer (water quantity),

the State environmental agency (general ground water, quality) and the State Health Department (public health aspects of potable supplies). In some cases, the authority of the State Engineer is so circumscribed that the allocation system is actually administered by the judiciary, introducing yet another complexity and possible impediment to the orderly management of the supply. In addition, surface water is not necessarily managed on the same legislative and administrative basis as is ground water, making effective protection of the water quality almost institutionally impossible.

Such fragmentation is generally considered to be undesirable. As a result, a number of States, particularly in the West, have taken at least initial steps, usually limited to integrated management of the quantity aspect alone, to make unified effective management possible.

Similar institutional problems exist between the Federal and State levels of government. The Federal agencies have little direct authority in ground water management, except in the case of the environmental legislation and the organic acts of the Federal land managers. As a result, the Federal developmental agencies have largely ignored ground water quality, since they have been constrained by the requirements of State water allocation systems, which all too often have failed to recognize ground and surface water interrelationships.

Given the thrust of the Presidential directive, it is probable that surface water development projects will no longer inadvertently exacerbate ground water quality problems, although very probably at the cost of tension between the Federal agencies and the States.

SUMMARY

In summary, there is a definite link between the use of ground water and ground water quality. A majority of States utilize allocation systems which fail to directly address the ground water quality problems resulting from ground water use. Similarly, only a few States have institutional structures that take into account the quality/quantity interface between surface and ground water resources. And, finally, the Federal government historically has not played a major role in ensuring the protection of ground water quality as it relates to the use of ground water.

Following are the findings or conclusions resulting from the foregoing analysis.

GROUND WATER CONCLUSIONS

- o There is an intimate hydrologic relationship between ground and surface waters.
- o Three quality/quantity problems exist:
  1. Saline intrusion caused by aquifer overdraft
  2. Polluting uses of ground water adversely affecting ground water
  3. Degradation caused by excessive withdrawals from independent ground/surface water systems
- o Congress failed to coordinate requirements of water quality legislation (e.g., SDWA, RCRA, 208, 402, SMCRA) with requirements of State allocation systems.
- o Basic legal doctrines used by States to allocate ground water generally do not address depletion and are often inadequate to resolve conflicts between surface and ground water uses.

- Split quality/quantity authority at State level for ground water.
- Institutions at the State level often do not reflect hydrologic relationship between ground and surface water and quality and quantity.
- Federal agencies have often failed to consider ground water quality impacts of their actions.
- President's Water Policy has attempted to address Federal failure to consider ground water impacts.
- There is a need for conjunctive management (surface, ground, quality and quantity) to assure effective management of total water resource.

CHAPTER IX

ALTERNATIVES AND RECOMMENDATIONS

Instream Flows

Alternatives

The alternatives relating to instream flows are grouped around three issues. The first issue addresses the relationship between waste treatment requirements and instream flows. Seven alternatives address this issue and suggest both EPA actions and complementary State actions. The second issue concerns flow levels necessary to meet the fishable, swimmable goals of Section 101 of the Clean Water Act. The third issue relates to consumptive waste treatment and regionalization.

Instream Flow

ISSUE: Waste treatment requirements are frequently determined on the basis of specific flow levels, and reduced flow levels will mean that these waste treatment requirements will not be adequate to protect water quality standards.

PROBLEM: Conflicts between State water law and wasteload allocations.

OBJECTIVE: Develop a process for reconciling conflicts between State water rights and wasteload allocations designed to implement water quality standards.

ALTERNATIVES	EPA ACTIONS	OTHER FEDERAL ACTIONS	STATE ACTIONS	IMPACTS/RESULTS
1. Develop flow-related NPDES permit conditions. Levels of treatment could be increased when flows drop, and decreased for high flow conditions.	- Change permitting policy - Develop new wasteload allocation methods and guidance - Change water quality standards policy - Be prepared to fund additional waste treatment works for low flow conditions		- Change permitting policy (of NPDES State) - Develop new wasteload allocation methods - Amend water quality standards	- Should help to attain water quality standards - Will increase the costs of developing and implementing waste treatment requirements - Higher capitol costs - Lower POTW O&M costs
2. Encourage States to control stream modifications and withdrawals to assure minimum stream flows established in water quality standards	- Adapt an existing program, or require the development of a new program, to restrict withdrawals		- Develop a program, or adapt an existing program to restrict withdrawals	- Might conflict w/State water rights - Would help to attain water quality standards without increasing treatment requirements - Would help to provide flows for instream uses

Instream Flow ISSUE

PROBLEM:

OBJECTIVE:

ALTERNATIVES	EPA ACTIONS	OTHER FEDERAL ACTIONS	STATE ACTIONS	IMPACTS/RESULTS
3. Condition grant funding for advanced waste treatment to require grantee, in selected situations as appropriate, to work with State to try to assure that adequate stream flows will be maintained.	- Change policy or regulations on funding waste treatment		- Revision of allocation law to allow restriction of withdrawals - grantee may not have authority over withdrawals	- Would save grant funds, but the effect on water quality is uncertain - Would help to maintain stream flows for water quality and instream uses - Might effect consumptive uses, including irrigated agriculture

Instream Flows ISSUE

PROBLEM:

OBJECTIVE:

ALTERNATIVES	EPA ACTIONS	OTHER FEDERAL ACTIONS	STATE ACTIONS	IMPACTS/RESULTS
4. Allow augmentation of flows by Federal projects to meet minimum stream flows included in water quality standards	- Modify flow augmentation policy	- Federal agencies would seek EPA approval for increasing storage for water quality purposes - Federal agencies might find it easier, to comply with President's water policy on minimum stream flows - Federal agencies must seek Congressional authorization for this purpose - Costs non-reimbursible	- States would have to establish minimum stream flows in their water quality standards	- Would help to assure stream flows for water quality objectives and instream uses
5. Make policy for downgrading water quality standards more flexible, if diminished flow makes standards unattainable	- Amend water quality standards regulations		- Downgrade water quality standards, where justified by changed policy	- Water quality is not restored and maintained

IX-5

Instream Flow ISSUE

PROBLEM:

OBJECTIVE:

ALTERNATIVES	EPA ACTIONS	OTHER FEDERAL ACTIONS	STATE ACTIONS	IMPACTS/RESULTS
6. Improve planning and planning coordination - Use level B projections of consumptive use for determining priorities for POTW development [Also see alternatives for the next problem]	- Amend regulations - Track development of Level B plans	- Develop interagency agreements	Change planning process to reflect new priorities for wasteload allocation development	- Some improved coordination, probably no major impacts

Instream Flow

ISSUE: Stream flows may be depleted beyond the point where they can assure the protection and propagation of fish, shellfish and wildlife, and provide for recreation in and on the water. At present, water quality standards generally include only concentrations for pollutants, and not velocity or flow requirements.

PROBLEM: Water quality goals of fishable/swimmable waters which cannot be met in streams where flows are not sufficient to support instream uses.

OBJECTIVE: Decide whether it is possible or desirable to encourage or require States to develop flow criteria.

ALTERNATIVES	EPA ACTIONS	OTHER FEDERAL ACTIONS	STATE ACTIONS	IMPACTS/RESULTS
1. Require States to develop minimum stream flow criteria, and promulgate for the States when they choose not to	- Amend regulations - Develop criteria guidance - Fund development under §106 - Approve adopted State standards	- Respect standards when developing water resources plans or projects	- Amend water quality standards - Coordination between State quality/resources agencies - Revise allocation system to support instream flow to meet water quality standards	- Little likelihood of any such policy being implemented - Flow could support instream uses
2. Encourage States to develop minimum flow criteria	- Develop criteria guidance - Fund development under §106 - Approve adopted State standards	- Respect standards when developing water resources plans or projects	- Amend water quality standards - Revise allocation system to allow instream flow to meet water quality standards - Coordination between State quality/resources agencies	- Flows could support instream uses

Instream Flow ISSUE

PROBLEM:

OBJECTIVE:

ALTERNATIVES	EPA ACTIONS	OTHER FEDERAL ACTIONS	STATE ACTIONS	IMPACTS/RESULTS
3. Encourage States to establish process to identify specific stream segments within State for which flow criteria will be developed	- Develop criteria - Develop guidance - Provide funding		- Amend water quality standards - Coordinate between State agencies developing water quality standards and State agencies making instream appropriations or otherwise protecting instream uses	- Protect minimum stream flows - Minimize possibility of conflicts between Clean Water Act programs and State water laws

Instream Flow

ISSUE: Both consumptive waste treatment requirements and regionalization of treatment works may divert water offstream or downstream, thereby interfering with the maintenance of instream flows for other purposes.

PROBLEM: The adverse impacts of consumptive waste treatment and regionalization on maintenance of instream flows.

OBJECTIVE: If it is decided that instream flow needs may justify change from consumptive waste treatment requirements, develop a system for doing this.

ALTERNATIVES	EPA ACTIONS	OTHER FEDERAL ACTIONS	STATE ACTIONS	IMPACTS/RESULTS
Expand the scope of facilities planning so as to require consideration of the effect of consumptive waste treatment and regionalization on minimum stream flows	- Change regulations and guidance for facilities planning			- Minimum stream flows might be afforded better protection - Allows for trade-offs between instream flows and consumptive waste treatment

INSTREAM FLOW

RECOMMENDATIONS

The following recommendations address problems with wasteload allocations and minimum stream flows. Consumptive wastewater treatment recommendations related to instream flow maintenance are addressed in the recommendations regarding consumptive waste treatment technologies.

1. Minimum Stream Flows as Conditions of Grant Funding

In selected situations, as appropriate, EPA should consider conditioning construction grants funding beyond secondary treatment, to require the grantee to work with the State to try to assure that adequate stream flow would be maintained. This approach would save grant funds as well as help to assure their effective use. It would encourage the maintenance of stream flow in selected situations, without requiring the development of new Federally mandated programs for stream flow maintenance.

2. Flow Augmentation

EPA could modify its existing policy for allowing flow augmentation as a fundable aspect of Federal projects, by allowing augmentation in order to meet minimum stream flows included in water quality standards, or otherwise legally required. Such a modification would have to be consistent with Section 102(b)(1) which states that such storage or water releases "shall not be provided as a substitute for adequate treatment or other methods of controlling waste at the source." In accordance with Section 102(b)(3) the EPA Administrator will determine

the "need for, the value of, and the impact of, storage for water quality purposes. . . ." This approach would encourage the development of minimum stream flow requirements in water quality standards, and it would facilitate Federal projects' compliance with the President's Water Policy on minimum stream flows. EPA could implement this recommendation by initiating a review of the FY 1979 policy.

3. Minimum Flow Standards

EPA should encourage States to develop minimum stream flow criteria on a site specific basis, i.e., where required to assure achievement of water quality standards. This should be done in coordination with State allocation programs. There is an increasing recognition of instream flows under State allocation systems. There should be a process for coordinating State instream flow programs with the development of Clean Water Act requirements. Specifically, the water quality standard setting process can be used jointly by State water quality programs and State water allocation programs to identify stream segments where minimum flow requirements are desirable and feasible. The programs can jointly develop flow and velocity criteria. These can be incorporated into water quality standards, and serve as the basis for waste treatment requirements. Restrictions on flow modifications or withdrawls could be implemented through State water laws, certification under Section 401 of the Clean Water Act, or any other authorities available to the States.

EPA is participating in the Cooperative Instream Flow Group at Fort Collins, Colorado, which is developing flow and velocity criteria. Whether EPA will

develop such a program of its own will depend on the demand it would make on EPA's already overtaxed resources and the effectiveness of other on-going programs, such as the one at Fort Collins.

4. Flow Related Permits

EPA should encourage the development of flow related NPDES permits where feasible. These would require higher levels of treatment when necessary to protect water quality in low-flow conditions, or modify water quality standards - based waste treatment requirements for other flow conditions. Such permits would reduce O&M costs for municipalities, although the initial capital investment would be higher.

Irrigated Agriculture

Alternatives

The alternatives presented for irrigated agriculture represent a series of Federal actions, which, if the identified related State actions are implemented, can be expected to result in implementation of more efficient irrigation practices to meet water quality goals while protecting the economic interests in irrigated agriculture. They suggest several incentives and disincentives which can be used to encourage needed change at the State level so that both quality and quantity concerns relating to irrigated agriculture can be accommodated.

IRRIGATED AGRICULTURE

ISSUE It is Federal policy to encourage provision of surface water for irrigation. State policy generally supports the development of irrigated agriculture in arid and semi-arid areas. Irrigation is sometimes conducted in such a way that it impairs water quality. Federal policy supports the attainment and maintenance of clean water.

PROBLEM: Identification of Federal and State actions which can be taken to accommodate both water quality and water quantity concerns regarding irrigated agriculture.

OBJECTIVE: To identify actions to resolve conflicts between policies which support water development and those that support improved water quality.

ALTERNATIVES	EPA ACTIONS	OTHER FEDERAL ACTIONS	STATE ACTIONS	IMPACTS/RESULTS
1. The Federal government should require a specific level of irrigation efficiency in new Federal irrigation projects and contracts and in renewals of existing contracts.	Technical assistance in defining irrigation efficiency BMP on a project specific basis.	o Identification of project specific practices o Policy and regulation change to require increased efficiency o Technical assistance (e.g. Department of Agriculture) in defining BMP	o Change in allocation law to ensure that water saved through increased efficiency is made available for uses compatible with water quality requirements	o More water made available for other uses o May impact vested water rights o Improved water quality o May cause discontinuance of some marginally efficient farm operations
2. The Federal government should, for new projects and renewal of existing contracts, reduce the direct subsidy for irrigation water resulting from the existing repayment formula to encourage higher irrigation efficiency.	Technical Assistance	o Legislative amendment to change pricing formula	o Change in allocation law to ensure that water saved through increased efficiency is made available for uses compatible with water quality requirements	o More water made available for other uses o Provides incentive for change o May impact vested water rights o May cause discontinuance of some marginally efficient farm operations o Change in planning and management of Federal water projects

IRRIGATED AGRICULTURE ISSUE

PROBLEM:

OBJECTIVE:

ALTERNATIVES	EPA ACTIONS	OTHER FEDERAL ACTIONS	STATE ACTIONS	IMPACTS/RESULTS
3. Provide Federal funding to assist in purchase of land and water rights for retirement in areas where irrigated agriculture creates significant water pollution problems (e.g., land over certain salt deposits)	Assist States and Federal agencies in defining water quality needs and target areas for acquisition	o Assist in purchase of land and water rights o Identify critical areas for acquisition o Enact legislation to authorize program	o Work with Federal agencies or take lead in determining sensitive areas for acquisition o May require change in allocation system to allow for change in use and transfer of water rights	o Improved water quality o Increased Federal costs
4. Long-term adequate funding of the Rural Clean Water Program (RCWP) for cost sharing implementation of Best Management Practices (BMP)	Approve WQM plans as precondition to RCWP grants	o Department of Agriculture enters into contracts with farm operators	o Develop WQM plans providing for BMP's eligible to be implemented through RCWP cost-sharing funds. o Changes in State allocation law to allow "saved" water to be available for uses compatible with water quality requirements	o Makes more water available for other uses o Improved water quality

IRRIGATED AGRICULTURE — ISSUE

PROBLEM:

OBJECTIVE:

ALTERNATIVES	EPA ACTIONS	OTHER FEDERAL ACTIONS	STATE ACTIONS	IMPACTS/RESULTS
5. Continue current EPA policy placing high priority on State development and implementation of nonpoint source (NPS) programs for control of pollution caused by agriculture	o Maintain Agency pollution control priorities o Make more funds available o Increased technical assistance	o Technical assistance-Especially USDA	o Development and implementation of NPS control programs for irrigated agriculture o Revision of State allocation laws to accommodate implementation of NPS controls for irrigated agriculture	o Implementation of NPS controls for irrigated agriculture may impact vested water rights o Leads to improved water quality o More water may be available for other uses
6. The Federal government should expand technical assistance to the States and private individuals in nonpoint source control for irrigated agriculture.	o Technology transfer o Personnel exchange	Increased technical assistance, especially from Department of Agriculture		o Improved BMP's o Increased implementation of BMPs o Better informed decision-making at State and local level

IRRIGATED AGRICULTURE ISSUE

PROBLEM:

OBJECTIVE:

ALTERNATIVES	EPA ACTIONS	OTHER FEDERAL ACTIONS	STATE ACTIONS	IMPACTS/RESULTS
7. Appropriation of additional funds for 208 or water quality standards setting process for States to develop system to integrate water quality and water quantity decision-making at the State level	o Provide needed funding o Identify as a priority o Where State administrative structure is supportive, include in State/EPA Agreement		o Develop system for program coordination	o Improved decision-making o Maximum utilization of total water resource o Increased Federal costs

IRRIGATED AGRICULTURE

RECOMMENDATIONS

The actions recommended below are framed to support the primary State role in allocation of water for reasonable and beneficial use, in this case irrigated agriculture. The Federal actions that are identified are intended to encourage the States and individual irrigators to use water more efficiently, which is consistent with State goals of maximum utilization and Federal and State interests in water quality protection.

1. Federal Water Development Projects

a) It is recommended that the Federal government condition new water development projects and renewals of existing water contracts on specific levels of irrigation efficiency. While this alternative will have only limited impact on existing projects in the near future, it is important that Federal agencies assume a leadership role in ensuring adequate consideration of water quality. The State action related to this proposal is to ensure that water "saved" through increased efficiency remains available to meet water quality requirements.

b) It is further recommended that for new projects and renewal of existing water contracts, the pricing formula for water from Federal projects be revised so as to discourage waste of water. Such a change would require Congressional actions and, if implemented, water saved through more efficient practices should be made available by the States for uses compatible

with water quality requirements. Any new pricing formula would have to be sufficiently flexible to consider different levels of pollution problems in different areas, admittedly a difficult task. One method of making water pricing more realistic would be to use an increasing block rate structure in determining costs and only subsidize reasonable water usage.

2. Purchase of Land and Water Rights

In some areas conditions may be such that it is impossible to practice irrigated agriculture and also attain water quality goals. It is recommended that in those cases Federal funds be made available to purchase land and water rights for retirement to protect water quality. The Federal government and the States would work together to identify appropriate areas for acquisition. Some changes may be needed in State allocation systems to allow for transfer of these water rights to other uses that are more protective of water quality.

3. Rural Clean Water Program

Adequate and long-term funding of the Rural Clean Water Program (RCWP) is recommended as a necessary measure to assist irrigators in meeting the costs of installing new or improved irrigation systems for water quality purposes. Assurances will be needed from the States that water saved through increased irrigation efficiency under RCWP will be available for uses compatible with water quality requirements.

4. Nonpoint Source Controls

Current EPA policy places a high priority on development of nonpoint source control programs for agriculture. It is recommended that this high priority be maintained. It is also recommended that Federal technical assistance to States and private individuals be expanded to support the EPA priority on agriculture with special emphasis on irrigated agriculture. Existing programs within the Agriculture and Interior Departments could be used to implement this recommendation.

5. Conjunctive Water Quality/Quantity Management

The final recommendation is that additional Water Quality Management (208, 106) funds be appropriated to assist States in developing systems to integrate water quality decision-making at the State level to reduce conflicts in the area of irrigated agriculture and other areas as appropriate. Such a system is essential to decision-making which will accommodate both quality and quantity concerns.

Consumptive Waste Treatment Technologies Alternatives

The alternatives presented for Consumptive Waste Treatment Technologies (CWTT) can be categorized into two groups. The first three alternatives concern actions which could be taken at the Federal and State level to help resolve conflicts between EPA's policy to encourage municipalities to use CWTT and State water allocation systems. The remaining four alternatives concern Federal and State actions which could be taken in help resolve conflicts between requirements for zero discharge of pollutants for some industrial subcategories and State water allocation systems.

Consumptive Waste Treatment Technologies (CWTT)

ISSUE: To what extent should CWTT for water quality purposes be encouraged for municipal use when it is in conflict with State water allocation systems?

PROBLEM: EPA's policy to encourage municipalities to use CWTT can in some instances be in conflict with State allocation systems or result in high secondary treatment costs since the municipality may not be able to purchase water rights because of restrictions in the State system regarding transferability and definition of beneficial use.

OBJECTIVE: To protect surface and ground water quality in a cost effective manner by encouraging the reuse of water by means of municipal land treatment without unnecessary conflict with State water allocation system.

ALTERNATIVES	EPA ACTIONS	OTHER FEDERAL ACTIONS	STATE ACTIONS	IMPACTS/RESULTS
1. Maintain current policy to condition Federal financial assistance for construction of treatment facilities on CWTT if required for water quality purposes and is the most cost effective option.	o Maintain current financial incentives o Planning for changes in State allocation system would be eligible WQM cost		o Modify State allocation requirements and allocations as necessary, to provide flexible decision-making for CWTT on a case-by-case basis.	o Could lead to some reduction in instream flows o Would provide high nutrient irrigation water. o Will result in some costs which are not Federal eligible costs. o Should result in surface water quality protection o Could result in limited degradation of ground water quality.

Consumptive Waste Treatment Technologies (CWTT) **ISSUE**

PROBLEM:

OBJECTIVE:

ALTERNATIVES	EPA ACTIONS	OTHER FEDERAL ACTIONS	STATE ACTIONS	IMPACTS/RESULTS
2. EPA should modify the Cost Effectiveness Guidelines for land treatment to require that the total costs of net losses of water be included in the analysis.	o Modify Cost Effectiveness Guidelines			o Very water consumptive projects, especially in water short areas, will probably be eliminated. o Should help to maximize benefical uses of water
3. Expand the Cost Effectiveness analysis to specifically include basin-wide impacts associated with proposed CWTT's.	o Revise Cost Effectiveness Guidelines to specifically address basin-wide impacts.		o Modify State allocation requirements and allocations as necessary to provide flexibility to facilitate use of CWTT when there is a positive cost effectiveness analysis on a basin-wide basis.	o Basin-wide C-E anaysis may result in less use of CWTT. o Should help to maximize beneficial use of water on a basin-wide basis o Will increase the cost of the C-E analysis

Consumptive Waste Treatment Technologies (CWTT)

ISSUE: How can zero discharge requirements for industry for water quality purposes be reconciled when such requirements are in conflict with State water allocation systems?

PROBLEM: EPA requires zero discharge of pollutants for some industrial subcategories - Consumptive waste treatment technologies may, in some circumstances, be the only feasible treatment approach but may conflict with water allocation systems, especially in prior appropriation States.

OBJECTIVE: To protect water quality with the least possible conflict with State allocation systems. In instances where CWTT would consume large volumes of water and such consumption is in conflict with the State water allocation system, flexibility in water quality programs and State allocation systems, and State/Federal coordination is needed to minimize conflicts.

ALTERNATIVES	EPA ACTIONS	OTHER FEDERAL ACTIONS	STATE ACTIONS	IMPACTS/RESULTS
1. Require zero discharge of pollutants as necessary for pollution control purposes.	o Could require some change in effluent guidelines o Maintain current financial incentives o Planning for changes in State allocation system would be eligible water quality management (WQM) cost.		o Modify State allocation requirements and allocations, as necessary, to provide flexibility to allow zero discharge techniques when required to meet water quality standards.	o Could reduce instream flows o Could result in ground water recharge o Would help to improve/protect surface water quality o Could degrade local ground water quality
2. Require zero discharge only when needed to protect the public health or when effluent is incompatible with publicly owned treatment works (POTW's).	o May require amendment to CWA o Would require significant change in effluent guidelines o Maintain current incentives o Planning for changes in State allocation system would be eligible WQM cost.		o Modify State allocation system to provide sufficient flexibility to allow and protect CWTT when required for public health purposes.	o In some instances could reduce offstream uses and flows o Could result in ground water recharge and/or contamination. o Limited water quality protection would still permit discharge of pollutants which don't threaten health but could degrade water for other uses.

Consumptive Waste Treatment Technologies (CWTT) ISSUE

PROBLEM:

OBJECTIVE:

ALTERNATIVES	EPA ACTIONS	OTHER FEDERAL ACTIONS	STATE ACTIONS	IMPACTS/RESULTS
3. The Federal government, specifically EPA and DOE, should significantly increase research and development program funding to advance the technology of dry cooling towers.	° Expand R&D program for dry cooling towers to produce a more energy/cost efficient technology	° DOE and other appropriate agencies should expand R&D efforts related to dry cooling towers to produce a more energy/cost efficient technology	° Support R&D efforts as possible	o Long term goal would be a more energy efficient and more cost effective industrial cooling technology o Increase short term Federal R&D costs o Potential to minimize water withdrawals and consumptive uses for cooling purposes o May reduce long term industrial cooling costs o Could provide technology to resolve quality/quantity conflicts

Consumptive Waste Treatment Technologies (CWTT) ISSUE

PROBLEM:

OBJECTIVE:

ALTERNATIVES	EPA ACTIONS	OTHER FEDERAL ACTIONS	STATE ACTIONS	IMPACTS/RESULTS
4. Develop a Federal/State process to coordinate quality/quantity requirements and to resolve conflicts on a case-by-case and site specific basis.	o Use and modify, as appropriate, existing coordination processes under Sections 301(g), 316 and 309 of the Clean Water Act.		o Coordinate State quality/quantity interests and coordinate with EPA through the existing mechanisms	o Improved quality/quantity management and coordination o Maximum beneficial use of the water resource while protecting water quality

CONSUMPTIVE WASTE TREATMENT TECHNOLOGIES

RECOMMENDATIONS

State water allocation systems, especially those in prior appropriation States, generally are designed to provide for maximum utilization of the water resource. To the extent that there is insufficient water, certain highly consumptive uses which do not provide return flow may not meet the tests of reasonable or beneficial use applied by the States. Because of its consumptive nature, CWTT may, in some circumstances, be such a use. When the water quality and water allocation systems are in direct conflict, one or the other must provide sufficient flexibility to allow for conflict resolution.

1. Consumptive Waste Treatment Technologies for Municipal Use

The first alternative describes the Agency's current policy concerning consumptive waste treatment technologies for municipal use. The following two alternatives are recommended to expand and improve the cost-effectiveness (C-E) analysis, to more specifically take into consideration the impacts of a proposed consumptive use on other water uses.

a) Cost Effectiveness Analysis - Total Costs

The recommendation to modify the C-E guidelines to require that the total costs associated with the consumption of water be included in the analysis, is consistent with most current analyses and consistent with recommendations for change in the Multi-Purpose Project Guidelines. In situations where

insufficient water is available to support existing uses, a new consumptive use may be challenged.

b) Cost Effectiveness Analysis - Basin-Wide Impacts

It is recommended that the cost-effective analysis be conducted on a basin-wide basis to take into consideration all appropriate downstream and upstream damages related to a proposed consumptive use. These recommendations could possibly result in selection of advanced waste treatment as the most cost-effective alternative to protect water quality standards.

2. Zero Discharge for Industry

a) Coordination

To address possible conflicts between zero discharge requirements for industry and State water allocation systems, it is recommended that EPA work with the States to develop workable processes, using existing coordination processes under Section 301(c), 301(g), 309 and 316 of the Clean Water Act, as appropriate, to address and resolve conflicts on a case-by-case and site specific basis. Consideration should be given to taking advantage of the provisions under Section 301(b) and 304(b) for non-water quality impacts of industrial discharge standards. Such a coordination process, together with State efforts to coordinate quality/quantity activities, should improve quantity and quality management of the water resource. It should also tend

to maximize beneficial uses of the water while protecting the quality of the water. However, because of past tradition, legal mandates and institutional jealousies, at both the State and Federal levels, full coordination may be difficult to achieve in the short term.

b) Research and Development - Dry Cooling Towers

It is also recommended that the Federal government, specifically EPA and DOE, should significantly increase the funding of research and development programs to advance the technology of dry cooling towers. Dry cooling towers have the potential to offer a workable solution for a less water consumptive cooling process for water short areas. There are currently only a few dry towers in operation. Improvements are needed in the technology to improve the energy efficiency and overall cost effectiveness of the system.

Ground-Water Alternatives

The alternatives presented for ground-water fall into two groupings. The first three alternatives concern direct actions the Federal government can take to ensure adequate consideration of ground-water impacts in Federal decision-making and to utilize existing authorities to protect ground-water quality. The remaining alternatives address opportunities for cooperative Federal and State actions to provide for improved management of ground-water and conjunctive management of the total water resource.

Ground Water

ISSUE: Historically, the impacts of Federal action on ground water quality and quantity have not been considered to the same degree as surface water impacts. Recent Federal environmental legislation addressing ground water provides a legal basis for a strong Federal role in ground water quality management.

PROBLEM: Present Federal programs often fail to adequately emphasize the role of ground water in water resources decision-making.

OBJECTIVE: To ensure adequate consideration of and emphasis on ground water in Federal programs.

ALTERNATIVES	EPA ACTIONS	OTHER FEDERAL ACTIONS	STATE ACTIONS	IMPACTS/RESULTS
1. Amend WRC Principles and Standards (P&S) to specifically reference role of ground water (quality and quantity) in Federal water resources planning. Provide specific guidance to Federal agencies subject to P&S in P&S Manual of Procedures.		o Amendment of P&S o Include guidance in P&S Manual of Procedures on role of ground water in Federal water resources planning. o Revision of individual agency planning procedures and guidance to implement guidelines in Manual of Procedures.		o Increased consideration of ground water quality and quantity. o Increased resources and costs to obtain needed data.
2. Require all Federal agencies not subject to P&S with programs (including Federal assistance programs) which affect ground water, quality and quantity, to include in program requirements a mandatory analysis of the role of and effect on ground water of proposed actions.	o Technical assistance to other agencies. o Perform analysis for EPA actions.	o Revision of policy and planning procedures. o Obtain more data o Increase staff capability o May require legislation		o Increased consideration of ground water impacts of proposed actions. o Increased resources and costs to administer

Ground Water ISSUE

PROBLEM:

OBJECTIVE:

ALTERNATIVES	EPA ACTIONS	OTHER FEDERAL ACTIONS	STATE ACTIONS	IMPACTS/RESULTS
3. Full implementation of existing legislation addressing ground water.	o Apply additional resources to ensure full implementation (Clean Water Act, Resource Conservation and Recovery Act, Safe Drinking Water Act, NEPA). o Source control o Non-point source control o Standards development	o Apply additional resources to ensure full implementation (Federal Energy Regulatory Commission, Office of Surface Mining, Office of Water Research and Technology, U.S. Geological Survey).	o Account for use of funds. o Develop ground water management systems.	o Cleaner ground water o Possible economic dislocations due to changed patterns of ground water use.

Ground Water

ISSUE: In many States ground water management systems are less fully developed than surface water systems. In some cases State law does not adequately address ground water quality. Often decisions regarding surface and ground water, affecting both quality and quantity, are made independently of each other.

PROBLEM: Lack of integration of ground water, surface water, quality and quantity in management decisions at the State level.

OBJECTIVE: To identify mechanisms available to encourage conjunctive management of the total water resource.

ALTERNATIVES	EPA ACTIONS	OTHER FEDERAL ACTIONS	STATE ACTIONS	IMPACTS/RESULTS
1. Provide Federal financial and technical assistance to encourage States to develop improved ground water management systems, including ground water quality standards.	o Develop policy and guidelines to assure funds are being properly spent. o Increased staff expertize in ground water. o Coordination with other Federal agencies providing assistance. o Maintain high priority on ground water management. o Source control o Non-point source control o Standards development	o Coordinate with EPA and other agencies. o Increase staff expertize in ground water. o Develop guidelines and policy. o Disburse funds and assistance. o Increase USGS planning funds o Increase Congressional appropriations of §208 and §106 funds for ground water.	o Account for use of funds. o Develop or improve ground water management systems.	o Long range cost savings through planning. o Possible economic dislocations through changed patterns of ground water use. o More efficient use of ground water.

Ground Water ISSUE

PROBLEM:

OBJECTIVE:

ALTERNATIVES	EPA ACTIONS	OTHER FEDERAL ACTIONS	STATE ACTIONS	IMPACTS/RESULTS
2. Use Section 208 (Water Quality Management Planning) as a vehicle to encourage States to integrate ground water quality and quantity objectives.	o Increase staff expertize. o Additional 208 funding. o Issue guidance	o Federal compliance through Section 313, CWA. o Increased appropriations for 208	o Additional expert staff o Possible administrative and/or legislative change. o Ensure involvement of all appropriate agencies.	o Improved State conjunctive management of the total water resource. o Improved decision-making. o Cleaner ground water.
3. A National Ground Water Advisory Commission representing a broad cross-section of public interests should be established to make recommendations to assist in cooperative and individual efforts of Federal, State and local government in improved management of the ground water resource.	o Participate in the Commission.	o Participate in the Commission.	o Participate in the Commission.	o Better coordination and information exchange.

Ground Water ISSUE

PROBLEM:

OBJECTIVE:

ALTERNATIVES	EPA ACTIONS	OTHER FEDERAL ACTIONS	STATE ACTIONS	IMPACTS/RESULTS
4. An advisory board, consisting of State representatives from all 21 Water Resource Council (WRC) regions, should be added to the WRC to address Federal/State coordination of quantity/quality management issues.		o Establishment of the State advisory board by WRC.	o Participation in the advisory board.	o Improved coordination o Provide a forum for State input
5. Appropriation of adequate funds for WRC to fully implement Title III grant program		o Congressional appropriation o WRC funding of Title III grants, issuance of appropriate guidance to encourage conjunctive management	o Use of Title III grants to achieve conjunctive management of total water resource	o Improved decision-making o Maximum utilization of total water resource o Increased Federal costs

GROUND WATER

RECOMMENDATIONS

Historically, Federal programs impacting water resources have given only limited consideration to the impacts of actions taken under such programs on ground water. The first issue relates to direct Federal actions to improve ground water quality.

1. WRC Principles and Standards

a) The alternative that proposes the Water Resources Council's Principles and Standards (P&S) and Manual of Procedures be revised to provide increased emphasis on ground water in Federal water resource planning is recommended. A similar recommendation has been made through the President's Water Policy Initiative.

b) The option which would require agencies not subject to P&S to consider the ground water impacts of their decisions is recommended. The NEPA process would be one way to accomplish this option. Another would be to enact a specific legislative requirement. This option may meet with resistance from other Federal agencies because increased resources will be needed to comply.

2. Existing Federal Legislative Authorities

It is recommended that existing Federal legislative authorities be fully implemented. The positive impact on the quality of ground water will be substantial.

The second issue relates to Federal/State cooperative efforts in ground-water management.

3. Federal Financial and Technical Assistance

The first alternative reflects the traditional State responsibility for ground-water management. Federal technical and financial assistance, both through such EPA authorities as Sections 208 and 106, and authorities in other Federal agencies, can be utilized to encourage improved ground-water management at the State level. These actions are recommended. The additional costs of such a program should be justified by its benefits in terms of cleaner water and improved quantity/quality.

4. Coordination

a) Water Quality Management Program

The option which provides for the use of the existing Water Quality Management program (Section 208) to serve as a coordinating mechanism to encourage conjunctive management of the total water resource is recommended. While such an approach may only be effective in those States in which there exists a working relationship among agencies concerned with ground and surface water quality and quantity, the judicious use of Federal planning funds in these States could produce positive results. Thus, this option is recommended for use in those States where it is anticipated it will result in increased conjunctive management.

b) National Ground Water Advisory Commission

The alternative which discusses a National Ground-Water Advisory Commission, which would provide a forum for Federal agencies and States to identify problems and work toward resolving them, is recommended. A similar recommendation was made to implement the President's Water Policy Initiative, and was supported by a Federal interagency task force. The Commission report would provide the basis for a national ground-water policy.

c) WRC State Advisory Board

It is recommended that the Water Resources Council (WRC) establish a State advisory board consisting of representatives from all 21 WRC regions. The advisory board would provide a mechanism for the States to participate in Federal water policy decisions affecting water quantity allocation at the State level. It could also provide input to water resource development planning guidelines and Level B guidelines. Currently, there is no direct State input to the WRC process, especially from those States not part of River Basin Commissions. Increased coordination of quality and quantity decisions should result.

d) WRC Title III Grants

It is recommended that adequate and sustained funding be provided to States through WRC Title III grants for the development and implementation of comprehensive water resources planning programs. These State programs will be an additional mechanism to facilitate coordinated water quantity/quality planning.

APPENDICES

Appendix A - State Water Law Summaries

Appendix B - Riparian State Water Permit Systems

Appendix C - Riparian Permit States - Instream Flows

Appendix D - Increased Efficiency Irrigation BMP's

APPENDIX A

STATE WATER LAW SUMMARIES

[under separate cover]

APPENDIX B

RIPARIAN STATE WATER PERMIT SYSTEMS

APPENDIX B

Iowa Permit System

In 1957 the Iowa legislature enacted a statute applying to all water, whether surface or groundwater, which requires a permit from the State water commissioner before any water is withdrawn, diverted, or stored, with certain exceptions. The effect of the Act on riparian rights is unclear. The Iowa Natural Resources Council is responsible for administering the permit program. Exemptions from regulation include:

1) Domestic purposes, livestock, domestic animals
2) Any beneficial use of surface flow in border rivers
3) Beneficial uses existing on May 15, 1957, within the territorial boundaries of municipal corporations. Industrial users, within municipalities, which have their own water supply may be regulated when their use exceeds 3% more than the highest daily beneficial use prior to the effective date of the Act.
4) Beneficial use by any person of less than 5,000 gallons daily
5) Use of diffused surface water

Permits are required for the following uses:

1) Any municipal corporation or person supplying a municipal corporation which increases its water use in excess of 100,000 gallons or 3% (whichever is greater) per day more than its highest per day beneficial use prior to May 16, 1957.
2) Users who divert, store or withdraw more than 5,000 gallons per day, except for nonregulated (exempted) uses.
3) Any person who diverts water or any material other than water from the surface into an underground watercourse or basin. Such uses are exempt as of the date of the Act if they are not wasteful or do not pollute the aquifer. Permits for this purpose need prior approval of Iowa Water Pollution Control Commission. 5,000 gallon ceiling does not apply.
4) Industrial uses with own supply sources within boundaries of

municipalities if their use exceeds 3% of highest per day beneficial use prior to date of statute.

In practice permits are not required for farm ponds for storage in which impounded water does not exceed 18 acre-feet of permanent storage and use of water for highway construction. Routine conditional permits are issued for these uses.

Permits may be issued only for a beneficial use and a permit for a depleting use must protect the average minimum flow of a stream. In practice only permits for consumptive uses are required to contain a stream flow protection condition. For the most part, consumptive uses have been limited to irrigation. The standard used for protecting streamflow levels is a flow level "equaled or exceeded by the stream involved 84% of the time between April and September in the past years determined to be the most representative of normal conditions." This standard was adjusted for special circumstances of each stream. USGS data was used to determine past history of stream flow. Solutions to problems arising from consumptive use by several users at the same source which could deplete the source below the limit set for individual users are encouraged through sharing agreements among users.

The permit system only involves an administrative determination of the availability of unallocated water to satisfy a new permit, but there are no procedures provided for the adjudication of conflicts between vested water right holders. Conflicts are resolved by the courts. No preferences are established under the Iowa permit system. Permits may not impair pollution control laws or navigability. Permits are only issued for beneficial (non-wasteful and non-polluting) uses. The Commissioner has discretion as to the duration of permits provided they do not exceed 10 years. Periodic reports are required of the permittee. The Commissioner may suspend permits in time of emergency.

Mississippi Permit Statute

The permit system was introduced in the 1956 Water Code and is administered by the State Board of Water Commissioners. The Act does not apply to groundwater, but well drillers are regulated. With the following exceptions all new uses of water after April 1, 1958 must be permitted.

1) Salt water bodies and any lake without an outlet where only one landowner is riparian.
2) Dredging or washing of sand and gravel.
3) Customary domestic uses.
4) Groundwater
5) Springs arising on the owner's property as long as the use does not interfere with the right of any user below.
6) Diffused surface waters.
7) Dams across gullys on one's own land so long as provision is made to protect the established average minimum streamflow.
8) Dams on a stream having a minimum flow of not more than 1/2 million gallons per day for the purpose of diverting up to 300 acre feet of the impounded water, but such dams may not affect the established average minimum flow below the dam, and the impoundment will be subject to "lawful water rights of others."

Before approving an application the Board must find there is available unallocated water, and must conclude the proposed use is for a beneficial purpose and not detrimental to the public interest.

Permits are issued for a limited time period. For permits issued after December 31, 1968 the Code recognizes the water should be put to beneficial use to the greatest extent of which the resource is capable and that waste or unreasonable use or unreasonable method of use of water be prevented.

South Carolina Permit System

Surface water use is subject to the riparian system in South Carolina. However, groundwater use is regulated as the result of the 1969 Groundwater Use Act. Under this statute groundwater use is regulated in full capacity use areas and a permit is required to divert groundwater in excess of 100,000 gallons per day. Existing riparian rights in surface water are expressly preserved. To date no capacity use areas have been designated.

Hearings are not required for non-consumptive uses. In determining whether to grant a permit for consumptive use the South Carolina Water Resources Planning and Coordinating Commission is to consider several factors including the effect upon other watercourses or acquifers. Permits may not be granted to exceed the longest of 1) 10 years 2) the duration of the existing capacity use area or 3) the period found necessary by the Commission to amortize the water withdrawal and water-using facilities.

Delaware Permit System

The Delaware permit statute became effective July 1, 1966 and is administered by the Division of Environmental Control, Department of Natrual Resource and Environmental Control. The permit statute was enacted for the purposes, inter alia, of ensuring beneficial use of water resources avoiding waste, assuring adequate supply, protection from pollution, protection of water resources to protect the public health, safety, and welfare and for public recreation purposes and conservation of wildlife and aquatic life. There is some administrative confusion over division of responsibilities between the Division and its predecessor agency, the Delaware Water and Air Resources Commission, which still has responsibility for submerged and subaqueous lands. The Commission has the power to reverse or modify any order or action of the Division.

The permit program extends to all surface and underground sources, dams, diversions, waterway obstructions and underground wells. Exceptions are 1) the preservation of riparian rights pre-July 1, 1966 actually in use on or before that date 2) domestic (1 up to 3 families) and agricultural uses 3) constructing dams and impoundments and 4) extending municipal service through existing facilities. Exception #2 refers to dams which do not reduce the stream below the average minimum flow required by the Act, impoundments on a stream having a minimum daily flow of not more than 1/2 million gallons so long as the user does not utilize more than 360 acre inches per year and so long as the impoundment or use does not affect the established average minimum flow in the stream below the dam at any time, and ponds not larger than 60,000 square feet for purposes of conservation, recreation, propagation and protection of fish or wildlife, stock watering or fire protection (no minimum stream flow limitation).

Delaware recognizes the interrelationship of ground and surface water in its administrative regulations which state, "It is recognized by the Commission that the water resources in and on the State of Delaware may be physically and hydrologically related and that where such a relationship exists approval of uses of such waters shall take into account this relationship."

Permits for construction are valid for a period not to exceed one year. It is unclear whether this one year limit applies to use permits. The Division may require reports from water users regarding past and present water use and the nature and extent of water facilities. Riparian water use conflicts are resolved by the courts, although few such disputes have arisen. It is conceivable that the Department could play a role in resolving permit holders conflicts by terminating a permit as no longer reasonably beneficial and by reduction of water use during emergencies (powers the Department has), but there are no statutory provisions designed to resolve conflicts.

Kentucky Water Permits

The Water Resources Act of 1966 provides limited State regulation and control of water use. Administrative responsibility for the permit program is placed with the Division of Water, Department of Natural Resources. The Statute requires that before a user shall have the right to divert public water, he must obtain a permit. Permits are not required for agricultural or domestic purposes, including irrigation. Nor are they required for the customary use of water in manufacturing or industrial processing, provided the water is returned to the stream in substantially the same quantity and quality as when withdrawn. Nor are they required for water injected underground for the production of oil and gas. Permits must be obtained before construction of obstructions across any stream or deposition of any matter which w ll obstruct stream flow. Construction for a beneficial use or for agricultural purposes is exempted from the permit requirement.

A permit shall be issued if the proposed use will not be detrimental to public interests or rights of other public water users. No permit application for a useful purpose by a responsible applicant shall be denied, although it may be issued for a lesser amount than was applied for. Records must be kept of water withdrawn under a permit. Conflicts are resolved by the courts. During times of drought or emergency the Division may allocate water among permit holders. The permit system applies to waters which are surplus to the established rights on a source.

The permit system applies to groundwater as well as surface waters.

North Carolina Permit System

In 1967 North Carolina adopted a permit system for ground and surface waters which is administered by the Board of Water and Air Resources. The Water Use Act authorizes the designation of "capacity use areas", which are areas where there is such demand for surface and ground waters that regulation is necessary to protect the public interest and interests and rights of residents or property owners. The Board may require, in such areas, reports from water users. The permit system in these areas requires permits only for appropriations in excess of 100,000 gallons per day for any purpose. For noncomsumptive uses over that amount a permit will be issued without a public hearing. Permits are subject to modification or revocation on 60 days' written notice. "Consumptive use" refers to impact on *quality* or *quantity*. The Act preserves pre-existing riparian rights to surface waters, but not to groundwater.

Permits may be subjected to conditions. The duration of the permit may be no longer than the longest of the following periods: 1) 10 years, 2) the duration of the existence of the capacity use area or 3) the period found by the board to be necessary for amortization of the applicant's water withdrawal or water-using facilities. Permits may be renewed. There is no provision for priority among competing applicants; nor are there preferences in time of scarcity. A permittee seems to have no security in his use of the water as against later applicants, and his permit is a relatively unsubstantial right.

Maryland Permit System

In 1934 Maryland adopted a permit system which is administered by the Department of Water Resources, a division of the Department of Natural Resources. The permit system applies to surface and groundwater, and construction of reservoirs, dams, and waterway obstructions. The permit system requires a permit before appropriating or using any waters of the State except as follows:

1. Any use in existence on January 1, 1934 (except where such use was abandoned after that date).
2. Use of water for domestic and farming purposes.
3. Use of water for an approved water supply of any municipality if the use was in effect on July 1, 1969.
4. Small ponds except waste water stabilization ponds.
5. Special Acts of General Assembly granting water appropriation rights to City of Baltimore.

Conflicts among permit holders are resolved by the courts. A permit application may be rejected if the proposed use is determined to be "inadequate, wasteful, dangerous, impracticable, or will be detrimental to the Best public interest." A permit applicant must provide proof that the issuance of a permit will not violate State water quality standards or jeopardize the Natural resources of the State. All permits are reviewed every 3 years, at which time they can be modified. The permit must specify the time within which the appropriation is to be made (not more than 2 years) or the construction commenced (not more than 5 years). Extensions may be granted to these periods for good cause.

Wisconsin Permit Statute

The Wisconsin permit program is administered by the division of environmental protection within the Department of Natural Resources. The original, limited permit program was enacted in 1935 and amended in 1967 and 1969. The Act provides that it is lawful to divert the "surplus" water from a stream to maintain the water level of any navigable stream or lake.

Navigability is defined very broadly. "Surplus" water is defined as any water of a stream which is not beneficially used. Nonsurplus water may be diverted for the purpose of agriculture or irrigation with the consent of riparian owners damaged thereby but water shall not be diverted which shall injure an unconsenting riparian or public rights in the stream. A permit is required for diversion of surplus water for maintenance of water level and of nonsurplus waters for agriculture or irrigation purposes. An irrigation canal or diversion work must be completed within 2 years from the filing of an application. All permits issued since 1957 must be reviewed annually by DNR and be revoked if the withdrawal is found to be detrimental to other riparians. The permit system has not been extensively used. By the end of 1966 only 174 irrigation permits were outstanding. Conflicts are resolved by the courts.

Any person engaged in mining and processing of iron ore may apply for a permit to divert water from any stream on lake. Such mining is declared to be in the "public interest". Diversion from a watershed for a consumptive use is contemplated by the statute. Consent of riparians is not required as a condition to issuance of a permit. The applicant is entitled to condemn riparian rights adversely affected. However, such riparians may bring an action of inverse condemnation. The DNR may fix the duration of such taconite permits, which is the time necessary to exhaust the ore supply.

The 1945 High Capacity Well Law requires approval of DNR for underground withdrawals through wells where the capacity and rate of withdrawal of all wells on one property exceeds 100,000 gallons a day.

Minnesota Permit System

In 1937 Minnesota adopted a permit system which, although it does not incorporate the basic principles of a system of prior appropriation, does provide limited State regulation by requiring permits to appropriate or use State waters. The permit program is administered by the Commissioner of Natural Resources. Permits are required for appropriation or use of water, both surface and groundwater, except at follows:

1) domestic use serving at any time less than 25 persons
2) beneficial uses and rights, outside the geographical limits of any municipality, in existence on July 1, 1937 or any beneficial uses and rights, within the geographical limits of any municipality in existence on July 1, 1959.

Permits are also required before building a dam or other waterworks or before an installation for appropriating or using water can be modified. One is also required to change or diminish the course, current or cross section of any public water. Public waters are defined as all waters in streams and lakes capable of sustaining beneficial public use. A permit must be granted by the Commissioner if he concludes the proposed appropriation provides for the most practical use of the water and will adequately protect public safety and promote the public interest. He must deny a permit if he concludes the proposed use is "inadequate, wasteful, dangerous, or impractical, or detrimental to the public interest."

In the case of State v. Kuluvar the Minnesota Supreme Court upheld the constitutionality of the permit statute and, in holding that the State has a proprietary interest in all "public waters" which is paramount to the rights of private riparian owners stated "(t)o permit such owners to interfere with the natural rights of the public to fish, hunt, swim, navigate or otherwise enjoy such waters would result in subordinating public rights to private

rights and in abdicating the State's trust over an incomparable natural resource." The court in that case, however, did limit the applicability of the statute to require a permit only where public uses are in some way adversely affected.

Water permits are revocable at the will of the Commissioner. The only exception are permits for mining taconite, copper, copper nickel and nickel which may be for a specified time and during that time are irrevocable except for breach of permit condition by the permittee. Permits are not the basis for resolving conflicts between water users since the purpose of the permit statute is not to resolve private rights; rights are defined and conflicts resolved through the courts. The Commissioner has discretion to condition permits. Permits have occasionally been issued which prohibit lowering the stream level below a certain minimum level, particularly where smaller streams are involved. Opinion varies as to whether a permit will issue for water use on non-riparian land, although it appears such use has only been allowed a few times for temporary sand and gravel washing after access rights over riparian land have been obtained by the permittee. The statute contains no use preferences for times of scarcity. Priority in time of filing gives no preference over later applicants.

A permit must specify the time within the construction or the diversion will be completed, not to exceed 5 years from the date of the permit. Permittees must keep records of the quantity of water they use or appropriate. Installation of a flow meter or timing device may be required. It is unclear whether permit rights are transferable.

The Minnesota permit statute preserves riparian rights in existence on July 1, 1937 but it is unclear whether the statutes existinguish unused riparian rights. Minnesota follows the "reasonable use" rule. The State courts have indicated a bias toward recreational and esthetic uses over

those which are purely commercial.

Although a municipality is not regarded as a riparian owner, it does possess "public rights" which are superior to the rights of private riparian owners. The courts have held that a municipality can divert water from a large stream to supply its inhabitants even though downstream riparians' flow is diminished and the municipality does not have to compensate them.

Florida Permit System

Florida enacted the Water Resources Act in 1972, which applies to all surface and underground waters. The Act is administered by the Department of Natural Resources and largely implemented by water districts under the supervision of the Department. The Act abolishes all riparian rights, whether used or unused. Existing users had 2 years within which to obtain permits. Among the purposes of the Act is preservation of natural resources, fish and wildlife. The Department may divide areas within water districts into "hydrologically controllable areas" for the purposes of describing State water resources, establishing minimum flows for surface watercourses (the level at which further withdrawals would be significantly harmful to the water resources or ecology of the area), and establishing minimum levels for bodies of surface water and underground aquifers (levels at which further withdrawals would be significantly harmful to the water resources of the area). Minimum flows and levels may reflect seasonal variations and the Department shall consider and at its discretion protect nonconsumptive uses when setting minimum flows and levels. The Department has authority to establish a system of priorities or preferences in types of use, or purposes of use, for certain areas to be designated by the Department. Preferred uses are those designated as enhancing water resources and are given preference over competing applications. For uses which have been designated as objectionable, permits may be denied. Existing permittees are preferred over new applicants when the public interest would be served equally well. As between competing renewers it is not clear whether the advantage of priority in time exists.

Permits are required for all consumptive uses, except for domestic consumption by individual users. An application must show the proposed use is a reasonable - beneficial use, will not interfere with any presently existing legal use of water and is consistent with the public interest. Water under permit may be used on non-riparian lands. In approving an application and issuing a permit, the Department or district board may reserve water otherwise covered by the permit in such locations, quantities and seasons as may be required for protection of fish, wildlife, and public health and safety. Permits are for a limited duration and even while in effect are subject to restrictions in water use during times of shortage and modification at the request of the applicant.

If a proposed use does not exceed 150,000 gallons per month, the board may consider an application and any objections without a hearing. If it exceeds 3,000,000 gallons per month the application may be considered without a hearing if no objections are filed. Permits may be issued for any period not to exceed 20 years, except they may be issued for up to 50 years to municipalities and other governmental entities and the extended time is required to retire bonds issued to finance construction of waterworks and waste disposal facilities.

In addition to the permit system for consumptive uses, permits are required for the construction, alteration, and operation of dams, reservoirs, and impoundments. A third permit system exists for wells.

Since the 1972 Act recognizes no permanent rights to water use, no statutory procedure was developed to resolve water use conflicts. The courts would be the forum for resolving such conflicts.

The Florida statute requires permits for the withdrawal of groundwater and contains specific provisions for recharge of aquifers, regulation of discharges into aquifers to prevent pollution and saltwater barrier lines to prevent saltwater intrusion.

New Jersey Permit System

In 1963 New Jersey adopted a permit system to control the use of waters of the State which is administered by the Water Policy and Supply Council, Division of Water Policy and Supply, Department of Environmental Protection. The permit system only applies to designated watersheds. It applies to both surface and groundwater. Under the permit system no person may divert in excess of 70 gallons per minute for any private use other than reasonable domestic use without first obtaining a permit. If the proposed use is nonconsumptive, a public hearing is not required. Before granting the permit the Council must consider whether the permit is in the public interest, provides for proper and safe construction of all works involved, provides for proper protection of the watershed from contamination, will unduly injure private interests, and whether it will be just and equitable to all persons concerned. Consideration must also be given to present and future demands on the water supply.

Prior riparian rights in newly designated areas can be preserved through obtaining a permit. Permits may be conditioned, are limited to a definite period not to exceed 25 years and are not transferable. Permits for diversion of surface water for private consumptive use can only be issued for periods of time where water is available in excess of the average minimum daily flow of the watercourse or the minimum desireable low flow to be determined by the Council. Irrigation permit applications must be accompanied by a recommendation from the Agricultural Extension Service as to optimum rates of application and total amounts of water required by the crops and soil types involved. Permits may not be transferred except upon approval by the Council. Conflicts between water users are resolved under principles of riparian law (reasonable use) by the courts. However, when the Council grants a permit, the attendent diversion or use shall not be enjoined. This provision of the statute is apparently designed to protect a permittee from a cause of action

by a riparian owner to prevent the use of the unallocated waters of a stream.

The permit system applies to groundwater in designated areas where the diversion of groundwaters exceeds or threatens the natural recharge. Where the permit system is in effect no one may divert in excess of 100,000 gallons per day for any purpose without first obtaining a permit. The Council may refuse to grant a permit or may include conditions as the Council deems necessary to protect and conserve groundwaters. A refusal to grant a permit is reviewable by the courts. Groundwater diversions prior to designation of an area can continue without obtaining a permit. In nondesignated areas the reasonable use rule applies to groundwater withdrawals (quality and quantity). The New Jersey court has recognized the interrelationship between ground and surface water and has held that the improper use or diversion of groundwater may make a person liable where the flow of springs and streams is materially interfered with as a result of excessive groundwater use.

Groundwater is presumed to be percolating water. The permit system covers groundwater withdrawal but there is no general legislative scheme regulating aquifers or drilling of wells. Nor has there been any attempt to preserve artesian pressures, maintain underground water levels or establish any other concept similar to the protected minimum flow relating to surface streams.

APPENDIX C

RIPARIAN PERMIT STATES - INSTREAM FLOWS

Appendix:

Permit laws in riparian States that specifically require maintenance of minimum stream flow levels include:

Iowa - Permits for a depleting use must protect the average minimum flows of a stream. Generally, this requirement has only been applied to irrigation.

New Jersey - Permits for diversion of surface water for consumptive use can only be issued for times when water is available in excess of the average minimum desired flow. The minimum desired flow is determined by the Water Supply and Policy Council. A permit must be obtained for withdrawing over 100,000 gallons of ground water per day. A permit may be denied or conditioned to protect and conserve ground water.

Minnesota - Water permits may prohibit lowering the stream level below a certain minimum level, particularly on smaller streams. The State courts have favored recreational and aesthetic uses over purely commercial uses. Municipalities can divert water for public water supply without compensating any downstream riparians who might be injured.

Wisconsin - The law allows diversion of "surface" water from a stream to maintain the water level of any navigable stream or lake.

Maryland - A permit applicant must provide proof that the issuance of a permit will not violate State water quality standards or jeopardize the natural resources of the State. The permit system applies to ground and surface waters.

Delaware - The permit system applies to impoundments and dams that reduce the stream flow below specified levels.

Mississippi - The permit system applies to dams on streams with flow above the statutorily defined minimum. Excepted dams may not affect the established average minimum flow below the dam. The Board of Water Commissions cannot approve appropriations that will reduce flows below the average minimum stream flow or lake level.

Florida - The Department of Natural Resources has authority to establish minimum levels for bodies of surface water and underground water aquifers. In the granting of permits, water may be reserved for protection of fish, wildlife, and public health and safety.

APPENDIX D

INCREASED EFFICIENCY IRRIGATION BMP's

Potential benefits to be obtained from efficient use and management of irrigation water supplies include:

(1) Improved surface and ground water quality

(2) Increased water supplies during water short years

(3) Replenishment of needed instream flows, particularly during period of low flow

(4) Provision of additional quantities of water for other beneficial uses where needed

(5) Minimizing "mining" of nonrenewable ground water supplies.

Technical and management procedures presently available for increasing the efficiency of irrigation and reducing the quantity of water needed involve both off-farm and on-farm systems. Off-farm improvements needed include reducing conveyance system water losses by providing impervious linings to canals and laterals, installing closed pipe systems, and consolidating or realigning systems. These improvements help to control water consumptive weed and aquatic growth in order to minimize erosion of soils, reduce operation and maintenance problems, improve water flow and quality, and prevent drainage problems.

Other off-farm measures can include flow-measuring devices or the automation of system facilities to regulate the flow of water, control its evaluation, and schedule its transmission to discharge areas. If the system cannot maintain a demand related uniform water level and flow, efficient deliveries to an on-farm system cannot be made. The proper operation of storage reservoirs,

outlet works, diversion dams, and conveyance systems to the farm is essential to meet downstream flow demands and diversion demands, and to provide efficient operation of the entire system.

As in off-farm conveyance systems, impervious linings, water control structures, and automation can increase the efficiency of on-farm systems and reduce water use. In addition, leveling of the land may be practiced to allow better control and more uniform application of the water when needed. Measuring devices to allow application of only the correct amount of water needed at each irrigation also increase efficiencies. They must be used and maintained to be effective.

Switching to the best method of applying water to the surface (sprinkler, drip, or trickle methods) in accordance with soils and crop requirements will improve the efficiency of on-farm irrigation. No one method is consistently superior to another and the selection of the method should be based upon site conditions to maximize benefits and conserve water. To achieve the most effective operation and efficient use of water, factors to consider are the local rainfall, energy requirements for the system involved, operation and maintenance costs, and availability of labor.

Tailwater recovery systems on farms can be used to reduce the quantity of runoff. They consist of a detention pond or sump and a pump and pipeline system used to recirculate the water back through the system and re-apply it to the land.

Proper waste management for irrigation purposes will involve control of the rate, quantity, and schedule for applying water to the soil for use by the crops in an efficient manner. Effective management of an improved and efficiently designed system can reduce diversions from streams, extractions from ground water bodies, tailwater runoff, and losses to ground water. Water quality can be improved, labor costs reduced and crop yields increased. Adequate scheduling is most effective when irrigation water supplies are adequate, but can be useful in managing a limited supply.

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