FROM TOILET TO TAP: THE GROWING USE OF RECLAIMED WATER AND THE LEGAL SYSTEM'S RESPONSE

Ginette Chapman*

During the last quarter-century, wastewater from homes, businesses, and industries has undergone a dramatic transformation from a little-appreciated and under-utilized resource to an increasingly valuable water source. Until the 1970s, municipal wastewater (known as effluent or reclaimed water in its treated form)[1] was generally discharged into waterways after undergoing modest treatment at wastewater treatment plants ("WWTPs.") Stricter water quality standards, improved treatment technology, and growing demand for water have led to an upsurge in the reuse of wastewater to meet a variety of municipal, residential, agricultural, commercial, and environmental needs.

The use of reclaimed water is an important strategy for addressing looming water shortages across the United States and in other countries.[2] The

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* J.D. Candidate, 2006, University of Arizona James E. Rogers College of Law. The author would like to thank Collin Sult, Kami Schvaneveldt, Brett Liles, Professor David Adelman, Professor Robert Glennon, Professor Kathy Jacobs, and Mitch Tobin for their valuable contributions to this Note.

1. Arizona defines effluent as "water that has been collected in a sanitary sewer for subsequent treatment in a facility that is regulated pursuant to [Arizona law]." ARIZ. REV. STAT. ANN. § 45-101 (2004). Arizona defines reclaimed water as "water that has been treated or processed by a wastewater treatment plant or an on-site wastewater treatment facility." ARIZ. REV. STAT. ANN. § 49-201 (2004).

2. More than 99% of the world's water supply is located in oceans and polar ice caps, and is therefore unavailable for human use. James R. Watson, *Water—Where Will It Come From?*, *in* WASTEWATER REUSE FOR GOLF COURSE IRRIGATION 2, 2 (1994).

> In many parts of the world water is scarce and a large uncertainty exists about the future water supply. . . . The water needs of households, industry and agriculture will certainly increase in the years to come. Using almost the same water and land resources, more food must be grown for the 800 million people malnourished today and the two billion more people expected around the world by 2025. In addition, global warming and associated land-use change are likely to make precipitation patterns more variable, reducing water availability in some regions and increasing it in others. This shift would have a huge impact on both

nearly decade-long drought in the American Southwest[3] and the recent drop in the Lake Powell and Lake Mead reservoirs to their lowest recorded levels[4] are mere reflections of the growing pressures on water supplies across the United States. Migration trends, the potential for global climate change, droughts, and seasonal variations are among the factors placing pressure on municipal water sources.[5]

The prospect of increased effluent reuse holds particular promise for the arid Western United States, where officials are scrambling to assure water supplies for future growth.[6] The arid West is experiencing rapid population gains—nine of the ten fastest-growing U.S. cities of the 1990s are located in the West—and attendant growth in demand for water.[7] In addition to household water needs, Western irrigation places disproportionately large demands on water supplies; "[s]eventeen Western states contain 85 percent of the land irrigated for agricultural purposes."[8]

Evidence abounds of impending water scarcity across the West.[9] Growing demand in the Lower Colorado River water resource region has led to water consumption that outstrips natural replenishment of water supplies.[10] The mining

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> irrigated and non-irrigated agriculture because a reliable water supply throughout each year is crucial for agriculture.

Joop Steenvoorden, *Wastewater Re-use and Groundwater Quality: Introduction, in* WASTEWATER RE-USE AND GROUNDWATER QUALITY 1, 1 (Joop Steenvoorden & Theodore Endreny eds., 2003) (internal citations omitted).

3. BONNIE G. COLBY ET AL., ARIZONA'S WATER FUTURE: CHALLENGES AND OPPORTUNITIES 5 (2004).

4. GOVERNOR'S DROUGHT TASK FORCE, ARIZONA DROUGHT PREPAREDNESS PLAN, BACKGROUND & IMPACT ASSESSMENT SECTION i (2004), *available at* http://www.water.az.gov/gdtf/content/files/conclusion/Background_Section_100804FINAL.pdf.

5. David S. Brookshire et al., *Western Urban Water Demand*, 42 NAT. RESOURCES J. 873, 874 (2002). It should be noted that the picture of water use is not entirely bleak; since 1980, Americans' water use has decreased, American farmers have increased water efficiency, and industries have reduced their water demand. JOSEPH L. SAX ET AL., LEGAL CONTROL OF WATER RESOURCES 13 (3d ed. 2000); Douglas Jehl, *Saving Water, U.S. Farmers Are Worried They'll Parch*, N.Y. TIMES, Aug. 28, 2002, at A1.

6. While the Western United States faces particularly notable water demands, assuring water supplies is also critical in other parts of the country. For instance, while southern Florida enjoys a comparative abundance of water, "cultural practice and regional hydrogeology combine to result in frequent water shortages and restrictions on water use." James Crook, *Regulations Affecting the Use of Wastewater on Golf Courses, in* WASTEWATER REUSE FOR GOLF COURSE IRRIGATION 54, 57 (1994).

7. SAX ET AL., *supra* note 5, at 12–13. Nevada, Idaho, and Arizona led the way. *Id*. at 13.

8. Watson, *supra* note 2, at 8.

9. Rainfall rates differ sharply between the east and west sides of the Hundredth Meridian, which runs from the Dakotas through Texas. For example, average precipitation exceeds sixty inches in Baltimore but is only seven inches in Phoenix. SAX ET AL., *supra* note 5, at 4–5.

10. SAX ET AL., *supra* note 5, at 5. The lower Colorado region includes most of Arizona, parts of southern California and southern Nevada, and small areas of Utah and

of the Ogallala Aquifer, which underlies portions of Kansas, Texas, Nebraska, Oklahoma, Colorado, Wyoming, and New Mexico, and which supplies 30% of the nation's irrigation water, serves as a particularly stark example of scarcity: the U.S. Geological Survey projects that the aquifer will experience severe depletions by 2020, leading to a 50% reduction in irrigation on the high plains of Texas by 2050.[11] In Texas alone, population is projected to nearly double by 2050, while the state's existing water supplies will be 19% less than current levels.[12] It is therefore not surprising that the very "viability" of life in the Southwest has been said to depend on its use of scarce water resources.[13]

Groundwater overdraft—the withdrawal of water from aquifers at a faster rate than natural replenishment—has created problems beyond those of shortages for human use.[14] Overdraft can produce destructive and costly land subsidence, desertification stemming from the death of starved surface vegetation, salt water intrusion into aquifers, and higher proportions of contaminants in aquifers as water levels dip.[15] Surface water dams and diversions also create their share of environmental impacts; the future of such projects appears dim, as most suitable sites have already been developed.[16]

For several decades, reclaimed water has served nonpotable (nondrinking) uses and has been recharged to aquifers that provide drinking water supplies.[17] Against the backdrop of water scarcity and groundwater overdraft, reclaimed water is emerging as an increasingly important water resource nationally and internationally.[18] Returning to Texas as an example, "[r]euse of water is expected to provide 12 percent of the total water demand" by the year 2050.[19] A growing number of municipalities across the United States plan to indirectly reuse

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New Mexico. U.S. Bureau of Reclamation, Lower Colorado Region, http://www.usbr.gov/lc/ (last visited Mar. 31, 2005).

11. SAX ET AL., *supra* note 5, at 7–8.

12. Jehl, *supra* note 5, at A1. A doubling in population does not necessarily translate into a doubling of water needs. Texas water planners estimate that municipal water use will increase 67% by 2050. *Id*.

13. Brookshire, *supra* note 5, at 873.

14. SAX ET AL., *supra* note 5, at 7.

15. *Id*. Land subsidence is the dropping of land, sometimes by dozens of feet. *Id*.

16. Interview with Robert Glennon, Morris K. Udall Professor of Law & Pub. Policy, Univ. of Ariz. Rogers Coll. of Law, in Tucson, Ariz. (Apr. 4, 2005) [hereinafter Interview with Glennon].

17. *See* Crook, *supra* note 6, at 55.

18. For example, Israel has exhausted its fresh water supply and is turning to the reuse of effluent. Itzchak E. Kornfeld, *Groundwater Conservation: Conundrums and Solutions for the New Millennium*, 15 TUL. ENVTL. L.J. 365, 369 (2002).

19. HARI KRISHNA, TEX. WATER DEV. BD., WATER REUSE IN TEXAS, http://www.twdb.state.tx.us/assistance/conservation/Municipal/Reuse/ReuseArticle.asp (last visited Oct. 5, 2004). "Currently, 190 utilities in 115 Texas counties report some form of water reuse." *Id.*

effluent for drinking water.[20] Not surprisingly, arid areas are leading the way in reuse of effluent.[21]

Since the wide-scale use of reclaimed water is a relatively recent development, the ownership and use of effluent are relatively new issues in water law.[22] Therefore, this Note seeks to provide a framework for understanding the legal and policy dimensions of reclaimed water use. This Note focuses on the state of Arizona because Arizona is facing especially critical future water shortages and has assumed a leading role in adopting programs and policies to further the use of reclaimed water. Part I of the Note provides an overview of the history, uses, advantages, and barriers to use of reclaimed water. Part II explores federal and state laws and regulations, focusing on Arizona and drawing comparisons to other Western states. Finally, Part III analyzes ongoing and future reuse of effluent in Tucson, Arizona, examines the practical implications of legal and policy regimes governing effluent reuse, and analyzes the prospects for future use of reclaimed water.

I. THE HISTORY, USES, AND VALUE OF EFFLUENT

A. Historical uses of effluent and the treatment process

Until relatively recently, effluent was considered little more than a nuisance.[23] The Wyoming Supreme Court illustrated this perspective in a key opinion relating to the disposal of effluent: "It is well known that the disposition of sewage is one of the important problems that *embarrass* municipalities."[24] However, the 1972 Clean Water Act ("CWA")[25] helped to elevate the status of effluent to that of a potentially valuable resource. The CWA set higher standards for effluent discharge, leading municipalities to produce effluent that was cleaner

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20. *See* Mitch Tobin, *We Have to Drink That?*, ARIZ. DAILY STAR, June 19, 2005, at A8 [hereinafter Tobin, *We Have to Drink That?*].

21. For example, most effluent reuse in Texas occurs in the drier western half of the state. KRISHNA, *supra* note 19. However, effluent reuse is also gaining currency as a solution to water shortages in nonarid areas. For example, in 2005, the State of New Jersey approved a $35 million program to fund use of effluent to water lawns at casinos, flush toilets at state parks, and recharge an aquifer, among other projects. Steve Chambers, *N.J. To Put Its Treated Wastewater To New Use*, STAR-LEDGER (NEWARK, N.J.), Feb. 1, 2005, at 19.

22. Interview with Glennon, *supra* note 16.

23. Gary C. Woodard & Elizabeth Checchio, *The Legal Framework for Water Transfers in Arizona*, 31 ARIZ. L. REV. 721, 737 (1989). Even as recently as 1988, the Arizona Court of Appeals described effluent as "a noxious by-product of the treatment of sewage which the cities must dispose of without endangering the public health and without violating any federal or state pollution laws." City of Phoenix v. Long, 761 P.2d 133, 137 (Ariz. Ct. App. 1988).

24. Wyo. Hereford Ranch v. Hammond Packing Co., 236 P. 764, 772 (1925) (emphasis added).

25. 33 USC §§ 1251–1387; *see also* ANDREW LIEUWEN, EFFLUENT USE IN THE PHOENIX AND TUCSON METROPOLITAN AREAS 29 (1990). Formerly, the CWA was called the Federal Water Pollution Control Act.

and therefore more useful.[26] These standards indirectly encouraged effluent reuse by making it cheaper for municipalities to comply with the standards for the sale of effluent than with the more stringent discharge standards.[27] The new effluent discharge standards also spurred greater industrial recycling of water.[28]

Effluent can be treated and reused in many settings. For instance, industrial facilities often treat their own effluent on-site and then reuse it for cooling processes,[29] and some homeowners have installed residential "graywater" systems, which capture and reuse domestic water.[30] This Note, however, focuses on the wide-scale reuse of effluent that comes about through the treatment and reuse of *municipal* wastewater. Municipal wastewater is collected from homes connected to sewer systems, as well as from commercial and industrial users.[31] A system of collection sewers and pumping stations routes wastewater to a WWTP.[32] In some cases, municipalities reuse or sell their reclaimed water directly following treatment; in other cases, they recharge water into the ground for later withdrawal and use.[33] It is important not to draw an artificial distinction between effluent and noneffluent water supplies. In fact, many "fresh" sources include some effluent because discharged effluent often enters downstream water systems.[34]

The treatment of effluent essentially accelerates the natural process of water purification that occurs in streams and other waterways by dilution and bacterial processes.[35] The chosen level of treatment determines the water's

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26. *Id*. The Act required secondary treatment of municipal wastewater discharged by WWTPs. *Id.* The CWA also required wastewater dischargers to "provide whatever further treatment was necessary to meet in-stream water quality standards." David S. Baron, *Water Quality Standards for Rivers and Lakes: Emerging Issues*, 27 ARIZ. ST. L.J. 559, 559 (1995).

27. Baron, *supra* note 26, at 589.

28. SAX ET AL., *supra* note 5, at 13. These standards led to significant reductions in industrial water demand. *Id*.

29. ENVTL. PROT. AGENCY REGION 9, WATER RECYCLING AND REUSE: THE ENVIRONMENTAL BENEFITS (1998), *available at* http://www.epa.gov/region9/water/recycling/ [hereinafter ENVTL. PROT. AGENCY REGION 9].

30. *See, e.g.*, COLO. DIV. OF WATER RES., GRAYWATER SYSTEMS AND RAINWATER HARVESTING IN COLORADO (2003), *available at* http://www.water.state.co.us/pubs/policies/waterharvesting.pdf.

31. *See* LIEUWEN, *supra* note 25, at 3.

32. ENVTL. PROT. AGENCY, PUBL'N NO. 833-F-98-002, HOW WASTEWATER TREATMENT WORKS . . . THE BASICS, (1998), *available at* http://www.epa.gov/npdes/pubs/bastre.pdf [hereinafter ENVTL. PROT. AGENCY, THE BASICS]. Homes with private septic systems do not send their water to WWTPs and therefore do not contribute to the usable supply of effluent. *See* LIEUWEN, *supra* note 25, at 3.

33. ENVTL. PROT. AGENCY REGION 9, *supra* note 29; Mitch Tobin, *Reclaimed Water Use Will Grow*, ARIZ. DAILY STAR, Jan. 17, 2005, at B1 [hereinafter Tobin, *Reclaimed Water Use Will Grow*].

34. NAT'L RESEARCH COUNCIL, ISSUES IN POTABLE REUSE 2 (1998). "[M]ore than two dozen major water utilities use water from rivers that receive wastewater discharges amounting to more than 50 percent of the stream flow during low flow conditions." *Id*.

35. ENVTL. PROT. AGENCY, THE BASICS, *supra* note 32.

suitability for various uses.[36] Primary treatment, which involves physical removal of suspended solids, is largely ineffective in addressing health risks.[37] Secondary treatment, which involves biological oxidation and disinfection,[38] is significantly more effective than primary treatment.[39] Secondary effluent can be reused for a variety of purposes, including nonfood crop irrigation; surface irrigation of orchards and vineyards; recharge of nonpotable aquifers; environmental restoration; industrial cooling processes;[40] materials processing in the mining, sand, and gravel industries; and cement mixing.[41] Tertiary treatment involves biological treatment and physical-chemical separation techniques, and can achieve "almost any degree of pollution control desired."[42] In addition to the secondary reuses listed above, tertiary effluent may be used to irrigate landscapes, golf courses, and food crops, and for indirect potable reuse, which means recharging effluent to an aquifer and then withdrawing it to serve as drinking water.[43]

B. Current uses of reclaimed water

The reuses of effluent can be grouped into several broad categories: municipal, agricultural, industrial/commercial, environmental protection/ enhancement, and potable use. Common municipal uses of reclaimed water include irrigation of parks, golf courses, and other landscapes.[44] Golf courses reuse a significant amount of municipal effluent, in part due to municipal regulations concerning golf course irrigation.[45] In agriculture, effluent can be used to irrigate

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36. ENVTL. PROT. AGENCY REGION 9, *supra* note 29.

37. *See* LIEUWEN, *supra* note 25, at 15. The U.S. Environmental Protection Agency ("EPA") does not recommend any reuses of effluent that has undergone only primary treatment. ENVTL. PROT. AGENCY REGION 9, *supra* note 29.

38. ENVTL. PROT. AGENCY REGION 9, *supra* note 29. These processes include trickling filters and the activated sludge process. LIEUWEN, *supra* note 25, at 16.

39. *See* ENVTL. PROT. AGENCY, THE BASICS, *supra* note 32. The activated sludge process generally removes 80 to 90% of viruses and more than 90% of bacteria. LIEUWEN, *supra* note 25, at 16. "Secondary effluent . . . usually contains TDS, nitrate, sulfate, metals, and bacteria at concentrations higher than those present in public water supply systems with groundwater sources." ARIZ. DEP'T OF WATER RES., THIRD MANAGEMENT PLAN FOR TUCSON ACTIVE MANAGEMENT AREA, 2000–2010 at 7-20 (1999), *available at* http://www.water.az.gov/adwr/Content/Publications/files/ThirdMgmtPlan/tmp_final/default .htm [hereinafter THIRD MANAGEMENT PLAN].

40. ENVTL. PROT. AGENCY REGION 9, *supra* note 29.

41. LIEUWEN, *supra* note 25, at 19.

42. ENVTL. PROT. AGENCY, THE BASICS, *supra* note 32. These techniques include carbon absorption, filtration, distillation, and reverse osmosis. *Id*.

43. ENVTL. PROT. AGENCY REGION 9, *supra* note 29.

44. *Id*.

45. Effluent also can be applied to golf courses as part of municipal wastewater treatment processes. CH2MHILL, REUSE OF MUNICIPAL WASTEWATER AND BIOSOLIDS, http://www.penweb.org/issues/energy/ch2m-sludge.html (last visited Oct. 5, 2004) For example, the city of Prineville, Oregon developed a golf course as part of a land discharge treatment plan when EPA required it to stop discharging wastewater into a nearby river. *Id.* Golf courses also can relatively easily reuse their *own* effluent by incorporating effluent impoundments into golf course designs. David B. Dornak, *A New Generation is Teeing Off:*

orchards, vineyards, nonfood crops, and even food crops, depending on the degree of treatment.[46] In addition, there is significant demand for reclaimed water for industrial and commercial reuses such as cooling, steam generation, processing, and washing.[47] Effluent can also be used for mining purposes, such as ore processing.[48]

Effluent discharges can serve a variety of environmental purposes, including restoring riparian areas, providing habitats, and supporting wetlands, which in turn improves water quality and prevents flood damage.[49] In fact, the traditional practice of discharging effluent from WWTPs to waterways has helped to restore Western riparian systems that otherwise would be dry due to groundwater pumping and surface water diversions; in many cases, these effluent discharges support "lush vegetation."[50] "Today, much of the flowing water left at lower elevations near cities is found in effluent dominated streams—streams dependent on the flow of effluent from [WWTPs]."[51] In addition to traditional effluent discharges, a number of effluent projects have been specifically designed to create or enhance riparian habitats.[52]

Is Tiger Woods Making Divots on Environmentally Sound Golf Courses?, 23 COLUM. J. ENVTL. L. 299, 329 (1998).

46. ENVTL. PROT. AGENCY REGION 9, *supra* note 29. Effluent may be a superior water source for agricultural irrigation because of its nutrient content. LIEUWEN, *supra* note 25, at 20. Since agricultural reuse of effluent presents certain risks to workers, consumers, the environment, and agricultural equipment, standards for effluent use in agriculture are quite strict and costly to meet. *See* Steenvoorden, *supra* note 2, at 2; LIEUWEN, *supra* note 25, at 20. A variation on agricultural use of effluent is irrigation of hardwood tree plantations as part of effluent treatment. CH2MHILL, *supra* note 45.

47. *See* LIEUWEN, *supra* note 25, at 18. Industrial facilities are "good candidates for effluent use," since they often use large amounts of water, they tend to be located near urban areas where wastewater is treated, and many industrial water users can employ effluent. *Id*. Industrial effluent reuse depends on water quality requirements for particular uses, which vary considerably across industries. *Id.* at 19. The safety of workers, consumers, industrial equipment, and the environment are important considerations in the industrial context. For example, even though the gravel washing process itself does not require high-quality effluent, the risk of worker inhalation of mist impedes effluent use in this industry. *Id*.

48. *Id*.

49. ROBERT GLENNON, WATER FOLLIES 76–77 (2002); *see also* ENVTL. PROT. AGENCY REGION 9, *supra* note 29.

50. BARBARA TELLMAN, ARIZONA'S EFFLUENT DOMINATED RIPARIAN AREAS: ISSUES AND OPPORTUNITIES 1 (Water Res. Research Ctr., Univ. of Ariz., Issue Paper No. 12 1992); Baron, *supra* note 26, at 588. Discharges of effluent with substandard water quality may have the opposite effect. For example, high volumes of effluent discharge to the south San Francisco Bay threatened a natural saltwater marsh and two endangered species that lived there. In that case, a $140 million water recycling program was implemented in 1997 that provides up to twenty-one million gallons per day of recycled water for irrigation and industrial use, thereby avoiding the conversion of the bay's natural salt water marsh to brackish marsh. ENVTL. PROT. AGENCY REGION 9, *supra* note 29.

51. TELLMAN, *supra* note 50, at 1.

52. Some of these projects supply effluent to areas with declining stream flow. For example, reduced stream flows threatened the water quality and natural resources of

One area of growing importance is potable reuse. The issue of potable reuse, given its associated health risks, draws attention to the distinction between direct and indirect reuse of effluent. Direct use of effluent simply means that wastewater is used directly after treatment, with no intervening recharge to groundwater aquifers. Effluent can be directly used for a variety of purposes, but direct introduction of highly treated effluent into potable water supplies is not generally considered to be viable.[53] Indirect use of effluent involves recharging effluent to groundwater aquifers by surface spreading, pond infiltration, or well injection, and subsequently withdrawing the water.[54] An advantage of recharge is that the water undergoes natural cleaning processes before it is withdrawn for use.[55] On the other hand, there is a risk that contaminants in effluent may pollute aquifers through recharge.[56] A growing number of communities are using tertiary effluent for indirect potable reuse.[57]

C. Benefits of reuse of effluent

Effluent has several advantages over conventional water sources for meeting water demands. The most significant advantage is that effluent "is the only source of water that automatically increases with economic and population growth," even in times of drought.[58] In addition, the fact that effluent is a locally

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Mono Lake, California, and the City of Los Angeles was required to stop diverting one-fifth of its historic withdrawals from the lake. Water recycling projects in Los Angeles have helped to offset the loss of the lake's water and allow its restoration. ENVTL. PROT. AGENCY REGION 9, *supra* note 29.

53. NAT'L RESEARCH COUNCIL, *supra* note 34, at 1–2. Namibia directly uses reclaimed water for potable purposes, but American municipalities do not because of the cost and risk involved with treating water to meet potable water standards. ENVTL. PROT. AGENCY REGION 9, *supra* note 29.

54. NAT'L RESEARCH COUNCIL, *supra* note 34, at 2; *see also* Simon Toze et al., *Determination of Water Quality Improvements Due to the Artificial Recharge of Treated Effluent*, *in* WASTEWATER RE-USE AND GROUNDWATER QUALITY 53, 53 (Joop Steenvoorden & Theodore Endreny eds., 2003). The benefits of artificial recharge include providing storage, re-pressurizing depleted aquifers, and preventing saline intrusion. *Id.* at 70–72. Effluent is generally recharged in specially constructed facilities that control water movement and infiltration. JOE GELT ET AL., WATER IN THE TUCSON AREA: SEEKING SUSTAINABILITY 26–29 (1999), *available at* http://ag.arizona.edu/AZWATER/publications/sustainability/report_html/chap3_04.html. Another method of indirect potable use is adding effluent to surface water reservoirs or waterways that serve as communities' raw water supplies. NAT'L RESEARCH COUNCIL, *supra* note 34, at 1–2.

55. NAT'L RESEARCH COUNCIL, *supra* note 34, at 2. "[A]rtificial recharge can significantly contribute to water quality improvement by natural attenuation of contaminants via passage of the water through the aquifer." Toze, *supra* note 54, at 53. Under certain conditions, recharged water that is later recovered is "chemically and microbiologically improved compared with . . . treated effluent, and is more suitable for irrigation than native groundwater." Toze, *supra* note 54, at 59, 53–59.

56. JANICK F. ARTIOLA ET AL., ARIZONA: KNOW YOUR WATER 29–30 (2004).

57. *See* NAT'L RESEARCH COUNCIL, *supra* note 34, at 1.

58. KRISHNA, *supra* note 19. For example, Tucson's production of effluent is projected to increase from 68,061 acre-feet in 2003 to 128,000 acre-feet by 2050. CITY OF TUCSON WATER DEP'T, CITY OF TUCSON, WATER PLAN: 2000–2050 at 4–13 (2004),

controlled water supply can mitigate some of the political uncertainties associated with certain water sources, such as the Colorado River.[59] Effluent is also a very reliable water source, with only minor interruptions in supply.[60]

Several features of wastewater create possibilities of cost savings. The proximity of urban treatment plants to end-users is a clear advantage.[61] Using reclaimed water rather than groundwater also reduces costs associated with groundwater overdraft, such as mitigating subsidence, adding pumping lifts, and addressing the increased salinity of water drawn from lower depths.[62] Municipalities can often realize cost savings by selling effluent to users such as golf courses rather than treating it to the level required to meet discharge standards.[63]

The environmental benefits of using reclaimed water can be significant. Reducing the overdraft of groundwater prevents subsidence, as mentioned above, and curbs water quality degradation.[64] In areas with surface water resources, use of effluent may reduce the need to divert surface water from sensitive riparian areas, thereby preventing the deterioration of water quality and ecosystem health that stems from reduced water flows.[65] Conserving surface water also preserves recreational activities, such as boating, fishing, and swimming.[66] Reusing effluent instead of discharging it can also prevent polluted effluent from damaging sensitive water bodies.[67] In fact, some nutrients in effluent that may harm riparian systems, such as nitrogen, can benefit agricultural and landscape irrigation, and reduce the need for synthetic fertilizers.[68] On the other hand, some riparian areas can tolerate effluent discharges and have come to depend on those discharges.[69]

D. Drawbacks and barriers to reuse of effluent

The most salient impediments to the reuse of effluent are health, environmental, and economic risks from using effluent; public opinion; costs associated with acquisition, storage, distribution, and treatment; and the limits of

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available at http://www.tucsonaz.gov/water/waterplan.htm [hereinafter TUCSON WATER PLAN].

59. ENVTL. PROT. AGENCY REGION 9, *supra* note 29.

60. Crook, *supra* note 6, at 56.

61. KRISHNA, *supra* note 19. The proximity of effluent to end users is particularly noteworthy if one considers that the State of Arizona spent $3.6 billion to build the 336-mile Central Arizona Project to carry water from the Colorado River on the western side of Arizona to interior areas. GOVERNOR'S DROUGHT TASK FORCE, ARIZONA STATEWIDE WATER CONSERVATION STRATEGY 12 (2004).

62. LIEUWEN, *supra* note 25, at 26.

63. *See id.* at 25; ENVTL. PROT. AGENCY REGION 9, *supra* note 29.

64. LIEUWEN, *supra* note 25, at 26.

65. ENVTL. PROT. AGENCY REGION 9, *supra* note 29. Maintaining large streamflows dilutes contaminants in those waters and reduces the build-up of sediments that can contribute to flooding and erosion. SAX ET AL., *supra* note 5, at 3.

66. SAX ET AL., *supra* note 5, at 3.

67. ENVTL. PROT. AGENCY REGION 9, *supra* note 29.

68. *Id.*

69. TELLMAN, *supra* note 50, at 1.

the efficacy of effluent reuse in the overall context of water usage. Legal limits are analyzed in Parts II and III below.

1. Health and environmental risks and quality for reuse applications

Effluent presents health and environmental risks associated with microbiological, chemical, and toxic contaminants.[70] These risks depend on the probability and degree of exposure and the quality of treatment processes.[71] Tertiary treatment produces nearly pathogen-free reclaimed water; however, not even the most advanced treatment can be 100% effective in eliminating health risks.[72] In general, health studies have found that uses of reclaimed water—even indirect potable use—can be safe, given appropriate pretreatment of the water.[73] The reclaimed potable water in communities using tertiary effluent for indirect potable reuse "generally . . . meets or exceeds the quality of the raw waters those systems would use otherwise, as measured by current standards."[74]

WWTPs are largely effective in removing the pathogens that historically were the dominant health concern associated with effluent.[75] However, treatment systems do not fully remove toxic industrial and organic chemicals.[76] Moreover, the health and environmental effects of endocrine disruptors in effluent is an area of growing concern.[77] Experts still consider reclaimed water to be safe for recharge

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70. *See* NAT'L RESEARCH COUNCIL, *supra* note 34, at 3.

71. LIEUWEN, *supra* note 25, at 15.

72. *See id.* at 16.

73. "[P]lanned, indirect potable reuse is a viable application of reclaimed water—but only when there is a careful, thorough, project-specific assessment that includes contaminant monitoring, health and safety testing, and system reliability evaluation." NAT'L RESEARCH COUNCIL, *supra* note 34, at 3.

> [Epidemiological] studies [conducted by UCLA and the Rand Corporation] examined the health of people ingesting water containing up to 35 percent reclaimed water, versus similar populations receiving no reclaimed water. There were no statistically significant increases in cancers, gastrointestinal disease or adverse birth outcomes in those areas where the people were drinking the reclaimed water.

Gigi Hanna, *Water Reuse: Experts Hope to Expand Public Acceptance of Water Recycling and Reuse*, AQUEDUCT MAG. (Mar. 2001), *available at* http://www.mwdh2o.com/Aqueduct/march2001/reuse.htm.

74. NAT'L RESEARCH COUNCIL, *supra* note 34, at 2.

75. *See* ARTIOLA ET AL., *supra* note 56, at 20; LIEUWEN, *supra* note 25, at 15.

76. ARTIOLA ET AL., *supra* note 56, at 20. Organic chemicals are "carbon-based compounds, including pesticides and oil-derived products (fuels, plastics, and solvents)." *Id.* at 84; s*ee also* LIEUWEN, *supra* note 25, at 16, 25.

77. H. Chapman, *Removal of Endocrine Disruptors by Tertiary Treatments and Constructed Wetlands in Subtropical Australia,* 47 WATER SCI. & TECH. 151 (2003), *available at* http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=12830954&dopt=Abstract. Endocrine disruptors are substances that have the potential to create hormone imbalances and disrupt the functioning of the organs that hormones regulate. ExtoxNet, Questions about Endocrine Disruptors, http://extoxnet.orst.edu/faqs/pesticide/endocrine.htm (last visited Feb. 21, 2005). Endocrine

and irrigation, but emerging pollutant concerns call for ongoing monitoring and research.[78]

Another effluent quality issue is salinity, or total dissolved solids ("TDS") content.[79] Treated effluent is generally about "1.5 times higher in TDS than the original water source."[80] Water with high salinity may taste slightly salty and have a slippery feel.[81] Further, the use of treated effluent for irrigation may increase salinity and water hardness in underlying aquifers.[82]

In considering the quality issues and risks presented by effluent, it is important to recognize that conventional water sources are also often impaired. Since many water sources receive discharges of waste, "[h]ighly treated wastewater does not differ substantially from some sources already being used as water supplies."[83] Furthermore, groundwater drawn from lower depths often contains naturally occurring elements such as arsenic, fluoride, and radon.[84]

Finally, effluent presents an entirely different kind of environmental risk; its use may justify environmentally harmful growth patterns that otherwise would be reined in by limited water availability.[85]

2. Public and end-user opinion

Public opinion is a critical factor in determining how public funds will be expended to support the reuse of reclaimed water.[86] Public acceptance of effluent reuse appears to correlate with "the degree of human contact, conservation, environmental and public health protection, and cost."[87] The framing and presentation to the public of effluent reuse has significant implications. Public

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disruptors include medicines, which anyone can excrete into the wastewater system. Tobin, *We Have to Drink That?*, *supra* note 20, at A8.

78. ARTIOLA ET AL., *supra* note 56, at 20.

79. *Id*.

80. *Id*.

81. *Id.* at 32.

82. Lucila Candela et al., *Treated Urban Wastewater Re-use for Irrigation of a Golf Course and Impacts on Soil and Groundwater*, *in* WASTEWATER RE-USE AND GROUNDWATER QUALITY 41, 41–47 (Joop Steenvoorden & Theodore Endreny eds., 2003). Further, industrial facilities are not able to recycle effluent as many times as they can recycle other water due to the initial impaired quality of effluent. LIEUWEN, *supra* note 25, at 18.

83. NAT'L RESEARCH COUNCIL, *supra* note 34, at 18. "[M]any [groundwater] wells have had to be closed due to increasing contamination." SAX ET AL., *supra* note 5, at 15.

84. GLENNON, *supra* note 49, at 32.

85. Chambers, *supra* note 21. "It has often been claimed that meeting demand for water in arid western cities simply facilitates urban sprawl, and aids in creating metropolitan growth in places that cannot rationally sustain it." SAX ET AL., *supra* note 5, at 206.

86. *See* LIEUWEN, *supra* note 25, at 16.

87. *Id.* at ix.

opposition halted a recent plan by Los Angeles to recharge effluent for indirect potable use when a journalist dubbed the proposal "toilet-to-tap."[88]

3. Costs

"While water recycling is a sustainable approach and can be cost-effective in the long term, the treatment of wastewater for reuse and the installation of distribution systems can be initially expensive compared to such water supply alternatives as imported water or groundwater."[89] Costs associated with effluent reuse derive principally from acquisition, treatment, storage, and distribution.[90] Acquisition costs often merely entail the expense of pumping water from its original source to the treatment facility.[91] Treatment costs vary considerably based on the wastewater source and the processes applied, ranging from zero to several hundred dollars per acre-foot.[92] Since effluent quality is often lower than the quality of conventional water sources, end-users of effluent may incur additional costs for plumbing fixtures, increased maintenance, and supplemental treatment.[93] Also, because irrigation in arid areas peaks during the summer, large surface or subsurface storage facilities may be required to meet year-round demand for effluent.[94] Distribution costs derive from the infrastructure and energy required to transport reclaimed water to end-users through effluent-dedicated pipes.[95] In short, while the economic efficiency of using reclaimed water is likely to increase as water supplies become scarcer and more costly, the costs of reusing effluent remain a barrier.[96]

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88. D.J. Waldie, *Los Angeles' Toilet-to-Tap Fear Factor*, L.A. TIMES, Dec. 1, 2002, at M2; *see also* Hanna, *supra* note 73. Golf course architects have noted that the terms "effluent" and "reclaimed water" are more palatable to the public than the term "wastewater." *See* Garrett Gill & David Rainville, *Effluent for Irrigation: Wave of the Future?*, *in* WASTEWATER REUSE FOR GOLF COURSE IRRIGATION 44, 49 (1994). The author-architects suggest that the public is more likely to accept irrigation of golf courses with effluent if effluent is presented as a recycled resource, for example, in terms of its nutrient content. *Id*. at 48.

89. ENVTL. PROT. AGENCY REGION 9, *supra* note 29.

90. LIEUWEN, *supra* note 25, at 23. Another potential cost associated with use of reclaimed water is the possibility of liability for end-users. Personal injury claims could arise if consumers were to become ill due to exposure to effluent. In addition, damage to crops by contaminants contained in effluent could give rise to property damage cases. *Id.* at 37.

91. *Id.* at 23. Naturally, such costs are lower when WWTPs are located near the sources of wastewater. *See* KRISHNA, *supra* note 19.

92. LIEUWEN, *supra* note 25, at 23. An acre-foot is 325,851 gallons, which is roughly typical of a family of four's annual use of water. Mitch Tobin, *More Effluent, CAP Called Vital for City*, ARIZ. DAILY STAR, Oct. 31, 2001, at B1 [hereinafter Tobin, *More Effluent*].

93. *See* LIEUWEN, *supra* note 25, at 25.

94. *See id.* at 24.

95. GELT ET AL., *supra* note 54, at 24–25. Some WWTPs are designed chiefly to facilitate the disposal of effluent, and are therefore located a considerable distance from the reuse site. *See* LIEUWEN, *supra* note 25, at 4.

96. *See* LIEUWEN, *supra* note 25, at x, 26; KRISHNA, *supra* note 19.

4. The share of municipal effluent in the overall water usage scheme

Given that municipal wastewater represents a small portion of the total water supply, reclaimed water has limited potential to meet growing water demands. Since agriculture accounts for approximately 80% of total water consumption nationally,[97] it will be necessary to reduce irrigation or increase reuse of agricultural water to significantly reduce groundwater pumping and surface water diversions.

II. APPLICABLE LAW, REGULATIONS, AND POLICY

Three legal issues are central to the reuse of effluent: (1) standards for effluent quality; (2) regulation of effluent reuses; and (3) legal rights to effluent. These issues are governed by a combination of federal, state, and local laws and regulations. Federal law generally governs water quality,[98] while state law generally governs water rights and quantity management.[99]

A. Regulation of effluent quality

The U.S. Environmental Protection Agency ("EPA") regulates various aspects of wastewater treatment and drinking water quality.[100] It was Congress's decision to mandate quality improvements under the Clean Water Act ("CWA") that initially "broadened the scope of potential uses" of effluent.[101] The CWA largely provides the federal regulatory framework for effluent quality.[102] The National Pollutant Discharge Elimination System ("NPDES") ensures that effluent dischargers comply with federal effluent quality requirements through the issuance of permits.[103]

Federal requirements for effluent quality encompass both pretreatment and treatment standards. The National Pretreatment Standards "control pollutants which pass through or interfere with treatment processes in Publicly Owned Treatment Works ("POTWs") or which may contaminate sewage sludge."[104] The

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97. SAX ET AL., *supra* note 5, at 12. This pattern is largely mirrored internationally, where "70-80% of the world's freshwater withdrawals are used to irrigate crops." Steenvoorden, *supra* note 2, at 1 (internal citations omitted).

98. SAX ET AL., *supra* note 5, at 882–84.

99. *See* Katharine L. Jacobs & James M. Holway, *Managing for Sustainability in an Arid Climate: Lessons Learned from 20 Years of Groundwater Management in Arizona, USA*, 12 HYDROGEOLOGY J. 81 (2004).

100. ENVTL. PROT. AGENCY REGION 9, *supra* note 29.

101. LIEUWEN, *supra* note 25, at 29.

102. The CWA authorizes effluent limitations for existing sources, water-quality-related effluent limitations and guidelines, federal performance standards for new pollution sources, and pretreatment standards for pollutants entering Publicly Owned Treatment Works (POTWs). Clean Water Act, 33 U.S.C. §§ 1311(b), 1312, 1314(b), 1316(b)(1)(B), 1317 (2000).

103. *Id.* § 1342. NPDES permits are generally administered by the states. In Arizona, ADEQ administers the NPDES system. ARIZ. REV. STAT. ANN. §§ 49-104, 49-203 (2004); LIEUWEN, *supra* note 25, at 29.

104. 40 C.F.R. § 403.1(a) (2005).

CWA requires secondary treatment of effluent discharged by WWTPs.[105] Pursuant to the CWA, the EPA sets national effluent guidelines, which are technology-based, industry-specific regulations of the discharge of pollutants to surface waters and to POTWs.[106] States sometimes also regulate effluent quality, such as by requiring permits to ensure quality of discharges.[107]

B. Regulation of reuse of effluent

Federal regulations do not directly govern wastewater reuse.[108] The EPA may indirectly regulate the use of reclaimed water under the authority of laws that set general standards for water, such as the Safe Drinking Water Act.[109] However, "the majority of states have established criteria or guidelines for the beneficial use of recycled water."[110] Such regulations play an important political and economic role. They provide legal certainty to prospective effluent users and signify to the public that the reclaimed water is safe.[111] Municipalities also may set more stringent standards for local use of water.[112]

C. Rights to effluent

Allocation of water rights is generally a matter of state law.[113] Rights to reclaimed water are an "unsettled area of the law" in most states.[114] One possibility for governing rights to effluent is the prior appropriation system, which allocates surface water rights across most of the West.[115] The traditional rule in water law is that a landowner who diverts water from a natural stream may recapture "waste" or "seepage" water from her land but may not reuse "return flow" if doing so

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105. ENVTL. PROT. AGENCY REGION 9, *supra* note 29; LIEUWEN, *supra* note 25, at 29.

106. ENVTL. PROT. AGENCY, FINAL EFFLUENT GUIDELINES PLAN FOR 2004/2005 FACT SHEET (2004), http://www.epa.gov/waterscience/guide/final-fs2004-2005plan.htm.

107. See *infra* Part II.D on Arizona Aquifer Protection Permits.

108. Baron, *supra* note 26, at 589 n.233. However, the EPA publishes water reuse guidelines to assist states in developing their own reuse guidelines. Crook, *supra* note 6, at 63.

109. LIEUWEN, *supra* note 25, at 18. The Safe Drinking Water Act regulates most public and privately owned water systems. *See id*.

110. ENVTL. PROT. AGENCY REGION 9, *supra* note 29. States with "well-developed, comprehensive water reclamation and reuse regulations" include Arizona, California, Florida, and Texas, where there is extensive reuse of water. Crook, *supra* note 6, at 54–55.

111. *See* Crook, *supra* note 6, at 57. Crook suggests that regulations are preferable to guidelines because they provide greater legal certainty. *Id* at 58.

112. For example, Tucson voters banned the residential use of water transported through the Central Arizona Project in a 1995 referendum. *Election '99: Results from Arizona, Colorado, Maine, and Washington*, GREENWIRE, Nov. 3, 1999.

113. SAX ET AL., *supra* note 5, at 10.

114. Dornak, *supra* note 45, at 332.

115. ARIZ. REV. STAT. ANN. § 45-141 (2004). Under this system, the first appropriator of water has a superior right to that water. *Id*. An appropriator must beneficially use the water, and may lose the right if it is not used for five successive years. *Id*.

would harm downstream junior water users with vested rights in maintaining stream conditions.[116] The influential *Arizona Public Service Co. v. Long* case in Arizona modified this common law rule, by according rights to effluent to those who treat it.[117] The *Long* case and other states' water rights systems are discussed below.

D. Arizona law, regulations, and policies governing reclaimed water

1. Overview

At the state level, the Arizona Department of Environmental Quality ("ADEQ") regulates effluent quality through reuse rules and permits.[118] The Arizona Department of Water Resources ("ADWR") is responsible for water supply and rights.[119] At the local level, municipalities have broad powers to operate and regulate sewer systems.[120] The Arizona legislature has not enacted comprehensive legislation governing effluent, as it has for surface water and groundwater.[121]

2. Regulation of initial quality of effluent

As discussed above, much regulation of effluent quality takes place at the federal level through the CWA and EPA regulations. Some of this regulation operates under a cooperative federalism model; for example, ADEQ cooperates with the EPA in writing and administering National Pollutant Discharge Elimination System permits.[122] Arizona law also requires treatment of effluent to a certain level before discharge,[123] including requiring Aquifer Protection Permits for effluent discharge or recharge.[124] To obtain such a permit, the permittee must demonstrate to ADEQ that the facility uses the best available demonstrated control technology to reduce discharges and that the discharges will not contribute to aquifer water-quality violations or that discharged pollutants will not further

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116. Dornak, *supra* note 45, at 332. Return flow is water that an upstream appropriator does not consumptively use that returns to a waterway. SAX ET AL., *supra* note 5, at 101.

117. 773 P.2d 988 (Ariz. 1989).

118. ARIZ. REV. STAT. ANN. §§ 49-203(A)(6), 49-221(E) (2004). ADEQ's duties and powers related to water quality include: adopting water quality standards, a permit program for the point discharge of pollutants into navigable waters, an aquifer protection permit program, technical standards for conveyances of reclaimed water, and a permit program for the direct reuse of reclaimed water. *Id.* §§ 49-104, 49-203.

119. Ariz. Dep't of Water Res., http://www.water.az.gov/adwr/ (last visited Apr. 9, 2005). Regional "Active Management Areas" assume some responsibility for policy-making. Interview with Kathy Jacobs, Assoc. Professor & Specialist, Univ. of Ariz. Water Res. Research Ctr., in Tucson, Ariz. (Mar. 8, 2005) [hereinafter Interview with Jacobs].

120. City of Phoenix v. Long, 761 P.2d 133, 136 (Ariz. Ct. App. 1988).

121. *Long*, 773 P.2d at 995.

122. LIEUWEN, *supra* note 25, at 29.

123. *See, e.g.*, ARIZ. REV. STAT. ANN. § 49-255.03 (2004). Section 49-241 governs the discharge of effluent from sewage treatment facilities.

124. *Id*. § 49-243.

degrade an aquifer that is failing to meet standards.[125] In addition, a variety of wastewater treatment regulations prescribe performance requirements, secondary treatment, and removal of certain constituents for new sewage treatment facilities, and establish pretreatment regulations for various sources of pollution.[126]

Several facets of Arizona law address the nuisance-like aspects of effluent. ADEQ promulgates rules for reclamation systems to prevent the transmission of diseases.[127] Also, under state law, effluent used for land fertilization or irrigation constitutes a public and environmental nuisance, unless the effluent use is approved by the Arizona Department of Health Services or ADEQ.[128]

In addition, Arizona law provides special water quality rules for effluent-dependent waters (which are waterways whose flow is maintained by effluent discharges).[129] ADEQ may adopt site-specific water quality standards for such waters, which in turn affects limitations for WWTP discharges to those waters.[130] ADEQ may also modify a water quality standard if effluent discharges provide a net ecological benefit of protecting a riparian habitat in an area with limited water resources.[131]

3. Safety regulations for reuse of effluent

ADEQ is charged with adopting "technical standards for conveyances of reclaimed water and a permit program for the direct reuse of reclaimed water."[132] Arizona regulations for the reuse of reclaimed water establish classes of reclaimed water by quality.[133] Allowable uses vary by class of reclaimed water.[134] Some

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125. *Id.* A higher standard applies to certain listed carcinogenic and other organic pollutants. *Id.*

126. ARIZ. ADMIN. CODE §§ 18-9-A906, 18-9-B204 (2004).

127. ARIZ. REV. STAT. ANN. § 49-104(B)(13) (2004).

128. *Id.* §§ 36-601(A)(14), 49-141(A)(7); Ariz. Water Co. v. City of Bisbee, 836 P.2d 389, 391 (Ariz. Ct. App. 1991). ADEQ may act to abate environmental nuisances and shall act to ensure the nuisance is abated. ARIZ. REV. STAT. ANN. § 49-141.

129. ARIZ. ADMIN. CODE §§ 18-11-106, 18-11-113 (2004).

130. *Id.* § 18-11-113.

131. Administrative Code section § 18-11-106 provides ADEQ a set of criteria to use in determining whether to modify a standard; it also provides that "the discharge of effluent shall, at a minimum, comply with applicable technology-based effluent limitations."

132. ARIZ. REV. STAT. ANN. § 49-203(A)(6) (2004).

133. *See, e.g.*, ARIZ. ADMIN. CODE §§ 18-11-303, 18-11-3 tbl.A (2004). The classes are A+, A, B+, B, and C. *Id.* §§ 18-11-309, 18-11-3 tbl.A.

134. ARIZ. ADMIN. CODE § 18-11-3 tbl.A. For example, Class A water is required for irrigation of food crops, recreational impoundments, and irrigation of residential and schoolground landscapes; Class B water may be used for surface irrigation of orchards and vineyards, golf course irrigation, pasture for milking animals, and concrete and cement mixing; Class C water may be used for pasture for nondairy animals and irrigation of sod farms. *Id.* Uses not listed in Table A may be permitted in ADEQ's discretion. *Id.* § 18-11-309(A). Factors are provided for ADEQ to consider in determining whether a certain class of reclaimed water is appropriate for a new reuse. *Id.* § 18-11-309(C).

reuses of reclaimed water, such as in public swimming pools, are altogether prohibited.[135] In other cases, such as where industrial wastewater affects the reclaimed water, reuse permits are required.[136] State law prohibits municipalities from directly using treated effluent for potable supply; however, they may augment the potable supply by recharging treated effluent.[137]

4. Conservation and storage regulations

In *Arizona Public Service Co. v. Long*, the Arizona Supreme Court held that, until the state legislature adopts a regulatory scheme for effluent, producers of effluent are entitled to put effluent to any reasonable use.[138] As a result, effluent exchanges are exempt from general water exchange permitting rules,[139] water bodies filled exclusively with effluent are exempt from the general statutory prohibition on filling bodies of water,[140] and golf courses that exclusively use effluent are exempt from Active Management Area allotment regulations.[141]

Two principal Arizona water-related legal regimes provide a context in which effluent storage and reuse should be understood; they also provide incentives for effluent reuse. The first is the 1980 Groundwater Management Act ("GMA"), which was designed to halt groundwater overdraft.[142] The GMA concentrates groundwater management efforts in five Active Management Areas ("AMAs"): Phoenix, Tucson, Prescott, Pinal, and Santa Cruz.[143] Each AMA has a water management goal, which for the major urban areas—Phoenix, Tucson, and Prescott—is "safe yield" by 2025.[144]

Under GMA management plans, a formula limits how much water municipal water providers may withdraw, divert, or receive for customer delivery.[145] However, directly delivered effluent is not subject to these requirements.[146] ADWR further encourages effluent use by not counting effluent

135. *Id*. § 18-5-206. This appears to represent outdated notions of the risks of reclaimed water.

136. *See, e.g.*, *id*. §§ 18-9-707, 18-9-711, 18-9-719.

137. TUCSON WATER PLAN, *supra* note 58, at 4–14.

138. 773 P.2d 988, 995 (Ariz. 1989).

139. MICHAEL J. PIERCE, WATER LAW, § 3.2.9–3.2.9.1 (2002) (citing ARIZ. REV. STAT. ANN. § 45-1002(A)(1)-(2) (2004)).

140. *Id*. § 3.2.10 (citing ARIZ. REV. STAT. ANN. § 45-132(A)-(B) (2004)).

141. Cristián A. Sierra, *Par for the Course*, TUCSON WKLY., Jan. 31, 2002, *available at* www.tucsonweekly.com/gbase/currents/Content?oid=oid:44981.

142. PIERCE, *supra* note 139, § 3.2.4.2–3.2.4.2.2.

143. COLBY ET AL., *supra* note 3, at 5. The GMA "also established a new water rights system, precluded the development of new irrigated agricultural land and established a well-measuring and reporting system and a mandatory conservation program." *Id*. For further discussion of the GMA, see: Ariz. Mun. Water Users Ass'n v. Ariz. Dep't of Water Users, 888 P.2d 1323 (Ariz. Ct. App. 1994).

144. PIERCE, *supra* note 139, § 3.2.4.2.2. "Safe yield" is a long-term balance between the amount of groundwater withdrawn annually and the annual amount of natural and artificial groundwater recharge in the area. ARIZ. REV. STAT. ANN. § 45-561(12) (2004).

145. *Ariz. Mun. Water Users Ass'n*, 888 P.2d at 1324.

146. THIRD MANAGEMENT PLAN, *supra* note 39, at 11–14.

that is stored underground and subsequently recovered in the area of hydrologic impact.[147] While water providers are permitted to recharge effluent in one area and pump groundwater from another,[148] this counts against GPCD requirements.

The GMA's Assured Water Supply program "requires that a demonstrated 100-year water supply of adequate quality will be available prior to approval of new subdivisions" and requires use of renewable water supplies.[149] Effluent is one of the types of water, along with groundwater and surface water, that an applicant may demonstrate is available in order to secure a certificate/designation of assured water supply.[150] An alternative route to meeting the AWS rules exists for developers who do not have access to renewable water supplies; they may pay the Central Arizona Groundwater Replenishment District to replenish groundwater that they use.[151]

Second, the Underground Water Storage, Savings and Replenishment Program ("Storage Program") governs the underground storage of renewable water supplies, including effluent, to facilitate future recovery of stored water.[152] Under the Storage Program, ADWR issues permits for underground storage and recovery projects.[153] Holders of "long-term storage credits" may subsequently recover stored water.[154] This system facilitates effluent reuse by allowing for storage followed by indirect use,[155] and by conferring legal control over treated effluent to the permit holder.[156] The Storage Program provides that effluent recovered

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147. *Ariz. Mun. Water Users Ass'n*, 888 P.2d at 1325.

148. Mitch Tobin, *Planning for 2050*, ARIZ. DAILY STAR, Nov. 19, 2004, at A1 [hereinafter Tobin, *Planning for 2050*].

149. COLBY ET AL., *supra* note 3, at 8; *see also* ARIZ. REV. STAT. ANN. § 45-576(I) (2004). State officials have notified several municipal and private water providers that their supplies are inadequate to serve new housing developments, bringing a halt to planned developments. Laura Dobbins, *State Halts Development Where Water Is Inadequate*, ARIZ. REPUBLIC, Dec. 20, 2003, at 1A. This law highlights the need to find alternate water supplies, such as effluent, if new growth is to be supported.

150. ARIZ. ADMIN. CODE § 12-15-703 (2004).

151. Roger S. Pulwarty, et al., *The Hardest Working River: Drought and Critical Water Problems in the Colorado River Basin*, *in* DROUGHT AND WATER CRISES: SCIENCE, TECHNOLOGY, AND MANAGEMENT 249, 273 (Donald A. Wilhite ed., 2004).

152. PIERCE, *supra* note 139, § 3.2.7; *see* ARIZ. REV. STAT. ANN. §§ 45-801.01–898.01 (2004). The program's goals are "1) to promote the use of renewable water supplies . . . by allowing for effective and flexible storage and recovery of those supplies; and 2) to provide for the efficient use of all water resources by allowing water to be 'transported' by storing in one location and recovering in another." PIERCE, *supra* note 139, § 3.2.7 (citing ARIZ. REV. STAT. ANN. § 45-801.01 (2004)).

153. ARIZ. REV. STAT. ANN. §§ 45-811.01, 45-831.01, 45-834.01 (2005).

154. *Id*. § 45-834.01. The Act enables ADWR to monitor water storage and recovery. Ariz. Mun. Water Users Ass'n v. Ariz. Dep't of Water Users, 888 P.2d 1323, 1325 (Ariz. Ct. App. 1994). This program is a noted success, with statewide storage of more than three million acre-feet of water. COLBY ET AL., *supra* note 3, at 9.

155. Interview with Sharon Megdal, Director, Univ. of Ariz. Water Res. Research Ctr., in Tucson, Ariz. (Feb. 15, 2005).

156. Interview with Kenneth Seasholes, Director, Tucson Active Mgmt. Area , in Tucson, Ariz. (Feb. 19, 2005) [hereinafter Interview with Seasholes].

pursuant to a long-term storage credit maintains its legal character as effluent. This provides an incentive for recharge of effluent, since effluent use is subject to less regulation than groundwater or surface water use.[157]

Under the Storage Program, holders of permits for "constructed" underground storage facilities, such as spreading basins, are eligible to receive credits for 95% of the effluent that they place in these facilities.[158] Holders of permits for "managed" underground storage facilities, in which effluent is discharged into natural waterways and allowed to percolate into the aquifer, may receive credits for only 50% of the effluent that they discharge.[159] Permits for "constructed" facilities that use natural waterways are available, under ADWR's discretion, when the project enhances the level of infiltration or control.[160]

Moving beyond the GMA and Storage Program, Arizona has established regulations that require certain entities that irrigate turf to use effluent.[161] Further, within AMAs, the "Lakes Bill" allows the filling of artificial lakes with groundwater only if treated effluent is to be phased in within five years; furthermore, legislation has significantly restricted the filling of artificial lakes with water sources other than effluent.[162]

5. Rights to effluent

Much of Arizona law on rights to effluent is based on or explicated in the seminal *Long* case.[163] This case involved contracts in which Phoenix-area cities agreed to sell their effluent to utilities that were planning construction of the Palo Verde nuclear power plant.[164] Two ranching companies claimed that they had appropriative rights to surface water flows that largely consisted of the cities' effluent discharges, and that delivering effluent to the utilities would infringe upon these rights.[165] The ranches argued that under Arizona surface water law, the cities

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157. PIERCE, *supra* note 139, § 3.2.7 (citing ARIZ. REV. STAT. ANN. § 45-832.01 (2004)).

158. Ariz. Dep't of Water Res., Annual Reporting and Recharge Credits Accounting, http://www.water.az.gov/recharge/Credits-Accounting.htm (last visited Aug. 31, 2005) [hereinafter Ariz. Dep't of Water Res., Annual Reporting]; PIERCE, *supra* note 139, § 3.2.7 (citing ARIZ. REV. STAT. ANN. § 45-811.01 (A), (C) (2004)).

159. Ariz. Dep't of Water Res., Annual Reporting, *supra* note 158; PIERCE, *supra* note 139, § 3.2.7 (citing ARIZ. REV. STAT. ANN. § 45-811.01(B)-(C)). The lower amount of credits granted for managed facilities ensures that effluent dischargers do not reap windfall profits for their customary water discharges and that credits are not granted for a larger amount of water than that which actually reaches the aquifer.

160. Interview with Seasholes, *supra* note 156.

161. LIEUWEN, *supra* note 25, at 34.

162. ARIZ. REV. STAT. ANN. §§ 45-131 to -132 (2004). Water bodies in recreational facilities that are owned or operated by governmental entities are exempted from these restrictions. *Id*. § 45-132. This has been used as a loophole in southern Arizona, where private developers deeded a lake to the municipality to avoid having to comply with the statute. Interview with Glennon, *supra* note 16.

163. Ariz. Pub. Serv. Co. v. Long, 773 P.2d 988 (Ariz. 1989).

164. *Id.* at 991.

165. *Id*.

had only the right to use the water, not the right to sell unconsumed effluent, since appropriable surface waters belong to the public.[166] Developer John F. Long joined the suit and argued that "the groundwater element of the effluent must be put to reasonable and beneficial reuse for the benefit of the land from which it was withdrawn, and, if reuse is not possible, the effluent must be returned to the common supply, by discharging it into a stream and allowing it to percolate into the ground."[167] In contrast, the cities and utilities contended that the effluent had lost its character as surface water or groundwater, and had become property of which the cities could dispose as they pleased.[168]

The Arizona Supreme Court rejected all of these arguments. The court found that effluent is neither surface water nor groundwater until it is returned to the ground in one of those states; it also found that one may have a right to use, but not to own, effluent.[169] Therefore, the cities had the right to put their effluent "to any reasonable use that [they saw] fit," including selling it to the utilities.[170] The court noted that the effluent was subject to appropriation by downstream users if the cities allowed the effluent to return to the waterway.[171] However, the cities were not required to continue discharging the effluent into the river, despite the downstream ranches' appropriative rights.[172] The court further held that the cities had not previously abandoned the effluent by placing it in the waterway, since abandonment statutes apply only when an appropriator fails to withdraw water to which she is entitled.[173] Finally, the court appeared to invite the state legislature to regulate effluent.[174]

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166. *Id.* at 993.

167. *Id.* at 991–93. It appears that Long wanted to ensure that current supplies of water in waterways would remain available for those with appropriative rights, including developers.

168. *Id.* at 993.

169. *Id.* at 995. This means that effluent is not subject to the prior appropriation system.

170. *Id.* at 994–95.

171. *Id.* at 996 (citing ARIZ. REV. STAT. ANN. § 45-141(A) (2004)).

172. *Id.* at 997.

173. *Id*.

174. The court noted:

> Absent any explicit undertaking by the legislature, the parties' submittals regarding construction of the extant statutes are actually invitations to create a regulatory system for effluent by judicial decision. We decline that invitation for several reasons . . . . Regulation of water use . . . especially in a desert state, does not lend itself to case-by-case definition . . . . [W]e must look to the legislature to enact the laws they deem appropriate for wise use and management of what may be a valuable water resource for Arizona.

Id. at 995.

The court's rationale for its holding appears to be that cities must have flexibility in disposing of a potential nuisance.[175] The court stated that permitting the cities to put the effluent to any reasonable use would "allow municipalities to maximize their use of appropriated water and dispose of sewage effluent in an economically feasible manner" and "provide[] a degree of flexibility that is essential to a city's ability to meet federal and state environmental and health standards."[176] There would be "alarming" ramifications to a doctrine that would require cities to discharge effluent to satisfy downstream appropriators' needs, including risk of municipal liability for merely changing the point of effluent return.[177] The court concluded:

> To . . . require the Cities to continue to discharge effluent would deprive the Cities of their ability to dispose of effluent in the most economically and environmentally sound manner . . . . Moreover, such a holding would be contrary to the spirit and purpose of Arizona water law, which is to promote the beneficial use of water and to eliminate waste of this precious resource.[178]

6. Comparison of Arizona law with law in other Western states

In some respects, Arizona's regulation of effluent reflects a wider pattern of effluent regulation among Western states. For example, California, Idaho, Nevada, and New Mexico are among the other states that have enacted legislation providing for artificial groundwater recharge.[179]

Arizona's legal regime governing effluent is distinct in terms of effluent rights. Arizona has been called "progressive" in the area of promoting effluent reuse.[180] In part, this is due to the degree of certainty that *Long* established about who has the right to use or sell effluent.[181] The *Long* decision has had at least some influence in other parts of the West, as demonstrated by Montana's administrative adoption of this approach to effluent rights.[182]

In a number of states, a lack of statutory guidance coupled with a lack of case law on effluent rights[183] make ownership and control of effluent unclear.[184]

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175. *Id.* at 994–95. The court cited *Wyo. Hereford Ranch v. Hammond Packing Co.*, 236 P. 764, 772 (1925), which discussed sewage disposal as "one of the important problems that *embarrass* municipalities." (emphasis added).

176. *Id.* at 994.

177. *Id.* at 996. The court noted the following: "Waste water exists only as long as there is waste. No appropriator can compel any other appropriator to continue the waste of water which benefits the former." *Id.*

178. *Id.* at 997.

179. Pulwarty et al., *supra* note 151, at 271.

180. Interview with Glennon, *supra* note 16.

181. *Long*, 773 P.2d at 994–95.

182. Final Order, *In re* City of Deer Lodge, B-No. 97514-76G (Mont. Dep't Nat. Res. & Conservation June 4, 1996), *cited in* SAX ET AL., *supra* note 5, at 175.

183. Mark A. McGinnis, *Creating A "New" Class of Water—Regulation of Municipal Effluent*, 22 ARIZ. ST. L.J. 987, 996 (1990). The Arizona Supreme Court noted the following in 1989: "There is no body of case law dealing with rights to and the use of

For instance, California's statutory ambiguities make it uncertain "whether the treatment plant owner has superior legal rights to the wastewater over a downstream user of the discharged wastewater."[185] In contrast, Utah's Conservation and Use of Sewage Effluent Act specifies a procedure for government entities to follow in putting treated effluent to beneficial use.[186]

One of California's innovations relating to effluent is statutory modification of the prior appropriation rules. The California Legislature declared that "the use of potable domestic water for nonpotable use, including . . . golf courses . . . is a waste or an unreasonable use of the water within the meaning of . . . the California Constitution if reclaimed water is available."[187] Further, California golf courses must connect to a reclaimed water line if one is available.[188]

III. EFFLUENT REUSE AND THE LEGAL REGIME GOVERNING EFFLUENT IN TUCSON, ARIZONA

A. Overview

History has shown Arizona politics and development patterns to be closely linked to water management and availability.[189] Four water sources are available to the state: groundwater, surface water, the Central Arizona Project ("CAP") (water delivered through a canal from the Colorado River), and effluent.[190] While groundwater serves more than 40% of the water demand,[191] officials are looking for other sources to reduce groundwater overdraft.

Effluent, as an expanding water resource, represents a key water supply.[192] Effluent may be particularly important in thirsty rural communities with limited rights to other water sources.[193] Significant investments in infrastructure for delivering effluent to water users have been made,[194] particularly in the Phoenix and Tucson areas.[195] As of 2004, effluent served 2% of the state's total water demand.[196] It has been used mostly for turf and agricultural irrigation,

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effluent. Research by counsel and the court has produced, at best, two or three outdated cases dealing with rights to the type of effluent with which this case is concerned." *Long*, 773 P.2d at 995.

184. Dornak, *supra* note 45, at 332.

185. *Id*.

186. *See* G. Oliver Melgar, Note, *Sewage Effluent Happens: But Who Has the Right to Its Beneficial Use?*, 24 J. LAND RESOURCES & ENVTL. L. 587, 587, 612 (2004).

187. Dornak, *supra* note 45, at 333.

188. Gill & Rainville, *supra* note 88, at 47.

189. COLBY ET AL., *supra* note 3, at 2.

190. *Id*. at 3.

191. *Id*.

192. *Id*. at 7.

193. *Id*. at 7, 14–15.

194. *Id*. at 7–8.

195. Jacobs & Holway, *supra* note 99, at 81.

196. COLBY ET AL., *supra* note 3, at 63.

industrial cooling, maintenance of riparian areas, and artificial recharge.[197] The following examination of effluent use in Tucson illustrates the implications, advantages, and barriers to effluent reuse both in Arizona and, to a degree, across the West.

B. Effluent use in Tucson

As in many parts of the state, Tucson and Pima County face risks associated with groundwater overdraft.[198] In the Tucson area, WWTPs produced 68,061 acre-feet of effluent in 2003.[199] Production is expected to climb to approximately 121,000 acre-feet by 2030 and 128,000 acre-feet by 2050.[200] The system produces both secondary effluent and tertiary reclaimed water;[201] the tertiary water meets ADEQ's standards for Class "A" effluent.[202]

Tucson Water's reclaimed water system, one of the first of its kind, was constructed in 1984.[203] The system now boasts more than 100 miles of effluent-dedicated pipes and 600 customers, including golf courses, parks, schools, industries, and some homes.[204] Reclaimed water accounts for approximately 8% of Tucson Water's overall supply, with many large users already connected to the system.[205] Since irrigation accounts for close to 60% of the Tucson area's water use, and irrigation is particularly well suited to effluent reuse, there are possibilities for expansion in effluent reuse.[206]

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197. UNIV. OF ARIZ. OFFICE OF ECON. DEV. & WATER RES. RESEARCH CTR., ARIZONA'S WATER FUTURE: CHALLENGES AND OPPORTUNITIES 63 (2004).

198. Tobin, *More Effluent*, *supra* note 92, at B1. Ten-foot-wide and fifty-foot-deep fissures in the ground in parts of southern Arizona are an example. GLENNON, *supra* note 49, at 34.

199. TUCSON WATER PLAN, *supra* note 58, at 4-13. Pima County operates two effluent treatment facilities that are located along the Santa Cruz River. THIRD MANAGEMENT PLAN, *supra* note 39, at 7-20.

200. TUCSON WATER PLAN, *supra* note 58, at 4-13.

201. THIRD MANAGEMENT PLAN, *supra* note 39, at 7-20.

202. TUCSON WATER PLAN, *supra* note 58, at 4-14.

203. *Id*. Effluent had been used on a limited basis for irrigating some golf courses since the late 1970s. THIRD MANAGEMENT PLAN, *supra* note 39, at 3-18. Tucson Water is a department of the City of Tucson and serves approximately 675,000 customers across a 375-square mile part of the Tucson metropolitan area. Tucson Water, About Us, http://www.ci.tucson.az.us/water/about_us.htm (last visited Apr. 7, 2005).

204. TUCSON WATER PLAN, *supra* note 58, at 4-14. The 8% demand represents about 11,000 acre-feet. *Id*. at 5-5. "[T]he utility's reclaimed system pales by comparison with the 4,000 miles of mains for its potable supply." Tobin, *Reclaimed Water Use Will Grow*, *supra* note 33, at B1. "Industrial use of effluent was 800 acre-feet in 1995 and is projected to reach 4,700 acre-feet in 2025. Projected industrial use consists primarily of use by turf-related facilities and some projected use by sand and gravel facilities located along the Santa Cruz River." THIRD MANAGEMENT PLAN, *supra* note 39, at 11-14.

205. Tobin, *Reclaimed Water Use Will Grow*, *supra* note 33, at B1.

206. *Id.* For example, Pima County's golf courses use approximately 5.7 billion gallons of water for irrigation. Joe Burchell, *City Gives Approval to Effluent Deal*, ARIZ. DAILY STAR, Feb. 8, 2000, at B1 [hereinafter Burchell, *City Gives Approval*]. Agricultural

Under a water rights settlement, up to 28,200 acre-feet of Tucson's effluent are obligated to the U.S. Secretary of the Interior for the Tohono O'odham Indian Nation.[207] Of the remaining effluent, 16% is either sold or recharged, and 84% is released into the Santa Cruz River, where it flows north out of the Tucson area.[208] The current rate of direct effluent reuse is somewhat lower than had been anticipated when the effluent system was put in place; "cost constraints, ownership issues, and location of treatment plants and delivery systems in relation to potential users" have been cited as impediments.[209]

C. Plans for future effluent use

Tucson Water's plan for 2000–2050 hinges on shifting from reliance on groundwater to renewable supplies.[210] As effluent and CAP water are the two major renewable supplies available to the City,[211] effluent reuse figures prominently in the utility's planning.[212] Tucson Water recommends augmenting the potable supply by recharging effluent into the aquifer and subsequently recovering the water.[213] The City plans to implement this recommendation by emptying its effluent into constructed recharge facilities rather than discharging unused effluent to the Santa Cruz River.[214] Tucson Water notes that an indirect potable use plan will require an "intensive outreach effort" and community acceptance.[215] In addition, the City plans to use reclaimed water to restore a section of the Santa Cruz River as part of its Rio Nuevo downtown redevelopment plan.[216]

D. Local policies to encourage effluent reuse

Local pricing policies and prohibitions against use of potable water for new golf courses and for certain other uses have been "effective mechanisms for

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reuse of effluent in the Tucson area is expected to remain at approximately 3,000 acre-feet per year. THIRD MANAGEMENT PLAN, *supra* note 39, at 11-14.

207. GELT ET AL., *supra* note 54, at 24.

208. *Id*. at 23. The discharged effluent "accrues water credits at a rate of 50 percent of the total volume recharged in managed underground storage facilities." TUCSON WATER PLAN, *supra* note 58, at ES-12.

209. THIRD MANAGEMENT PLAN, *supra* note 39, at 3-18.

210. TUCSON WATER PLAN, *supra* note 58, at ES-2.

211. *Id*.

212. The Plan puts the importance of effluent in stark terms:

> Tucson Water currently has only a limited amount of available ground water and Colorado River water to meet future potable demand. Without the expanded use of effluent, the successful acquisition of additional water resources, and/or the initiation of a more aggressive demand management program to reduce per capita water use, the Utility will not be able to meet future water demand and could have a shortfall in sustainable supply before 2020.

Id. at ES-8.

213. *Id.* at ES-9.

214. *Id.* at ES-12.

215. *Id.* at ES-13.

216. City of Tucson, Rio Nuevo Master Plan at 31, *available at* www.ci.tucson.az.us/pdf/designvision.pdf, (last visited Sept. 12, 2005).

increasing effluent use."[217] As of 1999, new golf courses in unincorporated Pima County that are located within three miles of a WWTP or a CAP water line must irrigate with effluent or CAP water, rather than groundwater.[218] In addition, a golf course "overlay zone" in Pima County requires golf courses to move as quickly as possible toward using effluent.[219]

The Tucson AMA has relatively little authority over effluent, but has adopted some incentives geared towards use of effluent.[220] Each acre-foot of effluent used at golf courses is only counted as seven-tenths acre-feet towards golf courses' total allotment of water as governed by the management plan.[221] "As of the year 2000, golf courses accounted for 72 percent of effluent water use, up 38 percent [sic] in 1990."[222]

E. Nonlegal considerations associated with effluent reuse in Tucson

Four main categories of nonlegal considerations affect effluent reuse in Tucson: institutional constraints; cost, infrastructure, and supply; public and user acceptance of the risks associated with effluent reuse; and environmental concerns.

1. Institutional constraints

Under a 1979 intergovernmental agreement, Pima County treats all the Tucson area's wastewater, and the City of Tucson controls 90% of the treated effluent.[223] This agreement has given rise to intergovernmental squabbling, with county officials arguing that the City should no longer be entitled to the lion's share of the effluent and that "the city's high price and control over how treated effluent is used have stymied negotiations with farmers and golf courses in outlying areas over the sale of treated wastewater."[224] An example of a different kind of institutional barrier comes from Tucson's northern neighbor of Casa Grande; there, a private water company with an exclusive service franchise thwarted plans to supply effluent to a planned $260 million power plant, thereby blocking construction of the plant.[225]

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217. LIEUWEN, *supra* note 25, at x.

218. Hipolito R. Corella, *Pima Steers Courses to Effluent, CAP*, ARIZ. DAILY STAR, Mar. 10, 1999, at A1.

219. Interview with Glennon, *supra* note 16.

220. Interview with Seasholes, *supra* note 156.

221. Sierra, *supra* note 141.

222. *Id*.

223. GELT ET AL., *supra* note 54, at 24.

224. Burchell, *City Gives Approval*, *supra* note 206, at B1. A City-County legal battle developed in 1999 when the City charged the County with unlawfully planning to divert treated effluent to golf courses at city taxpayers' expense. Joe Burchell, *Pima Plan Breaks Pact on Effluent, City Says*, ARIZ. DAILY STAR, Feb. 2, 1999, at A1 [hereinafter Burchell, *Pima Plan*]. The City did not want city taxpayers to effectively subsidize the development of a County reclaimed water business through sewer bonds financed by city residents' sewer fees. *Id*.

225. Max Jarman, *Water Supply Woes Threaten Power Plant*, ARIZ. REPUBLIC, Mar. 30, 2000, at 1D. Without a supply of effluent to cool its generators, the plant would

2. Cost, infrastructure, and supply

Tucson Water currently charges $610 per acre-foot for reclaimed water.[226] "Turf-related facilities served by municipal providers have an incentive to convert to effluent due to the City of Tucson's delivery policies and the favorable cost of effluent delivered through the City's reclaimed system as compared to the cost of potable groundwater delivered by the City."[227] While costs can be expected to decrease as the use of effluent becomes more widespread, financial impediments still play an important role.[228]

In addition to treatment costs, there are significant up-front costs for building effluent distribution systems, especially where effluent must be pumped a long distance or uphill.[229] It is difficult to justify the expense of extending the system unless large end-users will be connected.[230] The expense of installing delivery pipes largely explains why many potential users in Tucson's outlying areas, including twenty-five of the thirty-eight area golf courses,[231] are not connected to the reclaimed system.[232] The chicken-and-egg problem of needing large users to justify extension of the system and disinclination among potential users to pay for distribution raises an important question: who should subsidize extension of effluent lines? It appears likely that government will have to subsidize extension of reclaimed water lines to further encourage reuse of effluent.

In addition to the cost of extending the effluent distribution system, the fact that state law allows pumping of groundwater from private wells provides a disincentive to effluent reuse.[233] By drawing upon private wells, large turf facilities

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have to rely on groundwater or CAP water, but using these water sources could jeopardize Casa Grande's municipal water supply. *Id.*

226. Tucson Water, Frequently Asked Questions on Reclaimed Water, http://www.ci.tucson.az.us/water/faqs_on_reclaim.htm (last visited Apr. 8, 2005).

227. THIRD MANAGEMENT PLAN, *supra* note 39, at 3-18.

228. Karina Ioffee, *Pack Park, Golf Course Use Effluent*, ARIZ. DAILY STAR, Mar. 5, 2002, at B3.

229. GELT ET AL., *supra* note 54, at 24–25. Since Tucson's WWTPs are located in low-lying areas, this is a notable local concern. Interview with Jacobs, *supra* note 119. It costs approximately $1 million to build one mile of pipeline. *Id.*

230. Interview with Jacobs, *supra* note 119. While large water users such as golf courses can theoretically build their own effluent systems, these systems are very expensive; as of 2001, only one Arizona golf course had its own recharge facility. John Davis, *State Golfers May See Browner Fairways*, ARIZ. REPUBLIC, May 24, 2001, at 1C.

231. Sierra, *supra* note 141. As of 2002, sixteen of the thirty-eight golf courses in the Tucson area used effluent, while the rest depended solely on groundwater. *Id*. The thirty-eight golf courses in the Tucson AMA used 3.3% of the area's groundwater as of 2002. *Id*. According to Laura Grignano of ADWR, "Most of the time there isn't a system that goes to the golf courses. You have to build the infrastructure to get the reclaimed water there." *Id*.

232. Burchell, *Pima Plan*, *supra* note 224, at A1.

233. Burchell, *City Gives Approval, supra* note 206, at B1. *See infra* Part III.E for discussion of groundwater withdrawal rules.

"pay a fraction of the reclaimed water rates."[234] For this reason, it is not currently in the financial interest of most businesses to switch to effluent.[235]

The State of Arizona and Tucson Water have developed some funding programs to help extend the reclaimed water system. For instance, the State has allocated federal and state funding to extend turf irrigation to additional schools and golf courses, and the City has funded the extension of a local school district's effluent system.[236]

As effluent assumes an increasingly critical role in Tucson's water planning, the City will seek to maximize its supply. One means for increasing supply is placing new treatment plants in a location where discharged effluent does not immediately flow into another political jurisdiction (as currently occurs); another method is requiring new homes to be connected to the sewer system rather than private septic systems.

3. Public and user acceptance of the risks associated with effluent reuse

Public acceptance of effluent for domestic and other uses is critical for the expansion of effluent reuse. However, past problems with water delivery, particularly related to CAP water that did not meet public expectations,[237] make this potentially thorny. The general health risks associated with effluent and local risks, such as the presence of nitrates, which can harm infants, may affect public acceptance of effluent reuse.[238] Further, the mineral content of Tucson's potable water supply will increase as effluent and CAP water become a proportionally larger part of the supply.[239] Contaminants in effluent also pose risks for other end-users of effluent. Some golf courses in Arizona have been reluctant to use effluent because of aesthetic concerns and salt build-up,[240] and mines tend to prefer to use groundwater because of inconsistencies in the level of TDS in effluent.[241]

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234. Burchell, *City Gives Approval*, *supra* note 206, at B1.

235. Ioffee, *supra* note 228, at B3. According to John Schladweiler, deputy director of the Pima County Department of Wastewater Management, "[I]t's just not practical [for most businesses] to have to pay for an extension from the treatment facility." *Id.*

236. Tobin, *Reclaimed Water Use Will Grow*, *supra* note 33, at B1. The City recovers its expenditure through surcharges on the district's water bill, while the district saves money in the long run due to the lower cost of reclaimed water. *Id*.

237. Tobin, *Planning for 2050*, *supra* note 148, at A1.

238. GELT ET AL., *supra* note 54, at 25. Tucson's effluent supply is vulnerable to industrial contaminants because Tucson's treatment plants receive water from industrial facilities. LIEUWEN, *supra* note 25, at 16. Tucson's WWTPs have not yet taken comprehensive measures to remove endocrine disruptors. Telephone Interview with Paul Bennett, Deputy Dir. Planning & Eng'g, Pima County Wastewater Mgmt. (Apr. 21, 2005).

239. TUCSON WATER PLAN, *supra* note 58, at ES-5. The City is involved in research on treating salinity. *Id.*

240. Davis, *supra* note 230, at 1C; Ioffee, *supra* note 228, at B3. On the other hand, direct irrigation of golf courses with effluent can provide nitrogen-associated benefits for the courses. Interview with Jacobs, *supra* note 119.

241. Interview with Glennon, *supra* note 16.

4. Environmental protection

Most of Arizona's streams have experienced reductions in flow due to diversions and groundwater pumping.[242] The remaining riparian habitats support a wealth of biodiversity,[243] and further streamflow reductions threaten some plant and animal species with extinction.[244] In Tucson, as across much of the West, effluent discharges help to maintain streamflow.[245] The major surface water drainage in Tucson, the Santa Cruz River, contains ephemeral streamflows that depend on precipitation and discharges from WWTPs.[246] Effluent that is not transferred, sold, or recharged is released into the Santa Cruz River.[247] Approximately 96% of this discharged effluent eventually recharges to the aquifer, while 4% either evaporates or is used by riparian vegetation.[248] The discharges currently support a ribbon of vegetation that provides habitat for land species and for migrating birds, many of which have habitually used the river corridor as a flyway.[249] Since the groundwater table has dropped, the discontinuation of effluent discharges would degrade this habitat.[250]

The City and County have taken some measures to protect riparian areas. The City designed the Sweetwater Wetlands, an effluent treatment project, with an eye to environmental considerations.[251] The Wetlands provide habitat for more than 120 bird species and provide environmental education opportunities for the

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242. COLBY ET AL., *supra* note 3, at 17; Robert Jerome Glennon & Thomas Maddock, III, *In Search of Subflow: Arizona's Futile Effort to Separate Groundwater from Surface Water*, 36 ARIZ. L. REV. 567, 567 (1994); *see also* Baron, *supra* note 26, at 588–89. "[S]urface water diversions and groundwater pumping have contributed to the degradation of 90% of Arizona's once perennial low desert streams and rivers and about an equal amount of its riparian habitat." Glennon & Maddock, *supra*, at 567.

243. COLBY ET AL., *supra* note 3, at 17.

244. SAX ET AL., *supra* note 5, at 249. Migratory bird species have declined greatly due to the loss of southern Arizona's riparian areas. Tucson Audubon Society, Santa Cruz River Restoration Project, http://www.tucsonaudubon.org/restoration/scrhpmore.htm (last visited Feb. 26, 2005).

245. THIRD MANAGEMENT PLAN, *supra* note 39, at 2-2, 2-4; *see also* Baron, *supra* note 26, at 588–89.

246. THIRD MANAGEMENT PLAN, *supra* note 39, at 2-2, 2-4. At the turn of the twentieth century, the Santa Cruz River flowed year-round near downtown Tucson. PIMA COUNTY, SONORAN DESERT CONSERVATION PLAN, RIPARIAN PROJECTS 1 (2003), *available at* www.dot.pima.gov/flood/riparian/sdcp_rip.pdf. The vegetation and hydrology of the river were significantly affected by agriculture, flood control, and groundwater pumping, among other factors. PIMA COUNTY, SONORAN DESERT CONSERVATION PLAN RIPARIAN PRIORITIES 31 (2002), *available at* http://www.co.pima.az.us/cmo/sdcp/reports.html.

247. GELT ET AL., *supra* note 54, at 23.

248. *Id*. at 23–24.

249. Tucson Audubon Society, *supra* note 244. These flows may help to support some of the fifty-five vulnerable species identified for protection in Pima County's Sonoran Desert Conservation Plan; most of these species depend on riparian areas for at least part of their life cycles. Tobin, *More Effluent*, *supra* note 92, at B1.

250. Telephone Interview with Julia Fonseca, Envtl. Program Manager, Pima County Flood Control Dist. (Apr. 4, 2005).

251. TUCSON WATER PLAN, *supra* note 58, at 2-10.

public and for local schools.[252] Further, the City and County have begun to cooperate on effluent projects that can benefit the environment. Under an intergovernmental agreement signed in 2000, the county will be able to buy reclaimed water for riparian habitat projects at a significantly reduced rate.[253] The City and County are also participating in cooperative planning to recharge effluent in a manner that supports riparian habitat.[254]

The prospect of increased effluent reuse is one factor casting doubt upon the future of municipal effluent discharges to riparian habitat in Tucson and other Western areas.[255] Another such factor, which has been noted by planners in Tucson's downstream neighbor Marana, is the risk that contaminated effluent flowing in streambeds will pollute the water table and thereby compromise future indirect potable use.[256]

F. Implications of the legal regime for Tucson and lessons for beyond

While some state and local policies encourage effluent reuse, the continued availability of cheaper water from groundwater sources, surface water sources, and the CAP reduces the economic justification for reusing effluent.[257] Effluent reuse is not yet a financially attractive option for many potential users in part because homes and businesses in Tucson, and across the country, do not pay for the full cost of water they consume.[258] Further, the GMA, despite its generally forward-looking nature, contains certain disincentives to effluent reuse. The GMA granted farmers both grandfathered water rights (set at a level higher than average use) and bankable "flex credits;" water use standards for municipalities and mines are similarly nondemanding.[259] The fact that developers can pay the Central

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252. *See* Martin M. Karpiscak et al., *Constructed Wetlands in Southern Arizona*, ARID LANDS NEWSL #45 (1999), http://ag.arizona.edu/OALS/ALN/aln45/wetlands.html.

253. TUCSON WATER PLAN, *supra* note 58, at 2-10; Burchell, *City Gives Approval*, *supra* note 206, at B1. No water has yet been used under this agreement, however. Interview with Glennon, *supra* note 16.

254. One example is Tres Rios del Norte, a collaborative project between Pima County, the City of Tucson, the Town of Marana, and the U.S. Army Corps of Engineers, which aims to restore riparian habitat and recharge reclaimed water to the aquifer. Telephone Interview with Ralph Marra, Chief Hydrologist, Tucson Water (Apr. 7, 2005).

255. *See* Baron, *supra* note 26, at 588–89. Some Western cities have threatened to sell, rather than recharge, a larger proportion of their effluent unless state and federal actors loosen water quality standards. *Id.*

256. Telephone Interview with Mark Myers, Consultant to Town of Marana (Feb. 19, 2005).

257. LIEUWEN, *supra* note 25, at 26.

258. GLENNON, *supra* note 49, at 220. Water users typically pay for extraction, delivery, and administration costs, but not for the actual value of the water itself. *Id*. Glennon argues that water users should "pay the replacement value of the water, which is not just the cost of drilling a new well, but also the cost of retiring an existing user's well." *Id*. "A major impediment to using financial incentives is the existence of state public utility commission rules that permit private water companies to charge customers only for the 'cost of service' . . . ." *Id*. at 221.

259. Interview with Glennon, *supra* note 16.

Arizona Groundwater Replenishment District to replenish the groundwater that they pump lessens developers' incentive to pay for extension of the reclaimed system.[260] Finally, the GMA grandfathered in existing groundwater pumping rights inside the AMAs, allowing even irrigators to continue pumping groundwater.[261]

The *Long* decision has several notable implications for the future of effluent use in Arizona and the states that follow Arizona's lead. In several ways, the decision encourages reuse of effluent and helps to reduce reliance on groundwater. Most importantly, the decision facilitates the development of effluent markets by awarding rights to the municipalities that invest in treating effluent.[262] This principle encourages private treatment and reuse of wastewater by assuring prospective wastewater treaters that downstream users will not force them to continue to discharge their wastewater.[263] Moreover, the decision could lessen groundwater dependence if purchased effluent replaces the use of groundwater.[264]

However, the decision may provide unhelpful incentives in certain respects. Downstream appropriators, such as the ranches in the *Long* case, may turn to other water sources, such as groundwater, if they fear their supply of effluent will be cut off.[265] Moreover, cities could merely add effluent to their existing supply and continue to pump groundwater at the same rate.[266] Finally, awarding effluent rights to cities that have effectively abandoned their effluent, rather than to downstream beneficial users of effluent, does not encourage wise use.[267]

The *Long* decision, while making strides toward clarifying effluent rights, does not fully resolve uncertainties. For example, it is unclear whether a municipality that released effluent to a riverbed could be sued under the doctrine of forfeiture and thereby lose its right to the effluent.[268] This uncertainty, along with the risk of transmission losses in the river channel, may lead effluent sellers to convey treated effluent to purchasers through pipes, to the detriment of riparian habitats.[269] The court also failed to clarify whether discharging, as effluent, some

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260. *Id*.

261. *Id*. Outside of the AMAs and several Irrigation Nonexpansion Areas, the reasonable use doctrine allows new groundwater withdrawals for reasonable and beneficial use. PIERCE, *supra* note 139, § 3.2.4.2.3 (citing ARIZ. REV. STAT. ANN. § 45-453 (2004)).

262. McGinnis, *supra* note 183, at 998.

263. Dornak, *supra* note 45, at 332–33.

264. McGinnis, *supra* note 183, at 998.

265. *Id.* at 999.

266. *Id*. at 998.

267. *Id*. at 1000. The dissent in *Long* argues that discharged effluent should be considered a return to the natural stream and subject to reappropriation, so that it cannot be taken away from those who have acquired vested rights in the effluent. Ariz. Pub. Serv. Co. v. Long, 773 P.2d 988, 1010 (Ariz. 1989) (Haire, J., dissenting).

268. McGinnis, *supra* note 183, at 1000. Forfeiture is the loss of a water right based upon nonuse for a statutorily prescribed period. *See, e.g.*, ARIZ. REV. STAT. ANN. § 45-141(C) (2004).

269. Interview with Seasholes, *supra* note 156.

portion of an appropriative right will be considered a beneficial use.[270] The state legislature missed opportunities to clarify such uncertainties by declining the Arizona Supreme Court's invitation to regulate effluent.[271] On the other hand, the current lack of broad effluent regulations provides a certain incentive for exclusive use of effluent in projects, since water users are subject to extensive regulation for use of surface water and groundwater.

Turning to environmental issues, the Storage Program provides a disincentive to maintain streamflows in riparian areas by providing fewer credits for recharge in waterways than for recharge in constructed basins.[272] While this credit system can be defended on the grounds that it prevents treatment plants from receiving a windfall for their customary discharges to waterways, that it contributes to achieving safe yield, and that it prevents parties from circumventing the Lakes Bill,[273] the environmental consequences of this rule should be further examined. While meeting these goals, the State could help to secure effluent flows by legally authorizing greater credits to managed projects, by lowering the requirements for a constructed designation, or by providing credits according to the amount of discharges required to maintain certain riparian habitats. Given the increasing pressure for municipalities to recharge effluent in constructed basins for indirect potable use, the decision to maintain effluent flows for environmental purposes will require a commitment of governmental resources to this goal. A last environmental consideration is that Arizona and other Western states may be forced to address the discontinuation or reduction of effluent discharges to riparian systems due to municipal discontentment with stringent discharge standards.[274]

IV. CONCLUSION

Tucson's experience with reclaimed water is largely representative of the challenges and benefits associated with effluent reuse in communities across the West, and beyond. The City's water supplies are increasingly burdened by rapid population growth. Already, effluent is serving a significant portion of Tucson's total water demand, and the City's water planning is heavily dependent on effluent. In this respect, Tucson mirrors the nationwide transformation of effluent into a valuable water resource.

Tucson's institutional framework presents challenges to expansion of effluent use, reflecting the EPA's noted concern that "[i]nstitutional barriers, as

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270. McGinnis, *supra* note 183, at 1000. A water right must be used for a "beneficial use" under the prior appropriation system. SAX ET AL., *supra* note 5, at 98.

271. Further, uncertainty about liability aspects of effluent reuse under Arizona law may create barriers to effluent reuse. *See* LIEUWEN, *supra* note 25, at x.

272. PIERCE, *supra* note 139, § 3.2.7 (citing ARIZ. REV. STAT. ANN. § 45-811.01 (A)-(C) (2004)).

273. Interview with Jacobs, *supra* note 119.

274. Baron, *supra* note 26, at 589. David Baron suggests that several legal theories could prevent the discontinuation of municipal effluent discharges, including antidegradation and use protection policies, the Endangered Species Act, and the public trust doctrine, which could prevent municipalities from impairing such trust uses as boating, fishing, and wildlife habitat. *Id*.

well as varying agency priorities, can make it difficult to implement water recycling projects."[275] The significant upfront costs of extending the effluent system in comparison to the cost of traditional water sources has hindered effluent reuse in Tucson, as in other parts of the country.[276] Similarly, a range of effluent quality and safety issues, stemming both from valid concerns about contaminants and from misunderstandings, persists in Tucson and nationally. Effluent plays a critical role in Arizona, as across much of the arid West, in maintaining dwindling riparian habitat, and increased reuse of effluent may deprive riparian communities of this critical water source. While state and local governments in Arizona have assumed a leading role in encouraging the reuse of effluent, effluent regulation is still inchoate. Legal uncertainties impede investment in treatment and the reuse of effluent and provide some disincentives to environmental protection.

Overall, effluent is clearly on its way to assuming a critical role in meeting future water supplies in the West and across the country. In the national context, the EPA has concluded that "[w]ater recycling has proven to be effective and successful in creating a new and reliable water supply, while not compromising public health."[277] The EPA confidently predicts increased nonpotable reuse and indirect potable reuse of effluent.[278] The legal regime has made strides toward recognizing this new water source, and further legal developments are certainly on the horizon.

275. ENVTL. PROT. AGENCY REGION 9, *supra* note 29.
276. *Id.*
277. *Id.*
278. *Id.*