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WATER REUSE:
CONSIDERATIONS FOR COMMISSIONS

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CONSIDERATIONS FOR COMMISSIONS

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EXECUTIVE SUMMARY

Water distributed by utilities is a processed product brought to standards appropriate for human consumption. After use by the customer much of that water is collected as wastewater, treated to standards appropriate to protect the environment and released. This report addresses reclamation of the wastewater flow as the source of supply for utility distribution as a non-potable alternative.

The role of the public utility commission in the emergence of reclaimed water projects depends to a large extent on their participation in the broader issues of water resource management. Utilities that are currently regulated by a commission are subject to general oversight. That oversight may include requirements that the utilities pursue opportunities that improve regulated services or lower their costs. Since reclamation may be less costly than treating wastewater to the standards for unrestricted release from the treatment plant, commissions with responsibilities for wastewater utilities may require those utilities to investigate reclamation and institute it where it would benefit the wastewater service customers.

Some commissions participate to a greater extent in their state's management of water resources in general. Since there are benefits associated with reclamation beyond those reflected in the wastewater and potable water services to customers, commission consideration of these benefits may support a broader public interest agenda. Commissions participating in the development of such agendas with other state agencies and various public constituencies may encourage or require jurisdictional utility participation in reclamation projects even if the direct benefit to the utility and its customers is marginal. Commissions with the broader public interest objective will need to gain substantial insight into the costs and benefits, both internal and external to the providers and their customers.

Reclaimed water has several potential uses. Among those are agricultural and industrial uses. Both of these uses have the potential of generating revenue streams to directly support the reclamation effort. Other uses include: environmental enhancements, groundwater recharge, recreational uses, and urban reuse. These possible uses do not normally create revenue streams for the service provider. They are the benefits that require specific arrangements if their value is to be converted to cash to fund the operation of the reclamation activity.

The well established methods for rate making in the water and wastewater industries are generally applicable, appropriate and feasible for reclaimed water service. Reclamation does raise some issues not commonly encountered in these industries, however. Since the source of the water is likely to be a utility, either the same utility that is selling the reclaimed water, or another one, the appropriate transfer price for the water is important. The provider, a wastewater treatment facility may actually save operating costs by selling water for reuse. The regulator must decide on the appropriate price for the water at the treatment site.

The issue of whether commissions should regulate the reclaimed water industry at all has not been settled. There are several reasons favoring regulation. Among the most compelling are those having to do with the appropriate allocation of costs among various beneficiaries of the service. Without regulation there could be a tendency to ignore all benefits external to the actual users of the reclaimed water which may inhibit the development of the industry. The similarity between potable water service and reclaimed water service in regard to the facilities, financing, and customer characteristics supports parallel treatment of the two services. On the other hand, regulation is sometimes seen as an impediment to the emergence of innovative industries, technologies, and practices. This thinking supports minimal or no commission regulation of the industry. At least for the present, it can be argued that the customers of reclaimed water providers are adequately protected by market alternatives and the public is adequately protected by environmental regulators. These same observations are likely to surface in considerations of the degree of regulatory oversight that a commission should exercise, if regulatory authority is granted.

The balancing of the various interests and the complexity of water reclamation projects are apparent when the three case studies included in this report are considered. Texas, Florida, and California are the locations of the case studies. In each of these cases limitations on raw water supply are important to the decision to proceed with water reclamation. The economics of reuse were certainly a consideration, but more from the standpoint of a factor to be minimized and controlled rather than a primary determinant in the decision to move forward with the projects. In fact, in one case the revenues generated from the reclaimed water is less than the cost of providing the supply. This does not suggest that the project was uneconomical overall, but rather it serves as an example where the benefits that cannot be captured through selling the reclaimed water are sufficient to overcome the cost shortfall of the revenue generating potential of the supply.

In the near term, water reclamation may only be practiced in areas where water is in short supply. However, growing demands for water will increase the number of areas meeting this criteria. Other advantages of reclamation coupled with a growing expertise and acceptance of the concept may result in many new applications throughout the country. Commissions need to consider both the potential for the industry in their states and the regulation that will be appropriate.

Based upon our analysis we conclude that water reclamation can be successful when the:

- Net cost of wastewater treatment for reclamation is less than the cost of treating for release,
- Wastewater collection and treatment facilities already exist,
- Price of reclaimed water will be less than the price of potable water,

- Reclaimed water rates are sufficient to cover costs net of any allocation, cost assignment, or revenue that may be generated from other beneficiaries,

- State commission, municipality, water district, or utility has the ability to assign reclamation costs to appropriate beneficiaries,

- Demand for water exceeds the near-term supply of potable water, and

- Customer acceptance of reclaimed water exists.

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FOREWORD

The reuse of our nation's water supplies is well established in some regions of the country. With growing demands for water and increasing costs to bring water to potable standards, reuse may gain greater acceptance both to avoid shortages in supply and to supply non-potable needs more economically. This report addresses the role of public utility commissions in the reuse of water.

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CHAPTER 1

INTRODUCTION

Wastewater is about 99 percent water by weight and is generally referred to as wastewater influent at the treatment plant. The other 1 percent is made up of organic solids that are suspended or dissolved in water. Most of these organic solids can be decomposed by natural biological processes. After receiving a predetermined level of treatment at a wastewater treatment plant, the treated wastewater is referred to as wastewater effluent. Utilities have two options for dealing with wastewater effluent: release or reuse.

Utilities have two options for dealing with wastewater effluent: release or reuse.

Release is usually the most cost-effective option in states with abundant water supplies. After treatment, the cleansed wastewater is usually released downstream. It is generally reused along the way for irrigation, industrial purposes and drinking water. Some evaporates into the atmosphere, returning as precipitation. In costal areas, the remaining fresh water supply is lost as it flows into the sea. When market or environmental conditions exist that warrant increases in water supply or decreases in effluent discharges, wastewater effluent can become a valuable commodity and reuse a cost-effective consideration. Under these circumstances, wastewater effluent is viewed as an additional water supply. When wastewater is treated in this manner, the wastewater effluent is said to be reclaimed.

Chapter 1 of this report presents an overview of wastewater treatment methods, processes and related background information. The goal of chapter 1 is to provide the reader with the information necessary to fully understand water treatment and reclamation. Chapters 2 thru 5 describe the potential uses of reclaimed water and the externalities resulting from reclamation activities, and set the stage for a discussion of the costs associated with water reclamation. A regulator already familiar with reclamation may go directly to chapters 5 through 7 where regulatory considerations and a conceptual framework are presented. Chapter 7 contains three reclamation case studies.

This report was written for the state commissions and associated agencies involved in the regulation of public and investor-owned water utilities. Specifically, this report is meant to serve as an aid to those involved in the regulatory process of ensuring the equitable and efficient provision of water resources whenever water reclamation is an issue.

Background

Before the 1970s, the main focus of wastewater treatment was the prevention or control of pollution to waterways that received wastewater effluent. Pollution control was directed towards the prevention and the elimination of potential health hazards caused by the presence of pathogenic bacteria in wastewater. Increasing urbanization and overburdening of the natural assimilative capacity of receiving waters demanded technological improvements in treatment technology and alternative effluent disposal practices. These demands were recognized throughout the 1970's through a series of federal efforts aimed at rectifying that problem.

Water quality efforts in the United States are directed through three major pieces of legislation at the federal level: (1) the Water Pollution Control Act and amendments, (2) the Clean Water Act and its amendments and, (3) the Safe Drinking Water Act and subsequent amendments.[1]

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[1] John D. Borrows and Todd Simpson, *The Drinking Water State Revolving Loan Fund: A Guide for Regulatory Commissions* (Columbus, OH: NRRI, 1997).

The first national legislation to promote reuse was the Water Pollution Control Act of 1972. The Environmental Protection Agency administrator was authorized to make grants available for reclamation projects. In 1974 Congress passed the Safe Drinking Water Act.[2] While the primary goal was to protect public health and establish drinking water regulations, the act contained needed research money for reuse demonstration grants. Much of this early research concluded that the economics of reuse are marginal, and that uncertainties exist with health effects in sub-potable and potable reuse.

A mid-course correction to the Water Pollution Control Act occurred in 1977 with the Clean Water Act. The wording regarding reuse was strengthened, saying, "the EPA Administrator *shall* provide financial incentives." Incentives and grants were offered for reuse projects or innovative/alternative technologies. This legislation also called for the control of discharges from municipal wastewater treatment facilities.

In terms of directives, President Carter's Water Resources Reform Message to Congress in June of 1978 is important in that water conservation was declared a national issue for the first time in the United States. All federal agencies were asked to examine their existing programs and policies so that they could implement appropriate measures to increase water conservation and reuse. Of particular importance was the request to remove any federal disincentives to reuse the resource.

Reclaimed water came to be seen as a potential resource.

As a result of these events, every wastewater treatment plant and every individual or commercial facility that discharges directly into a water body must have a permit issued by the EPA or an approved state agency. Technological advances had led to less costly treatment alternatives and water quality standards had pushed wastewater treatment standards to

[2] Title XIV of the Public Health Service Act (42 U.S.C. 300f-300j-9) as added by Public Law 93-523 (Dec. 16, 1974).

a secondary treatment minimum. The combination of federal efforts and technological improvements paved the way for water reclamation. Reclaimed water came to be seen as a potential resource.

Throughout the 1980's, legislation regarding wastewater effluent standards, as well as water quality as a whole, continued to develop. Waters across the nation were still degrading in quality and a growing demand for water continued to plague water-scarce states. These factors promoted the growth of water reclamation.

Presently, reclaimed water is widely used in areas where alternative water sources are costly. Many utilities supply reclaimed water for a variety of uses. Several states consider wastewater effluent to be a valuable resource. In these areas, reclaimed water has become a valuable commodity. With its emergence as a marketable commodity and the existence of a viable market, several regulatory issues need to be considered. The most important of those issues is the treatment of revenues made from the sale of reclaimed water. Even when costs associated with the provision of this product exceed revenues, externalities exist that may warrant water reuse. Under circumstances where net costs exceed revenues, but not benefits, there still could exist a potential for a reuse industry. Regulators need to be aware of both positive and negative externalities in order to determine adequate rate designs for those utilities providing customers with reclaimed wastewater.

Even when costs associated with the provision of this product exceed revenues, externalities exist that may warrant water reuse.

Wastewater Treatment

Wastewater treatment technology is concerned with processing the used waters of society. The objective of such processing is the partial or total removal of materials added to water during its use. Wastewater treatment for reuse is a manufacturing process in which a raw material, wastewater, is processed to produce a product, reclaimed wastewater. For the process to be viable, the product must be acceptable to the consumer, i.e., commerce, industry, and the general public. For reclaimed water, consumer acceptance for a given use may be specified in terms of several parameters collectively called water quality. Figure 1-1 shows three available wastewater treatment levels and common uses associated with different levels of treatment. Potable use is included in Figure 1-1 only because it is possible to treat wastewater to potable standards; it is not discussed as a possible reuse application in this report. Because water quality requirements vary widely with intended use, the level of treatment must match the intended use of the reclaimed water. For example, using tertiary treated wastewater for crop production would be less cost effective than using secondary treated wastewater. Since excess treatment costs could be passed on to the consumer it is important for state commissions to be familiar with the different levels of treatment available. The possible uses of wastewater will be discussed later in this report.

Appendix A contains a brief description of the processes involved in the treatment of wastewater. The analysis of reclamation opportunities will be influenced by the wastewater treatment processes currently in use, the capacity of existing systems to meet standards for reuse or release, and standards that exist or are expected to be introduced.

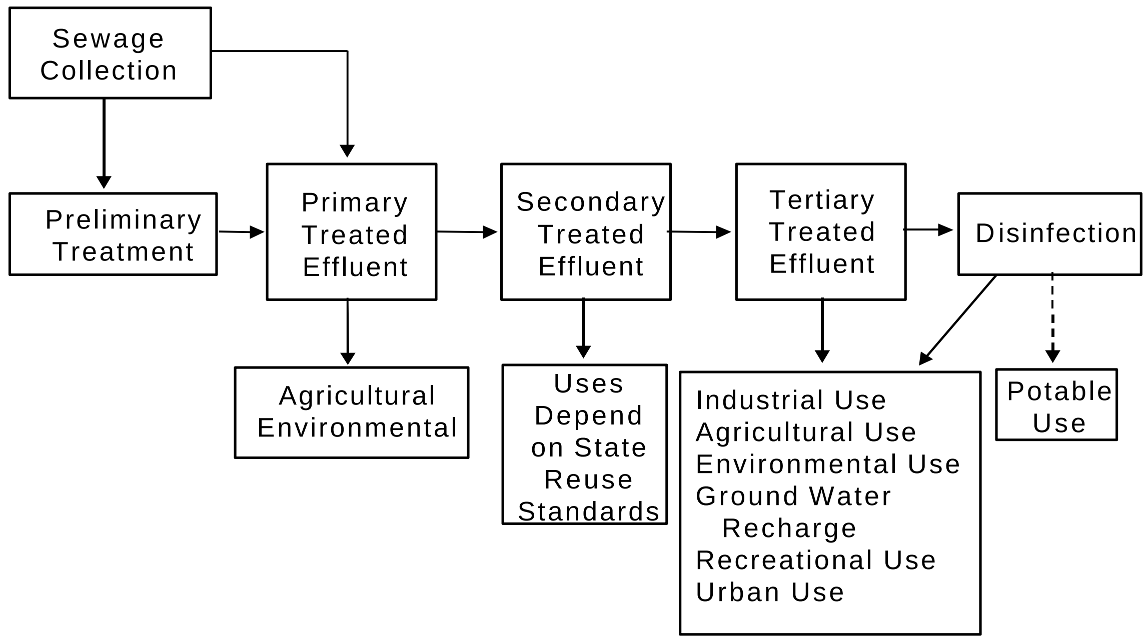

Figure 1-1: Wastewater treatment levels and possible uses associated with different levels of treatment.[3]

Source: Authors' construct using a similar model applicable to California.

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[3] *Water, the Magazine of the National Association of Water Companies* 36, No. 2 (Summer 1995): 21.

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CHAPTER 2

RECLAIMED WATER USES

In this chapter the viable uses of reclaimed water are explained along with the value of these uses. The uses are discussed in the following categories:

- Industrial Reuse
- Agricultural Reuse
- Environmental Reuse
- Groundwater Recharge
- Recreational Reuse
- Urban Reuse

These categories of reuse encompass all major uses of water that require less than potable standards. Specific options are available within each of these general categories. For example, within the category of environmental reuse, there are several reuse applications including stream augmentation and wetland restoration. Since these categories of reuse are not based on any uniform standard, some categories overlap. Various authors have presented different interpretations of reuse categories based on specific areas, such as the western United States. For example, the United States Environmental Protection Agency (USEPA) addresses aspects of environmental reuse through a discussion of a category entitled "Habitat Restoration/Enhancement and Recreational Reuse."[1] Distinctions are made in this report mainly to ensure the regional applicability of this report to any interested party.

The desirability of one or more of the uses discussed below will vary from area to area. In areas where possible uses exist, the feasibility of using reclaimed water will depend on several factors. Those factors include topography, climatic conditions, the degree of industrial and agricultural development, and the extent and quality of natural water resources.

Industrial Reuse

Industrial reuse represents a significant, potential market for reclaimed water in the United States. Although industrial uses accounted for only about 8 percent of the total US water demands in 1985, industrial demands accounted for as much as 43 percent of the total water demand in some states.[2] Reclaimed water is fully satisfactory for many industries where processes do not require water of a potable quality. Also, industries are often located near populated areas where centralized wastewater treatment facilities already generate an available source of reclaimed water.

Agricultural Reuse

Agricultural irrigation represents an estimated 40 percent of the total fresh water demand nationwide,[3] mainly due to the needs of western states with significant

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[1] United States Environmental Protection Agency, Agency for International Development, *Guidelines for Water Reuse*, WWBKDM72, (Washington, D.C.: USEPA, September 1992).

[2] USEPA, *Guidelines for Water Reuse*.

[3] Ibid.

agricultural production. Montana, Colorado, Idaho, and California are the top four consumers of water for agricultural irrigation. In these states, agricultural irrigation accounts for more than 90 percent of their total water demand.[4] Efficient water reuse programs often involve agricultural irrigation; given the high demands for agricultural irrigation, the significant water conservation benefits of reuse in agriculture, and the opportunity to integrate agricultural reuse with other reuse applications.

A significant portion of existing water reuse systems supply reclaimed water for agricultural irrigation. According to the Florida Department of Environmental Regulation, agricultural irrigation accounts for approximately 34 percent of the total volume of reclaimed water used within the state, as of 1990. According to the California State Water Resources Control Board, as of 1990, agricultural irrigation accounted for approximately 63 percent of the total volume of reclaimed water used within the state.[5]

Environmental Reuse

Over the last 200 years, approximately 50 percent of the wetlands in the continental United States have been destroyed. Wetlands provide many worthwhile functions, including flood control; wildlife and waterfowl habitat; productivity to support food chains; aquifer recharge; and water quality enhancement. In addition, the maintenance of wetlands in the landscape mosaic is important for the regional hydrological balance. Wetlands naturally provide water conservation by regulating the rate of evapotranspiration and in some cases by providing aquifer recharge. The deliberate application of reclaimed water to wetlands can be beneficial if the wetlands are maintained so that they may provide these valuable functions. For wetlands that

[4] Ibid.

[5] Ibid.

have been altered hydroponically, application of reclaimed water serves to restore and enhance the wetlands. New wetlands can be created through the application of reclaimed water, resulting in a net gain in wetland acreage and functions.

Stream augmentation is differentiated from a surface water discharge in that augmentation seeks to accomplish a beneficial end, whereas discharge is primarily for disposal purposes. Stream augmentation may be desirable to maintain stream flows and to enhance the aquatic and wildlife habitat as well as to maintain the aesthetic value of the watercourses. This may be necessary in locations where a significant volume of water is withdrawn for potable or other uses, significantly reducing the downstream volume of water in a river. In some situations, the reclamation activity may reduce stream flow. Maintaining stream flow may limit the volume of water diverted for reuse. Further, release standards must be met for stream flow augmentation use which may limit the savings from reduced treatment.

Groundwater Recharge

The purposes of groundwater recharge using reclaimed water include: (1) to establish saltwater intrusion barriers in coastal aquifers, (2) to provide further treatment for future reuse, (3) to augment potable or non-potable aquifers, (4) to provide storage of reclaimed water, and (5) to control or prevent ground subsidence.[6]

The pumping of groundwater from aquifers in coastal areas may result in sea water intrusion into the aquifers, making them unsuitable as sources of potable supply or for other uses where high salt levels are intolerable. Reclaimed water can be injected directly into a confined aquifer to maintain a seaward pressure gradient and thus prevent inland subsurface seawater intrusion.[7]

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[6] Ibid

[7] Ibid.

Infiltration and percolation of reclaimed water takes advantage of the natural ability of subsoil for biodegradation and filtration, thus providing additional treatment of the wastewater and additional treatment reliability to the overall wastewater management system.[8] The treatment achieved in the subsurface environment may eliminate the need for costly advanced wastewater treatment processes, depending on the method of recharge, hydro-geological conditions, requirements of the downstream users, and other factors.

Groundwater aquifers provide a natural mechanism for storage and subsurface transmission of reclaimed water. Irrigation demands for reclaimed water are often seasonal, requiring either large storage facilities or alternative means of disposal when demands are low.[9] Groundwater recharge eliminates the need for surface storage facilities and the attendant problems associated with uncovered surface reservoirs, such as evaporation losses; algae blooms resulting in deterioration of water quality; and the creation of odors. Also, groundwater aquifers serve as a natural distribution system and may reduce the need for surface transmission facilities.

Recreational Reuse

Uses of reclaimed water for recreational purposes range from the maintenance of landscape ponds, such as water hazards on golf course fairways, to full-scale development of water-based recreational sites for swimming, fishing, and boating. In between lies a gamut of possibilities including ornamental fountains, snow making, and the rearing of freshwater sport fish.

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[8] Frank M. D'Itri, ed., *Municipal Wastewater in Agriculture (*New York: Academic Press, 1981).

[9] G. Stuart Pettygrove and Takashi Asano, eds., *Irrigation with Reclaimed Municipal Wastewater -- A Guidance Manual* (Davis, CA: Department of Land, Air and Water Resources, University of California Davis, Lewis Publishers, Inc., July 1984).

Urban Reuse

Urban reuse includes systems serving large users, such as parks, playgrounds, athletic fields, highway medians, golf courses, and recreational facilities. Major water-using industries or industrial complexes and a combination of residential, industrial, and commercial properties are also possible through "dual distribution systems." In dual distribution systems, the reclaimed water is delivered to the customers by a parallel network of distribution mains separate from the potable water distribution system.

Colorado Springs has used reclaimed wastewater for landscape irrigation since 1955.[10] Secondary effluent from both an activated sludge treatment plant and a trickling filter plant is polished by several filters, chlorinated, and stored in uncovered reservoirs. Non-potable water is used to irrigate approximately 600 acres of landscaping in Colorado Springs including the wastewater treatment facility grounds, municipal parks, golf courses, cemeteries, and private commercial establishments. Also in Colorado Springs, construction firms purchase reclaimed water for construction purposes and dust control.

Summary

This chapter has provided an overview of the potential uses for reclaimed water. The six categories of reuse identified in this chapter show that traditional views that limit the use of wastewater effluent strictly to agricultural or industrial settings are outdated. Commissions considering reuse may use this chapter as an initial checklist for gauging water reclamation potential in their state.

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[10] United States Environmental Protection Agency, *Water Use Via Dual Distribution Systems* (Washington, D.C.: USEPA, May 1995).

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CHAPTER 3

BENEFITS ASSOCIATED WITH RECLAMATION

In markets where utilities have made the decision to reclaim wastewater there are specific economic and non-economic benefits associated with the activity. The possible benefits realized through reclamation include the following:

- Savings in treatment costs
- Revenue from sale of reclaimed water
- Enhanced potable water supply
- Agricultural production improvement
- Ownership of water rights
- Environmental enhancement

In this chapter, these benefits will be examined within the context of a market situation. To aid in this discussion, these benefits have been divided into two categories: internal and external.

Internal Benefits

Internal benefits are those realized by the wastewater consumers and producers. The value of reclaimed water may be the direct, internal benefit of monetary payment for the water by customers. It may be an indirect, internal benefit such as providing water for a municipal recreation facility, for example, lake or golf course; or the provision of an additional water supply available for industrial development by replacing potable water previously used for irrigation with reclaimed water.[1] As a result, determining the true value of reclaimed water is a complex process. Valuation is further complicated by issues such as public acceptance and equitable rate determination.

Savings In Treatment Costs

Savings in treatment costs are an internal benefit realized by the wastewater treatment facility. It is an avoided cost. Avoided costs are routinely considered at the time of initial evaluation of a reclamation project. After initiation, avoided costs, while still real, are more difficult to confidently measure or allocate among project participants. For example, consider the savings assignment issue that arises when more strict release standards are propagated which increase treatment costs for facilities that are not reclaiming the wastewater. Does such a change justify the reduction of cost assignment to the reclaimed water for a facility that is already engaged in reclamation and avoids the more costly treatment?

> *Savings in treatment costs are an avoided cost.*

From state to state, regulations and guidelines governing the quality of reclaimed water vary with intended use. For example, in Nevada, secondary treatment is required for agriculture irrigation of food crops. Disinfection, however, is not required. In West Virginia, both secondary treatment and disinfection are required.[2]

The stringency of regulations concerning water reclamation will ultimately determine the savings benefit derived from reclaiming water versus traditional disposal methods. Savings benefits are important because of the high costs associated with traditional disposal methods.

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[1] USEPA, *Guidelines for Water Reuse*.

[2] Ibid.

Revenue from the Sale of Reclaimed Water

In addition to direct savings from a reduction in treatment, the direct monetary payment for reclaimed water is an important benefit. The revenue is a benefit to the supplier. There usually is an additional direct benefit to the buyer. The buyer typically values the resource higher than the price paid. An upper limit on this value is the difference between the price paid and the cost that would have been incurred for an available alternative supply. For example, in Tucson, Arizona, reclaimed water is sold for $348 per acre-foot, roughly 80 percent of the price of potable water. The net internal benefit to the consumer has a limit of about $70 per acre foot used, the difference between the price of reclaimed and potable water. In South Carolina, one utility charges $.40 per thousand gallons of reclaimed water for golf course irrigation compared to $2.40 per thousand gallons for potable water.[3] The net internal benefit to the consumer of the reclaimed water has a limit of $2 per thousand gallons. Both of these values of net benefit assume that adequate supplies of potable water exist to allow its use where the reclaimed water is used and that the reclaimed water is equivalent to potable water for the considered uses. The reclaimed water may actually be superior for irrigation purposes which would increase the consumer benefit. Scarcity may preclude some uses of potable water which would indicate that the consumer benefit could be higher than the simple price differential indicates.

> *Water reclamation can be a useful component of a conservation program.*

[3] South Carolina Public Service Commission, *Kiawah Island Utility, Inc.,* Docket 96-168-W/S, Order No. 97-4 (Columbia, SC: South Carolina PSC, Jan. 8, 1997).

Enhanced Potable Water Supply

Natural water scarcity and the high cost, or non-availability, of needed water have prompted conservation efforts in many areas across the nation. Conservation has also been widely accepted and promoted by commissions, through incentive regulation, in states facing water shortage. Regulated water utilities that lack assured future water supplies are encouraged by commissions to encourage conservation. Under the appropriate conditions, water reclamation can be a useful component of a conservation program. In California and other states reclaimed water has been used to indirectly supplement potable water supplies.

Figure 3-1 shows the national pattern of water use according to the US Geological Survey.[4] The largest water demands are associated with agricultural irrigation and thermoelectric generation, representing 40 and 39 percent, respectively, of the total water use in the United States. This 79 percent represents a large portion of clean water that is being used in situations where reclaimed water may be the more efficient choice. The potential uses of reclaimed water to serve needs below potable standards is significant. The resulting potential to reduce demand for source water is a major benefit. While that benefit is internal because it is enjoyed by the participants in the reclamation project, it is not a direct benefit economically realized in the reclamation operation. Basically, easing strains on currently stressed water supplies ensures future stability in the market for water and allows for other areas of economic growth such as industrial development. This is accomplished through reduced consumption of potable water supplies and is an important consideration in cases where expected revenues from reclaimed water activities fall short of costs.

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[4] USEPA, *Guidelines for Water Reuse*.

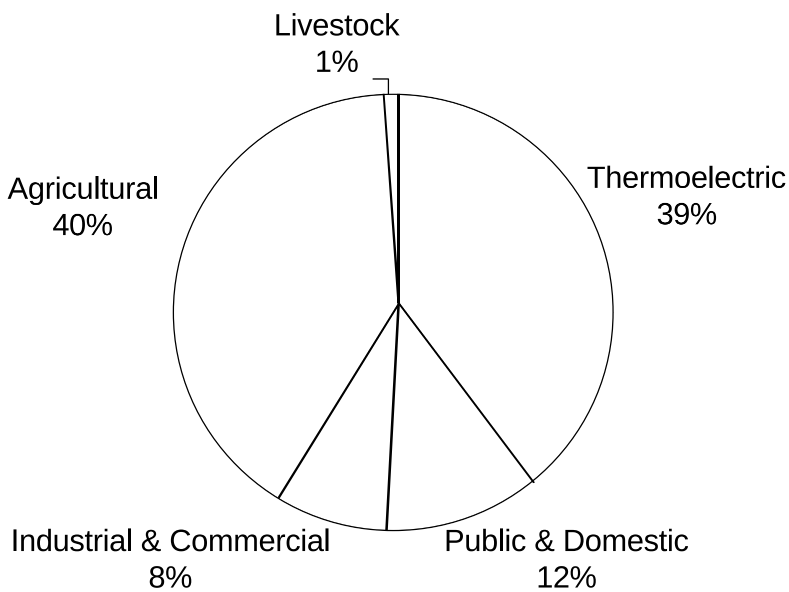

Figure 3-1: U.S. fresh water demands by uses.
Source: Authors' construct.

Agricultural Production

In considering the benefits of agricultural use, the impurities in the water are particularly important. There can be harmful impurities but there are also beneficial elements in the reclaimed water. Both need to be recognized.

The types and concentrations of plant harming constituents in reclaimed water depend on several factors including:

- Original potable supply characteristics
- Influent waste stream constituents

- Type of treatment process
- Type and length of storage

Assuming the wastewater has been treated to remove harmful trace elements, salts, and chlorine with the purpose of agricultural reuse in mind, the remaining constituents are primarily essential nutrients.[5]

Potassium, boron, zinc, phosphorus, and nitrogen are among the most important crop nutrients. Reclaimed water, assuming proper levels of treatment, usually contains important amounts of these nutrients for agricultural needs. Constituents not taken up by crops, under normal soil conditions, will account for some degree of non-point source pollution. Therefore, the amount of wastewater applied, or the appropriate level of treatment to minimize non-point source pollution, is a consideration. There are similar considerations involved with the application of conventional fertilizers.

As a result, agricultural irrigation with reclaimed water is an extremely popular venture, especially in the dry areas. Those using reclaimed water are often able to reduce the consumption of traditionally applied fertilizers. Those supplying reclaimed water, in turn, are able to reduce treatment levels required for traditional disposal.[6]

Ownership of Water Rights

The ownership of water rights is an issue in areas where water scarcity is a factor. In states operating under the appropriations doctrine, an indirect economic benefit of reclamation is associated with securing rights to a given supply of water.[7]

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[5] D'Itri, *Municipal Wastewater in Agriculture*.

[6] Pettygrove and Asano, *Irrigation with Reclaimed Municipal Wastewater.*

[7] USEPA, *Water Reuse Via Dual Distribution Systems*.

In these states, reclaimed water is an additional supply of water owned by a particular treatment facility. Under these circumstances, it is beneficial to maintain this source of water. The indirect economic benefit of securing water rights can be greater than other costs incurred through reclamation. For example, the city of Colorado Springs says that the indirect economic benefit of effectively securing an increase in the city's water rights outweighs the operating expenses of the water reclamation system.[8]

External Benefits

In the reclaimed water market, beneficial side effects are often enjoyed by those not directly involved in the market exchanges. These beneficial side effects are called external benefits or positive externalities. The term externality is used because the effects are felt beyond, or external to, the parties directly involved in generating the effects. Commission consideration of externalities, in part, involves not an issue of whether, but of when and how environmental factors will be considered.[9]

> *In the reclaimed water market, beneficial side effects are often enjoyed by those not directly involved in the market exchanges.*

Protection of Fresh Water Supply

Since water supplies benefit a geographically diverse population, there may be benefits from reuse beyond the limits of the actual customers participating in the

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[8] Ibid.

[9] Kenneth Rose, Paul A, Centolella, and Benjamin F. Hobbs, *Public Utility Commission Treatment of Environmental Externalities* (Columbus, OH: NRRI, 1994).

reclamation program. Limiting the evaluation of source water preservation to those most directly effected will understate the value. More diverse advantages, while difficult to quantify, may enter into public policy decisions regarding reuse.

Environmental Enhancement

An excellent example of environmental recovery through water reclamation has occurred in Florida. St. Petersburg is apparently the only major United States city to have closed its cycle by completely reusing all its wastewater and discharging none to the surrounding lakes and streams.[10] Prior to this activity, serious environmental degradation due to effluent disposal had occurred that jeopardized the entire water system. As a result of water reclamation, not only has the surrounding ecosystem made a significant recovery, but more importantly, the environmental enhancement of has become a publically recognized benefit. Public support for a policy of reclamation is possible.

Summary

Possible benefits of reclamation activities have been discussed for two reasons. First, successful reclamation projects are only possible if one or more of the discussed benefits are realized. Second, the consideration of benefits is vital to the determination of the true value of reclaimed water, which is an important component of a thorough rate design process. Similar to the uses discussed in chapter 2, commissions can use the list of possible benefits to gauge the desirability of reclamation activities in their states.

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[10] Sandra Postel, "Last Oasis: Facing Water Scarcity," *The Worldwatch Environmental Alert Series* (New York: W. W. Norton and Company, 1992).

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CHAPTER 4

RECLAMATION COSTS

Throughout this chapter, the costs associated with preparing effluent for reuse and the costs associated with effluent disposal will be discussed at a conceptual level, illustrating some of the policy options available to regulators in identifying and assigning costs. These costs include the following:

- The cost of treatment and disposal to the environment
- The cost of additional treatment for reuse
- The transportation costs associated with reuse
- The effluent storage costs associated with reuse
- The cost of reclaimed water distribution

Specific costs of providing reclaimed water ultimately depend on two factors, the intended use of the reclaimed water, and the treatment circumstances present in a given area. Unfavorable circumstances may set reclamation costs too high for cost recovery even with the maximum realization of benefits. The cost factors of one water reclamation venture cannot necessarily be applied to other localities. The purpose of this chapter is to broadly define the costs applicable in common reclamation ventures. Circumstances that lead to profitable reclamation activities are described through an examination of market conditions suitable for water reclamation activities.

Water Reclamation Costs

The first step in utility rate making is to determine revenue requirements.[1] Utility revenue requirements are dependent on the costs a utility incurs through the provision of services. Due to the equity and efficiency concerns of state commissions, reclamation project costs must be minimized to assure meeting revenue requirements.

The costs associated with water reclamation will vary depending on the manner in which wastewater is dealt with by a potential supplier. Basically, wastewater can either be reclaimed or disposed of into a water course. Both of these options involve several cost considerations. Before exploring the cost considerations, distinctions between the possible functions of potential suppliers must be discussed. In general, three pre-existing provisioning options are possible: combined potable water and wastewater utilities, water utilities that only supply potable water, and treatment plants that only receive wastewater influent. Table 4-1 depicts the possible scenarios through which water reclamation and disposal activities occur based on the character of the utility providing the service. Based on the three scenarios presented in Table 4-1, each utility performs a different function. As a result of that function, each utility has different options available in its consideration of wastewater recovery.

Basically, Utility A and Utility C, as a result of their function, are both under circumstances that would enable feasible reclamation activities. Treatment facilities exist so no significant new construction costs are necessary. Utility B is not able to participate unless either Utility A or Utility C is willing to sell their effluent or Utility B is willing to absorb the capital costs of constructing a treatment facility. This option is not included in Table 4-1 because sufficient cost recovery is unlikely based solely on revenues from the sale of reclaimed water.

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[1] Janice A. Beecher, Patrick C. Mann, and James R. Landers, *Cost Allocation and Rate Design for Water Utilities* (Columbus, OH: NRRI, 1990).

TABLE 4-1

EXISTING SERVICE PROVIDER'S RECLAMATION OPTIONS

	Function	Options	New Cost
Utility A: a combined water and wastewater utility	Provides Potable water and receives and treats wastewater	Reclaim or dispose of wastewater	• Added costs of reclamation (positive or negative) • Distribution costs
Utility B: a potable water utility	Only provides potable water	Purchase reclaimed water and resell	• Profit from sales • Distribution costs • Cost of purchasing reclaimed water
Utility C: a wastewater utility	Only receives and treats wastewater	Reclaim or dispose of wastewater	• Added costs of reclamation (positive or negative) • Distribution costs

Source: Authors' construct.

The function of existing Utilities A and C allow the option to either reclaim the wastewater or dispose of it. Either decision requires some level of treatment, but since treatment facilities are already in place, reclamation may cost less than normal wastewater treatment. Choosing the option of disposal would imply that after treating the influent to legal levels for disposal, it would be released into the environment. Costs incurred are:

- The cost of collecting the influent

- The cost of treating the influent
- The cost associated with releasing the effluent into the environment

These are the costs traditionally incurred through the operation of a conventional water system in which wastewater is treated and released of into a water course.[2]

The decision to reclaim the wastewater influent is slightly more complex from a cost perspective. Under circumstances in which a water utility supplies reclaimed water, the cost incurred through this reclamation activity will be incremental if the treatment facility already exists. The true cost of reclaimed water is the cost net of the costs associated with a conventional water system.[3]

The costs of supplying reclaimed water include:

- The cost of additional treatment for reuse (which may be positive or negative depending on the costs of meeting standards for environmental release)
- The cost of transporting the product from the reclamation site to the use site
- The cost of storage
- The cost of effluent collection

In cases where wastewater influent is received and treated by some other entity not involved in the traditional water market, reclamation costs are also different. This is the case with Utility C in Table 4-1. Under these circumstances, one of two events can occur. Either the reclaimed water can be sold to a utility willing and capable of reselling the effluent (an option for Utility B in Table 4-1), or the reclaimed wastewater

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[2] United States Environmental Protection Agency Office of Water, *Municipal Wastewater Reuse: Selected Readings on Water Reuse*, WWPCGN35 (Washington, D.C.: USEPA, September 1991).

[3] Ibid.

can be directly sold by the treatment facility. In California, utilities providing reclaimed water are marketers of the product. These utilities purchase reclaimed water directly from treatment plants and resell the water to private customers. The possibility of removing the utility from this process does exist, especially in circumstances where reasonable profits are possible. In fact, with the removal of the third party, the wastewater consumer may benefit through lower rates. Water utility regulators need to be aware of this possibility as well as the costs incurred through middle managing the reclaimed water. A thorough examination of these costs will ensure equitable revenue requirements for rate payers and fair returns to stockholders.

Cost of Treatment and Disposal of Wastewater to the Environment

Wastewater treatment cost is defined as the cost to produce an effluent of a quality sufficient to meet discharge requirements based on intended use of the receiving waters.[4] The high cost of wastewater treatment is usually due to stringent effluent quality requirements imposed by regulatory agencies to protect, or upgrade, receiving water quality. Any utility that receives wastewater influent and does not reclaim the effluent is faced with the cost of treatment and disposal.[5] Reclamation decisions can be evaluated using this cost as a base.

Cost of Additional Treatment for Reuse

The cost of additional treatment for reuse may be positive or negative depending on the quality required for environmental release and the intended use of the reclaimed

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[4] USEPA, *Guidelines for Water Reuse*.

[5] USEPA, *Municipal Wastewater Reuse: Selected Readings*.

water.[6] In areas with stringent discharge standards, treatment levels can be reduced if corresponding uses are determined. Under these circumstances, the costs associated with traditional disposal are greater than the costs associated with, for example, urban reuse. However, it is impossible to determine additional treatment costs until intended uses are identified.

Transportation Costs Associated with Reuse

The total transportation cost to a reuse site will depend heavily on the distance from the treatment plant and the lift, if any, to move the treated wastewater. Construction costs may vary from one geographical location to another as well as within the same area, depending upon the particular construction conditions encountered.[7] Construction costs also vary according to the size and material of pipe used, appurtenances, construction depth, pumping requirements, etc. Under ideal circumstances, the total cost of reclaiming the water is the cost associated with transporting the water to the customer. This is the case for utilities with sufficient treatment facilities in place prior to the decision to reclaim water. Under these circumstances, water previously discharged into a water flow can be diverted to its intended use site. Revenues from the sale of the reclaimed water and other possible benefits are usually greater under these circumstances.

Unfortunately, most areas have less than ideal circumstances. Other costs required to provide reclaimed water, or a lack of a strong customer base for reclaimed water, may discourage reclamation activity. Under these circumstances, transportation costs are "one more factor" that add to total reclamation costs.

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[6] Ibid.

[7] Pettygrove and Asano, *Irrigation with Reclaimed Municipal Wastewater.*

Effluent Storage Costs Associated with Reuse

Storage costs are relevant where seasonal water shortages occur. The primary supply of reclaimed water is proportional to the amount of wastewater influent received at the utility. Storage of reclaimed water is necessary if the supply of wastewater influent drops below the demand for reclaimed water. This is especially important where reclaimed water completely replaces the use of potable water, such as in irrigation.

Design factors for the reclaimed wastewater storage capacity include the length of the non-application season, wastewater flow, precipitation, evaporation, and seepage. Based on climate and weather variations, computer programs have been developed by the US Environmental Protection Agency that enable the estimation of storage requirements for all areas of the United States.

Depending on the contractual arrangements between the utility and the landowner, the cost of storing wastewater may be paid by the utility, by the landowner, or by both. Storage costs can be quite significant and must be taken into account when determining the economic feasibility of utilizing reclaimed wastewater.

Cost of Reclaimed Water Distribution

Similar to other costs discussed thus far, the cost associated with distributing reclaimed water will depend on the intended use. Distribution costs are excessive in certain cases of urban reuse. Dual distribution systems, for example, require a substantial capital investment per customer. Elaborate distribution systems that provide two sources of water at different quality levels are the extreme. Less costly distribution systems are mainly achieved through the provision of large supplies of reclaimed water to a relatively small number of large users. At the other end of the spectrum, for certain types of environmental reuse, such as wetland recharge, distribution costs may be small and therefore, not as relevant of a factor.

Summary

Throughout this chapter, the costs associated with preparing effluent for reuse and the costs associated with effluent disposal were discussed. These costs include the cost of treatment and disposal to the environment; the cost of additional treatment for reuse; the transportation costs associated with reuse; the effluent storage costs associated with reuse; the cost of reclaimed water distribution; and the effluent collection costs associated with reuse. One or more of these costs will be a consideration of any given reclamation project. The extent of the costs will ultimately depend on the intended use of the reclaimed water and the circumstances present in a given area. Unfavorable conditions can result in reclamation costs too high for cost recovery even with the maximum realization of benefits.

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CHAPTER 5

COSTS, PRICES AND MARKETS

The market conditions suitable for reclamation activities are good indicators of potentially successful reclamation circumstances. Broadly, these market conditions include an adequate demand for reclaimed water and an adequate supply, or sufficient potential supply, of wastewater effluent. Specifically, market conditions involve several considerations including the preferences of water users, the costs and benefits of reclamation activity, the cost of developing alternative water sources, and expectations from reclaimed water producers.

Demand

An adequate demand for reclaimed water is dependent on the price of the reclaimed water, the price of potable water, and a basic need for water based on some intended uses. For the water user, the decision as to the desirability of using reclaimed water will be viewed as part of an overall water management program. In deciding whether or not to use reclaimed water, the user will attempt to minimize the cost of satisfying relevant water requirements. Water users, similar to water providers, would have profit maximization as their economic goal, and their decision to purchase or accept treated wastewater will be based on the quantity, timing, quality, and cost of treated wastewater.

The Price of Reclaimed Water

The wastewater utility's objective in pricing reclaimed wastewater for reclamation should be to minimize the cost of disposing of a fixed quantity of wastewater subject to water quality standards. If standards for disposal into a water course require tertiary treatment, costs may be minimized by “giving away” the water to avoid some of the expense of meeting these stringent standards. In states like California, Florida, and Texas, reclaimed water has been widely used due to its lower price. Consumers who use large amounts of water for crop production or some other use receive reclaimed water at a savings of as much as 20 percent of the price of potable water. This substantial savings to the consumer is critical to establishing a demand for reclaimed water.

The Price of Potable Water

The total amount of water available effects the price of potable water. As potable water supplies decrease, the price for potable water should increase. Utilities faced with shrinking water supplies will develop other water sources to ensure meeting future demands. The alternative, the depletion of current water supplies, is not a feasible consideration. Under these circumstances, the cost of developing alternative water sources can be compared to the cost of reclaiming water. When the cost of reclaiming water is less than the cost of developing an additional water source, or when funding for water reclamation projects is available, the suitability of water reclamation activities is enhanced.

The Need For Additional Water

The basic need for additional water effects the demand for reclaimed water. The benefits derived from sustaining shrinking water supplies are closely linked to this need. Under these conditions demand for reclaimed water may be great enough to allow the utility to recover treatment, transportation, storage, and collection costs through sales of reclaimed water.

Supply

The supply of reclaimed water is dependent upon the supply of wastewater influent, treatment costs, and the potential demand. Assuming that a demand for reclaimed water exists, the supply of reclaimed water can supplement the supply of potable water. As a result, the sale of potable water will decrease as the sale of reclaimed water increases. Reductions in potable water sales may mean reductions in revenues and, in the case of regulated investor owned utilities, reductions in profits as well.[1] Profit reduction, however, is not likely when the revenues from the sale of reclaimed water equal or exceed reclamation costs. This is possible in cases where demand is high and facilities exist with the potential to supply reclaimed water at low costs.

Figure 5-1 depicts the use of reclaimed water in St. Petersburg, Florida. Since the city started using reclaimed water in 1977, a decline in the demand for potable water has occurred. Reportedly, in St. Petersburg, existing water supplies have been stabilized.[2]

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[1] Janice Beecher, Patrick C. Mann, Youssef Hegazy, and John Stanford, *Revenue Effects of Water Conservation and Conservation Pricing: Issues and Practices* (Columbus, OH: NRRI, 1994).

[2] USEPA, *Water Reuse Via Dual Distribution Systems*.

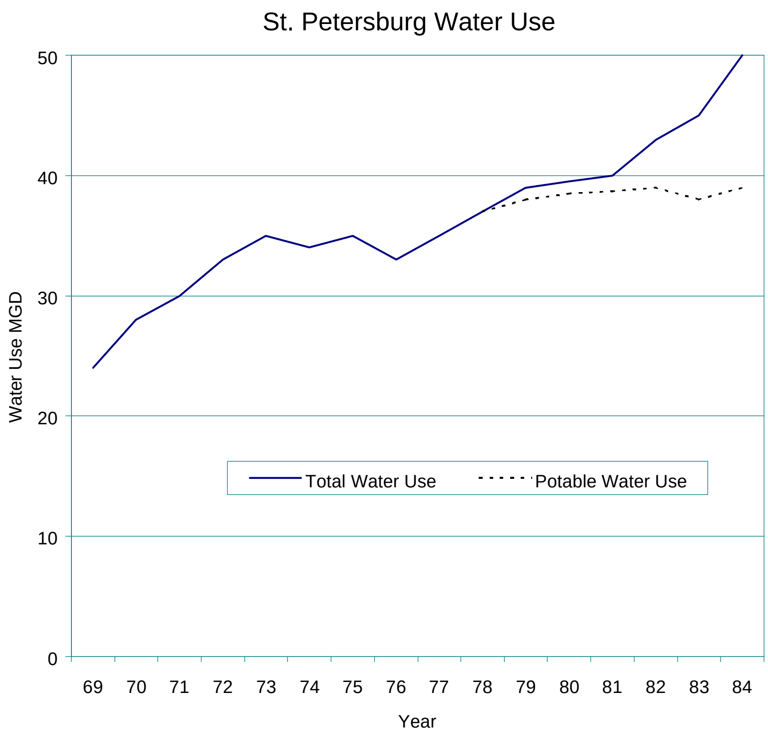

Figure 5-1: Reduced demand growth for potable water with reclamation.

Source: Authors' presentation from USEPA, Water Reuse Via Distribution Systems.

Cost/Benefit Analysis

Cost/benefit analysis has a seductive quality in that it quantifies factors and appears to reduce decision making to a science. There is no doubt that it is a powerful tool that should be used in making decisions concerning reclaimed water projects. In practice cost/benefit analysis should be viewed as a screening tool to identify projects that may be in the public interest. It is also a tool to identify reasonable means of including the costs and benefits of the project in the market transaction prices.

Reclaimed water service differs from potable water service. There is no assumption that the service is necessary. To a much greater extent than with potable service, reclaimed water projects must stand market tests.

Examining the market for the product, that is the information on the prices the supplier will charge and the quantities that the users will buy at those prices is essential in evaluating reclaimed water projects. Once this information is evaluated considering the most direct and conventional measures, it is possible to move incrementally through the consideration of other costs and benefits.

Consider a hypothetical proposal. The direct costs of providing reclaimed water are estimated and a supply curve is drawn. The supply curve indicates the quantity of water that the project can supply at various costs. The demand for reclaimed water can be estimated as a function of price. If these curves intersect, the price-quantity intersection indicates a feasible operating point. The problem with reliance on the supply/demand curves for the public policy analyst is that they reflect only the costs or benefits realized by the direct participants in the market. Benefits enjoyed by and costs bourne by non-participants in the market do not influence the curves unless those benefits and costs are transferred to the principals. Transferring shifts either the supply or demand curve, shifts the intersection point, and may create a feasible project from one that was originally infeasible. The following discussion addresses some of the elements that might be transferred to the market participants and the means of transfer.

Initial Screening

The first step in the evaluation of the reclamation alternative is an assessment of the general conditions in the region. If the factors that generally favor reclamation are present more specific analysis is indicated. However, if an adequate fresh water supply exists and adequate treatment facilities for general release of wastewater treatment effluent to the environment are in place it is unlikely that reclamation is a viable activity. Reclamation may have limited applications even in areas with abundant fresh water supplies if an existing potable water system is reaching the limit of its facilities. There may be an opportunity to use reclaimed water in place of potable water and defer the installation of expensive water treatment facilities.

The initial assessment should identify the principal benefits that could be derived from reclamation. The costs of establishing a program should be estimated to provide a preliminary assessment of the overall costs and benefits that could be expected.

The initial screening should be conducted with the perspective of total social cost and benefits. For example, if the reclamation program is expected to reduce the pollution of public waters, that advantage should be included in the preliminary screening assessment. The goal of initial screening is to determine if government should institute a program to encourage, facilitate, promote or require reclamation of wastewater.

If initial screening indicates that reclamation may be desirable in at least some instances, consideration should be given to identifying who the beneficiaries of projects will be and who will bear the costs of the projects.

Distribution of the Costs and Benefits

Table 5-1 identifies some of the affected parties and the incremental costs and benefits associated with each of them. It is important to examine these relationships because reclaimed water projects must, in addition to being in the public interest, be economically viable for those that bear the cost, and must be accepted by the constituencies of the governmental agencies involved in funding. A project that is thought to be in the general public interest, but which can not generate sufficient

TABLE 5-1

AFFECTED PARTIES, COSTS AND BENEFITS

Affected Party	Cost	Benefit
Reclaimed water provider	• Reclaim or dispose of wastewater • Operating costs	• Revenues from sales
Reclaimed water user	Price of reclaimed water	• Availability of reclaimed water • Avoided costs of potable water
Wastewater service provider	Provision of flow to reclaimed water provider	Avoidance of treatment requirements
Wastewater service user	No direct cost	Flow through of treatment savings
Potable water supplier	Reduced sales of potable water	Reduced capacity requirements
Potable water user	Higher allocation of supplier costs if total sales are reduced	• Enhanced supply security • Avoided plant expansion cost pass through
Public	General tax support of projects, where applicable	• Enhanced development • Greening of public space • Improved raw water supply • enhanced environment

Source: Authors' construct.

revenue to support the costs bourne by the providers will fail. Projects which are only viable to their owners through subsidies (implicit or explicit) can only be successful if the subsidy arrangements are supported by those providing the subsidies.

The first two affected parties identified in the table are the provider and user of the reclaimed water service. They constitute the market for the service. They are critical. If the project cannot be designed so that each of these parties enjoys a net benefit, the project will fail. If each will receive net benefits from the arrangements, the project is financially viable. By focusing on these net benefit criteria, the regulator can best evaluate a proposed project. If circumstances are such that no new program or project specific initiative or special arrangement is required for the reclamation proposal to satisfy the net benefit test for both the provider and user, the project would be expected to be initiated without a major effort by the regulator. Regulatory review of such a proposal would focus on the reasonableness of the assumptions made by the proposers.

The more challenging circumstance occurs when there is confidence in the net societal benefit from reclaiming wastewater but circumstances are such that the market tests of the provider and user of the service itself are not satisfied. These situations justify the quantification of benefits to those outside the direct reclaimed water market and the transfer of those benefits to the participants. Regulatory scrutiny is essential in this process when jurisdictional utilities are involved.

One benefits that may be transferred is the avoided treatment cost by the wastewater service provider. Two means of transfer are easily identified. The first is a structural one occurring when the wastewater service provider enters the business of providing reclaimed water. The savings are realized in the wastewater operation. These savings are included in the provider's analysis of the project. From the perspective of the regulator with the responsibility for approving prices for both wastewater and reclaimed water services, such an internal transfer of costs and benefits can be authorized. For cost-of-service study purposes, an internal transfer price charged to the wastewater treatment operation and credited to the reclaimed water costs would be the appropriate methodology. Even if the transfer price was not explicitly identified, the regulator could set rates for the company based upon total revenue requirements and establish a reasonable allocation of those revenue requirements based upon other considerations. For example, a reasonable price for reclaimed water could be determined as a percentage of the price charged for potable water with the wastewater service charges being designed to recover the remainder of the revenue requirement.

Transferring the wastewater treatment savings from to the reclaimed water provider when they are separate entities would require that the wastewater utility pay the reclaimer for accepting the water to be reclaimed. The preferred mechanism for establishing that transfer price would be an arms-length negotiation between the independent entities. A price arrived at by that means would generally be acceptable to regulators. However, if the wastewater service provider is a commission regulated utility, the commission may need to examine its practices regarding avoided costs as they apply in the particular instance. For example, assume that the wastewater utility can avoid treatment costs by paying the reclaimer for accepting partially treated wastewater. Further, assume that the arrangement results in the partial shutdown of the treatment plant. If the commission is aggressive in reducing rate base in these circumstances, the wastewater utility may be reluctant to provide the water to the reclaimer. The commission may find it proper to allow continued inclusion of some or all of the plant in the wastewater rate determinations. Essentially, such a policy would reduce the flow through of the avoided cost to the wastewater service rate payer and allow it to benefit the reclaimed water provider and users. Wastewater service users are made no worse off by such an policy then they would have been without the reclamation project. That logic could be used to justify the transfer of the operating savings from reduced treatment to the reclaimer as well.

The transfer of benefits from the potable water operations to the reclaimed water operation raise many of the same issues. If the reclaimed water supplier is the same entity as the potable water supplier, allocation of costs within the company provides an opportunity to price the reclaimed water on a market basis and recover the residual

> *The public is an affected party in reclamation transactions.*

revenue requirement through potable water rates. Since there is no commodity that passes from the potable operation to the reclamation operation, there is no readily discernable transfer price to establish. Savings associated with avoided potable water treatment and distribution costs may be real, but since they are avoided, they are much more subjective than incurred costs. When the potable water supplier is a separate entity, it becomes much more difficult to transfer the benefits to the reclaimer. No direct mechanism for such a transfer has been identified. This difficulty applies equally to the benefits associated with reduction in demands for raw water. Again, the savings for the potable water supplier and its customers are real, but there is no standard mechanism to directly quantify them and transfer them to an independent reclaimed water provider. An independent potable water supplier and its customers may actually be financially disadvantaged by the establishment of a reclaimed water program. The immediate effect on the potable water supplier would be the loss of sales as some uses were converted to reclaimed water. Any savings associated with reduced demands for potable water would not necessarily materialize for some time and even then would not ensure a net benefit the rate regulated potable supplier. Commissions may need to consider the appropriate policies to assure that the legitimate concerns of incumbent regulated water suppliers are addressed.

No direct mechanism for such a transfer has been identified.

The public is an affected party in reclamation transactions. The benefits they receive from a water reclamation project may justify their participation in the meeting project costs. The obvious example is the residents of a city. In addition to any utility service benefits they may receive, they may also benefit from better community services and improved economic development. These advantages, coupled with advantages in the potable water supply situation, which could not be captured directly, may justify a city's support for a reclamation initiative paid for through any of a number of vehicles available to municipal governments. For example, they could offer tax abatements to the reclaimer and they could promise to purchase reclaimed water for municipal uses. If the city operates the wastewater treatment facility, the payment to the reclaimer for accepting the wastewater could reflect considerations beyond the direct treatment savings costs. Presumably a city would be very cautious in using any of these methods to improve the financial prospects of an independent water reclamation operation, however, they are each possible and the benefits may justify their use.

It is the lack of established transfer mechanisms that is the challenge.

From this categorization of affected parties and discussion of the mechanisms available for transferring benefits to the principals in the provision of reclaimed water service it is apparent that not all benefits or costs can actually be utilized within the financial structure of any proposed project. Indeed, it is likely that the net societal benefits exceed the direct benefits to reclaimed water providers and users. It is the lack of established transfer mechanisms that is the challenge. However, it is possible to design mechanisms to transfer many costs correctly. If a project is still not viable after those mechanisms are utilized, it should not go forward.

Internalizing Costs and Benefits

Internalizing costs and benefits is the key to realizing economically sound public policy for non-essential services such as wastewater recovery. To internalize means to cause the cost or benefit to be transferred to the provider or user of the service so that it enters into their decision making. The costs and benefits that a commission can internalize are limited by its jurisdiction. Those that are actually internalized depend on the policies and practices of the commission. Unless the commission has substantial authority to cause the diverse beneficiaries of reclamation to contribute to the costs of the service and has the will to impose those costs, then wastewater recovery will only occur where the benefits out-weigh the costs to the direct participants in the reclamation market. Commissions may not be well positioned to promote wastewater recovery. Other agencies may take the lead in policy implementation favoring recovery. For example, environmental protection agencies may raise the standards for wastewater release which would tend to internalize the costs of pollution to the wastewater treatment facilities. The impact on price for jurisdictional wastewater utilities would then be determined by the state commissions. Water districts or municipalities may be able to internalize the benefit of long-term fresh water supply enhancement by subsidizing reclamation through water rates. In neither example can the state regulatory commission currently assign costs to other providers or to the public.

The scope of jurisdiction is worth noting in the case studies presented later in this report. In California the prices for the recovered water are sufficient to justify the costs without special consideration of the diverse benefits. In the Florida city case study the scope of operations of the provider appears sufficient to allow consideration of most of the diverse benefits, and the rate making authority, a city, has the ability to distribute the costs over most of the beneficiaries without having to precisely track individual cost/benefit values. Texas is another example of wastewater recovery emerging as a viable business without need for special subsidy arrangements.

It is probable that many situations can be identified where, once the more diverse benefits are counted, reclamation appears to be a reasonable undertaking.

However, if an elaborate or large subsidy mechanism is necessary in order to internalize diverse benefits, commissions should be cautious in promoting the programs. Unless there is considerable confidence that wastewater recovery is a superior use of scarce societal resources, it is prudent to allow the private markets to choose the reclamation projects without the subsidies. Commissions on the other hand should also examine their practices to be sure that there are no inadvertent impediments to wastewater recovery projects, to assure that the markets will function appropriately and that appropriate transfer mechanisms are used wherever appropriate.

> *It is prudent to allow the private markets to choose the reclamation projects without the subsidies.*

If transfer mechanisms are needed, then the arena, processes and type of decision making will also change. Commissions can set policies for jurisdictional utilities, but lack the authority to assign costs to other entities. Indeed, even if all water providers were under the jurisdiction of the commission it is not clear if a commission would apply a “single-tariff” type reclamation surcharge to noncontiguous utilities or to customers not directly benefitting from consumption of reclaimed water. The focus would likely shift to a multi-agency, consensus-building process where the state commission would be one party to joint decision making.

Summary

The market conditions suitable for reclamation activities include an adequate demand for reclaimed water and an adequate supply or sufficient potential supply of wastewater effluent. Specifically, the evaluation of market conditions involves several considerations including the preferences of water users, the cost of developing alternative water sources, the costs and benefits of the reclamation activity, and expectations from reclaimed water producers. Under suitable conditions there are multiple consumers of water for purposes that require less than potable water and there are facilities capable of supplying reclaimed water to the consumers.

Regional circumstances such as the availability of uses, the existence of benefits, and the costs of reclamation are all relevant to the viability of a wastewater recovery industry. The degree to which costs and benefits are realized by service providers will determine their willingness to undertake specific projects. Regulatory presence can effect how costs and benefits can be transferred for the providers and will be discussed in the next chapter.

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CHAPTER 6

REGULATORY CONSIDERATIONS

This chapter discusses general considerations regarding the regulation of wastewater reclamation service providers by public service commissions. The characteristics of the providers are discussed first to identify relevant variables that could affect regulatory decisions. A brief discussion of the general regulatory policies and practices follows because not all commissions have the same goals, objectives, authorities, and resources. The characteristics of the commission may influence regulatory choices. The chapter concludes with an integration of the observations concerning the characteristics of the industry and the characteristics of regulatory commissions. Policy makers can use this information as a guide in deciding the level of regulation and the regulatory practices that are most reasonable in their state.

Regulatory Objectives

The first consideration in discussing the regulation of water reclamation by public utility commissions is to examine the objectives of the commission. Commissions can view their responsibilities anywhere along a continuum of objectives. A commission that engages in meeting a broad set of public needs will make substantially different regulatory choices than a commission whose objectives are primarily the efficient administration of rate making, consumer complaint, and service quality monitoring activities. The administratively oriented commission will evaluate the need for regulation of the water reuse industry based upon an assessment of the likely effects of regulation on the quality and price of the reclaimed water service. They will consider whether the imposition of regulation will provide better quality service at lower prices. The commission that has a broader objective will also consider the likely effects of regulation and regulatory initiatives directed at the reclamation business on the general water supply, environmental quality, regional development, and other general public policy issues.

The authority and resources necessary for the water reuse program varies considerably depending on the scope of the commission's objectives. Administering rate cases, consumer complaint processes and service quality monitoring programs requires considerable expertise, but it is expertise that is common to all such programs within the commission. The formal and informal processes and staff resources for resolving issues are already in place. The addition of responsibilities for the oversight of individual reclaimed water suppliers is an incremental addition to their programs.

A broader set of potential commission initiatives could include requirements that reuse service be examined by initiating long-term integrated resource planning for water utilities. This analysis would include consideration of reuse as a means of meeting demand, and requirements that regulated utilities engage in regional planning activities. While a commission may be able to implement some of these initiatives through their regulation of potable water and wastewater utilities, regulatory authority over the reuse industry itself would be complementary.

The decision to impose rate and service regulation on individual reclaimed water suppliers depends on the ability of market forces and the adequacy of other regulatory agencies to meet the consumer protection needs of the public. The decision to impose strategic planning requirements reflecting public interest objectives on the reuse industry depends on how critical the water supply situation is in the state and importance of reuse to meeting public requirements. Because the water supply situation is different in the various states, the appropriate level of commission regulation will not be uniform.

Reclaimed Water Company Organization

The reclamation activity will have some effect on the provision of water and wastewater services within its service area, and may affect those operations outside of its own service territory. The business relationship between the reclamation service provider and affected utilities is of interest to the regulator.

The economics of the reclaimed wastewater operation depend, among other factors, on the level of treatment the wastewater has received before acceptance by the reclamation operation. If the reclamation operation starts at the receipt of the wastewater from the wastewater collection system, then the reclamation operator will be responsible for all treatment. The environmental protection considerations will be primarily the reclaimers responsibility. It is reasonable to assume that those responsible for the wastewater collection would pay the reclaimer for accepting their collections. The reclaimer would have at least two revenue streams, one from the wastewater collector and one from the end-users of the reclaimed water.

The reclaimer would have at least two revenue streams, one from the wastewater collector and one from the end-users of the reclaimed water.

A similar situation would arise if the reclaimer accepts the wastewater after some level of treatment. So long as the treatment provided before transfer to the reclaimer were less than that required for release to the environment, the wastewater service provider would be expected to pay the reclaimer for accepting the wastewater.

The reclaimer might obtain the wastewater after it has been treated to a level which would permit release to the environment by the wastewater treatment facility. The treated wastewater might be purchased by the reclaimer, or the wastewater treatment facility still might pay the reclaimer for accepting the water, although the price it would pay would be expected to be small.

Unless the reclaimer has virtually no quantity of service limits imposed by its customers, provisions must be made to store or dispose of the wastewater when the supply exceeds the reclaimers demand. These services could be provided by the wastewater facility or by the reclaimer. Similarly, if the reclaimer has a service obligation to its customers it may need a source of supply for periods when the wastewater flow is less than the demand for reclaimed water. Provision of alternative supply could come from storage or an alternative source and could be self-supplied by the reclaimer or purchased from the wastewater facility.

Provider Structure and Access to Accounting Information

Water reuse providers can be organized in a number of different ways in regard to other utility service providers. These range from independent ownership and management to fully integrated ownership, management and operation. The ownership relationship between a reclamation services provider and other service providers influence the need for, character of, and emphasis of the regulatory program.

One mode is to have a fully integrated provider. This means that the supplier of another utility service, either water or wastewater, undertakes the development and operation of the water reclamation business with the same personnel, management and financial resources used to provide other services. The utility may elect to create internal divisions and record keeping provisions to pursue the water reclamation business. However, the fully integrated operation will make its organizational and record-keeping choices for its own purposes. The resulting organization and records may not support the examination of issues important to the regulator.

A second arrangement is a reclamation operation undertaken by an existing utility with some agreed upon level of separation of assets, manpower, and operations between the services. This arrangement is known as accounting separation. The allocation of costs and resources will be done pursuant to mandated accounting rules, providing the regulators with information useful to their purposes, so long as the records and activities are conducted in accordance with the letter and spirit of those rules.

The third arrangement is structural separation. The reclamation activity is pursued by a separate affiliate with common ownership but with its own management and its own accountability to owners and to the regulators. Structural separation, in concept, precludes the use of common personnel or facilities. In practice there may be some advantages in the sharing of resources. In order for the arrangement to be considered structurally separated, any such sharing is done exclusively by contracts derived from arms-length negotiation. The affiliated companies will typically have their own directors and function with a high degree of independence. The accounting records needed for regulation are available and follow mandated commission standards.

A fourth arrangement involves separate corporate identities with some, but not complete common ownership. This arrangement frequently occurs when there is a joint undertaking among two or more companies to establish a new line of business.
A commission may need to act proactively to ensure its access to accounting records.

The fifth organizational arrangement is completely separate business organizations without any common ownership. The only relationship is that which occurs between buyers and sellers in a market. Even here the commission needs to be alert for abuse because the market has few participants. Maintaining some expertise in underlying cost characteristics may be necessary to assess the reasonableness of the reported transactions.

Regulatory commissions are concerned about the quality of the records of utilities. The records are the basis of commission decisions and accuracy is important to decision quality. The organizational structure of the utility can substantially affect the reliability of the records. Utilities providing several products using common production resources do not have to maintain separate records for each of their products. If a utility is providing reclaimed water service and another utility service it will not necessarily allocate common costs or even carefully monitor to assure that costs associated with one service are segregated from those of the other service. Internal controls and external auditors will focus on the reliability of the records for reporting results externally, i.e. to stockholders, taxing authorities, etc. The regulatory commission will not have the benefit of independent audit review of cost assignments within the organization unless they take the initiative to conduct such a review or cause it to be conducted. This differs from the circumstances of a single service, investor owned company where the regulators can use such information with confidence.[1]

The regulatory audit and analysis burden for oversight of the water reclamation services are less when the business is conducted by an independent, investor owned company then with other organizational forms. The record verification effort required for water reclamation regulation will be greatest is the case of a fully integrated multi-product company because the commission will have to review the internal cost assignment methods of the company without benefit of independent auditor certification of the methods.

A consideration that may partially offset the reliability assurances of adequate total cost data for the fully independent operation is the potential usefulness of the commission's own investigations of the other utility operations of a multi-service company. If the commission is reviewing the rates for the water service of a company that also provides reclaimed water service, then the information requirements for each service will overlap. Auditing and evaluation necessary for the water service may be useful in determining reclaimed water rates. To maximize the benefits of common use of the information for setting both sets of rates, they should be reviewed simultaneously, possibly in the same rate case. Extra care must be exercised in a combined services company if it is allowed to pursue rate changes for the separate

[1] David Wirick, Raymond Lawton, and Robert Burns, *Information Risk In Emerging Utility Markets: The Role of Commission Sponsored Audits* (Columbus, OH: NRRI, 1996).

services in separate proceedings, particularly if those proceedings use different test periods. There are opportunities for presentation of cost allocation results in a way the maximizes the revenue requirement calculation in each case. The commission must guard against such possibilities by comparing the allocation and cost assignment methodologies followed by the company in preparing each case to assure consistency.

Regulation or No Regulation

There are advantages and disadvantages to the regulation of suppliers of reclaimed water. Each state commission, acting in cooperation with their legislators, other regulatory agencies and interested members of the public should carefully weigh the circumstances of the state and decide what sort of oversight, if any, is appropriate.

Considerations Favoring Regulation

Reclaimed water provision has many characteristics of a monopoly. It is relatively capital intense with a substantial sunk cost associated with each increment of revenue. Franchised service territories may be appropriate to justify the capital investment necessary. Once connected to a supplier, a customer will be captive to that supplier, to the extent that the customer wishes to have reclaimed water service. Regulatory oversight is appropriate to protect captive customer interests.

> *Reclaimed water provision has many characteristics of a monopoly.*

With regulation, the reclaimed water supplier will be a utility. Utility status carries with it valuable infrastructure development advantages. Generally, utilities have access to rights-of-way. Construction of distribution facilities on public rights-of-way may be necessary for the delivery of the reclaimed water. Utilities typically have the right of eminent domain which facilitates the acquisition of rights-of-way on private property and the purchase of property for necessary facilities. The right of eminent domain is an important consideration even when property needs are negotiated and the right is not explicitly exercised. Its existence helps assure reasonable negotiations by the property owners. Utility status may also convey attractive tax benefits and local zoning exemptions.

Regulation may enhance the ability of a reclaimed water supplier to attract capital. The regulatory authority is in a position to provide a higher degree of assurance of future revenues than private contracts. If the reclaimed water activity is pursued on an integrated basis with the potable water and/or the sewerage businesses, the regulator will be able to tap the reliability of the revenue streams associated with those services to assure debt service for reclamation related expenditures. There may be funding sources available to utilities that are not available to non-utilities. For example, a state may have loan funds available for utility services that would not be accessible to non-utilities engaged in the reclaimed water business.[2]

Regulation may provide greater customer and public acceptance of the reclaimed water business. In general, public utility commissions enjoy substantial public credibility. The approval, by a commission, of a water reclamation business may enhance its acceptance by the community and its ability to sell its product.

Commissions may be more able and willing to promote water reclamation if the business is their regulatory responsibility. In those areas where reclamation makes sense, it may be necessary for a public agency, such as a commission, to actively promote the business among public officials, the water and wastewater industries and the general public. Of course, the promotion referred to would be directed toward

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[2] Loan Funds have been discussed in: Borrows and Simpson, *The Drinking Water State Revolving Loan Fund*; and Raymond Lawton, *Lessons from PENNVEST Applicable to the Design of a State Safe Drinking Water Revolving Loan Fund* (Columbus, OH: NRRI, 1997).

ensuring the efficient use of water, rather than promoting the interests of a particular company.

> *Reclamation will have effects on the costs and revenues of other regulated services.*

Commissions actively engaged in water resource planning, either as a direct function of their regulatory program or by incorporation of planning requirements in their oversight of individual utilities, may need to incorporate reclamation into those considerations.[3] Regulation will facilitate both planning and implementation of the plans. Since reclamation will have effects on the costs and revenues of other regulated services, commissions can best meet their responsibilities for integrated planning by including all of the service providers in their programs. This integration will be facilitated if the reclaimed water operations are regulated.

Since water reclamation is likely to be a co-product of other utility services which are regulated, it may be efficient and appropriate to include it in the scope of regulation. It may be more efficient and certainly will avoid the difficulties of regulating only part of an enterprise if reclaimed water activities of existing utilities are included in the regulatory package. This consideration is separate from the planning consideration mentioned above. The rates and terms of service, and all of the other normal regulatory activities of closely related businesses can be conducted with greater confidence by regulators with authority encompassing the reclaimed water activities.

To the extent that externalities are to be incorporated in the decisions to implement reclamation programs and are to be incorporated in the rates for services, regulatory oversight may be necessary to assure equitable and enforceable policies. For example, if wastewater customers are to pay a premium over the cost of treatment

[3] Janice A. Beecher, James R. Landers, and Patrick C. Mann, *Integrated Resource Planning for Water Utilities* (Columbus, OH: NRRI, 1991).

to facilitate the recovery of water from the waste supply as a matter of public (as opposed to private) benefit, the entire business activity should be regulated.

Finally, reclaimed water service is similar in many respects to other businesses that are regulated. It may become increasingly important in the future. It may make sense to initiate regulation now in anticipation of a growing role for reclaimed water.

Considerations Favoring Non-Regulation

Reclaimed water faces competition. Users and potential users have alternatives, including not using water or self-supply. Price and supply regulation may prevent market forces from imposing constraints or incentives for the development of this resource. Regulation may create an artificial market or artificially constrain a market from developing.

> *Regulation may create an artificial market.*

The business arrangements between suppliers of reclaimed water and their customers may be complex. Imposition of uniformity through rate and service quality regulation may hamper the emergence of service arrangements that are beneficial to users and suppliers. In some instances contracts may be superior to tariff regulation.

Regulation is costly. Commissions will need to develop additional expertise and resources to effectively regulate the suppliers. Companies engaged in the business will have internal costs associated with regulation. Those costs may exceed the benefits of regulation for the customers.

Regulation may inadvertently shield the suppliers from accountability to their customers and the general public. Utilities enjoy a preferred status in regard to some requirements imposed on non-utility businesses. The importance of this consideration will depend on the exceptions existing in each state.

Companies may be reluctant to enter the business because of regulation. If they perceive a substantial risk and a limit on the possible reward because of profitability caps imposed by regulation, they may seek other opportunities.

Companies may be reluctant to enter the business because of regulation.

Regulation carries with it a perceived guarantee for the continued supply of the utility service. Regulators have few alternatives to meet that expectation in the face of a failing utility company. It may be prudent to avoid the appearance of supply guarantees by foregoing regulatory endorsement of the reclaimed water business.

Finally, there seems to be increasing enthusiasm for a reduction in regulatory oversight of all utilities. Ways are being sought to reduce the traditional regulatory role in other utility services. While most apparent in gas, electric, and telephone, it is clear that reduction in traditional economic regulation is a reality. The imposition of traditional economic regulation on a new class of business may be difficult in many states.

Defining Regulated Entities

The circumstances required to engage the regulatory authority of the commission can be multidimensional. Four classifications of criteria are identified below. The criteria are important because of their use in legislation that defines commission authority and also because they can be used by the commission to define those circumstances in which specific regulatory requirements are applicable. The four primary bases of defining regulatory requirements are the characteristics of the service provider, the product, the delivery system, and the customers. Examples of the differentiations that would be appropriate for reclaimed water regulation are outlined below.

Provider Characteristics
  a. Ownership
    i. Investor-owned
    ii. Municipally owned
    iii. Customer-owned
  b. Legal Organization
    i. Corporation
      (1) For profit
      (2) Not for profit
    ii. Sub-division of government
    iii. Partnership
    iv. Sole proprietorship
  c. Size
    i. Investment
    ii. Revenues
    iii. Number of customers
  d. Date established (grandfathering of existing operations)

1. Product Characteristics
  a. Reclaimed water for irrigation
  b. Reclaimed water for industrial cooling
  c. Water treated to a specified level

3. Delivery System Characteristics
  a. Piped
    i. Exclusively on private property
    ii Within public right-of-ways
  b. Other delivery system

4. Customer Characteristics
  a. Customer type
    i. Agricultural
    ii. Industrial
    iii. Commercial
    iv. Residential
  b. Customer location
    i Outside of a municipality or utility providing the service
    ii Other
  c. Limitation on customers served
    i All within a specified service territory
    ii. Only those with another, primary, relationship to the supplier, e.g. renters of the suppliers property.

iii. Only those entering into specific contracts

Regulation could be imposed based upon any combination of the identified circumstances of the reclamation project. For example, only investor-owned companies serving more than five customers, using a piped system on public right-of-ways might be regulated. There is considerable flexibility in defining the circumstances for regulation should it be desirable to limit jurisdiction. Caution should be exercised in limiting jurisdiction because the limitation may prejudice the business practices of potential reclaimers as they seek to either become regulated or to avoid regulation.

Degree of Regulation

Six categories of commission regulation are proposed as options commissions can consider and the regulatory activities likely to be included within each are discussed. Four of the six options favor “light touch” regulation, one is traditional cost-of-service regulation, and one increases regulatory involvement beyond traditional limits.

No Commission Regulation

With this option, the provision of reclaimed water service is not considered a utility service and is not regulated by the commission. The reclaimed water provider has no obligation to provide the commission with information about its operations or to follow any commission pricing or quality-of-service policies. Even if this option is in effect, the commission may have an interest in the business if it regulates the wastewater services. The reclaimed water operation may substantially affect the costs and/or revenues of the wastewater provider. The wastewater utility may pay the reclaimed water provider to accept wastewater that has not been treated to the levels that are required for stream release. Or the wastewater utility may sell its treated water to the reclaimer. In either case, the policies of the commission in regard to the wastewater utilities involvement with the reclaimed water supplier can affect the likelihood of reclamation activities and the sharing of costs and profits between the wastewater utility and the reclamation company.

Information Requirements

The reclaimed water provider might be required to provide informational filings to the commission. A commission may have the authority to require the information, or legislation may be required. The intent of this level of regulatory oversight is that the commission cannot require the company to change its service offerings, but can only require their disclosure. It is possible that a commission would find that the reclaimed water business is a public utility under its statutes, but that the public interest is best served by the lightest possible regulation. Information filings might include the following:

1. Name of the company, its business and officers
2. The service area
3. Services offered
4. Rates for services

Certification

Certification is a level of commission oversight that entails some verification, review, and authorization. Generally certification means that the commission has found that the service provider has met some commission specified standard. Commonly commissions find that the existence of the company as a utility is a public convenience and necessity. Obtaining a certificate is a major undertaking in some jurisdictions where companies must show in an administrative hearing process that the public interest is served by their proposed operations. In other jurisdictions, obtaining a certificate may be primarily perfunctory. The certification process makes specific information available to the commission, however, as the certification process is "front-loaded" a commission might only obtain start-up information and may not necessarily ever have on going information on rates, operations, or service quality. On the other hand, finding and declaring through a certification process that a reclaimed water operation is a public utility may trigger future oversight authority. A commission can issue a certificate and then have no further active oversight. While not perfectly analogous, this is the practice of most commissions in regard to cellular telephone and other telecommunications resale providers. The commission's potential authority remains intact, but it allows market forces to be the primary constraint on the utility.

Certification is a level of commission oversight that entails some verification, review, and authorization.

The commission's potential authority remains intact, but it allows market forces to be the primary constraint on the utility.

Regulation by Exception

This regulatory option minimizes regulatory requirements imposed on an ongoing basis and, instead, relies on a complaint process to address issues as they arise. Absent a complaint or rate increase action, little or no information is required from a reclaimed water provider. An example of this practice is a rate-setting process that allows a reclaimed water company to propose new rates, perhaps with some limit on the proposals with the commission accepting those rates unless there is substantial objection from, say ten percent of, the customers. Most regulatory oversight could be conducted on an exception basis.

Absent a complaint or rate increase, little or no information is required .

Traditional Rate and Service Regulation

In this option the utility is required to have its specific rates approved by the commission and to have its terms and conditions of service and service quality monitored by the commission. The utility files reports in formats specified by the commission and the commission has access to the information it needs to meet its statutory obligations. Of course there is wide variation in the methods individual commissions use in traditional regulation. Traditional rate and service regulation is differentiated from the policy alternative that follows in that it focuses on the present and recent past in reaching regulatory decisions. The role of the commission in projections of the future is limited.

Business Practices Regulation

The last general classification of regulatory practices includes commission involvement in the operations and planning of the utility. In this mode the commission is not only interested in the current costs of producing the service, or in the current quality of services rendered, but in the degree to which the utility is preparing for the future. The information requirements in this option are significant. The regulation is proactive and may require that a reclaimed water provider follow least-cost or "wise use" standards in ensuring the adequacy of its current and future supply.[4] Company financial projections are required as are projections of the costs and consequences of investments for future service. A commission pursuing this level of regulation has positioned itself to directly affect the growth, improvement, and operations of the utility. The demands on the commission and on the regulated companies can be quite heavy when this regulatory policy is pursued.

Additional Considerations

Structural

Once a reclamation operation is started it may be pursued as an integrated part of the provision of other utility services. Integrated operation of potable water supply, wastewater collection and treatment, and reclaimed water distribution will create a series of cost and revenue requirement allocation issues for the regulator. There is no compelling reason to conduct reclaimed water cost allocations incrementally. In fact, rate making should reflect the current realities of the production of the service. Once the additional costs and the savings associated with the reclamation activity become sunk costs, their recovery should be considered in the same ways and with the same freedoms and constraints of any other sunk cost. Similarly, common costs of operations need not be reflected incrementally in the allocations to wastewater reclamation, even though earlier decisions may have been based on incremental

[4] Beecher, et al., *Integrated Resource Planning for Water Utilities*.

analysis. The only considerations in the original decision making that should be binding are those for which either a contractual commitment exists or for which a commission order constraining subsequent cost or revenue treatment exists.

A simple example of this point is the treatment of billing costs. In a situation where the reclaimed water is used by customers that are not either potable water or wastewater customers of the utilities, there is no compelling reason to calculate reclaimed water billing costs only on the basis of the incremental cost to the utility of adding the reclaimed water customers. In the incremental studies that led to the decision to supply reclaimed water, the proper analytical technique is to consider only the changes to total costs of operation that would occur. Probably, the net change in billing cost changes to add a few reclaimed water customers is small, perhaps even negligible. This is proper for the analysis of the decision to start the reclamation operation, however, once that decision is made and the operation has begun, the proper cost allocation for rate making should be consistent for all customers. Since all of the billing costs must be recovered, the reclaimed water customers should be assigned a fair share of the total billing costs. More costs for billing will be allocated to the reclaimed water customers in rate making than were identified in the decision phase. Note that it is necessary to make this transition, not only for fairness, but also because it is no longer meaningful to assume that the reclamation activity is incremental, it has become part of the embedded operation. In this example the incremental data developed in the planning phase is not relevant. As costs change in the future, the incremental cost estimates developed in the original planning phase will become less and less reliable, so rate making practices should not be completely constrained by the initial analyses.

The reclamation activity may have reduced the cost of treatment of wastewater where the water released must meet a higher standard than the reclaimed use requires. In this case, it may be appropriate to allocate some or all of the savings to the reclaimed water. Revenue requirements for that service would be reduced. The rationale for this calculation would not be just the cost analysis or logic used prior to the initiation of the reclamation activity, but rather consideration of the avoided incremental cost that the utility experiences by continuing to provide the reclaimed water service as compared to stopping the service. Again, it is important to carry out the analysis based upon existing costs and alternatives available in the future, not upon historical factors. There are two reasons that this approach is important. First, this is the basis that promotes sound decision making for the future, an efficiency-enhancing reason. Second, current costs and estimates of cost consequences of future choices can be kept current. The cost estimates used for past decisions grow increasing unreliable and less relevant with the passage of time.

Costs associated with pumping, storage, transmission, distribution and metering of the reclaimed water after it has left the treatment facility should be assigned to the reclaimed water service. Cost allocation and rate design considerations for these services are the same as the well established practices for other utility services.

The utility may have to augment the supply with well water or even potable water.

Service reliability for the reclaimed water may need to be considered in the rate making for the service. If the reclaimed water is to be supplied in the quantities demanded by the customer, the utility may encounter situations where the supply of reclaimed water sold cannot actually be supplied exclusively from the wastewater source. The utility may have to augment the supply with well water or even potable water. The costs of supply augmentation must be considered in the rates of "full-demand" service. In these circumstances it may be necessary to adjust test year results in a rate making proceeding to normalize for the conditions that affect the need for the utility to augment the reclaimed water supply. Alternatively, the customer may benefit from "interruptible" water rates.

Regulation and Cost/Benefit Analysis

In the examination of a proposed wastewater reclamation project the expected costs and benefits are identified. A full discussion of the cost/benefit analysis underlying a “go/no-go” decision for a proposed reclamation project is beyond the scope of this report. However, there are several specific considerations arising from rate regulation that are discussed. Identification of the unique characteristics of a rate regulated wastewater utility will allow analysts that do not normally conduct studies of this class of business to incorporate special regulation considerations. For commissions, identification of considerations that arise because of their regulatory role will help assure that orders generated in the project development and approval process are sufficient to guarantee interpretations after the project is in service which are consistent with the decision parameters used in developing the project.

Revenue Requirements

Most regulatory analyses conducted by commissions use the revenue requirement as the dependent variable. That is, all costs are calculated, a model of the rate making process is run, and the required revenue to support the operation incorporating the rate making standards is determined. Normally, this result is converted to typical bills by using the commission’s standard revenue requirements allocation methods and the billing parameters for the company. Commissions have experience in judging the reasonableness of the results on a revenue requirements and typical bill basis. The decision parameter most frequently used in non-regulated firms estimates revenues based upon projected sales at prices constrained by market forces, subtracts cost projections, and arrives at profit projections. Those profit projections are the decision parameter for non-regulated analyses. These two methods are very similar in initial application. They vary significantly in the means used for subsequent adjustments

In the non-regulated case, if the initial analysis indicates that the project is not profitable, adjustments focus on reducing costs and increasing sales volume. Prices remain a function of the market for the product and can only be changed by marketing strategies of the company. In the regulated case, infeasibility arises when the commission judges that the rates are not acceptable. Reallocation of revenue requirements among the customers is an option which may lead to a set of rates that the commission judges reasonable. Commissions have some ability to move revenue requirements “up stream” to wastewater service users or down stream to reclaimed water users. Commissions have some ability to move revenue requirements in time, i.e. to delay the recovery of some costs. Using these tools, commissions can seek a set of rates and a pattern of cost recovery that it finds reasonable. It is important to recognize that the acceptability of the rates is a judgement made by the commission, which may not be subject to a rigorous market test. Specifically, reclaimed water service prices will not normally be tested by the entry of alternative suppliers into the company’s market. Cost reductions and sales volume increases are possible means to reduce rates, which can be considered in essentially the same way for regulated projects as they are for non-regulated projects.

Prices remain a function of the market for the product.

Revenue Requirement Allocation

Because of its close relationship with the wastewater utility, a commission may be able to impose a reasonable cost allocation strategy between the wastewater customers and the reclaimed water customers. Such a strategy may not be achievable if both services are not regulated. To the extent that the initial cost/benefit analysis leads a commission to conclude that benefits from the overall reclamation program justify a specific cost allocation method, the commission should document that conclusion through its orders. This practice can serve as a guide to future commissions in addressing cost allocation issues. The establishment of a predisposition for a specific regulatory treatment would be particularly important in those instances where externality benefits are necessary to justify the project on a cost/benefit basis. The commission originally considering the project may find that it is reasonable to charge wastewater customers a higher cost because they are recipients of the externality benefit. Without such documented guidance, subsequent commissions may be unable to justify the cost allocation based upon the initial analysis. Where the reclaimed water operation is separate from the wastewater operation, a commission could authorize a contract between the two with favorable treatment for the reclaimer because of the externality benefit to the customers of the wastewater utility. These kinds of public policy arrangements are rare or non-existent outside of government ownership and regulated utility operation.

Accounting Flexibility

A third characteristic of regulated companies is the ability of the regulatory commission to enter orders that affect the accounting practices of the regulated company. For example, commissions have authority to order the creation of accounts that accumulate costs for later recovery through regulated rates. Regardless of the constraints placed upon the reporting of results for investors and tax authorities, the commissions have considerable latitude in their subsequent treatment of deferred costs. The most common special accounting treatment for regulated utilities is the booking of construction work in progress (CWIP) and the accumulation of deferred earnings on those balances for subsequent recovery, allowance for funds used during

> *It may not be possible to secure the financing necessary to generate cash when needed without the commission's endorsement of special accounting treatment*.

construction (AFUDC). Some commissions have allowed the continuation of AFUDC after utility plant has gone into service, a practice known as post in service AFUDC. A policy such as this for reclaimed water operations may be important when a sizeable investment is necessary well before the market for the reclaimed water is fully developed. The flexibility inherent in the special accounting treatments available through regulation allows commitments to be made to projects when the timing differentials between cost incurrence and cost recovery is a problem. The use of discounted cash flow analysis in the cost/benefit analysis is helpful here. However, in some cases it may not be possible to secure the financing necessary to generate cash when needed without the commission's endorsement of special accounting treatment in a way acceptable to those providing project financing.

Regulatory Treatment of Related Utilities

A proposed water reclamation operation may have affects on established utilities that need special consideration by the commission. If the reclamation operation relieves the wastewater utility of some of its treatment responsibilities, the wastewater utility may no longer use some of its plant. Since, under normal circumstances, recovery of the investment in plant by a utility requires that the plant be "used and useful," the wastewater utility may have an incentive to resist the initiation of the reclamation project. A commission may be able to overcome this incentive by allowing the recovery of the costs of the displaced plant. The recovery of prudently incurred costs are frequently allowed even if the plant is not fully utilized because of changed circumstances. The initiation of a water reclamation project may be such a changed circumstance. The commission may use some test of reasonableness of the resulting rates. If it can be shown that the customers of the wastewater service

> *Reasonableness might be justified by the attribution of the externality benefits.*

provider are no worse off by the initiation of the project and payment of the costs associated with the displaced plant than they would have been without the reclamation project, then the allowance of recovery could be considered reasonable. Reasonableness might be justified by the attribution of the externality benefits enjoyed by those customers, even if they were faced with somewhat higher rates. Allowing recovery of the cost of wastewater treatment plant displaced by an approved reclamation initiative as a matter of commission policy is a possible means for the commission to provide an incentive for water reclamation activities.

Commissions may also need to consider the affect of the reclaimed water program on the demand for potable water. Some reclamation projects may provide water that replaces water previously provided by the potable water utility. The resulting loss of potable water revenues could be a disincentive to the current water supplier. Individual commissions may have the latitude to assure the potable water supplier that they will not be made worse off by the introduction of a reclaimed water supply. Such a policy may encourage incumbent potable water companies to initiate reclamation projects, or at least not resist them. The commission can consider the long-term interests of the public and the customers and use their considerable discretion to develop programs that are beneficial and have the appropriate incentives for participants.

The Product

The product offered to the customer by the reclamation operator may vary in quality, quantity, and terms and condition of service. The product quality may be constrained by what is required for discharge by the environmental and health authorities of the state. Further, the quality, that is the impurities permitted or desired in the water, will depend on the needs of the customer.

In addition to the physical characteristics of the delivered reclaimed water, the amounts of water to be provided and the timing of deliveries are important parameters defining the reclaimed water service. Most utility services are supplied on a full-requirement basis. The utility agrees to provide the service in the quantities desired by the customer when demanded by the customer. The reclaimed water service may be provided on a full-service basis, or the serving company may restrict the availability of service to some level or at some time periods, presumably based upon its ability to acquire the reclaimed water. Service limiting concepts such as "best efforts," or contractually scheduled deliveries may be used. In some cases the reclaimed service provider may be able to augment its reclaimed water and may be willing to meet full-service requirements. Rate structures or contract terms may address the provision of more costly supplies when there is inadequate reclaimed water to meet customer needs.

Service limiting concepts such as "best efforts," or contractually scheduled deliveries may be used.

A reclaimed water provider may have a service quality condition that is relatively rare for utility services to end users. The reclaimer may need to agree to take all of the wastewater from a treatment plant in order for the treatment plant to gain savings from a lowered treatment level. The reclaimer may, in turn, require its customers to absorb that supply. Tariff or contract terms specifying a minimum consumption level, or even requiring customer acceptance of all the reclaimed water offered by the supplier can be expected in this business.

Interests To be Considered

When considering the affects of the operations of any utility, the interests are can be considered in four groups:

1. The general public interest
2. The interests of the customers as a group
3. The interests of the individual customer
4. The interest of the utility, including investors and employees

The benefits accruing from a wastewater recovery project are dispersed in time and space. This can be represented graphically. Figure 6-1 shows the time dimension and a space[5] dimension. The benefits are indicated on the cart. Benefits are represented by the letters. Larger letters indicate larger benefits.

The “e” is an environmental improvement benefit. These benefits are small, numerous and widely dispersed in time and location.

[5] The concept of “space” here is not purely geographic. Space refers to the area of interest of the entity being considered. In the case of a regulatory commission, the space of interest will have geographic bounds and will also be bounded by the scope of its authority and responsibility.

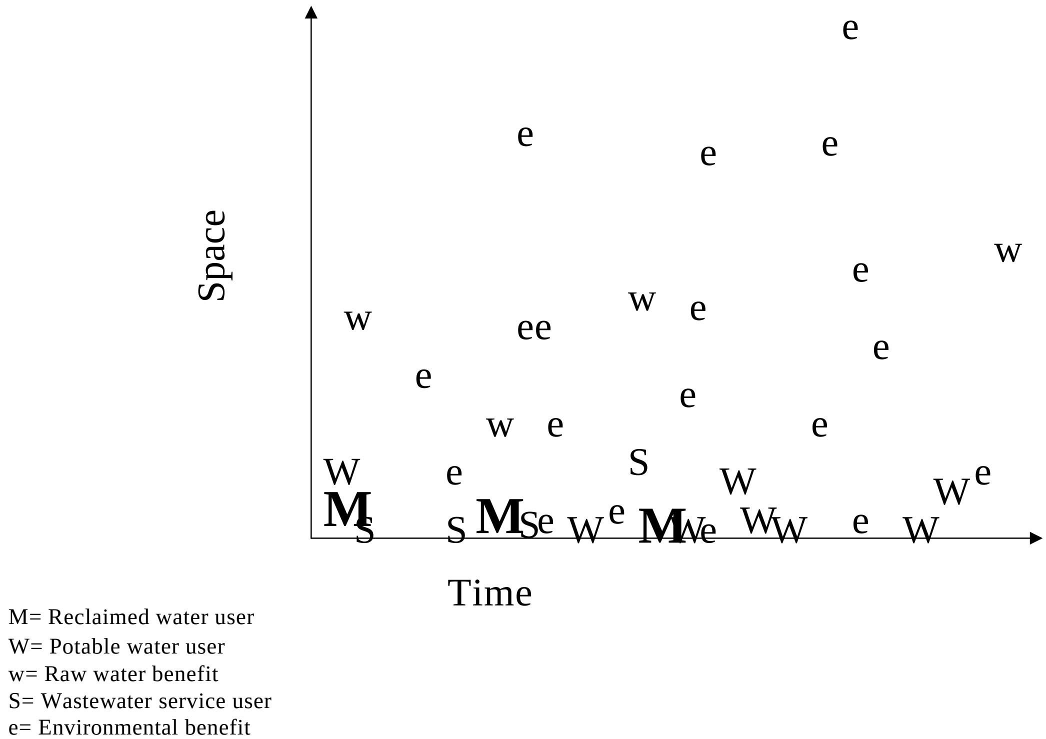


Figure 6-1: Distribution of benefits from a reclamation project.
Source: Authors' construct.

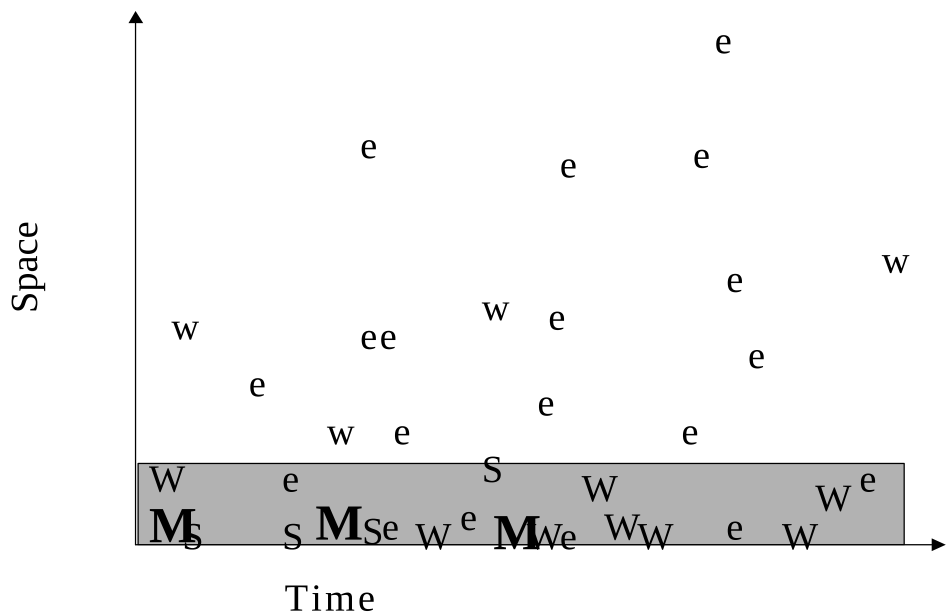
The "S" is a savings benefit from reduced wastewater treatment costs. The location of these benefits are close to the base line and they are distributed in time.

The "w" is a benefit from improvement in the raw water supply. While not as dispersed as the general environmental benefits, there are many beneficiaries some located quite remotely from the reclamation project.

"W" benefits are savings in the treatment of potable water. These are likely to be realized close to the reclamation project.

The “M” benefits are those realized by the users of the reclaimed water. They are all located on the zero location axis, indicating that they accrue coincident with the project. The “M” benefits are relatively large.

The shaded area in figure 6-2 represents the interests of the users of the reclaimed water. They are the beneficiaries of the consumption of the reclaimed water. Since they pay for the water they consume, they may be willing, or a regulatory body may be willing to require, that the rates they are charged include some measure of the benefits they receive beyond the direct costs of the reclaimed water. The ability to capture the benefits from the project within the transactions between the supplier and buyer of the reclaimed water are limited by the fact that benefits accrue to individuals in the unshaded portion that is outside of the time and space area of the provider. One



M= Reclaimed water user
W= Potable water user
w= Raw water benefit
S= Wastewater service user
e= Environmental benefit

Figure 6-2: Service area of reclaimed water provider.
Source: Authors’ construct.

way to think of figure 6-2 is that a water reuse project can only be cost-justified when enough of the beneficiaries are contributing to the costs. While cost-causation is a standard regulatory principle, the service territory of the utility (the shaded area) may not coincide with the geographic location of the beneficiaries. If the project cannot cover its costs by charges to the users in the shaded area, then it will not be pursued unless additional benefits from the unshaded area can be transferred to the provider.

Figure 6-3 shows that some benefits may coincide with the shaded service area of the potable water supplier servicing the area of the reclaimed water supplier. When compared to figure 6-2, the representation shows that the potable water supplier's service territory may not exactly coincide with that of the reclamation operation.

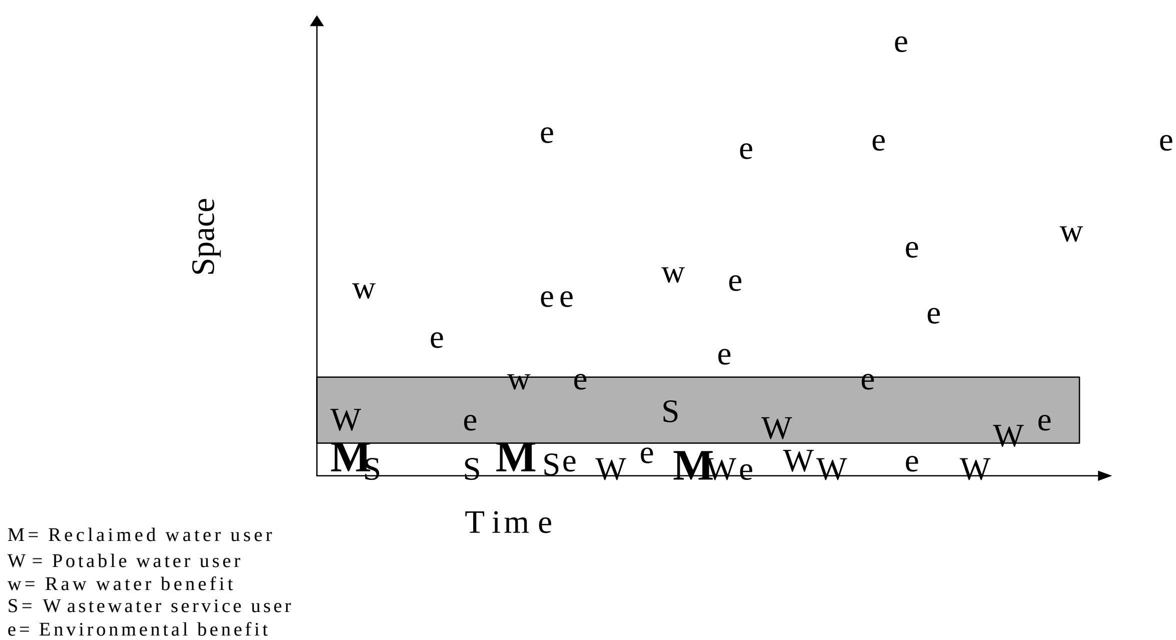
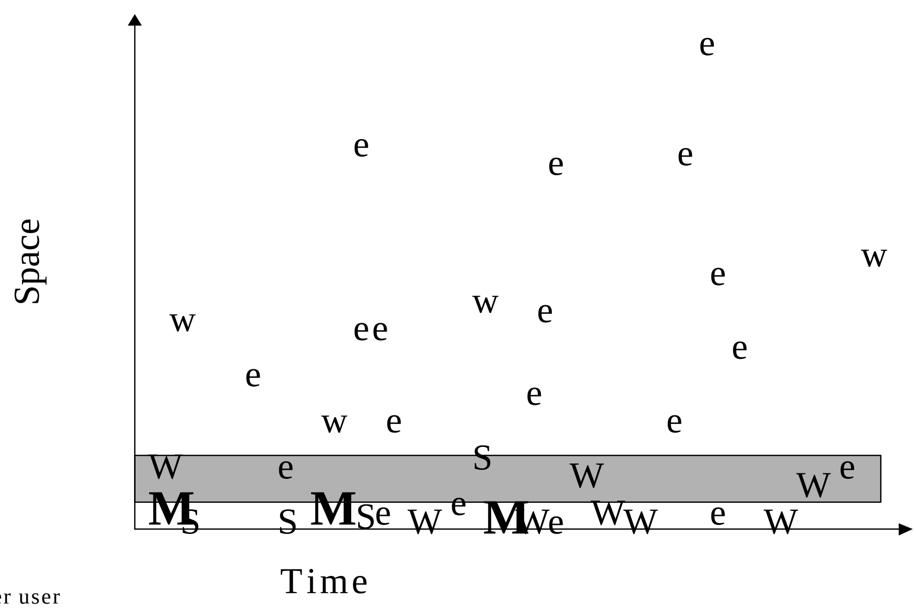


Figure 6-3: Service area of potable water provider.
Source: Authors' construct.

Figure 6-4 shows the benefitted, shaded, area of the wastewater treatment utility supplying the water to the reclaimer. This area does not necessarily correspond to either the reclaimed water utility's service area or that of the potable water supplier. Therefore, the benefits that are achieved for the customers may not be the same as those of the other two utilities. Whatever benefits are realized by the customers of the wastewater utility might reasonably be considered for contribution to the costs of providing the reclaimed water service.

If all three of the benefitted areas are combined because the provider of each of the three services are the same entity, then the benefits can be used to justify the costs within the cost allocation and revenue collections of that entity. If this combined entity is regulated by a state commission, the commission would need to authorize, through its cost allocation methods, those transfers.



M= Reclaimed water user
W= Potable water user
w= Raw water benefit
S= Wastewater service user
e= Environmental benefit

Figure 6-4: Service area of wastewater service provider.
Source: Authors' construct.

A wider net might have to be cast to capture more remote benefits. For example a municipality or a water district would be expected to consider a broader set of benefits. The shaded area in figure 6-5 indicates the broader scope of interests of such a body. If a state commission or municipality are able to convert more dispersed benefits through taxes or potable water rates into revenues for the reclamation provider, then they may be able to facilitate a reclamation project that could not be justified within the scope of previously identified benefitted groups. The wider jurisdictional net may capture enough of the benefits to cost-justify a project.

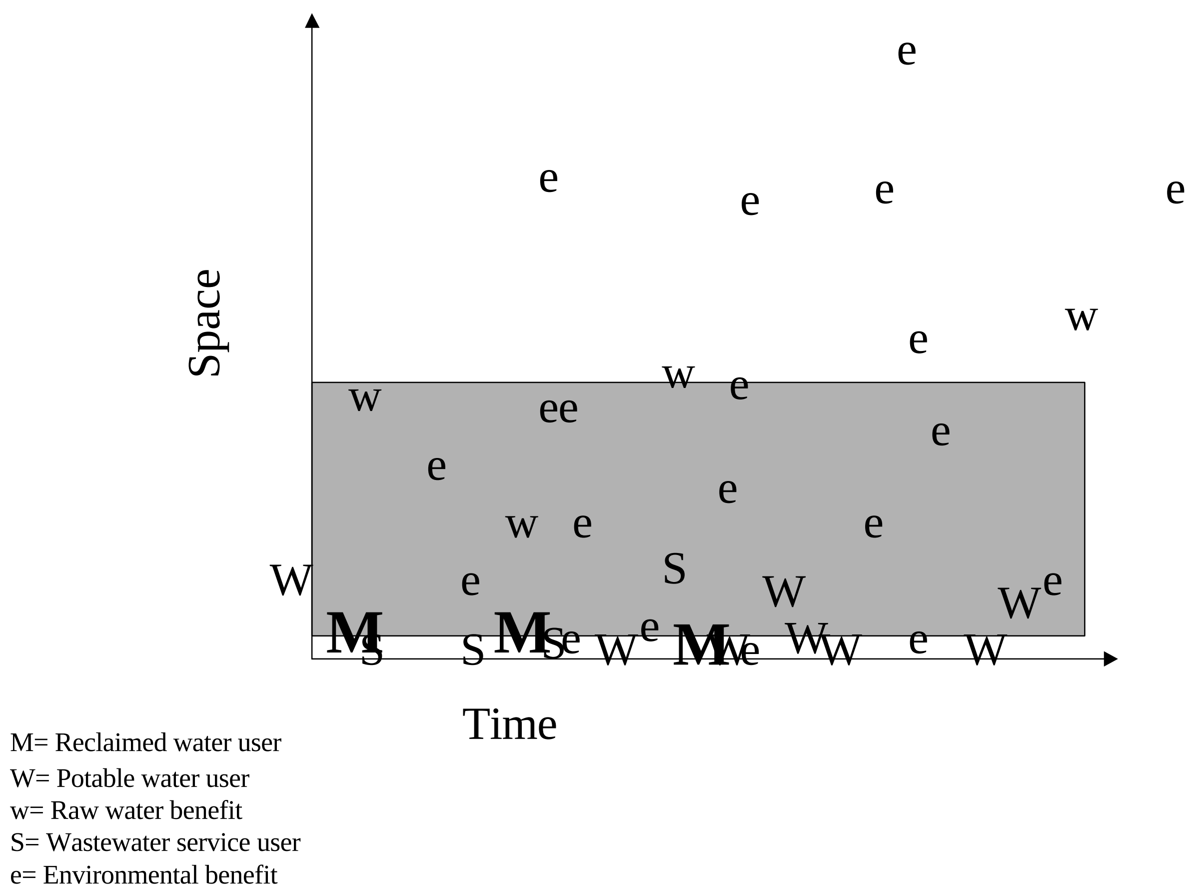


Figure 6-5: Water district or municipality
Source: Authors' construct.

As shown in figure 6-6, a state-wide consideration of benefits is possible. In most cases nearly all benefits would fall within a state-wide perspective. An interstate compact or federal action could provide for contributions from beneficiaries beyond a state's borders. However, full alignment of costs with beneficiaries would require the willingness of an authority to impose the costs across a broad base and deliver the resulting monies to the reclaimed water providers. No state commission has been called upon to invoke this approach. Such an approach may be appropriate for legislative action authorizing general tax revenue support for water reclamation projects when existing cost assignment mechanisms are insufficient.

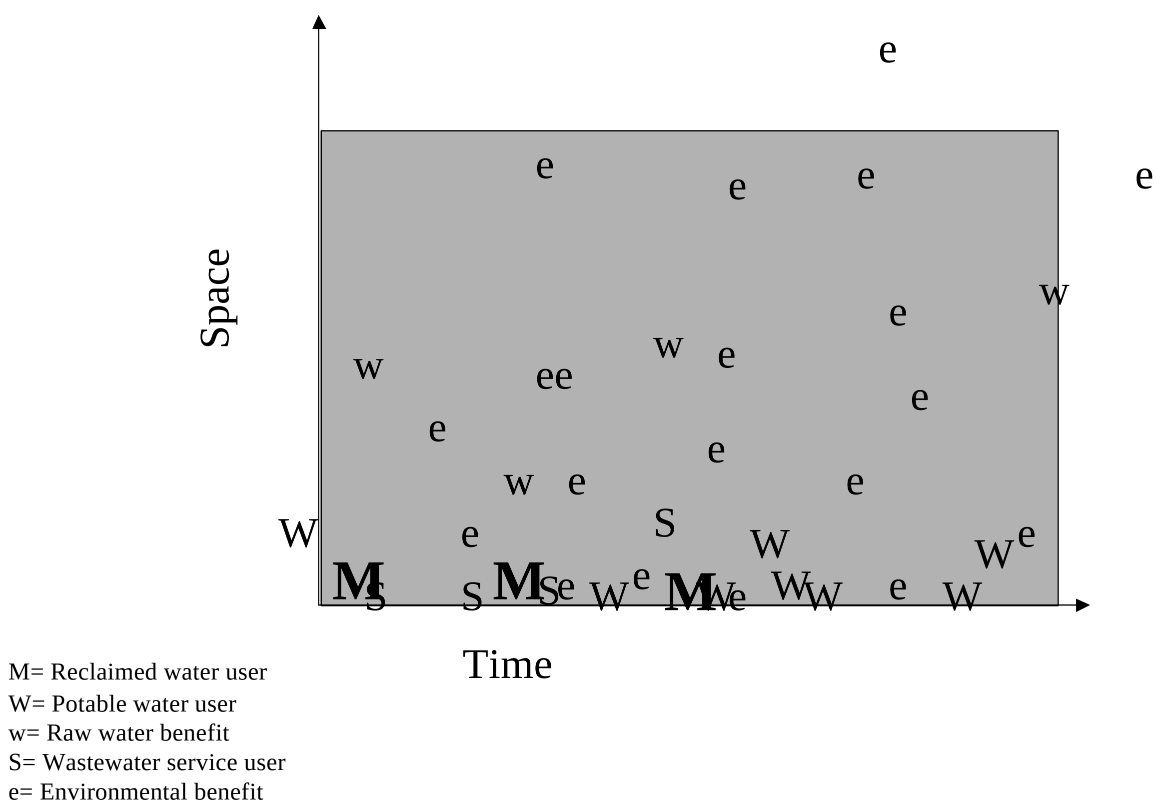


Figure 6-6: State-wide.
Source: Authors' construct.

The role of a commission in water reclamation decisions depends on the scope of its authority and the degree of coordination or integration its programs have with other governmental agencies. When the commission has jurisdiction over the reclaimed water provider, the potable water provider, and the wastewater service provider then the costs and benefits within the area of all three would be relevant considerations to the commission. If the commission's programs are integrated with those of other state agencies, the scope of the public policy decisions would encompass the areas of responsibility of all the integrated agencies and the authorities of all agencies could focus on the state's water reclamation program.

A Comparison of Business and Public Policy Discount Factors Approaches

For those responsible for constructing and operating a water reclamation project the decision to proceed is essentially a business decision. There must be sufficient resources made available to the reclaimed water provider to cover the costs of the service, including reasonable returns on investment. Business decision making is organized around the concept of discounted cash flow and it's impact on subsequent business decisions. A public policy decision methodology, using analogous discounting methods, may similarly serve to assess costs and benefits to businesses as well as sellers, and the general public.

Table 6-1 shows the discount factor applicable to the cost or benefit when evaluated as a business decision where T is the time discount factor. For an individual cost or benefit the factor $T=1/(1+I)^n$ where I is the discount rate and n is the number of years from the present that the effect occurs. Costs and benefits of the past or accruing to those outside of the business transaction are given no weight as indicated by the 0 factors.

TABLE 6-1
BUSINESS DECISION DISCOUNT FACTORS

	Past	Current	Future
Buyers and Sellers of Service	0	1	T
Constituency of Decision Makers	0	0	0
Non-Constituent General Public	0	0	0

Source: Authors' construct.

Table 6-2 shows the discount factor to a cost or benefit as it is evaluated by a public policy decision maker. The time discount factor, T, is the same as in the preceding table. Its presence in the "past" column indicates the likelihood that the decision maker will take into account past, accumulated, costs and benefits which are not considered in pure business-financial decisions. The additional elements are P and G. P is an indicator that the public policy decision maker may not give the same weight to costs or benefits effecting the principals in a transaction as the principals would. The G factor indicates that the public policy decision maker may give weight to effects outside his or her jurisdiction.[6]

[6] The decision criteria is: $\sum_n D_n b_n - \sum_m D_m c_m \geq 0$, where b is an individual benefit, c is an individual cost, D is the discount factor applicable to the respective cost or benefit, n is the number of benefits considered and m is the number of costs considered. The criteria simply states that the sum of the discounted benefits must equal or exceed the sum of the discounted costs.

TABLE 6-2
PUBLIC POLICY DISCOUNT FACTORS

	Past	Current	Future
Buyers and Sellers of Service	P X T	P	P X T
Constituency of Decision Makers	T	1	T
Non-Constituent General Public	G X T	G	G X T

Source: Authors' construct.

The differences in the two tables helps clarify reasons for differences in the decisions reached by public policy makers and business entities. Costs and benefits that enter into the calculus of the public interest do not necessarily appear in the business decision model. When public policy considerations indicate the desirability of water reclamation, but the business decision model does not support it, intervention may be appropriate to improve the business prospects of the projects. Essentially this is done by transferring costs and benefits among the affected parties.

Recalling the earlier figures showing the distribution of costs and benefits in time and space, this means that the business model inherently can only capture and assign costs to the "M" values. It does not assign costs and benefits to the other affected entities. The regulator, a city council, or state legislature can assign costs to all beneficiaries within their respective jurisdictions. Equally, just because the public policy model allows consideration and evaluation of a wider range of cost and benefit assignments, this does not mean that the policy maker will actually transfer all costs or approve a specific reclamation project.

Many of the transfer mechanisms available are identified in Table 6-3. These conceptual transfer mechanisms are necessary to assign costs to beneficiaries. Some transfers are directly administered by a commission, while others may require legislative action. No one reclamation project is likely to require the application of all of the possible transfer mechanisms.

Table 6-3 presents a number of transfer mechanisms that can affect an individual reclamation project. The value of the costs and benefits are what are transferred. Not all costs and benefits are transferred in any project. The table is useful in identifying the transfers that may be necessary to make a reclamation project feasible. It can contribute to the decisions concerning the regulation of the industry by the public service commission because some of the transfers are facilitated by economic and rate regulation. If the cost and benefit transfers necessary to make projects feasible in a state are facilitated by economic regulation, then a strong case can be made to adopt it. On the other hand, if the economics of reclamation and the value of the reclaimed water are such that projects will go forward without economic regulation, then regulation may not be appropriate.

Regulation by the state public service commission is most compelling when the related services, potable water or wastewater treatment, are regulated by the commission. This is because of the transfer payments expected among the related services. Where the related services are regulated the commission will need to evaluate those transfer payments. If the reclaimed water provider is one of the regulated, related utilities, that evaluation will be internal to the company. If the reclaimer is an independent entity, the transfers will need to be included in the review of the regulated companies costs for rate making purposes.

Since the public service commission does not have general taxing authority or the ability to directly administer general subsidy arrangements, the effect of commission regulation on those transfers depends on the value other state agencies assign to

TABLE 6-3

RECLAMATION COST AND BENEFIT TRANSFER MECHANISMS

COSTS

Cost	Bearer of Cost	Transfer Cost To:	Transfer Mechanism	Enforcer of Enforcement Method
Capital investment in facilities	Reclamation provider	Equity investors	Convert to periodic cost over the life of the project	Generally accepted accounting practices or regulatory accounting practices
Capital investment in facilities	Reclamation provider	Debt holders	Convert to periodic cost by financing	Bonds of contract between provider and debt holders
Periodic costs of capital over the life of the project	Equity and debt holders	Users of service	Include costs in rates charged (depreciation)	Reclaimed water market or rate regulator
Operating costs	Reclamation provider	Users of services	Include costs in rates charged	Reclamation market or rate regulator
Reduced revenue for potable water	Potable water provider	Potable water customers	Raise potable water rates	Rate regulator
Reduced stream flow	Down stream raw water users	Reclaimed water provider	Penalty or prohibition of reclamation	Water or taxation authority

TABLE 6-3 (Continued)
RECLAMATION COST AND BENEFIT TRANSFER MECHANISMS

BENEFITS

Benefit	Beneficiary	Transfer Benefit To:	Transfer Mechanism	Enforcer or Enforcement Method
Use of reclaimed water	Reclaimed water customer	Reclaimed water provider	Rates charged for service	Reclamation market or rate regulator
Reduction in wastewater treatment costs	Wastewater treatment provider	Reclaimed water provider	Payment to reclaimer for accepting wastewater, or internal benefit if reclaimer is wastewater service provider	Contract or rate regulator
Payment to reclaimer for wastewater acceptance	Wastewater treatment provider	Wastewater treatment customers	Include costs in rates	Rate regulator
Savings in wastewater treatment	Wastewater treatment provider	Wastewater treatment customers	Reflect savings in rates	Rate regulator
Avoided potable supply expansion costs	Potable water provider	Reclaimed water provider	Money payment to reclaimer or internal benefit if reclaimer is potable provider	Contract or rate regulator
Reduced demand for raw water	Many water users	Reclaimed water provider	Subsidy to reclamation provider	Taxation authority and subsidy administrator
Reduced pollution	Many citizens and firms in area	Reclaimed water provider	Subsidy to reclamation provider	Taxation authority and subsidy administrator
Economic development	General vicinity public	Reclaimed water provider	Subsidy for reclamation provider	Taxation authority and subsidy administrator

Source: Authors' construct.

commission regulation. For example, there may be a greater willingness to provide subsidy to an investor-owned company that is regulated than one that is not. Regulation in that instance facilitates the provision of the service.

Conclusion

The decision to authorize public service commission regulation of wastewater providers may depend on the necessity of commission regulation to maintain authority over critical elements of the operation of existing utilities and the degree to which economic regulation facilitates the transfer of reclamation benefits to the providers of the service. The traditional commission role in protecting the customer from possible abuses by the utility service provider are not as compelling in the case of water reclamation service as it is for potable water service. On the other hand, commission regulators with their technical, engineering, accounting, administrative and financial expertise and resources may be best suited to identify, assess the need for, and enforce important transfer mechanisms.

Go to Chapter 2

CHAPTER 7

SELECTED CASE STUDIES

In this chapter, three cases are presented that consider reclamation in Florida, Texas, and California. The purpose of the following case studies is to examine the factors that have made water reclamation possible in different areas. In all three cases, the circumstances and costs, the uses identified for the reclamation activity, and the benefits realized from area to area are examined. These cases will demonstrate the usefulness and applicability of the cost methodology presented in this report.

The focus of each case ranges from the activities of a single commission regulated utility, as in the California case, to the reclamation activities of an entire state, as in the Texas case. As a result, there is considerable variation in the content of each case study, illustrating the different aspects of water reclamation that regulators may face. Using this approach, the regulatory implications resulting from existing and potential water reclamation activities are identified in order to give commissions a 'heads-up' on the issue of water reclamation.

Florida

In the following case, reclamation activities in the South West Florida Water Management District (SWFWMD) are presented. This case was chosen because it identifies important factors affecting reclamation decisions. The focus of this discussion is on the non-commission regulated reclamation activities of the City of Largo and the commission regulated reclamation activities of the Rotonda West Utility Corporation. The reclamation activities chosen for this case study have commonalties and differences. Differences result from the type of utility ownership, municipal compared to investor-owned, and the funds available for reclamation. Commonalties reflect similar geographic condition and supply needs. Because both activities occurred for the same reason, in the same general geographic locality, under different schemes of utility ownership, and regulation; a comparison of these activities helps identify the limitations to water reclamation activities due to revenue requirements. The circumstances, costs, uses, and benefits in the water management district are identified briefly to aid in the comparison and present a holistic view. Also, the issue of rate determination and the role of the Florida Public Service Commission is addressed.

Background

In Florida, county governments have the choice to regulate investor-owned water utilities or to pass on the responsibility to the Florida Public Service Commission (PSC). The Florida PSC regulates water utilities in 39 of the 67 counties. The 67 counties are each part of one of five water management districts. The five water management districts establish their own rules and may require the implementation of water conservation measures when conditions are economically, environmentally, or technologically feasible.[1] At least one district mandates that reclaimed water be used when it is readily available, and when conditions are economically, environmentally, or technologically feasible. Florida statutes mandate that all prudent reclamation costs of commission-regulated utilities be recovered through rates.[2] Cost recovery is permitted through adjustments to water, wastewater, and reuse rates set by the Florida PSC. This legislation has led to the development of two key issues that face the Florida PSC: when is cost allocation appropriate and what are appropriate rates?

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[1] *Florida Administrative Code, Rule 40c - 2.301(4)(e)*.

[2] Section 367.0817.

Circumstances and Costs

Prior to water reclamation activities, the County of Pinellas supplied potable water and the City of Largo received wastewater influent at a treatment plant for treatment and disposal. Largo implemented their water reclamation project to reduce water withdrawals and lower pollution discharges. Pinellas County continues to supply potable water to the city while the city, itself, maintains and operates sewer, treatment, and, now, reclamation facilities. The costs involved include the additional costs of moving from an existing disposal method to a new wastewater effluent reclamation method. These costs include storage facilities, transportation, collection, and distribution costs. Through a cooperative funding program offered by the SWFWMD, the City of Largo received half of the necessary funds to implement their reclamation project. Estimates indicate that final cost of the system will total approximately $14.5 million, with roughly $7.25 million achieved through contributions. Money obtained from the matching grants covered transportation and storage costs. The additional costs of bringing a customer on-line and supplying the reclaimed water are paid by the city.[3] Partial cost recovery occurs through the collection of connection fees ranging from $312.50 to $1,500.50 and associated user rates. Residential users, within the city limits pay a flat fee of $7 per month per acre. Residential users outside of the city pay a flat rate of $8.75 per month per acre. Commercial and industrial rates are metered and priced at $.20 per 1000 gallons. According to Andrade, rates were not set with the intention of making money or breaking even. It is believed that cost recovery could only be possible at rates close to potable water rates.

Rotonda West Utility Corporation is a developer-owned water utility in the SWFWMD regulated by the Florida PSC. Rotonda began selling reclaimed water in 1994 to a considerably smaller service area than the City of Largo. Water reclamation

[3] Interview with Anthony Andrade, Reclaimed Water Information Specialist, City of Largo, FL.

was chosen to minimize potable water use and ease the stress on potable water supplies. Prior to the water reclamation project, Rotonda supplied potable water and received wastewater influent for advanced wastewater treatment.

The total cost of the reclamation system required a capital expenditure of $300,000 and was financed through a loan.[4] The costs incurred through the expansion of reclamation activities included collection, storage, and distribution costs. Treatment costs are not included because the treatment facility already existed and treatment costs are met through sewer rates. The Florida PSC granted reuse rates at $.35 per 1000 gallons to ensure reclamation cost recovery through rates. In its determination, operating and capital costs of all services were scrutinized by the Florida PSC to ensure equity.

Uses

The SWFWMD uses reclaimed water for irrigation, industrial activity, urban, and recreational purposes. The City of Largo's water system is a dual distribution system that delivers reclaimed water to a substantial customer base. Currently, the water reclamation delivery area includes 2,500 residential connections and 64 commercial connections at costs ranging from 10 to 12 million dollars.[5] Of the 64 commercial users, the large-volume users include the Pinellas Power Plant, a pharmaceutical company, a defense contractor, and the Home Shopping Network. In the City of Largo, reclaimed water is used for irrigating residential properties, businesses, parks, and schools. It is also used for the irrigation of food crops.

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[4] Interview with Kathy Unger, Rotonda West Utility Corp.

[5] Anthony Andrade, City of Largo.

The Rotonda West Utility Corporation supplies reclaimed water for irrigation and urban reuse. Reclaimed water customers include two golf courses and approximately 40 residential homes.[6]

Benefits

The Floridian aquifer is the primary fresh water source in the SWFWMD. Below average rainfall, excess water withdrawals, and heightened demands have stressed this aquifer and other adjacent aquifers to such extremes that permanent water restrictions have been mandated by the SWFWMD. These conditions led to the development of the Consumptive Use Permit Reuse Credits Policy (CUP) initiated by the SWFWMD. CUP allows utilities providing reclaimed water to increase fresh water withdrawals by 50 percent of the amount of reclaimed water provided.[7] Both utilities have reportedly eased some of the stress on the aquifer through their reclamation activities.

The City of Largo, in addition to stabilizing its water supplies, has identified several other benefits resulting from water reclamation. The first benefit is reduced monthly water bills for certain users. Because Largo supplies reclaimed water at a fraction of the price of potable water, this has allowed reclamation water users to reduce their monthly water bills. Second, reclaimed water users are also able to save some of the fertilizer costs normally incurred when potable water is used for irrigation. Finally, the City of Largo has reduced the amount of effluent discharged into Tampa Bay by roughly half.

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[6] Kathy Unger, Rotonda West Utility Corp.

[7] Florida Public Service Commission, *Memorandum on Docket No.950336-WS, Rotonda West Utility Corp - Application for Rate Increase* (Tallahassee, FL: Florida PSC, 1995).

The Florida PSC acknowledged several benefits of the reclamation activity implemented by Rotonda West.[8] The first benefit recognized was that the stabilization of ground water supplies is environmentally sound. Second, the need to develop additional water supplies is postponed. Similar to the City of Largo, this has translated into savings to water users.

Conclusion

Both of the water reclamation activities considered in this case were implemented because of impending water supply problems in the SWFWMD. Although there is some variance in the types of uses between the activities, the most significant difference between the two projects is the total size of the water reclamation project. The size of each project reflected the total capital investments associated with each project and expectations regarding cost recovery.

> *Water reclamation activities were implemented because of impending water supply problems.*

The costs of the City of Largo's water reclamation project are greater than projected revenues. In fact, a high-end estimate of possible revenues based on the existing system is less than $3 million per year. These revenues may cover operating and maintenance expenses, but will not allow for capital cost recovery.

The costs of the Rotonda project are less than reclaimed water revenues.[9] The Florida PSC sets rates for wastewater and for reclaimed water. Those rates are set to recover all prudent costs of the reuse system and the wastewater system. While cost allocation methods may vary, causing differing interpretations of the degree to

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[8] Ibid.

[9] Kathy Unger, Rotonda West Utility Corp.

which a specific service covers its costs, Rotonda may be an example of the wastewater system users benefitting, through rates, from the reclaimed water activities of their supplier.

The most important benefit resulting from the combined water activities is a lower demand for potable water and thus, a stabilized water supply.

Traditional regulator principles and procedures were sufficient to ensure a financially viable project.

From an environmental stand point, excluding all other benefits identified, this benefit is greater than costs in both projects. Water reuse projects contribute to stabilization of the Florida aquifier and help control pollution of the surface waters. Basically, the circumstances of the SWFWMD demanded conservation and promoted the success of the reclamation projects discussed in this case. For the City of Largo the environmental and other benefits accruing from a large scale reclamation project allowed the water district to impute benefits and defacto assign costs to a larger set of beneficiaries than the City of Largo could have done. In the smaller scale Rotonda reclamation project, traditional regulator principles and procedures were sufficient to ensure a financially viable project.

Texas

Texas is a unique case study because, although water reclamation occurs at a large number of utilities, no investor-owned utility is involved in water reclamation.[10] This is especially significant in view of the large amount of water reclamation in Texas. Unlike the two Florida cases, this case study does not focus on one specific utility. Rather, this case broadly presents water reclamation within the entire state of Texas

[10] Interview with Doug Holcomb, Texas Natural Resource Conservation Commission.

from the standpoint of the Texas Water Development Board and the Texas Natural Resource Conservation Commission.

Background

Water reclamation has been practiced in Texas since 1925. Initially, reclaimed water was used only for irrigation purposes. Currently, some 85 utilities in Texas operate specific reuse projects and over 350 utilities are permitted to dispose of effluent through irrigation. The Texas Water Development Board has found water reclamation to be a critical component of Texas' overall water management policy. The following excerpt from a paper published by the Texas Water Development Board reinforces this point:

> "Water reuse alone will not solve Texas' water problems, but it must and will be part of the solution. Our state has already developed 75% to 80% of its conventional fresh water resources. Reuse, conservation, desalting, and other innovative methods of meeting future demand for water must be employed if the state's economy is to continue to prosper. Taking steps now to insure that reuse can achieve its maximum economic potential is an important opportunity that must not be overlooked."[11]

As a result, the Texas Administrative Code includes strict and comprehensive guidelines on the reuse of water. These guidelines are contained in the Chapter 310 Rule - Use of Reclaimed Water (Appendix A). Chapter 310 applies to every aspect of water reclamation within the state, ranging from permit requirements to the quality and use of reclaimed water.[12] Chapter 310 does not, however, mandate water

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[11] Abu Sayeed and H. W. Hoffman, *The Potential for Water Reuse in Texas* (Austin, TX: Texas Water Development Board, January 27, 1995).

[12] Texas Administrative Code, Chapter 310, Rules - Use of Reclaimed Water.

reclamation.[13] Also, unlike Florida and most other states, water is regulated by the Texas Natural Resource Conservation Commission, which is charged with the responsibility of ensuring the equitable and efficient operation of investor-owned water utilities that supply potable water. Utilities with a function other than potable water provision are not included in their jurisdiction.[14]

Circumstances and Costs

Reclamation has occurred in Texas mainly because of diminished potable water supplies and the lack of alternative sources. Doug Holcomb, at the Texas Natural Resource Conservation Commission, reported that average groundwater supplies are down by ten inches. Each city supplying reclaimed water has its own potable water source and its own problems. Examples range from the City of San Antonio's over-pumped Edwards Aquifer to cities in the greater Austin area that are prohibited from discharging wastewater effluent into the Colorado River because of low levels and health factors.[15] Basically, the need for drought-proof water conservation exists and water reclamation one tool that fits this need. Utilities that provide reclaimed water are required to meet quality requirements dependent upon the identified use for the reclaimed water. Most regulated utilities are not currently involved in water reclamation because these utilities generally have small service areas outside of a city or municipal water system. Investor-owned utility customers tend to use residential septic systems. These systems, at least for the short-term, postpone the need for costly treatment facilities. For an investor-owned utility to enter the water reclamation market, the utility

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[13] H. William Hoffman, *Industrial Water Reuse in Texas: Perspective, Potential and Policy* (Austin, TX: Texas Water Development Board, November 1995).

[14] Doug Holcomb, TNRCC.

[15] Sayeed and Hoffman, *The Potential for Water Reuse in Texas*.

would have to incur the capital costs of building a wastewater treatment plant. The strong need for alternative water sources and availability of municipal taxing authority, tax, funding enables cost justification of reclamation. As a result, cities throughout Texas have engaged in reclamation activities comparable to the City of Largo project. In fact, the City of San Antonio has modeled its water reclamation project based on the City of Largo project in Florida.[16]

The capital costs of constructing new treatment plants for the purpose of water reclamation is reportedly not feasible in Texas. In Texas, reclamation has been implemented by utilities that already provide wastewater treatment. The move to reclamation is often very simple. Utilities involved in water reclamation in Texas generally incur the additional reclamation costs minus disposal costs which include storage, collection, any additional treatment.

Uses

Industrial, agricultural, environmental, recreational, urban, and groundwater recharge are uses that have been implemented in Texas. However, the three most commonly accepted uses of reclaimed water are agricultural, industrial, and urban reuse. The Texas Water Development Board has provided the following projections based on a recent study of the potential demand for reclaimed water in relation to the supply of influent at existing plants:

1. Agricultural irrigation - a maximum of 50 percent of county-wide demand could be met through reuse.

2. Steam Electric - a maximum of 75 percent of power plant needs for cooling could be met through reuse.

[16] Anthony Andrade, City of Largo.

3. Manufacturing - estimates were made on a county-by-county basis, but the net result was that a maximum of approximately 40 percent of manufacturing water needs could be met by reuse.

4. Municipal use - the assumption is that 15 percent of seasonal use would be met by reclaimed water, if available. This is equivalent to an average of approximately 3 percent of total municipal use.[17]

Benefits

Currently, wastewater is the only increasing potential supply of water in Texas. Annual water use is already equal to the current dependable supply of 16 million acre feet per year.[18] Limits to this supply have already curtailed economic development in a number of areas. As a result, the catch phrase, "one's waste is another's' treasure," has become popular at the Texas Water Development Board. This phrase symbolizes the potential water savings available through water reclamation. For example, the City of Harlingen at one time treated and disposed of tertiary treated wastewater effluent by conventional means. The city, faced with limited water supplies, decided to forgo disposal and divert its treated wastewater to a local industry. In doing so, the city began saving roughly 2 million gallons of potable water each day. Also, 1,300 industrial jobs were secured with the stabilization of water supplies. Later, treatment facilities were expanded to meet demands from other industries interested in using reclaimed water. The City of Harlingen is one of dozens of projects with reported benefits.

In addition to potable water savings and the associated benefits from those savings, water reclamation in Texas results in the realization of the other benefits. Those benefits reportedly include reductions in pollutants discharged to the

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[17] Hoffman, *Industrial Water Reuse in Texas.*

[18] Ibid.

environment, reductions in the application of fertilizers to crops, and the direct monetary payment for reclaimed water. It is these benefits that have justified the cost recovery of reclamation projects throughout the state and have led to the wide public acceptance of water reclamation in Texas.

Conclusion

Water reclamation has occurred primarily through municipal utilities because of their ownership of water treatment facilities. Accordingly, water reclamation is viable under any combination of the following rationales:

- The incremental cost of reclaimed water is relatively small as most treatment costs have already been incurred.
- Municipalities interested in economic development and job retention can assign costs to all beneficiaries through direct water rate charges, or by various taxing mechanisms.
- Supply assurance is a real problem facing Texas water utilities. With no new water sources on the horizon, reclamation may be the best supply assurance option. The cost of this new source of water is the least cost option.

Water reclamation has occurred in cities in Texas that view water as a public good and finance reclamation costs through taxes and grants. Even though the need for water reclamation is widespread in Texas, investor-owned utilities could not recover reclamation costs absent equivalent access to tax dollars and grants. In fact, Doug Holcomb at the Texas Natural Resource Conservation Commission does not think it likely that investor-owned utilities will ever enter the reclaimed water business because of these constraints.[19]

[19] Doug Holcomb, TNRCC.

California

The following case study is focused on the activities of a single investor-owned water utility regulated by the California Public Utility Commission. This case was chosen because in it water reclamation is pursued by a utility not responsible for wastewater treatment. The implications of this case are very important especially to commissions in states with water rights issues and utilities that purchase water. Also, this case was chosen to demonstrate the potential for reclaimed water. In California, treatment facilities operated by sanitation districts provide treated wastewater to utilities for resale.[20] In this case study, the utility supplying reclaimed water required rates higher than rates traditionally set by the California Public Utility Commission.

Background

Conservation has always been a large part of California's overall water policy. Water shortages are a part of California's history. These shortages are predicted to reach record highs of up to 5.7 million acre feet in "average water years" by the year 2020 according to the California Department of Water Resources. As a result of this and similar predictions, the Water Recycling Act was passed in 1991. The purpose of this legislation is to enhance stability in existing water supplies by reuse.

The California Water Service Company is a regulated utility that has been involved in water reclamation for some time. The California Water Service Company operates large portions of two of California's largest recycled water projects. Currently, the California Public Utility Commission regulates a total of six utilities with access to reclaimed water. In every case, except one, rates for reclaimed water are 80 percent of

[20] Interview with Mosheh Kazemzadeh, Utilities Engineer, California Public Utility Commission.

the potable rate.[21] The exception is the California Water Service Company, which is permitted to sell reclaimed water at a reduced wholesale price, roughly 87 percent of potable water rates.[22] This price was decided upon through a hearing. The California Public Utility Commission allowed the higher rates based, in part, on its commitment to preserve stability in the water market.

Circumstances and Costs

The California Water Service Company provides reclaimed water service to the Hermosa-Redondo tariff area and the Westlake tariff area in Los Angeles County. The California Water Service Company purchases reclaimed water from sanitation districts such as the Triunfo Sanitation District and resells the water to various customers. The California Water Service Company, incurs a purchase cost for the reclaimed water, storage costs, transportation costs, and distribution costs. Storage, transportation and distribution costs are, of course, incurred for potable water supplies also. For the reclaimed water customer, the biggest difference between the price of the reclaimed water and that of potable water is in the cost the utility pays for the water. The wholesale purchase price to California Water for reclaimed water is less than the costs it incurs in obtaining potable water. The capital expenses of the reclaimed water distribution system required financing similar to that of distribution systems for potable supply; and senior notes were used by the company for the financing.[23]

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[21] Ibid.

[22] California Public Utility Commission, Commission Advisory and Compliance Division, *Staff Report On Issues Related to Small Water Utilities* (San Francisco: California PUC, June 10, 1991).

[23] Interview with Paul Extrom, California Water Company.

According to the California Public Utility Commission, "The most significant, and perhaps only, barrier to the widespread use of reclaimed water is the capital cost of building recycled water treatment facilities and their associated pipeline."[24] The California Public Utility Commission feels that it is the high construction costs which currently limit reclamation to select areas where treatment facilities already exist.

Uses

The California Water Service Company provides tertiary treated reclaimed water in accordance with state guidelines regarding reuse. At this level of treatment, the California Water Service Company is able to meet non-potable water needs of its customers.[25] Uses include urban reuse, such as the irrigation of golf courses, and many types of agricultural reuse.

Benefits

Due to the limits on available water in California any method of easing the stress to current water supplies is a significant benefit. The conservation benefit derived from using reclaimed water has led to a strong support of reclamation activities by the California Public Utility Commission. Paul Extrom of the California Water Company commented, "Politically in California, water reclamation is the right thing to do -- so we do it."[26]

Conclusion

[24] California PUC, *Staff Report on Issues Related to Small Water Utilities.*

[25] Ibid.

[26] Paul Extrom, California Water Company.

According to Paul Extrom, "California Water doesn't supply reclaimed water for a profit." The rates selected by the California Public Utility Commission make additional revenues from the sale of reclaimed water negligible after cost. The significance of this case has more to do with how as opposed to how much. California Water was not in a position to sell reclaimed water unless the water was purchased from an existing treatment facility, since the costs of a new treatment facility and related sewer system could not be recovered. California Water is a reseller of the reclaimed water. The implications of this case are clear. The California Commission has instituted policies that result in the entry of potable water suppliers into the reclamation business and has used traditional regulatory standards to supervise the overall profitability of the combined operations. Commission regulation of the wastewater recovery business is compatible with resource conservation and potable water efficiency objectives.

Summary

In each of the cases the differences in three states were discussed. In all three cases, reclamation activities were implemented to achieve stability in existing water systems (see Table 7-1). Reclamation occurred in these cases because reclaimed water was the least costly and most beneficial solution to each areas' water problems. Differences are identifiable in the discussions of Florida and California. For example, in California, the cost of reclamation for a commission regulated utility includes additional effluent purchasing costs.

TABLE 7-1
PROJECT CHARACTERISTICS OF CASE STUDIES

Characteristic	City of Largo	Rotonda West Utility Co.	California Water Co.
Initial Cost	$14.5 million	$300,000	Not available
Primary Benefit	Increases water supply	Increases water supply	Increases water supply
Additional Benefit	Agricultural production	Retains water rights	Agricultural production
Principal Users	• Industrial • Recreational • Urban environment • Agriculture	• Urban environment • Agriculture • Recreational	• Urban environment • Industrial
Cost/Revenue	Costs greater	Revenues greater	Approx. equal
Net Cost/Benefit	Benefits greater	Benefits greater	Benefits greater

Source: Authors' construct.

In Texas, the scope of water reclamation extends to the entire state. There are no investor-owned utilities in Texas involved in water reclamation because investor-owned utilities in Texas have traditionally only supplied potable water and have not been involved in wastewater treatment.[27]

In all cases benefits were perceived to exceed costs. In practice, it was the ability to authoritatively assign costs to beneficiaries that made the reclamation projects financially viable. In the City of Largo, the ability to assign costs by receiving grants from a water district made the difference. For the investor-owned Rotonda water utility, traditional regulatory procedures were sufficient and no direct problem occurred in assigning costs to beneficiaries.

[27] Doug Holcomb, TNRCC.

CHAPTER 8

CONCLUSION

Reclaimed water is an alternative source of water. As with any water source, the exploitation of that source will depend on the need for another water source; the cost of provision; the cost of exploiting other water sources; and, sometimes, the pollution levels of existing water supplies.

Unlike other water sources, the use of treated wastewater effluent has the potential of achieving multiple objectives in a complex water management program. Using reclaimed water reduces effluent discharges into receiving water and lowers the demand on existing resources.

Water reclamation is probably not feasible in states with abundant water supplies and low disposal standards. The costs associated with water reclamation in water rich states may be far greater than the costs of potable water. Water reclamation is not the solution in every circumstance.

Commissions involved in the regulation of water utilities need to be aware of the costs and benefits associated with the use of reclaimed water. As identified in this report, reclaimed water costs, benefits, and associated factors such as regulatory frameworks differ from area to area. The following recommendations are suggested to promote equitable reclaimed water rates, efficiency in reclaimed water supply, and harmony in existing water markets when reclaimed water is a consideration:

1. Commissions should assess the need for reclaimed water in areas of their jurisdiction.

2. Utilities interested in providing reclaimed water should be requested to identify these uses and provide the regulating commission with the appropriate use data. Commissions should have access to this data prior to the utilities commitment to provide reclaimed water.

3. The views and opinions of potential reclaimed water customers should be obtained and considered prior to the implementation or financial commitment of any water reclamation project.

4. Commissions should develop procedures (including interagency agreements) needed to enforce quality standards for each intended use of reclaimed water.

5. Commissions should require financial projections from utilities proposing to supply reclaimed water. Those projections should be reviewed to assure they are reasonable and that the assumptions, particulary those concerning future regulatory interpretations of the operation, conform with the practices of the commission. Critical regulatory treatment assumptions should be specifically addressed in any order authorizing the provision of the service.

6. The financial projections should be tested to determine if reasonable rates and shareholder equity can be sustained if actual circumstances deviate from the base line projections.

However, the key single financial variable is availability of wastewater, either through ownership of a wastewater treatment plant or by the ability to purchase. It does not appear that it would be economically viable to build a treatment plant in order to provide reclaimed water. Avoidance of new treatment plant construction costs and the avoidance of costs associated with fully treating wastewater to potable standards appear to be the two most significant factors associated with successful reclamation.

APPENDIX A
WASTEWATER TREATMENT PROCESSES

This appendix contains a brief explanation of the wastewater treatment process.

Levels of Treatment

Wastewater treatment is a combination of physical, chemical, and biological processes and operations which remove solids, organic matter, pathogens, and sometimes nutrients from wastewater. Similar treatment technology is applied to water withdrawn from water sources, i.e., rivers, lakes, etc., for potable uses. Differences in treatment are usually due to higher levels of contaminants in wastewater influent as compared to other water sources. General terms used to describe different degrees of treatment are preliminary, primary, secondary, tertiary and advanced treatment.
A disinfection step to remove pathogens usually follows the last treatment step.

Preliminary Treatment

Preliminary treatment operations include coarse screening and commination of large objects and grit removal by sedimentation. In grit chambers, the velocity of the water through the chamber is maintained sufficiently high to prevent settling of most organic solids. In most small wastewater treatment plants, grit removal is not included as a preliminary treatment step.

Primary Treatment

In primary treatment, the objective is to physically remove sand, grit, and larger solids from the wastewater by screening, settling, or floating. Screens, settling tanks, and skimming devices are most commonly used for the separation. Primary treatment removes roughly half of the pollutants.

The objective of primary treatment is the removal of settle able organic and inorganic solids by sedimentation, and the removal of materials that will float by skimming. Nonetheless, wastewater still contains a residue of floating, suspended and dissolved material after the primary treatment process. Typically 25 percent to 50 percent of the incoming biochemical oxygen demand, 35 percent to 50 percent of the chemical oxygen demand, 50 percent to 70 percent of the total suspended solids, and 65 percent of the oil and grease are removed during primary treatment.[28]

Secondary Treatment

Secondary treatment is the level of treatment required when the risk of public exposure to the wastewater is moderate. The goal of secondary treatment is to remove biological contaminants that are dissolved in the wastewater. In secondary treatment, air is supplied to accelerate the growth of bacteria and other organisms which consume most of the remaining waste materials. The wastewater is then separated from the organisms and disinfected by chlorine or ultraviolet light to remove remaining bacteria. After secondary treatment, around 90 percent of the pollutants have been removed.

Tertiary Treatment

Additional processing after secondary treatment is referred to as tertiary treatment. Tertiary treatment can remove more suspended solids, organic matter, nitrogen, phosphorus, heavy metals, and bacteria. This treatment relies on the addition of chemicals on filter beds of rock, sand, or other material.

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[28] USEPA, *Guidelines for Water Reuse*.

Advanced Treatment

Advanced treatment is necessary when specific wastewater constituents must be removed but cannot be removed by secondary treatment. Targeted treatment processes are used to remove nitrogen, phosphorus, additional suspended solids, refractory organdies, heavy metals, and dissolved solids. Advanced treatment is necessary when public exposure to the reclaimed water is probable.

Disinfection

Disinfection reduces hazards from biologically active pollutants. The disinfection process normally involves the injection of a chlorine solution at the head end of a chlorine contact basin. The precise chlorine dosage depends on the concentration of biologically active wastewater pollutants and other factors. Ozone may also be used for disinfection, but is not common in the United States. The effectiveness of disinfection is measured in terms of the concentration of indicator organisms remaining in the end of the chlorine contact basin.

Sludge

Sludge is a byproduct of any wastewater treatment process. The amount of sludge produced depends on the level of treatment imposed and the type of treatment system. Sludge production can decrease in cases involving water reclamation when levels of treatment are lowered to match their intended use. The treatment of this byproduct raises many regulatory issues in and of itself. A lengthy report would be required to address them all. Sludge is only mentioned in this report because its disposal is an issue that accompanies any wastewater treatment project.

Common Wastewater Treatment Methods

Aerobic biological treatment is performed in the presence of oxygen by aerobic microorganisms that metabolize the organic matter in the wastewater, thereby producing more microorganisms and inorganic end-products. Several aerobic biological processes are used for wastewater treatment. The processes differ primarily in the manner in which oxygen is supplied to the microorganisms and in the rate at which organisms metabolize the organic matter. The following treatment methods are the more common, proven, and publicly accepted methods of treatment available.

Stabilization Ponds

Stabilization ponds are large shallow ponds that collect and hold sewage for a period of time. Solids settle out and decompose with the help of the wind, sun, algae, bacteria, and air. There are two kinds of ponds: controlled discharge, where sewage stays 6 to 12 months in the pond before being released, and flow-through, where sewage flows out continuously at a slow rate.

Aerated Lagoons

Aerated lagoons account for about 25 percent of the municipal wastewater treatment facilities in the United States.[29] These lagoons are smaller and deeper than stabilization ponds and depend on devices that supply supplemental oxygen to the wastewater, frequently to counteract the odors produced without added oxygen.

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[29] *Municipal Wastewater Treatment: Wastewater Treatment and Collection Processes* (Montgomery, AL: Alabama Cooperative Extension Service, June 1995).

Trickling Filter Treatment

In a trickling filter plant, wastewater is given primary treatment and then applied to beds of stone 3 to 20 feet deep where microorganisms attached to the stones decompose the organic material in the water. The water is collected at the bottom of the filter and put into sedimentation basins. The water is then chlorinated and discharged.

Land Application

Treating wastewater by land application has regained popularity. Land treatment has the advantage of recycling the wastewater and its valuable nutrients. It can provide secondary sewage treatment as well as the equivalent of any advanced waste treatment process. Pollutants are removed by the physical filtering capacity of the soil, by various chemical processes, and by biological processes such as the decomposition of organic matter by microorganisms and the removal of nutrients by plants.

Activated Sludge Treatment

Activated sludge treatment involves a considerable investment of energy and maintenance. This form of treatment involves a combination of aeration and settling to de-water sludge. Often, this form of treatment results in large quantities of dry cake-like sludge which requires costly disposal measures.

APPENDIX B
CHAPTER 310 RULES
THE TEXAS WATER COMMISSION

Use of Reclaimed Water

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SUBCHAPTER A: USE OF RECLAIMED WATER

e310.14 Transfer of Reclaimed Water

e310.15 General Prohibitions

e310.16 Restrictions

e310.17 Responsibilities and Contracts

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Chapter 310

Use of Reclaimed Water

ee310.1-310.18

These new sections are promulgated under the Texas Water Code, ee5.103, 5.105, 5.120, which provides the commission with the authority to promulgate rules as necessary to carry out its powers and duties under the Texas Water Code and other laws of the state, and to establish and approve all general policies of the commission.

e310.1. Definitions. The following words and terms when used in this chapter shall have the following meanings unless the context clearly indicates otherwise.

BOD5 - Five day biochemical oxygen demand.

Blackwater - Wastewater from toilet, latrine, and agua privy flushing and sinks used for food preparation or disposal of chemical or chemical-biological ingredients.

CFU - Colony forming units

Edwards aquifer - That portion of an arcuate belt of porous, water bearing limestones composed of the Comanche Peak, Edwards, and Georgetown formations trending from west to east to northeast through Kinney, Uvalde, Medina, Bexar, Comal, Hays, Travis and Williamson Counties. (See Chapter 313 of this title (relating to Edwards Aquifer.))

Food crop - Any crops intended for direct human consumption.

Greywater - Wastewater from clothes washing machines, showers, bathtubs, hand washing lavatories and sinks that are not used for disposal of chemical or chemical-biological ingredients.

l - Liter

Landscape impoundment - Body of reclaimed water which is used for aesthetic enjoyment or which otherwise serves a function not intended to include contact recreation.

mg/l - Milligram per liter

NTU - Nephlometric turbidity units

Pond system - Facility in which primary treatment followed by stabilization ponds are used for secondary treatment and in which the ponds have been designed and constructed in accordance with applicable design criteria.

Recharge zone - Generally, that area where the Edwards Aquifer and associated limestones crop out in Kinney, Uvalde, Medina, Bexar, Comal, Hays, Travis and Williamson Counties and the outcrops of other formations in proximity to the Edwards limestone, where faulting and fracturing may allow recharge of the surface waters to the Edwards Aquifer, and the area in Uvalde County within 500 feet of the Nueces, Dry Frio, Frio and Sabinal Rivers downstream from the northern Uvalde County line to the recharge zone as otherwise defined.

The recharge zone is specifically that geological area delineated on official maps located in the offices of the commission and the Edwards Underground Water District. (See Chapter 313 of this title (related to Edwards Aquifer.))

Reclaimed water - Domestic wastewater that is under the direct control of the treatment plant owner/operator which has been treated to a quality suitable for a beneficial use.

Restricted landscaped area - Land which has had its plant cover modified and access to which may be controlled in some manner. Access may be controlled by either legal means (e.g. state or city ordinance) or controlled by some type of physical barrier (e.g. fence or wall). Example of such areas are: golf courses; cemeteries; roadway right-of-ways; median dividers.

Restricted recreational impoundment - Body of reclaimed water in which recreation is limited to fishing, boating and other non-contract recreational activities.

Spray irrigation - Application of finely divided water droplets to crops using artificial means.

Surface irrigation - Application of water by means other than spraying such that contact between the edible portion of any food crop and the irrigation water is prevented.

Wastewater - Water containing waste including greywater, blackwater or water contaminated by waste contact, including process-generated and contaminated rainfall runoff.

Unrestricted landscaped area - land which has had its plant cover modified and access to which is uncontrolled. Examples of such areas are: parks; school yards; greenbelts; residences.

User - person or entity utilizing treated wastewater for agricultural, domestic, commercial or industrial purposes but does not originally treat the domestic wastewater.

e310.2. Purpose and Scope.

(a) The purpose of this chapter is to establish quality criteria, design and operational requirements for use of reclaimed water which may be substituted for potable water and/or freshwater. Specific use categories are defined with corresponding reclaimed water quality requirements. These criteria are intended to allow the safe utilization of reclaimed water for conservation of surface and ground water; to ensure the protection of public health; to protect ground and surface waters; and to help ensure an adequate supply of water resources for present and future needs.

(b) The commission has defined other types of reclaimed water in separate chapters. This rule does not modify those definitions; however, the term reclaimed water is limited in scope for the purpose of this rule as defined in e310.1 of this title (relating to Definitions). Approval by the executive director of a reclaimed water use project does not effect any changes of existing water rights. If water rights are an issue to a reclaimed water use project, a separate water rights authorization from the commission must be obtained by the reclaimed water provider and/or user, as appropriate.

(c) Reclaimed water projects approved under this chapter do not require a permit from the commission except as provided in e310.5 of this title (relating to Permits Required). Persons who desire to develop projects not included in this rule may apply for a permit under Chapter 305 of this title (relating to Consolidated Permits).

e310.3. Applicability. This chapter applies to both the reclaimed water provider and the reclaimed water user who does not own or operate a domestic wastewater treatment system.

With respect to the reclamation of greywater, this rule applies to greywater generated by facilities not under the jurisdiction of the Texas Department of Health (i.e. those facilities that produce more than 5000 gallons of wastewater per day when the volume of blackwater and greywater is summed). This chapter does not apply to facilities permitted by the commission in accordance with the requirements of Chapter 305 of this title (relating to Consolidated Permits).

e310.4. Notification.

(a) Prior to use of reclaimed water, the reclaimed water provider and user shall notify the executive director and obtain approval. The notification shall include:

(1) a description of the intended use of the reclaimed water, including quantity, quality, origin, location of intended use;

(2) clearly indicate the means for compliance with this chapter; and

(3) an operation and maintenance plan which shall contain, as a minimum the following:

(A) a copy of a signed contract between the user and provider;

(B) a labeling and separation plan for the prevention of cross connections between reclaimed water distribution lines and potable water lines;

(C) the measures that will be implemented to prevent unauthorized access to reclaimed water facilities (e.g., secured valves);

(D) procedures for monitoring reclaimed water;

(E) a plan for how reclaimed water use will be scheduled to minimize the risk of inadvertent human exposure;

(F) schedules for routine maintenance;

(G) a plan for worker training and safety; and

(H) contingency plan for system failure or upsets.

(b) If the reclaimed water provider plans to distribute reclaimed water via a separate distribution line to residences or other entities for purposes of landscape irrigation, then only the provider need notify the executive director and obtain approval prior to distribution of the reclaimed water. The notification shall include the same items listed in subsection (a) of this section.

(c) If effluent is to be irrigated within the Edwards Aquifer recharge zone, plans and specifications for the disposal system must be submitted to the executive director for review and approval prior to construction of the facility in accordance with Chapter 313 of this title (relating to Edwards Aquifer.)

(d) Notification and approval for use of reclaimed water is required without consideration of the origin of the water (i.e. surface or ground water).

(e) Any change in an approved plan for use of reclaimed water must be approved by the executive director.

e310.5. Permits Required.

(a) Prior to discharging any reclaimed water to the waters in the state, the provider or user shall obtain a permit from the commission in accordance with the requirements of e305 relating to Consolidated Permits except as provided in ee310.7(b) and 310.9(b) of this title (relating to Storage Requirements for Reclaimed Water and Landscape Impoundments, Restricted Recreational Impoundments, and Ornamental Fountains, Respectively).

(b) The executive director may, if conditions warrant, require a reclaimed water user to apply for and obtain a permit to utilize reclaimed water.

(c) The treatment and use of greywater does not require a permit from the commission if the greywater (reclaimed water) is used by the owner/operator of the treatment facility and the user satisfies the requirements of this chapter.

(d) A reclaimed water user who accepts effluent and provides additional treatment for a more restrictive use must apply for and obtain a permit from the commission prior to engaging in such activity. If the user elects to treat reclaimed water to a quality, better than the minimum standards supplied by the provider for the same use, such treatment does not require a permit. Additional disinfection is not considered treatment for purposes of this rule.

(e) No person may receive reclaimed water, store and transfer such water to another person without first obtaining a permit for storage/treatment from the commission.

Pipeline delivery of reclaimed water is not considered storage.

e310.6. General Requirements.

(a) No wastewater treatment plant operator (provider) shall transfer to a user reclaimed water without first notifying the commission as required in e310.04 of this title (relating to Notification.)

(b) Irrigation with untreated wastewater is prohibited.

(c) Food crops which may be consumed raw by humans shall not be spray irrigated. Food crops which will be substantially processed prior to consumption by humans and orchards may be spray irrigated. Other types of irrigation that minimize contact of reclaimed water with edible portions of food crops are acceptable.

(d) There shall be no nuisance conditions resulting from the use and/or storage of reclaimed water.

(e) Unless otherwise provided in this chapter, there shall be no off-site discharge, either airborne or surface runoff, of reclaimed water from the user's property except to a wastewater treatment system or wastewater treatment collection system unless the reclaimed water user applies for and obtains a permit from the commission which authorizes discharge of the water.

(f) Reclaimed water shall be utilized in a way that does not threaten ground water quality.

(g) Signs in both English and Spanish shall be posted at storage areas, hose bibs and faucets reading "Reclaimed Water, Do Not Drink" or similar warnings. Alternately, the area may be secured to prevent access by the public.

(h) Reclaimed water piping shall be separated from potable water piping when trenched by a distance of at least nine feet. Where the nine foot separation distance cannot be achieved, the reclaimed water piping must meet the requirements of e317.13(a)(1)-(4) of this title (relating to Separation Distance). Exposed piping shall be painted white and all piping shall be stenciled with a warning reading "NON-POTABLE WATER".

(i) The design of distribution systems which will convey reclaimed water to a user shall be approved by the executive director. Materials shall be submitted for approval by the executive director in accordance with the Texas Engineering Practice Act (Article 3271a, Vernon's Annotated Texas Statutes).

(j) Nothing in this chapter modifies any requirements of the Texas Department of Health found in Title 25 Texas Administrative Code, Chapter 337.

e310.7. Storage Requirements for Reclaimed Water.

(a) Unless the reclaimed water provider or user, as appropriate, submits soil and geologic data to demonstrate containment of the reclaimed water, which is reviewed by the executive director, and a specific exemption is obtained from the executive director, reclaimed water holding ponds shall conform to the following requirements:

(1) All ponds whether constructed of earthen or other impervious materials shall be designed and constructed so as to prevent groundwater contamination. Soils used for pond lining shall be free from foreign material such as paper, brush, trees, and large rocks. All soil liners must be of compacted material, at least 24 inches thick, compacted in lifts no greater than 6 inches and compacted to 95% of Standard Proctor Density. Soil liners must meet the following particle size gradation and Atterberg limits: 30% or more passing a number 200 mesh sieve; a liquid limit of 30% or greater; and a plasticity index of 15 or greater. Alternate linings may be utilized for a pond lining as long as they are constructed with a 12 inch thick soil base free of foreign materials such as paper, brush, trees and large rocks and the alternate lining material has a permeability less than or equal to 1 X 10-7 cm/sec. Synthetic membrane linings shall have a minimum thickness of 20 mils with a leak detection system. Certification shall be furnished by a Texas Registered Professional Engineer that the pond lining meets the appropriate criteria prior to utilization of the facilities.

(2) If soils are used in construction of a ponds embankment walls, it shall be free of foreign material such as paper, brush, trees, and large rocks. Soil embankment walls shall have a top width of at least five feet. The interior and exterior slopes of soil embankment walls shall be no steeper than one foot vertical to three feet horizontal unless alternate methods of slope stabilization are utilized. Soil

embankment walls must be constructed of material compacted in lifts no greater than 6 inches to 95% of Standard Proctor Density. All soil embankment walls shall be protected by a vegetative cover or other stabilizing material to prevent erosion. Erosion stops and water seals shall be installed on all piping penetrating the embankments.

(3) An alternative method of pond lining may be utilized with the approval of the executive director.

(b) Storm water may be directed to storage/holding ponds; however, the pond shall not be allowed to overflow unless the volume of reclaimed water to Storm water in the pond is less than or equal to 1:10.

(c) Reclaimed water may be stored in leak proof tanks.

e310.8. Irrigation Using Reclaimed Water. The following conditions apply to the use of reclaimed water for agricultural purposes.

(1) At a minimum, the reclaimed water provider shall only transfer reclaimed water of the following quality as described for each type of specific use:

(A) Irrigation of food crops:
Reclaimed water on a 30-day average shall have a quality of:
(i) *BOD5 (system other than pond system) 10 mg/l*
Turbidity 3 NTU
Fecal Coliform (not to exceed) 75 CFU/100 ml

(ii) *BOD5 (pond system) 30 mg/l*
Fecal Coliform (not to exceed) 75 CFU/100 ml

(B) Irrigation of fodder, fiber and seed crops:

Reclaimed water on a 30-day average shall have a quality of:
BOD5 30 mg/l

(C) Irrigation of pastures for animals milked for human consumption:

Reclaimed water on a 30-day average shall have a quality of:

BOD5 (other than pond system)

20 mg/l
(pond system)

30 mg/l
Fecal Coliform (not to exceed)
800 CFU/100 ml

(D) Irrigation of landscaped areas

(i) for unrestricted landscaped areas, reclaimed water on a 30-day average shall have a quality of:

BOD5 5 mg/l
Turbidity 3 NTU
Fecal Coliform (not to exceed) 75 CFU/100 ml

(ii) for restricted landscaped areas, reclaimed water on a 30-day average shall have a quality of:

BOD5 (other than pond system) 20 mg/l
(pond system) 30 mg/l
Fecal Coliform (not to exceed) 800 CFU/100 ml

(2) If a user stores reclaimed water prior to use on food crops or landscaped areas for a period of time, 24 hours or longer (based upon current daily average low rates), the reclaimed water shall be disinfected as needed to meet the fecal coliform limits for the corresponding specific use.

(3) The reclaimed water user must determine the application rate based upon a detailed water balance. The water balance should generally follow the example development shown in Table 1 of this paragraph.

(A) Precipitation inputs to the water balance shall utilize the average monthly precipitation based on past rainfall records. The consumptive use requirements (evapotranspiration losses) of the crop system shall be developed on a monthly basis. The method of determining the consumptive use requirement shall be documented as a part of the water balance study. A leaching requirement, calculated as shown in Table 1 of this paragraph shall be included in the water balance study when the total dissolved solids concentration of the reclaimed water presents the potential for developing excessive soil salinity buildup due to the long term operation of the irrigation system.

(B) The irrigation site must be maintained with a vegetative cover or be under cultivation during times when reclaimed water is being applied.

(C) The irrigation practices shall be designed so as to prevent incidental ponding or standing water except where local farming conditions and the accepted irrigation delivery systems and cropping patterns are such that, as an unavoidable consequence of such conditions, systems, and patterns, there will be standing water.

(D) Irrigation shall be achieved when the area is not in use by humans or by animals milked for human consumption.

(E) Irrigation application rates and application times shall be developed so as to minimize "wet grass" conditions in unrestricted landscaped areas during the periods the area could be in use.

(F) If irrigation water is stored prior to application, provision must be made to provide additional disinfection to meet the specified criteria for the designated use. Such disinfection must receive executive director approval. Pipeline and one-day truck delivery does not constitute storage.

(G) Irrigation spray shall not reach any privately-owned premises outside the designated irrigation area or public drinking fountains.

(H) There shall be no application of effluent when the ground is saturated or frozen.

(I) Tailwater water controls shall be constructed to preclude discharge of reclaimed water from irrigation sites used for production of food crops, grazing animals milked for human consumption, production of fodder, fiber and seed crops, and restricted landscape area.

(J) Distribution systems must be designed to prevent operation by unauthorized personnel.

e310.9. Landscape Impoundment, Restricted Recreational Impoundments, or Ornamental Fountains.

(a) Reclaimed water may be used for a source of water supply in a landscape impoundment, restricted recreational impoundment, or ornamental fountain if the quality of the water transferred from the provider is at a minimum:

BOD5 10 mg/l
Turbidity 3 NTU
Fecal Coliform (not to exceed) 75 CFU/100 ml

(b) There shall be no discharge from a landscape impoundment, restricted recreational impoundment, or ornamental fountain into surface water in the state unless such impoundments or fountains naturally provide or are designed, constructed, and operated so that any overflows of reclaimed water occur only when the volume of reclaimed water to Storm water in the impoundment or fountain is less than or equal to 1:10.

(c) Signs in both English and Spanish shall be posted stating that swimming and drinking the water is prohibited.

(d) Ornamental fountains shall be designed to minimize drift of water spray outside of the fountain.

e310.10. Commercial and Industrial Use of Reclaimed Water.

(a) Reclaimed water may be utilized in place of potable water and/or freshwater if the quality of the water transferred from the provider is at a minimum:

BOD5 (system other than pond system)

20 mg/l
(pond system)

30 mg/l
Fecal Coliform (not to exceed)

200 CFU/100 ml

(b) Usage of reclaimed water shall not result in drift of spray to areas outside the industrial or commercial area or to areas where the public would be exposed.

(c) Excess and/or used reclaimed water must be collected and returned to a wastewater treatment or collection system.

e310.11. Use of reclaimed water as toilet flush water.

(a) Reclaimed water may be utilized as toilet flush water if the quality of the water transferred from the provider or generated by the greywater treatment system is at a minimum:

BOD5 5 mg/l
Fecal Coliform 75 CFU/100 ml

(b) Reclaimed water shall be dyed blue prior to distribution for use as toilet flush water.

e310.12. Sampling and Analysis. The reclaimed water provider shall sample the reclaimed water prior to distribution to user to assure that the water quality is in accord with the intended contracted use. Analytical methods shall be in accord with those specified in Chapter 319 of this title (relating to Monitoring and Reporting). The minimum sampling and analysis frequency for reclaimed water is as follows:

(1) distribution for irrigation of food crops: once per week.

(2) distribution for irrigation of fodder, fiber and seed crops: once per month.

(3) distribution for irrigation of pastures for milking animals: once per two weeks.

(4) distribution for irrigation of unrestricted landscaped areas: once per week.

(5) distribution for irrigation of restricted landscaped areas: once per month.

(6) distribution for landscape impoundment water, restricted recreational impoundment water, or ornamental fountain water: once per week.

(7) distribution for industrial or commercial uses: once per month.

(8) distribution for use as toilet flush water: once per week.

e310.13. Record keeping and Reporting.

(a) The reclaimed water provider and user shall maintain records on site for a period of three years.

(1) Records to be maintained by the provider includes:

(A) copies of notifications made to the commission concerning reclaimed water projects.

(B) copies of contracts made with each reclaimed water user (this requirement does not include reclaimed water users at residences that have separate distribution lines for potable water).

(C) records of volume of water delivered to each reclaimed water user per delivery (this requirement does not apply to reclaimed water users at residences that have separate distribution lines for potable water).

(D) reclaimed water quality analyses.

(2) The user, except for residences and other entities who are distributed reclaimed water for yard use, shall maintain records of the date and volume of water used. The records shall be made available to the provider and the executive director upon request.

(b) The reclaimed water provider shall report to the commission on a monthly basis the following information. Such reports are due to the commission by the 25th day of the month following the reporting period.

(1) volume of reclaimed water delivered to a user.

(2) use of reclaimed water listed according to each user.

(3) quality of reclaimed water delivered to user reported as a monthly average for each quality criteria except those listed as not to exceed values which shall be reported as individual analyses.

e310.14. Transfer of Reclaimed Water. Reclaimed water transferred from a provider to a user shall be done on a demand only basis. This means that the reclaimed water user may refuse delivery of such water at any time. All reclaimed water transferred to a user must be of at least the treatment quality for the use specified in e310.8 of this title (relating to Irrigation Using Reclaimed Water), e310.9 of this title (relating to Landscape Impoundment, Restricted Recreational Impoundment, or Ornamental Fountains), e310.10 of this title (relating to Commercial and Industrial Use of Reclaimed Water) and e310.11 of this title (relating to Use of Reclaimed Water for Toilet Flush Water). Transfer shall be accomplished via pipes, tank trucks or constructed channels.

e310.15. General Prohibitions. Except for on-channel ponds, storage facilities for retaining reclaimed water prior to use shall not be located within the 5-year flood plain and shall be protected from the 100-year flood.

e310.16. Restrictions. This subchapter does not convey any property right and does not grant any exclusive privilege.

e310.17. Responsibilities and Contracts. The reclaimed water provider and user are responsible and liable for meeting the conditions of this chapter. The treatment plant owner will not be liable for misapplication of reclaimed water by users as provided in this section. Each party has, but is not limited to, the following responsibilities:

(1) The reclaimed water provider shall:

(A) assure construction of reclaimed water distribution lines/systems in accordance with this chapter and in accordance with approved plans and specifications.

(B) transfer reclaimed water of at least the minimum quality required by this chapter for the contractually specified use.

(C) sample and analyze the reclaimed water and report such analyses in accordance with this chapter.

(D) notify the executive director in writing within 5 days of obtaining knowledge of reclaimed water use not specified by the executive director's reclaimed water use approval.

(E) not be responsible for the misuse of the reclaimed water by the user if transfer of such water ceases promptly upon knowledge of misuse regardless of contract provisions.

(2) The reclaimed water user:

(A) shall use the reclaimed water in accordance with this chapter.

(B) must maintain and provide records as required by this chapter.

e310.18. Enforcement. If a provider and/or user fails to comply with the terms of this chapter, the executive director may take enforcement action provided by the Texas Water Code, ee26.121.

APPENDIX C

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CHAPTER 8

CONCLUSION

Reclaimed water is an alternative source of water. As with any water source, the exploitation of that source will depend on the need for another water source; the cost of provision; the cost of exploiting other water sources; and, sometimes, the pollution levels of existing water supplies.

Unlike other water sources, the use of treated wastewater effluent has the potential of achieving multiple objectives in a complex water management program. Using reclaimed water reduces effluent discharges into receiving water and lowers the demand on existing resources.

Water reclamation is probably not feasible in states with abundant water supplies and low disposal standards. The costs associated with water reclamation in water rich states may be far greater than the costs of potable water. Water reclamation is not the solution in every circumstance.

Commissions involved in the regulation of water utilities need to be aware of the costs and benefits associated with the use of reclaimed water. As identified in this report, reclaimed water costs, benefits, and associated factors such as regulatory frameworks differ from area to area. The following recommendations are suggested to promote equitable reclaimed water rates, efficiency in reclaimed water supply, and harmony in existing water markets when reclaimed water is a consideration:

1. Commissions should assess the need for reclaimed water in areas of their jurisdiction.

2. Utilities interested in providing reclaimed water should be requested to identify these uses and provide the regulating commission with the

appropriate use data. Commissions should have access to this data prior to the utilities commitment to provide reclaimed water.

3. The views and opinions of potential reclaimed water customers should be obtained and considered prior to the implementation or financial commitment of any water reclamation project.

4. Commissions should develop procedures (including interagency agreements) needed to enforce quality standards for each intended use of reclaimed water.

5. Commissions should require financial projections from utilities proposing to supply reclaimed water. Those projections should be reviewed to assure they are reasonable and that the assumptions, particulary those concerning future regulatory interpretations of the operation, conform with the practices of the commission. Critical regulatory treatment assumptions should be specifically addressed in any order authorizing the provision of the service.

6. The financial projections should be tested to determine if reasonable rates and shareholder equity can be sustained if actual circumstances deviate from the base line projections.

However, the key single financial variable is availability of wastewater, either through ownership of a wastewater treatment plant or by the ability to purchase. It does not appear that it would be economically viable to build a treatment plant in order to provide reclaimed water. Avoidance of new treatment plant construction costs and the avoidance of costs associated with fully treating wastewater to potable standards appear to be the two most significant factors associated with successful reclamation.

APPENDIX A

WASTEWATER TREATMENT PROCESSES

This appendix contains a brief explanation of the wastewater treatment process.

Levels of Treatment

Wastewater treatment is a combination of physical, chemical, and biological processes and operations which remove solids, organic matter, pathogens, and sometimes nutrients from wastewater. Similar treatment technology is applied to water withdrawn from water sources, i.e., rivers, lakes, etc., for potable uses. Differences in treatment are usually due to higher levels of contaminants in wastewater influent as compared to other water sources. General terms used to describe different degrees of treatment are preliminary, primary, secondary, tertiary and advanced treatment.
A disinfection step to remove pathogens usually follows the last treatment step.

Preliminary Treatment

Preliminary treatment operations include coarse screening and commination of large objects and grit removal by sedimentation. In grit chambers, the velocity of the water through the chamber is maintained sufficiently high to prevent settling of most organic solids. In most small wastewater treatment plants, grit removal is not included as a preliminary treatment step.

Primary Treatment

In primary treatment, the objective is to physically remove sand, grit, and larger solids from the wastewater by screening, settling, or floating. Screens, settling tanks, and skimming devices are most commonly used for the separation. Primary treatment removes roughly half of the pollutants.

The objective of primary treatment is the removal of settle able organic and inorganic solids by sedimentation, and the removal of materials that will float by skimming. Nonetheless, wastewater still contains a residue of floating, suspended and dissolved material after the primary treatment process. Typically 25 percent to 50 percent of the incoming biochemical oxygen demand, 35 percent to 50 percent of the chemical oxygen demand, 50 percent to 70 percent of the total suspended solids, and 65 percent of the oil and grease are removed during primary treatment.[1]

Secondary Treatment

Secondary treatment is the level of treatment required when the risk of public exposure to the wastewater is moderate. The goal of secondary treatment is to remove biological contaminants that are dissolved in the wastewater. In secondary treatment, air is supplied to accelerate the growth of bacteria and other organisms which consume most of the remaining waste materials. The wastewater is then separated from the organisms and disinfected by chlorine or ultraviolet light to remove remaining bacteria. After secondary treatment, around 90 percent of the pollutants have been removed.

Tertiary Treatment

Additional processing after secondary treatment is referred to as tertiary treatment. Tertiary treatment can remove more suspended solids, organic matter, nitrogen, phosphorus, heavy metals, and bacteria. This treatment relies on the addition of chemicals on filter beds of rock, sand, or other material.

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[1] USEPA, *Guidelines for Water Reuse*.

Advanced Treatment

Advanced treatment is necessary when specific wastewater constituents must be removed but cannot be removed by secondary treatment. Targeted treatment processes are used to remove nitrogen, phosphorus, additional suspended solids, refractory organdies, heavy metals, and dissolved solids. Advanced treatment is necessary when public exposure to the reclaimed water is probable.

Disinfection

Disinfection reduces hazards from biologically active pollutants. The disinfection process normally involves the injection of a chlorine solution at the head end of a chlorine contact basin. The precise chlorine dosage depends on the concentration of biologically active wastewater pollutants and other factors. Ozone may also be used for disinfection, but is not common in the United States. The effectiveness of disinfection is measured in terms of the concentration of indicator organisms remaining in the end of the chlorine contact basin.

Sludge

Sludge is a byproduct of any wastewater treatment process. The amount of sludge produced depends on the level of treatment imposed and the type of treatment system. Sludge production can decrease in cases involving water reclamation when levels of treatment are lowered to match their intended use. The treatment of this byproduct raises many regulatory issues in and of itself. A lengthy report would be required to address them all. Sludge is only mentioned in this report because its disposal is an issue that accompanies any wastewater treatment project.

Common Wastewater Treatment Methods

Aerobic biological treatment is performed in the presence of oxygen by aerobic microorganisms that metabolize the organic matter in the wastewater, thereby producing more microorganisms and inorganic end-products. Several aerobic biological processes are used for wastewater treatment. The processes differ primarily in the manner in which oxygen is supplied to the microorganisms and in the rate at which organisms metabolize the organic matter. The following treatment methods are the more common, proven, and publicly accepted methods of treatment available.

Stabilization Ponds

Stabilization ponds are large shallow ponds that collect and hold sewage for a period of time. Solids settle out and decompose with the help of the wind, sun, algae, bacteria, and air. There are two kinds of ponds: controlled discharge, where sewage stays 6 to 12 months in the pond before being released, and flow-through, where sewage flows out continuously at a slow rate.

Aerated Lagoons

Aerated lagoons account for about 25 percent of the municipal wastewater treatment facilities in the United States.[2] These lagoons are smaller and deeper than stabilization ponds and depend on devices that supply supplemental oxygen to the wastewater, frequently to counteract the odors produced without added oxygen.

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[2] *Municipal Wastewater Treatment: Wastewater Treatment and Collection Processes* (Montgomery, AL: Alabama Cooperative Extension Service, June 1995).

Trickling Filter Treatment

In a trickling filter plant, wastewater is given primary treatment and then applied to beds of stone 3 to 20 feet deep where microorganisms attached to the stones decompose the organic material in the water. The water is collected at the bottom of the filter and put into sedimentation basins. The water is then chlorinated and discharged.

Land Application

Treating wastewater by land application has regained popularity. Land treatment has the advantage of recycling the wastewater and its valuable nutrients. It can provide secondary sewage treatment as well as the equivalent of any advanced waste treatment process. Pollutants are removed by the physical filtering capacity of the soil, by various chemical processes, and by biological processes such as the decomposition of organic matter by microorganisms and the removal of nutrients by plants.

Activated Sludge Treatment

Activated sludge treatment involves a considerable investment of energy and maintenance. This form of treatment involves a combination of aeration and settling to de-water sludge. Often, this form of treatment results in large quantities of dry cake-like sludge which requires costly disposal measures.

APPENDIX B
CHAPTER 310 RULES
THE TEXAS WATER COMMISSION

Use of Reclaimed Water

INDEX

SUBCHAPTER A: USE OF RECLAIMED WATER

Chapter 310

Use of Reclaimed Water

ee310.1-310.18

These new sections are promulgated under the Texas Water Code, ee5.103, 5.105, 5.120, which provides the commission with the authority to promulgate rules as necessary to carry out its powers and duties under the Texas Water Code and other laws of the state, and to establish and approve all general policies of the commission.

e310.1. Definitions. The following words and terms when used in this chapter shall have the following meanings unless the context clearly indicates otherwise.

BOD5 - Five day biochemical oxygen demand.

Blackwater - Wastewater from toilet, latrine, and agua privy flushing and sinks used for food preparation or disposal of chemical or chemical-biological ingredients.

CFU - Colony forming units

Edwards aquifer - That portion of an arcuate belt of porous, water bearing limestones composed of the Comanche Peak, Edwards, and Georgetown formations trending from west to east to northeast through Kinney, Uvalde, Medina, Bexar, Comal, Hays, Travis and Williamson Counties. (See Chapter 313 of this title (relating to Edwards Aquifer.))

Food crop - Any crops intended for direct human consumption.

Greywater - Wastewater from clothes washing machines, showers, bathtubs, hand washing lavatories and sinks that are not used for disposal of chemical or chemical-biological ingredients.

l - Liter

Landscape impoundment - Body of reclaimed water which is used for aesthetic enjoyment or which otherwise serves a function not intended to include contact recreation.

mg/l - Milligram per liter

NTU - Nephlometric turbidity units

Pond system - Facility in which primary treatment followed by stabilization ponds are used for secondary treatment and in which the ponds have been designed and constructed in accordance with applicable design criteria.

Recharge zone - Generally, that area where the Edwards Aquifer and associated limestones crop out in Kinney, Uvalde, Medina, Bexar, Comal, Hays, Travis and Williamson Counties and the outcrops of other formations in proximity to the Edwards limestone, where faulting and fracturing may allow recharge of the surface waters to the Edwards Aquifer, and the area in Uvalde County within 500 feet of the Nueces, Dry Frio, Frio and Sabinal Rivers downstream from the northern Uvalde County line to the recharge zone as otherwise defined.

The recharge zone is specifically that geological area delineated on official maps located in the offices of the commission and the Edwards Underground Water District. (See Chapter 313 of this title (related to Edwards Aquifer.))

Reclaimed water - Domestic wastewater that is under the direct control of the treatment plant owner/operator which has been treated to a quality suitable for a beneficial use.

Restricted landscaped area - Land which has had its plant cover modified and access to which may be controlled in some manner. Access may be controlled by either legal means (e.g. state or city ordinance) or controlled by some type of physical barrier (e.g. fence or wall). Example of such areas are: golf courses; cemeteries; roadway right-of-ways; median dividers.

Restricted recreational impoundment - Body of reclaimed water in which recreation is limited to fishing, boating and other non-contract recreational activities.

Spray irrigation - Application of finely divided water droplets to crops using artificial means.

Surface irrigation - Application of water by means other than spraying such that contact between the edible portion of any food crop and the irrigation water is prevented.

Wastewater - Water containing waste including greywater, blackwater or water contaminated by waste contact, including process-generated and contaminated rainfall runoff.

Unrestricted landscaped area - land which has had its plant cover modified and access to which is uncontrolled. Examples of such areas are: parks; school yards; greenbelts; residences.

User - person or entity utilizing treated wastewater for agricultural, domestic, commercial or industrial purposes but does not originally treat the domestic wastewater.

e310.2. Purpose and Scope.

(a) The purpose of this chapter is to establish quality criteria, design and operational requirements for use of reclaimed water which may be substituted for potable water and/or freshwater. Specific use categories are defined with corresponding reclaimed water quality requirements. These criteria are intended to allow the safe utilization of reclaimed water for conservation of surface and ground water; to ensure the protection of public health; to protect ground and surface waters; and to help ensure an adequate supply of water resources for present and future needs.

(b) The commission has defined other types of reclaimed water in separate chapters. This rule does not modify those definitions; however, the term reclaimed water is limited in scope for the purpose of this rule as defined in e310.1 of this title (relating to Definitions). Approval by the executive director of a reclaimed water use project does not effect any changes of existing water rights. If water rights are an issue to a reclaimed water use project, a separate water rights authorization from the commission must be obtained by the reclaimed water provider and/or user, as appropriate.

(c) Reclaimed water projects approved under this chapter do not require a permit from the commission except as provided in e310.5 of this title (relating to Permits Required). Persons who desire to develop projects not included in this rule may apply for a permit under Chapter 305 of this title (relating to Consolidated Permits).

e310.3. Applicability. This chapter applies to both the reclaimed water provider and the reclaimed water user who does not own or operate a domestic wastewater treatment system.

With respect to the reclamation of greywater, this rule applies to greywater generated by facilities not under the jurisdiction of the Texas Department of Health (i.e. those facilities that produce more than 5000 gallons of wastewater per day when the volume of blackwater and greywater is summed). This chapter does not apply to facilities permitted by the commission in accordance with the requirements of Chapter 305 of this title (relating to Consolidated Permits).

e310.4. Notification.

(a) Prior to use of reclaimed water, the reclaimed water provider and user shall notify the executive director and obtain approval. The notification shall include:

(1) a description of the intended use of the reclaimed water, including quantity, quality, origin, location of intended use;

(2) clearly indicate the means for compliance with this chapter; and

(3) an operation and maintenance plan which shall contain, as a minimum the following:

(A) a copy of a signed contract between the user and provider;

(B) a labeling and separation plan for the prevention of cross connections between reclaimed water distribution lines and potable water lines;

(C) the measures that will be implemented to prevent unauthorized access to reclaimed water facilities (e.g., secured valves);

(D) procedures for monitoring reclaimed water;

(E) a plan for how reclaimed water use will be scheduled to minimize the risk of inadvertent human exposure;

(F) schedules for routine maintenance;

(G) a plan for worker training and safety; and

(H) contingency plan for system failure or upsets.

(b) If the reclaimed water provider plans to distribute reclaimed water via a separate distribution line to residences or other entities for purposes of landscape irrigation, then only the provider need notify the executive director and obtain approval prior to distribution of the reclaimed water. The notification shall include the same items listed in subsection (a) of this section.

(c) If effluent is to be irrigated within the Edwards Aquifer recharge zone, plans and specifications for the disposal system must be submitted to the executive director for review and approval prior to construction of the facility in accordance with Chapter 313 of this title (relating to Edwards Aquifer.)

(d) Notification and approval for use of reclaimed water is required without consideration of the origin of the water (i.e. surface or ground water).

(e) Any change in an approved plan for use of reclaimed water must be approved by the executive director.

e310.5. Permits Required.

(a) Prior to discharging any reclaimed water to the waters in the state, the provider or user shall obtain a permit from the commission in accordance with the requirements of e305 relating to Consolidated Permits except as provided in ee310.7(b) and 310.9(b) of this title (relating to Storage Requirements for Reclaimed Water and Landscape Impoundments, Restricted Recreational Impoundments, and Ornamental Fountains, Respectively).

(b) The executive director may, if conditions warrant, require a reclaimed water user to apply for and obtain a permit to utilize reclaimed water.

(c) The treatment and use of greywater does not require a permit from the commission if the greywater (reclaimed water) is used by the owner/operator of the treatment facility and the user satisfies the requirements of this chapter.

(d) A reclaimed water user who accepts effluent and provides additional treatment for a more restrictive use must apply for and obtain a permit from the commission prior to engaging in such activity. If the user elects to treat reclaimed water to a quality, better than the minimum standards supplied by the provider for the same use, such treatment does not require a permit. Additional disinfection is not considered treatment for purposes of this rule.

(e) No person may receive reclaimed water, store and transfer such water to another person without first obtaining a permit for storage/treatment from the commission.

Pipeline delivery of reclaimed water is not considered storage.

e310.6. General Requirements.

(a) No wastewater treatment plant operator (provider) shall transfer to a user reclaimed water without first notifying the commission as required in e310.04 of this title (relating to Notification.)

(b) Irrigation with untreated wastewater is prohibited.

(c) Food crops which may be consumed raw by humans shall not be spray irrigated. Food crops which will be substantially processed prior to consumption by humans and orchards may be spray irrigated. Other types of irrigation that minimize contact of reclaimed water with edible portions of food crops are acceptable.

(d) There shall be no nuisance conditions resulting from the use and/or storage of reclaimed water.

(e) Unless otherwise provided in this chapter, there shall be no off-site discharge, either airborne or surface runoff, of reclaimed water from the user's property except to a wastewater treatment system or wastewater treatment collection system unless the reclaimed water user applies for and obtains a permit from the commission which authorizes discharge of the water.

(f) Reclaimed water shall be utilized in a way that does not threaten ground water quality.

(g) Signs in both English and Spanish shall be posted at storage areas, hose bibs and faucets reading "Reclaimed Water, Do Not Drink" or similar warnings. Alternately, the area may be secured to prevent access by the public.

(h) Reclaimed water piping shall be separated from potable water piping when trenched by a distance of at least nine feet. Where the nine foot separation distance cannot be achieved, the reclaimed water piping must meet the requirements of e317.13(a)(1)-(4) of this title (relating to Separation Distance). Exposed piping shall be painted white and all piping shall be stenciled with a warning reading "NON-POTABLE WATER".

(i) The design of distribution systems which will convey reclaimed water to a user shall be approved by the executive director. Materials shall be submitted for approval by the executive director in accordance with the Texas Engineering Practice Act (Article 3271a, Vernon's Annotated Texas Statutes).

(j) Nothing in this chapter modifies any requirements of the Texas Department of Health found in Title 25 Texas Administrative Code, Chapter 337.

e310.7. Storage Requirements for Reclaimed Water.

(a) Unless the reclaimed water provider or user, as appropriate, submits soil and geologic data to demonstrate containment of the reclaimed water, which is reviewed by the executive director, and a specific exemption is obtained from the executive director, reclaimed water holding ponds shall conform to the following requirements:

(1) All ponds whether constructed of earthen or other impervious materials shall be designed and constructed so as to prevent groundwater contamination. Soils used for pond lining shall be free from foreign material such as paper, brush, trees, and large rocks. All soil liners must be of compacted material, at least 24 inches thick, compacted in lifts no greater than 6 inches and compacted to 95% of Standard Proctor Density. Soil liners must meet the following particle size gradation and Atterberg limits: 30% or more passing a number 200 mesh sieve; a liquid limit of 30% or greater; and a plasticity index of 15 or greater. Alternate linings may be utilized for a pond lining as long as they are constructed with a 12 inch thick soil base free of foreign materials such as paper, brush, trees and large rocks and the alternate lining material has a permeability less than or equal to 1 X 10-7 cm/sec. Synthetic membrane linings shall have a minimum thickness of 20 mils with a leak detection system. Certification shall be furnished by a Texas Registered Professional Engineer that the pond lining meets the appropriate criteria prior to utilization of the facilities.

(2) If soils are used in construction of a ponds embankment walls, it shall be free of foreign material such as paper, brush, trees, and large rocks. Soil embankment walls shall have a top width of at least five feet. The interior and exterior slopes of soil embankment walls shall be no steeper than one foot vertical to three feet horizontal unless alternate methods of slope stabilization are utilized. Soil

embankment walls must be constructed of material compacted in lifts no greater than 6 inches to 95% of Standard Proctor Density. All soil embankment walls shall be protected by a vegetative cover or other stabilizing material to prevent erosion. Erosion stops and water seals shall be installed on all piping penetrating the embankments.

(3) An alternative method of pond lining may be utilized with the approval of the executive director.

(b) Storm water may be directed to storage/holding ponds; however, the pond shall not be allowed to overflow unless the volume of reclaimed water to Storm water in the pond is less than or equal to 1:10.

(c) Reclaimed water may be stored in leak proof tanks.

e310.8. Irrigation Using Reclaimed Water. The following conditions apply to the use of reclaimed water for agricultural purposes.

(1) At a minimum, the reclaimed water provider shall only transfer reclaimed water of the following quality as described for each type of specific use:

(A) Irrigation of food crops:
Reclaimed water on a 30-day average shall have a quality of:
(i) *BOD5 (system other than pond system) 10 mg/l*
Turbidity 3 NTU
Fecal Coliform (not to exceed) 75 CFU/100 ml

(ii) *BOD5 (pond system) 30 mg/l*
Fecal Coliform (not to exceed) 75 CFU/100 ml

(B) Irrigation of fodder, fiber and seed crops:

Reclaimed water on a 30-day average shall have a quality of:
BOD5 30 mg/l

(C) Irrigation of pastures for animals milked for human consumption:

Reclaimed water on a 30-day average shall have a quality of:

BOD5 (other than pond system)

20 mg/l
(pond system)

30 mg/l
Fecal Coliform (not to exceed)
800 CFU/100 ml

(D) Irrigation of landscaped areas

(i) for unrestricted landscaped areas, reclaimed water on a 30-day average shall have a quality of:

BOD5 5 mg/l
Turbidity 3 NTU
Fecal Coliform (not to exceed) 75 CFU/100 ml

(ii) for restricted landscaped areas, reclaimed water on a 30-day average shall have a quality of:

BOD5 (other than pond system) 20 mg/l
(pond system) 30 mg/l
Fecal Coliform (not to exceed) 800 CFU/100 ml

(2) If a user stores reclaimed water prior to use on food crops or landscaped areas for a period of time, 24 hours or longer (based upon current daily average low rates), the reclaimed water shall be disinfected as needed to meet the fecal coliform limits for the corresponding specific use.

(3) The reclaimed water user must determine the application rate based upon a detailed water balance. The water balance should generally follow the example development shown in Table 1 of this paragraph.

(A) Precipitation inputs to the water balance shall utilize the average monthly precipitation based on past rainfall records. The consumptive use requirements (evapotranspiration losses) of the crop system shall be developed on a monthly basis. The method of determining the consumptive use requirement shall be documented as a part of the water balance study. A leaching requirement, calculated as shown in Table 1 of this paragraph shall be included in the water balance study when the total dissolved solids concentration of the reclaimed water presents the potential for developing excessive soil salinity buildup due to the long term operation of the irrigation system.

(B) The irrigation site must be maintained with a vegetative cover or be under cultivation during times when reclaimed water is being applied.

(C) The irrigation practices shall be designed so as to prevent incidental ponding or standing water except where local farming conditions and the accepted irrigation delivery systems and cropping patterns are such that, as an unavoidable consequence of such conditions, systems, and patterns, there will be standing water.

(D) Irrigation shall be achieved when the area is not in use by humans or by animals milked for human consumption.

(E) Irrigation application rates and application times shall be developed so as to minimize "wet grass" conditions in unrestricted landscaped areas during the periods the area could be in use.

(F) If irrigation water is stored prior to application, provision must be made to provide additional disinfection to meet the specified criteria for the designated use. Such disinfection must receive executive director approval. Pipeline and one-day truck delivery does not constitute storage.

(G) Irrigation spray shall not reach any privately-owned premises outside the designated irrigation area or public drinking fountains.

(H) There shall be no application of effluent when the ground is saturated or frozen.

(I) Tailwater water controls shall be constructed to preclude discharge of reclaimed water from irrigation sites used for production of food crops, grazing animals milked for human consumption, production of fodder, fiber and seed crops, and restricted landscape area.

(J) Distribution systems must be designed to prevent operation by unauthorized personnel.

e310.9. Landscape Impoundment, Restricted Recreational Impoundments, or Ornamental Fountains.

(a) Reclaimed water may be used for a source of water supply in a landscape impoundment, restricted recreational impoundment, or ornamental fountain if the quality of the water transferred from the provider is at a minimum:

BOD5 10 mg/l
Turbidity 3 NTU
Fecal Coliform (not to exceed) 75 CFU/100 ml

(b) There shall be no discharge from a landscape impoundment, restricted recreational impoundment, or ornamental fountain into surface water in the state unless such impoundments or fountains naturally provide or are designed, constructed, and operated so that any overflows of reclaimed water occur only when the volume of reclaimed water to Storm water in the impoundment or fountain is less than or equal to 1:10.

(c) Signs in both English and Spanish shall be posted stating that swimming and drinking the water is prohibited.

(d) Ornamental fountains shall be designed to minimize drift of water spray outside of the fountain.

e310.10. Commercial and Industrial Use of Reclaimed Water.

(a) Reclaimed water may be utilized in place of potable water and/or freshwater if the quality of the water transferred from the provider is at a minimum:

BOD5 (system other than pond system)

20 mg/l
(pond system)

30 mg/l
Fecal Coliform (not to exceed)

200 CFU/100 ml

(b) Usage of reclaimed water shall not result in drift of spray to areas outside the industrial or commercial area or to areas where the public would be exposed.

(c) Excess and/or used reclaimed water must be collected and returned to a wastewater treatment or collection system.

e310.11. Use of reclaimed water as toilet flush water.

(a) Reclaimed water may be utilized as toilet flush water if the quality of the water transferred from the provider or generated by the greywater treatment system is at a minimum:

BOD5 5 mg/l
Fecal Coliform 75 CFU/100 ml

(b) Reclaimed water shall be dyed blue prior to distribution for use as toilet flush water.

e310.12. Sampling and Analysis. The reclaimed water provider shall sample the reclaimed water prior to distribution to user to assure that the water quality is in accord with the intended contracted use. Analytical methods shall be in accord with those specified in Chapter 319 of this title (relating to Monitoring and Reporting). The minimum sampling and analysis frequency for reclaimed water is as follows:

(1) distribution for irrigation of food crops: once per week.

(2) distribution for irrigation of fodder, fiber and seed crops: once per month.

(3) distribution for irrigation of pastures for milking animals: once per two weeks.

(4) distribution for irrigation of unrestricted landscaped areas: once per week.

(5) distribution for irrigation of restricted landscaped areas: once per month.

(6) distribution for landscape impoundment water, restricted recreational impoundment water, or ornamental fountain water: once per week.

(7) distribution for industrial or commercial uses: once per month.

(8) distribution for use as toilet flush water: once per week.

e310.13. Record keeping and Reporting.

(a) The reclaimed water provider and user shall maintain records on site for a period of three years.

(1) Records to be maintained by the provider includes:

(A) copies of notifications made to the commission concerning reclaimed water projects.

(B) copies of contracts made with each reclaimed water user (this requirement does not include reclaimed water users at residences that have separate distribution lines for potable water).

(C) records of volume of water delivered to each reclaimed water user per delivery (this requirement does not apply to reclaimed water users at residences that have separate distribution lines for potable water).

(D) reclaimed water quality analyses.

(2) The user, except for residences and other entities who are distributed reclaimed water for yard use, shall maintain records of the date and volume of water used. The records shall be made available to the provider and the executive director upon request.

(b) The reclaimed water provider shall report to the commission on a monthly basis the following information. Such reports are due to the commission by the 25th day of the month following the reporting period.

(1) volume of reclaimed water delivered to a user.

(2) use of reclaimed water listed according to each user.

(3) quality of reclaimed water delivered to user reported as a monthly average for each quality criteria except those listed as not to exceed values which shall be reported as individual analyses.

e310.14. Transfer of Reclaimed Water. Reclaimed water transferred from a provider to a user shall be done on a demand only basis. This means that the reclaimed water user may refuse delivery of such water at any time. All reclaimed water transferred to a user must be of at least the treatment quality for the use specified in e310.8 of this title (relating to Irrigation Using Reclaimed Water), e310.9 of this title (relating to Landscape Impoundment, Restricted Recreational Impoundment, or Ornamental Fountains), e310.10 of this title (relating to Commercial and Industrial Use of Reclaimed Water) and e310.11 of this title (relating to Use of Reclaimed Water for Toilet Flush Water). Transfer shall be accomplished via pipes, tank trucks or constructed channels.

e310.15. General Prohibitions. Except for on-channel ponds, storage facilities for retaining reclaimed water prior to use shall not be located within the 5-year flood plain and shall be protected from the 100-year flood.

e310.16. Restrictions. This subchapter does not convey any property right and does not grant any exclusive privilege.

e310.17. Responsibilities and Contracts. The reclaimed water provider and user are responsible and liable for meeting the conditions of this chapter. The treatment plant owner will not be liable for misapplication of reclaimed water by users as provided in this section. Each party has, but is not limited to, the following responsibilities:

(1) The reclaimed water provider shall:

(A) assure construction of reclaimed water distribution lines/systems in accordance with this chapter and in accordance with approved plans and specifications.

(B) transfer reclaimed water of at least the minimum quality required by this chapter for the contractually specified use.

(C) sample and analyze the reclaimed water and report such analyses in accordance with this chapter.

(D) notify the executive director in writing within 5 days of obtaining knowledge of reclaimed water use not specified by the executive director's reclaimed water use approval.

(E) not be responsible for the misuse of the reclaimed water by the user if transfer of such water ceases promptly upon knowledge of misuse regardless of contract provisions.

(2) The reclaimed water user:

(A) shall use the reclaimed water in accordance with this chapter.

(B) must maintain and provide records as required by this chapter.

e310.18. Enforcement. If a provider and/or user fails to comply with the terms of this chapter, the executive director may take enforcement action provided by the Texas Water Code, ee26.121.

APPENDIX C

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