Emerging issues in desalination and reclaimed water law

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The rising population of the United States is straining freshwater resources. Increasing use of traditional ground and surface water sources is causing adverse impacts to natural systems and saline water intrusion. This has forced many water utilities to consider alternative water supplies to meet future water demands. Two frequently discussed options are salt water desalination and reuse of reclaimed domestic wastewater. These alternative sources offer significant opportunities and benefits to the public, but technical and legal issues prevent their widespread use. The benefits, costs, and legal issues associated with these alternative water sources are examined herein.

Desalination

Desalination describes any process for removing dissolved minerals such as salts from brackish water or seawater to produce potable water. It offers a virtually drought-proof solution to water shortages. The benefits include a high-quality potable water product, minimal reliance on extended delivery systems, and local control of potable water supply. Also, because desalination sources such as seawater are plentiful, the end-product is relatively immune to price fluctuations caused by changes in supply and demand.

Distillation, electrodialysis, and reverse osmosis are the three main technologies currently used to desalinate water. Distillation converts seawater to water vapor, which is then cooled and returned to liquid form. Electrodialysis uses direct current to separate dissolved minerals from the source water, but it is not suited for removing dissolved organic constituents and microorganisms, which are typically found in surface water. Reverse osmosis, the most widely used process, uses a semi-permeable membrane to separate the source water into a freshwater product containing little or no salt and a reject stream consisting of highly concentrated saline water. It is typically less energy intensive and requires less physical plant space than distillation and electrodialysis.

Significant impediments to the widespread adoption of desalination are costs, entrainment, and waste disposal. Design and construction costs for a desalination treatment facility are significantly higher than for a conventional water treatment plant. Additionally, operational expenses, such as energy and chemical supplies, are more costly. Depending on the treatment technology and the salinity of the source water, the unit cost of desalinated water can range from 1.2 to 10 times as much as the cost of conventionally treated ground and surface water.

Entrainment refers to the capture and destruction of aquatic wildlife in the feed system for a desalination plant. Unlike conventional treatment plants, desalination facilities experience large treatment losses. This requires a desalination plant to use substantially more feed water than a conventional plant to produce an equal amount of finished water. Thus, desalination facilities frequently have large intake structures, which, if not properly located and designed, could capture and extirpate aquatic animals and macroinvertebrates. Environmental concerns over entrainment issues have complicated and delayed the permitting and construction of desalination plants.

All three desalination processes produce a liquid waste stream comprising a significant portion of the source water. This wastewater typically consists of a concentrated form of the raw source water blended with some chemical additives from the desalination treatment process. Because regulatory agencies characterize this concentrate as an industrial waste, disposal must comply with applicable federal and state laws. The concentrate disposal options most often used by utilities include deep well injection, ocean and surface water discharges, reuse in a domestic wastewater treatment facility, and blending with freshwater for nonpotable industrial and irrigation use.

Reclaimed water reuse

Reclaimed water is treated wastewater that is recycled and reused for some beneficial purpose. In most states, reclaimed water must receive at least secondary treatment prior to reuse. In many states, higher treatment standards are required for public access reuse or food crop irrigation.

Although reclaimed water can be utilized for drinking water, this use is uncommon in the United States because of permitting issues and lack of public acceptance. Reclaimed water is more often used as a nonpotable supply for landscape irrigation, agricultural irrigation, groundwater recharge, industrial uses, and fire protection.

The benefits of reclaimed water reuse are clear. It conserves traditional ground and surface water supplies to meet potable and high-quality, non-potable water needs. Additionally, it reduces water demands during drought and other water shortages. It postpones the need to develop additional surface or ground water supplies and related infrastructure. Finally, reclaimed water recharges ground and surface water supplies after beneficial use by the public.

The impediments to the acceptance of reclaimed water include public resistance to uses featuring a high degree of human contact because of health risks and concerns over the presence of unregulated constituents, such as pharmaceuticals, hormones, and pathogens. State and local regulatory programs that treat reclaimed water as a waste product impose strict water quality and discharge standards, making most irrigation uses infeasible. There is often insufficient storage so that an ade-

quate supply is not available when demand is greatest. The costs are higher and are typically borne by the utility's water and sewer customers. The reclaimed water market has not matured to the point that utilities can recoup their expenditures strictly from reclaimed water customers.

Statutes and regulations

For reclaimed water or desalination projects to succeed, the facility must be designed to comply with the applicable statutes and rules governing wastewater disposal. The primary laws governing desalination and reclamation facilities are the Clean Water Act (CWA), the Safe Drinking Water Act (SDWA), the Endangered Species Act (ESA), the Rivers and Harbors Act, and related federal regulations and comparable state statutes and rules.

Clean Water Act

The CWA regulates desalination and reclaimed water facilities in two ways: (1) regulation of construction activities in waters of the United States and (2) discharge of reject concentrate and reclaimed water into the waters of the United States, including open ocean outfalls, and into publicly owned treatment works that ultimately discharge to waters of the United States.

The discharge of pollutants to waters of the United States is regulated under CWA § 402 through the National Pollution Discharge Elimination System (NPDES) program. Under this program, the Environmental Protection Agency (EPA) or delegated state programs issue permits authorizing the discharge of wastewater from point sources. These standards include effluent limitations, total waste load allocations, nondegradation requirements, and toxic and pretreatment effluent standards. Permitted reclaimed water discharges are subject to additional permit requirements incorporated into the applicable NPDES permit.

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Ocean outfalls present a higher level of regulation. Currently, CWA §§ 301(h) and 403 are the only regulations addressing ocean discharges. However, in recent years the federal government has sought to further limit ocean discharges. In May 2000, Executive Order No. 13158 addressing Marine Protected Areas (MPAs) was issued and required EPA to use its existing authority under the CWA to further protect ocean waters. As a result, EPA drafted new ocean discharge criteria for the first time since 1980, but a final rule was never developed. However, as a result of Executive Order No. 13158, a draft framework for a national system of MPAs was developed. The establishment of MPAs may lead to further protection of marine ecosystems associated with desalination plants.

Safe Drinking Water Act

Under the SDWA, EPA or delegated state agencies regulate the quality of public drinking water, including drinking water that comes from desalination of brackish groundwater or seawater. EPA has established primary and secondary drinking water standards, which may impact the design of desalination facilities or how desalinated brackish groundwater or seawater is used in public water systems. Compliance with drinking water standards may also need to be evaluated if desalinated water is to be blended with drinking water from other sources, or if desalinated water is to be distributed through drinking water systems that have used other sources of water.

Recent developments in drinking water regulation require compliance monitoring for certain contaminants at the point of use, which is frequently the residential water faucet. When a public water utility develops its own desalination facility, any impact on the public water system's compliance with drinking water standards can be addressed considering the entire system as a whole. But if water is provided to the public water system by an independent vendor or by another public water utility, issues concerning compliance with drinking water standards can become complex.

The EPA lead and copper rule requires that drinking water meets the primary drinking water standard at the point of use. The corrosion control requirements in 40 C.F.R. § 141.82 give direction to the state agencies on how to determine the proper corrosion control methods for large public water systems.

Endangered Species Act

The ESA is the principal federal statute protecting fish and wildlife species that have deteriorated to the extent that the continued survival of the species is in question. The U.S. Fish and Wildlife Service (FWS) has primary jurisdiction to enforce the ESA. The National Marine Fisheries Service also has authority to implement the ESA to protect endangered marine species.

Section 9 of the ESA and federal regulations prohibit the "take" of federally listed species. "Take" is defined under the ESA, in part, as killing, harming, or harassing such species. Under federal regulations, "take" is defined further to include modifying or degrading habitat so that essential behavioral patterns, including breeding, feeding, and sheltering, are significantly impaired and lead to the death or injury to the wildlife. An incidental "take" permit is required under § 10(a), and federal consultation is required under § 7 if the development could affect a federally listed species. "Take" of a federally listed species may be allowed through § 7 consultation between the FWS and another federal agency if the proposed project is sponsored by or under another federal agency's jurisdiction.

Disposal of reject concentrate water and the application of reclaimed water may trigger the ESA if habitat critical for the continued survival of an endangered or threatened species is impacted. The ESA frequently comes into play when reject concentrate is discharged to estuarine or marine systems, where increased salinity may have an impact on species survival.

In conclusion, at present a number of obstacles stand in the way of effective utilization of desalinated and reclaimed water, including public acceptance, costs, and environmental concerns. However, the pressure of supplying adequate water to meet the needs of a growing populace and preserving fresh ground and surface water sources will eventually overcome these obstacles. Consideration should be given to modifying federal and state regulatory programs to promote the effective use of desalinated and reclaimed water.

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