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Reclaimed Water, A Developing Resource To Help Meet State Water Needs

In its effort to best use all its available water supplies, Arizona must do more than conserve water. The state must also identify and develop new water resources to support its growing population, and effluent is being increasingly looked to as an important and valuable source of water. Plans are under way to develop this resource more fully to reduce groundwater pumpage in the state.

(Due to varied usages, the word "effluent" has become an imprecise term. As the word is often used, effluent may refer to untreated wastewater--or it may mean wastewater that has been treated and is available for various uses. To avoid ambiguity the term "reclaimed water" will be used when referring to water resources derived from treated effluent.)

Reclaimed water is the only increasing water resource in the state and is therefore unique. As urban indoor water use expands--a situation that contributes to the ground water overdraft problem--the supply of effluent also increases. In Arizona each individual contributes, on average, approximately 60 to 75 gallons of water per day to the state's wastewater flow.

The 1980 Groundwater Management Act (GMA), which is the legal expression of Arizona's commitment to conserve its groundwater resources, recognizes the potential for reclaimed water use to reduce groundwater pumping. As a result, the use of reclaimed water is an issue that is addressed and encouraged in the management plans that are being implemented in Arizona as part of the GMA.

Reclaimed Water and the Second Management Plan

Arizona's GMA established four Active Management Areas (AMAs) in locations where groundwater overdraft is most severe. It required each AMA to develop five successive management plans to cover the period from 1980 to 2025. Included as part of each management plan is a strategy to achieve water conservation goals. Certain provisions from the recently promulgated Second Management Plan (SMP) demonstrate

Arizona's developing interest in using reclaimed water.

The SMP notes that effluent is significantly underutilized at present and stresses the critical need to develop this resource early in the implementation of the plan. Reclaimed water generation projections combined for all four AMAs indicate that over 500,000 acre-feet per year will be available by 2025.

To encourage reclaimed water application the SMP emphasizes an increase in its direct use. Also, the plan calls for the recharge of reclaimed water supplies that cannot be directly used. The SMP's strategy to accomplish these reclaimed water use goals includes incentives, mandates, and technical and financial support.

Incentives are included with the SMP to encourage municipal providers and certain water users to make use of reclaimed water rather than relying exclusively on groundwater and surface water resources. The main incentive to water providers is that reclaimed water supplied to their customers is excluded from their gallons-per-capita-per-day rate (GPCD). The GPCD rate is a critical figure. According to the SMP, water providers are to meet conservation goals that are either totally set by GPCD or are based on GPCD in conjunction with ADWR-prescribed conservation programs. Since it is not used to compute a GPCD rate, reclaimed water is, in effect, a bonus to water providers.

Although this incentive is a boon to water providers, some people have expressed concern about its effectiveness as a conservation measure. To effect conservation goals, reclaimed water should replace water that would otherwise be pumped from the ground. Some fear, however, that this incentive, as formulated, could actually increase overall water demand.

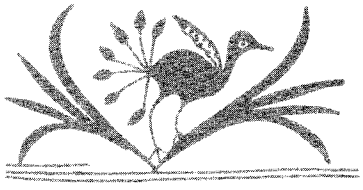
For example, a provider, who is meeting its GPCD target, could decide to water all its turf with reclaimed water. Since the reclaimed water does not count against the provider's GPCD rate, water previously used on turf would be released to apply to the residential and commercial sectors. As a result, the released water would be expanding the market for water resources, and the overall demand for water would actually increase.

The SMP also provides an incentive to prompt turf-related facilities to use reclaimed water. If a facility uses 100 percent reclaimed water, the draft version of the SMP allowed an extra half acre-foot of water per acre over its allocation. In response to public comment, the incentive may be raised along a sliding scale, with a facility allowed an extra half-acre foot of water if 50 to 89 percent of its water use is reclaimed water, and a full acre-foot of water allowed if 90 to 100 percent of its water use is reclaimed water.

Also included within the SMP is a mandate that the water supplies of turf-related facilities that come on line after 1990 must include 75 percent reclaimed water by 1995.

Finally, the SMP commits ADWR to support, through administrative actions and technical assistance, the development and implementation of projects to recharge reclaimed water. Further, the SMP's augmentation grant program commits the department to provide funds for certain reclaimed water projects. Of limited supply, such funding would basically be confined to seed money.

Some reclaimed water projects, however, may not be eligible for augmentation funds. ADWR attorneys have questioned whether reclaimed water use is, in fact, an augmentation measure. They believe that it might be more properly classified as a conservation method and, therefore, ineligible for funds under the ADWR augmentation program. The recharge of reclaimed water, however, is acknowledged to be an augmentation measure and eligible for program funding.



Bird design on San Ildefonso water jar.

The GMA and its management plans play a major role in shaping Arizona's water policy, including its commitment to reclaimed water use. To better understand the implications of this increasing commitment, various issues relating to reclaimed water need to be examined.

Reclaimed Water Use

Before an actual use for reclaimed water is identified--whether agricultural, industrial, or potable--the cost to treat and distribute it needs to be considered. Significant expenditures are necessary to construct treatment plants that can process effluent to secondary and post-secondary standards, as well as to build a distribution system to deliver reclaimed water to various facilities. Tucson and Pima County are expecting to spend over $14 million to expand wastewater treatment and reclaimed water use. An important consideration for many potential users is whether the financial advantages outweigh the costs.

At present reclaimed water is primarily used in agriculture to irrigate crops. Another major use of reclaimed water is on golf courses, parks, cemeteries, highway medians and other expansive turf areas. Power generating stations, such as Palo Verde Nuclear Generating Station outside of Phoenix, use reclaimed water for cooling purposes, and sand and gravel operations use this water resource to wash materials. Also, reclaimed water will be increasingly used to fill artificial lakes. The 1987 Lakes Bill requires that reclaimed water eventually

replace potable supplies used in artificial lakes.

As future GMA management plans take effect, more reclaimed water will be produced to enable AMAs to meet increasingly stringent water conservation goals. The effluent supply in the Tucson AMA is expected to increase from the 7,000 acre-feet available in 1985 to 62,000 acre-feet in 2000 and 105,000 acre-feet in 2025. During those same years the Phoenix AMA effluent supply is expected to increase from 78,000 acre-feet in 1985 to 246,000 acre-feet in 2000 and 398,000 acre-feet in 2025.

How will this expanding water resource be used as its supply increases? To answer this question the plans of three cities--Tucson, Phoenix and Mesa--will be reviewed to determine how they encourage reclaimed water use, and how they view its projected uses.

Tucson developed an early interest in using reclaimed water. In 1982 the city commissioned an assessment to evaluate the technical and economic feasibility of wastewater reuse in the metropolitan area. Early planning included the establishment of a reclaimed water recharge demonstration project in 1986. A permit was recently granted to expand operation. Recharge is expected to play an important role in Tucson's reclaimed water use program.

The City of Tucson and Pima County require new turf facilities to use reclaimed water, and they support the conversion of current turf facilities to this water resource. Also, reclaimed water is priced at about 80 percent of potable cost to further encourage its use.

The goal of the city is to serve all public turf facilities with reclaimed water, although private facilities are also being served. An extensive distribution system is being built and is expected to reach all metropolitan areas by 1995. Eventually, the system will also be able to serve smaller users, such as groupings of apartment complexes.

Phoenix does not presently have an incentive program to encourage reclaimed water use. The city, however, has negotiated individual package agreements with developers that include specific advantages if reclaimed water is used. Also, Phoenix does not offer financial incentives, including special pricing policies, to encourage the use of reclaimed water. Individual agreements with financial advantages, however, are worked out with users for reclaimed water use, and a general policy to benefit users who switch from potable to reclaimed water is being developed. The city's lack of a delivery system for reclaimed water inhibits the development of an overall policy for its use.

Phoenix's long-range water resources plan specifies various reclaimed water uses for the city. The city will continue to sell reclaimed water to the Palo Verde Nuclear Generating Station, although the sale of reclaimed water is not a priority for the city. Reclaimed water will also be exchanged with agricultural users for potable water. In addition, there are plans for regional treatment plants that will deliver reclaimed water to new developments through a separate non-potable distribution system. Finally, plans call for wastewater to be reclaimed and integrated into the city's potable water resources.

Mesa passed an ordinance in 1986 that requires all artificial lakes and new turf facilities over ten acres to use reclaimed water. The ordinance also empowers the city to negotiate individually with present users to commit them to replace potable resources with reclaimed water. A straight trade would result, since the city would supply reclaimed water at the same cost as the user paid for potable water.

Mesa's water resources master plan calls for a total water reclamation system, with four plants located in a loop around the city. The first plant at Turner Ranches is operating, and the completion of the final plant is scheduled for 2001. A distribution system is also being constructed that will eventually reach all major turf areas in Mesa.

The city has a three-phase reclaimed water use plan. Phase one is to use reclaimed water to substitute for potable resources. After all possible substitutions are worked out, phase two begins as the city recharges reclaimed water for future withdrawal as potable water. In phase three, plans call for reclaimed water, after appropriate treatment, to be pumped directly into the city system, without intermediate recharge.

Potable Reuse

Cities take on a controversial issue when planning a potable use of reclaimed water, with much of the controversy related to public attitudes. Many people consider a potable use of reclaimed water unappealing and even threatening. They are concerned that reclaimed water may not be able to be treated to a quality suitable for human consumption. If the potable use of reclaimed water is to gain acceptance, these objections will have to be addressed.

Most water managers generally support the potable use of reclaimed water. Some believe that given the developing water shortage in the Southwest, every city in the region will eventually consider potable use. As a result, water managers are anxious to relieve public concerns regarding potable use through information and education.

They point out that treatment technologies have greatly advanced over the last 20 or 30 years and are quite capable of producing potable resources from wastewater. They also explain that the potable use of reclaimed water is not a new concept. Towns and cities of eastern states have long been treating

wastewater for potable uses.

For example, a river is often a water source for a number of communities that are located along its course. Upstream communities discharge their treated wastewater into the river. Downstream communities then pump the water from the river to be treated for their use. In the semiarid Southwest, however, the treated wastewater would be pumped into an aquifer, rather than into a river.

Many are concerned that the cost of treating wastewater to potable standards is too high. At the same time, however, it is recognized that the acquisition and treatment of water from other sources will continue to rise. The cost of treating reclaimed water is expected eventually to be comparable with, or perhaps more economical than acquiring other water resources.

Arizona water managers differ in their opinions about the readiness of state residents to accept reclaimed water as a potable resource. Most believe that Arizonans, not having the experience of residents in eastern states, will be reluctant to accept potable reclaimed water. A few claim, however, that since most Arizona residents are desert dwellers, they are sophisticated about water use and reuse and will accept reclaimed water as a potable resource.

Along with public attitudes, institutional factors must also be dealt with. The issue of potable use is relatively recent and most existing standards, laws, and policies that were developed to regulate conventional water supplies, do not necessarily address concerns related to the potable use of reclaimed water.

For example, while the federal government sets drinking standards regardless of the source, concern has been expressed that these standards may not be extensive enough to cover drinking water derived from wastewater. As the number of chemicals regulated by federal standards increases, however, the quality of potable reclaimed water will be more thoroughly regulated.

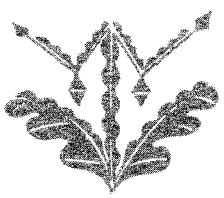
Presently the direct use of reclaimed water in Arizona is prohibited by state wastewater reuse rules. These rules, however, are in the process of being revised, and it is expected that the prohibition will be removed. This expectation is shared by the city and state agencies that are involved in reviewing various options related to potable use of reclaimed water.

Recharge of Reclaimed Water

Whatever uses are established for reclaimed water, the increasing supply is unlikely to be consumed totally through direct non-potable uses, and a surplus will possibly result. As a result, the recharge of reclaimed water--a process of storing and filtering water--will become an increasingly prominent issue.

The seasonal demand for reclaimed water, given the current use patterns--a high summer irrigation demand and a lower demand in winter--is another factor to support recharge. Since the generation of effluent is generally constant throughout the year, a surplus of reclaimed water supplies accumulates during the winter months when direct use of the resource is limited.

Recharge helps to resolve the problem of surplus reclaimed water. Through recharge, the surplus reclaimed water from advanced sewage treatment plants that is of, or near to, drinking standards could be recharged and stored for future use.



San Ildefonso pottery design of leaf forms and clouds.

This would allow the supply of reclaimed water to be distributed over varied demand periods.

Also, the recharge process could enhance the water quality of reclaimed water. Recharge provides additional filtering as the reclaimed water percolates through the subsurface. Further water quality benefits result as reclaimed water blends, dilutes and mixes with groundwater.

Incidental recharge of reclaimed water has been an ongoing practice. For example, excess water from irrigation is incidentally recharged when it percolates through the subsurface and into the aquifer. Also, before reclaimed water was recognized as a valuable resource, treatment plants would commonly discharge their effluent into dry river beds to be incidentally recharged.

At one time the recharge of water was not good water policy in Arizona. Legal ambiguities in state law left rechargers with uncertain ownership rights. For example, incidentally recharged water became groundwater to be claimed by anyone with groundwater rights. Further, no incentive existed to recharge reclaimed water since it was not yet generally recognized as the important water resource it was later to become.

The recharge of reclaimed water became sensible and feasible water policy with the passage of two Arizona laws. Passed in 1980, the GMA established a state commitment to conserve groundwater and prompted the recognition of effluent as a valuable water resource. The Artificial Recharge and Underground Storage and Recovery Act (RUSR) of 1986 assured rechargers of their rights to reclaim water stored underground. The latter law also established an accounting process that quantifies the amount of water stored and recovered and set up specific review critieria to be used to approve or deny recharge projects.

Of special significance to those interested in recharging reclaimed water is the RUSR provision deter-

mining that recovered water has the same legal definition as its original source. For example, if reclaimed water is recharged, it can be recovered, even at a location outside the area of hydrologic impact, and still be designated reclaimed water. This is significant because reclaimed water, according to the SMP, is not computed as part of a water provider's GPCD.

Although this RUSR provision greatly benefited providers who recharged reclaimed water, its effects on the implementation of the management plans worried ADWR. The agency's concern centered on the fact that what was being withdrawn was not reclaimed water but groundwater.

As a result, a provision within the SMP states that reclaimed water that is recharged must be withdrawn from the same area of hydrologic impact, if it is not to count against a provider's GPCD. If withdrawn outside of the area of hydrologic impact, the water is still considered reclaimed water but it counts against the GPCD rate.

Some argue that this is a disincentive to recharge and recover reclaimed water. If an area of hydrologic impact were studied thoroughly, they say, it would be found to be extremely large. To demonstrate this is difficult since all the wells in an area would have to be inventoried and sampled, and the impact on the entire area would have to be analyzed. As a result, a more confined area of hydrologic impact is defined. Since it is imprecise, it should not form the basis for the SMP provision. ADWR replies that the SMP, in reality, is providing an incentive to store and recover reclaimed water in the same location.

Legal Concerns

A basic legal question regarding reclaimed water is still unresolved: Is reclaimed water to be regulated as surface water or groundwater or is it a separate and distinct category of water? The question is now before the State Supreme Court in the Arizona Public Service vs. John F. Long case.

APS claims that reclaimed water is a special category of water, neither surface water nor groundwater and, therefore, unaffected by state regulations. The utility argues that the Legislature created this distinct category of water when it referred specifically to effluent in various pieces of legislation. It is argued, as a result, that the Legislature treated effluent as a specialized category of water. A lower court decision supported APS's claim.

If the State Supreme Court upholds this ruling, cities might have an unregulated monopoly over how they use their reclaimed water, including the freedom to sell it outside their service areas. For example, Phoenix could continue to sell its reclaimed water to the Palo Verde Nuclear Generating Station, which is the situation that initially sparked the suit.

Long's position, which is supported by ADWR, is that the GMA rules regulating the initial withdrawal of groundwater also apply to reclaimed water. The GMA specifies that groundwater must be used in the service area from which it was withdrawn. If this provision applies to reclaimed water, as Long argues, then reclaimed water cannot be transported and sold outside the service area from which it was pumped.

The effect that a decision against Long might have on ADWR and its management plans is uncertain. Such a decision might leave ADWR with virtually no control over reclaimed water, except in areas where current statutes specifically indicate that the agency has control over reclaimed water or water in general. ADWR might not be able to limit reclaimed water use, nor determine whether someone has a right to use it under surface water or groundwater laws.

Also uncertain is how a ruling against Long would affect the SMP. Although some see ominous consequences, others say that such a ruling might not significantly affect the plan's commitment to reclaimed water use. They claim that many of the SMP standards refer to conservation measures, not reclaimed water use. Therefore, the SMP is enforcing conservation measures not reclaimed water use.

For example, the SMP's industrial section set standards based upon the use of the latest available conservation technology that is consistent with economic return. In this context the use of reclaimed water can be considered a conservation technology. It could, therefore, continue to be regulated by ADWR, if the pending court case rules against state control of reclaimed water.

If the above argument is followed through, however, the municipal section of the SMP could be affected by a ruling against Long. This is because the municipal section includes standards based on a GPCD rate, not on conservation measures. And the GPCD rate is determined with reference to reclaimed water use; i.e., the use of reclaimed water does not count against the GPCD rate. Therefore, this incentive to encourage reclaimed water use might not be possible with the above legal interpretation.

While many are speculating about how a ruling against Long will affect ADWR and its SMP, some legal authorities stress that the case is extremely complicated and that such a ruling may not necessarily impact ADWR operations. Of more importance than the ultimate decision, they say, is how the Court interprets the issue. For example, it could decide against Long but express an opinion that ADWR control of reclaimed water is not affected in certain situations. This complexity discourages legal experts from attempting to predict the outcome of the case and its implications. Even the expected

date for a ruling is uncertain. Meanwhile city and state agencies that could be affected by the case continue to work on reclaimed water issues as they await the decision.

Water Quality

Wastewater can be treated to achieve various levels of quality and then applied to various uses. Most wastewater is presently treated to a secondary level and is used to irrigate agricultural crops and turf. The following discussion of reclaimed water quality refers to this current state of affairs.

Reclaimed water still contains various chemical contaminants when discharged from a treatment plant. Organic chemical components result from fecal material, and toxic chemical components are often present from commercial and industrial discharges. The kinds of chemicals that are present depend upon the type of industry doing the discharging.

Compounding the problem of chemical contaminants in reclaimed water is the difficulty of monitoring them. Chemical discharges are often occasional and sometimes infrequent, with their occurrences related to the operations of industries discharging into the wastewater system. A regular monitoring of wastewater may not detect chemical contaminants since the monitoring may occur at a time when chemical discharges have not recently taken place.

Also of concern are the microbiological components. These include viruses, bacteria and parasites that derive from fecal material treated at the plant.

Chlorine is another water quality concern related to reclaimed water use. Chlorine is used in the treatment process to destroy microbiological pathogens. The gas, however, can bind with organic constituents to form biotoxins such as trihalomethanes (THM), lindane, chloroform and other compounds.

Reclaimed water quality will be affected when Central Arizona Project (CAP) water enters the wastewater flow. CAP water is high in total dissolved solids (TDS) which are not removed by the wastewater treatment process. The resulting reclaimed water, therefore, will have increased levels of TDS.

Regulations have been established to assure quality standards for reclaimed water. Enforced by state and federal agencies, the standards set limits for the presence of constituents in reclaimed water and protect public health and the environment by assuring adequate treatment.

Some experts stress, however, that treatment processes can reduce, but not completely eliminate, risks to public health. Admittedly, as treatment becomes more complex and sophisticated, risk is reduced but costs rise. Realizing this, these experts say that to provide cost-effective water reclamation, a balance must be struck between risk reduction and cost. They claim that a demand for the greatest risk reduction regardless of cost is unreasonable.

Institutions and Regulations

The two state agencies involved with the regulation of reclaimed water are the Arizona Department of Environmental Quality (ADEQ) and ADWR, with the Environmental Protection Agency concerned at the federal level. The area of concern of each agency is described.

The *Arizona Department of Environmental Quality* is concerned with water quality and issues two types of permits affecting the management of reclaimed water. One permit relates to reuse, and the other regulates the recharge of reclaimed water.

A reuse permit is required when reclaimed water is to be utilized for a particular purpose. The permit application involves stating the quality of reclaimed water to be produced and the use or uses for which it is intended.

The reuse rules are the central, critical component of the reuse permit application procedure. They identify the reuse categories that are permitted and set water quality standards for each category. The reuse rules are currently being revised to better integrate them with the new aquifer protection regulations. Their final version will greatly affect wastewater treatment and reclaimed water use in Arizona.

Several issues are being confronted as the reuse rules are being revised. A basic concern is whether reclaimed water standards should be treatment-process-based or product-quality-based. If based on treatment, standards would specify the minimum treatment process that must be applied to the wastewater, with a de-emphasis on performance monitoring. If based on product quality, standards would specify the reclaimed water quality standards without designating a process to be used.

Regardless of their basis, however, the new standards are expected to be more stringent than those they are replacing. Also, anticipating increasing interest in the concept, ADEQ is expected to develop standards for potable use of reclaimed water.

If reclaimed water is to be recharged rather than used directly, a different permit is required. Pres-

San Ildefonso pottery design of cloud with rain.

ently called a Groundwater Quality Protection Permit, the permit will become an Aquifer Protection Permit when Environmental Quality Act (EQA) rules go into effect, probably in late spring of 1989.

To obtain a permit, a recharge operation must demonstrate that its facility will not exceed water quality standards at points of compliance within the aquifer. According to state law the aquifer standards specify that water be drinking quality.

Whether a recharge facility that includes a wastewater treatment plant must have the Best Available Demonstrated Control Technology (BADCT) is now being considered. The Environmental Quality Act exempts recharge facilities from needing BADCT. ADWR, however, is concerned about this exemption.

ADWR, which by law establishes the definition of recharge projects, excluded wastewater treatment works from its definition of a recharge facility. The agency is now proposing that BADCT be enforced in the treatment plant, with the recharge facility exempted as required by EQA. This would ensure that the treatment of wastewater would be done with BADCT, despite the EQA exemption.

Another major requirement of the application process is the development of a hydrologic study to assess critical aspects of the recharge operation such as its ability to meet water quality standards and the operation of the wastewater treatment plant.

The *Arizona Department of Water Resources* is also concerned with reclaimed water that is to be recharged. Focusing primarily on water quantity rather than quality, ADWR issues two permits: a recharge permit and a storage and recovery permit. The recharge permit does not allow recharged water to be recovered.

To obtain either permit, applicants must demonstrate that they have a right to the water to be recharged; that they have the technical and financial capability to operate the project; that they have applied for a water quality permit from ADEQ; that the project is hydrologically feasible; and that the project won't cause unreasonable harm to land and other water users.

Since permits are required from both ADEQ and ADWR to recharge reclaimed water, the two agencies work together during the permit process. They confer with an applicant during a preapplication meeting and relate the requirements of each agency. Some of the requirements are common to both agencies, such as the development of a hydrologic study. Efforts to better coordinate the application process between ADEQ and ADWR are under way.

An *Environmental Protection Agency* permit is required of a facility that discharges reclaimed water directly into a body of water, a designation that includes lakes, streams, dry riverbeds, washes or playas. Administered under the National Pollutant Discharge Elimination System (NPDES), the permit enforces standards that protect aquatic life and wildlife and thus complements ADEQ's direct protection of the quality of the state's aquifers.

In Arizona NPDES standards are generally based on the surface water standards that are set by ADEQ. The state agency sets standards for each body of water in Arizona, and the NPDES program requires that a discharge meets the surface water standards of the body of water into which it flows. For example, NPDES discharge limitation standards would vary depending upon whether water was being discharged into a stretch of stream with nitrogen or phosphorous limitations or a stream without such standards.

Since Arizona does not have primacy over the NPDES program, ADEQ writes up a draft form of the permit that then goes to the EPA office in San Francisco for review. EPA issues the final NPDES permit.

Conclusion

Although not a new concept, reclaimed water use is in certain ways an emerging issue. This is partly because its recognition as an important water resource for Arizona is relatively recent, with interest prompted by the passage of the 1980 GMA and the state's subsequent interest in conserving its groundwater resources.

Also contributing to recent interest in reclaimed water is the acknowledgement that the resource can complement conservation efforts. Supplies of reclaimed water can be increased, and uses for the resource can be expanded through developments in technology, public policy and education.

Technology enables wastewater to be treated to various levels of quality and ensures that reclaimed water will be available for use without threat to public health or the environment. If increased supplies of reclaimed water are to be available for expanded uses, the technology must be in place to assure supplies of suitable quality.

Public policy development is a complicated process and becomes more complex when confronting an issue involved with risk, such as reclaimed water use. Scientists, policymakers and members of the public must interact to assure that proper laws are passed and regulations adopted.

This public policy process is now in a critical stage with respect to reclaimed water use. Laws and regulations are being developed to deal with the increasing treatment and use of this water resource. For example, the wastewater reuse rules are currently being revised and are expected to be available for public comment in 1989.

Public education will also be needed to encourage acceptance of reclaimed water as a viable water resource. Education should include

an explanation of benefits as well as an appraisal of risks associated with the various uses of reclaimed water, including potable use.

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