SWEETWATER RECHARGE FACILITIES: SERVING TUCSON FOR 20 YEARS

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Introduction

The City of Tucson is located in the northern semi-arid reaches of the Sonoran Desert in eastern Pima County, Arizona. Very few surface streams contain perennial flow and most of these are effluent-dominated streams located downstream from municipal wastewater treatment plants. Until the early 1990s, the Tucson community relied almost exclusively on pumped groundwater to meet water demand. Due to rapid growth in population and associated water demand following World War II, the groundwater system transitioned from an approximate state of equilibrium to one of accelerating depletion. Despite the successful implementation of water conservation programs and the “desert landscape” ethic of Tucson residents, groundwater withdrawals for municipal use continued to increase through the year 2000. Rapidly declining water levels in the metropolitan and surrounding areas have resulted in land subsidence, increased pumping costs, and the gradual loss of native riparian habitat.

Tucson Water’s need to develop renewable water supplies in order to reduce reliance on groundwater and meet projected future demand has long been recognized and is a critical goal of *Water Plan: 2000-2050* (Tucson Water, 2004). Reclaimed effluent is a renewable water supply that Tucson Water has come to rely upon to help meet the community’s growing thirst for water. The Reclaimed Water System supplies high-quality recycled water for non-potable uses. The Sweetwater Recharge Facilities are the key source of supply to this system and have served the community for two decades.

Tucson’s Reclaimed Water System

In the early 1980s, the City of Tucson constructed one of the first reclaimed water systems in the country. This system provides tertiary treatment of secondary effluent derived from Pima County Wastewater Department facilities to produce water of sufficient quality to be used for landscape irrigation and certain industrial uses. The system began operation with 10 miles of pipeline and only one customer—a destination resort golf course. Since then, the system has grown to include over 100 miles of transmission pipelines and serves almost 13,000 acre-feet per year of reclaimed effluent to about 600 customers including multiple golf course facilities, parks, schools, industrial sites, and certain residential sites. Tucson Water’s reclaimed water system remains an industry leader and serves to meet approximately eight percent of Tucson’s total water demand. This reuse of wastewater effluent reduces groundwater pumping and conserves higher quality water sources for potable supply.

The secondary effluent that is received from Pima County’s treatment facilities is either filtered at the Tucson Reclaimed Water Treatment Plant or recharged in a number of facilities. The recharge facilities include the Sweetwater Recharge Facilities (SRF), the Santa Cruz River Managed Underground Storage Facility (Santa Cruz Phase I), and the Lower Santa Cruz River Managed Recharge Project (Santa Cruz Phase II) as shown in Figure 1 (Tucson Water, 2004). While all of these facilities are essential to the successful operation of the Reclaimed Water System, the SRF are the core supply source providing high water quality, system reliability, and a beneficial public amenity.

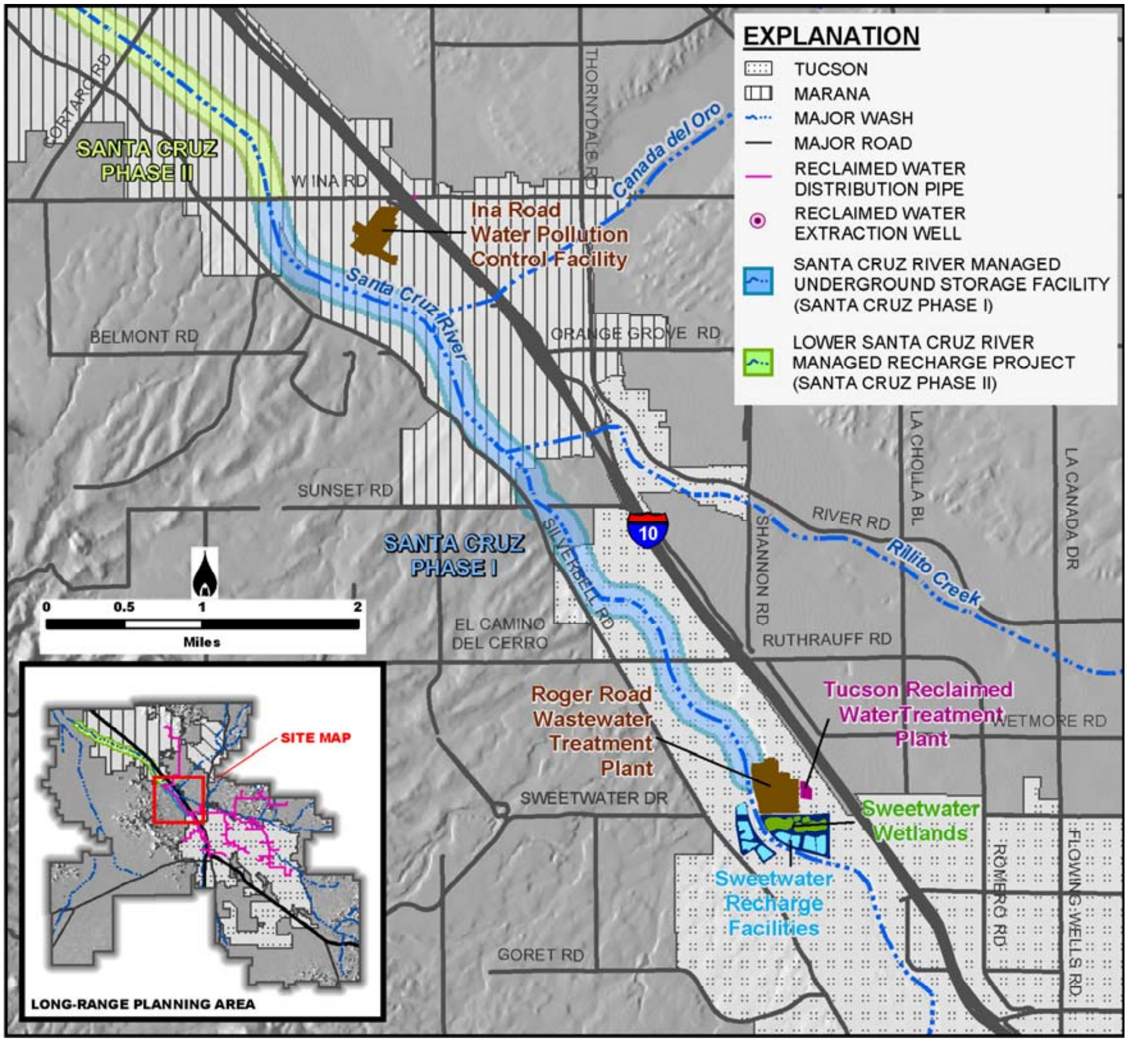

Figure 1. Sources of Supply to the Reclaimed Water System.

The Sweetwater Recharge Facilities (SRF)

Planning for reclaimed water production, recharge, and recovery officially began in 1983. It was during this time that Tucson Water, a Department of the City of Tucson, made the commitment to utilize reclaimed water in economical and feasible ways to offset water demand in the Tucson basin. At the same time, the Central Arizona Project (CAP) was nearing completion in the Tucson area. The CAP was designed to bring Colorado River water to agricultural interests, Native American communities, and municipalities in central and southern Arizona to help further reduce reliance on mined groundwater. The use of Colorado River water coupled with the new reclaimed water use program has allowed Tucson Water to be a viable desert city with a reliable water supply for years to come.

The SRF have evolved through three major phases during the last twenty years. The first ("Demonstration") phase occurred from 1984 through 1989, the second ("Developmental") phase occurred from 1989 through 1997, and the third ("Full-Scale") phase has run from 1997 to the present.

Demonstration Phase 1984 – 1989

The objectives of the Demonstration Phase of the SRF were to determine the hydrologic feasibility of aquifer recharge and recovery, evaluate the potential impacts of recharge on aquifer water quality and water levels, obtain geologic information on site characteristics during construction, and gain experience in the operation and maintenance of a recharge and recovery facility. Once the decision was made to fully investigate and prepare for the use of reclaimed water, Tucson Water hydrologists and engineers, University of Arizona researchers, and consulting professionals began the process of designing and testing a small scale demonstration project.

The demonstration project was constructed on the west bank of the Santa Cruz River near Pima County's Roger Road Wastewater Treatment Plant and Tucson Water's newly constructed Reclaimed Water Treatment Plant. A group of four recharge basins, about three quarters of an acre each, were constructed for the project. Initial design intentions were to take tertiary treated reclaimed water and utilize it for recharge and recovery. Three pipelines were constructed to convey water to and from the demonstration project. The first pipeline was used to deliver potable water for testing purposes, the second pipeline delivered reclaimed water from the tertiary treatment plant to the recharge basins for storage, and the third pipeline conveyed recovered reclaimed water to the distribution reservoir located at the tertiary treatment plant.

By January 1986, potable water was delivered to the demonstration basins for testing. The testing goals were to determine infiltration rates, evaluate monitoring and measuring equipment, and study any possible water quality or groundwater level changes that would result from recharge operations. The first ("short-term") tests were designed to be conducted over a seven-day recharge event. Due to equipment failures and data logging problems, only two of the four basins completed the test. The second ("long-term") tests were conducted on all four basins between January 28, 1986 and May 23, 1986. The original intent of these tests was to operate through two wet and dry cycles for each basin. However, due to continued equipment problems, each basin was instead tested through a single long-term wetting cycle. These wetting cycles ranged between 18 and 83 days. The average of the infiltration rates recorded during the long-term tests was slightly above 1 ft/day (Tucson Water, 1990).

Between July 1984 and February 1988, ten monitoring wells and two extraction wells were installed at the site. The ten monitoring wells were placed throughout and along the perimeter of the demonstration project and were designed to measure water quality and water level changes in the vadose zone and the aquifer. The major water quality change during the demonstration phase was an initial increase in total dissolved solids. This was attributed to a flush of vadose zone salts.

The apparent success of the Demonstration Phase at this location led Tucson Water to continue to advance the growth of the reclaimed system and the SRF.

Developmental Phase 1989 – 1997

Tucson Water provided preliminary design specifications for the development of an operational underground storage and recovery facility based on the results of the Demonstration Phase. The initial design called for the construction of four recharge basins (RB-001 through RB-004) totaling 13 acres to be located in the vicinity of the demonstration project (Figure 2). By October 1988, the Arizona Department of Water Resources (ADWR) had approved the Underground Storage Facility (USF), Water Storage, and Recovery Well permits for the proposed facility. The final design was approved by the State in February 1989. In addition, the facility was required to obtain an Aquifer Protection Permit from the Arizona Department of Environmental Quality (ADEQ).

Facility construction began in June 1989 and the basins were excavated to a depth of 10 to 15 below ground surface to increase the efficiency of infiltration rates by taking advantage of more permeable sediments located at these depths. During the Developmental Phase, additional monitor wells and two additional extraction wells were added to the facility.

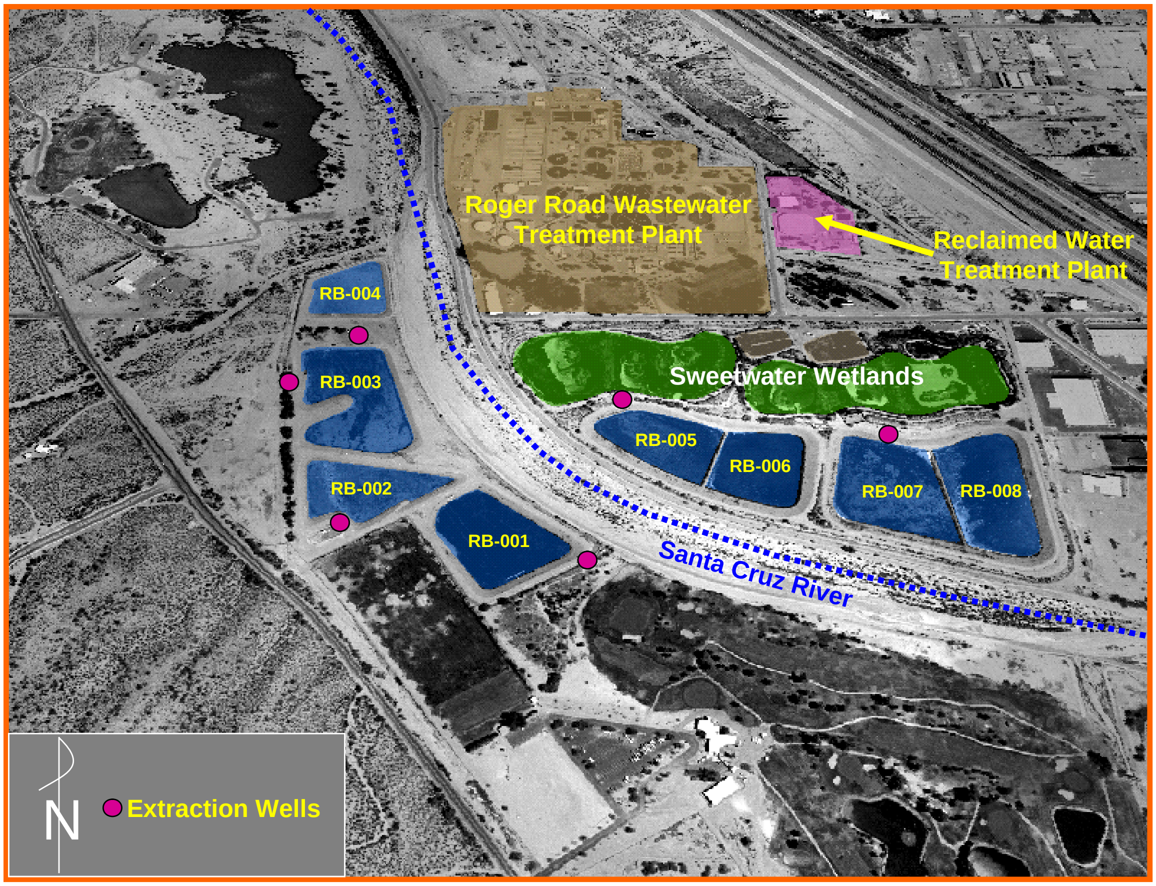

Figure 2. Site Map of Sweetwater Recharge Facilities

The first completed recharge basin, RB-004, began accepting secondary effluent on October 28, 1989. After operating wetting cycles that lasted for 10 to 13 days within this basin, algal flocculation was observed. Infiltration rates were directly impacted by the algal flocculation which greatly reduced the amount of water that could be infiltrated. Tucson Water facility operators reduced the wet cycle duration to less than one week while increasing the length of drying cycles. The advantage of the drying cycles was to desiccate, shrink, and crack the layer of algae and fine sediments that accumulated in the basin bottom during each wetting cycle. Operating in this way allowed the infiltration rates to maintain their optimum efficiency. Recharge basins RB-002 and RB-003 were completed in April and May 1990, respectively. By June 1990, three recharge basins were operational and the use of chlorinated recharge water was initiated. Chlorinated source water coupled with appropriate wet cycle durations were utilized to reduce the growth of algae in the basins.

Recharge basin RB-001 was under construction during 1990. This basin was selected as the location where the processes of Soil Aquifer Treatment (SAT) would be intensely studied. An intergovernmental agreement (IGA) was entered into by the City of Tucson, the University of Arizona, and the Salt River Project to provide funding, equipment, analysis, and materials to groups investigating SAT. Research goals included determining the effectiveness of SAT in the Tucson basin and what benefits SAT could provide to the process of recharging the aquifer with reclaimed water. RB-001 did not receive recharge water until April 1991 when monitor wells and equipment were in place.

Basin infiltration rates were observed to decrease over time during the Developmental Phase. After completion of initial operations and SAT testing, RB-001 was ripped to help improve infiltration efficiency (Tucson Water, 1994). Ripping a basin refers to the process of using mechanized equipment to 'turn over' the basin soils at a certain depth, generally one to three feet below ground surface. The ripping process assists in breaking up or 'fluffing' the upper-most soils that may have been compacted, clogged with biological materials, or filled with fine sediments that can form a clogging layer and minimize infiltration rates.

Based on the results of several studies, Tucson Water determined it was feasible to start delivering secondary effluent directly from Pima County's Roger Road Wastewater Treatment Plant to the recharge basins in January 1994. Previously, the basins were receiving tertiary-treated effluent from the Reclaimed Water Treatment Plant. During the Developmental Phase, the SRF were permitted to recharge and recover approximately 3,200 acre-feet per year.

As a condition of a judicial consent order issued by ADEQ, Tucson Water agreed to construct a wetland facility at the SRF. The wetlands were conceptualized to provide broad community benefits in addition to their core purpose of treating backwash water from the Reclaimed Water Treatment Plant. By March 1995, Tucson Water had decided to design the wetlands and incorporate four additional recharge basins to be placed on the east side of the Santa Cruz River. With the future construction of this new expanded facility, Tucson Water proceeded with major modifications to its Aquifer Protection, Underground Storage Facility, and Water Storage permits to increase the recharge capacity to 6,500 acre-feet per year thus initiating the Full-Scale Phase.

Full-Scale Phase 1997 – Current

In 1997, the Sweetwater Wetlands and recharge basins RB-005 through RB-008 were completed (Figure 2). With these additions, the SRF was now able to double the amount of recharge and recovery capacity to 6,500 acre-feet per year.

The Sweetwater Wetlands total 17.3 acres and were built with two parallel flow pathways (east and west). Each side has a pathway that consists of two settling basins followed by one polishing basin. The outflow from the wetland area is combined with secondary effluent and delivered to the newly constructed recharge basins. A small stream feature was constructed as part of the wetlands as an aesthetic enhancement. The entire project was designed in conjunction with a strong public advisory committee. The wetlands were considered a public amenity and features such as walking paths, ramadas, public restrooms, and interpretive signage were incorporated into the design. A small evaporation bed was constructed to treat sewage from the public restrooms. The evaporation bed is a closed system and does not contribute recharge water to the basins.

Recharge Basins RB-005 through RB-008 were constructed directly south of the wetland area. The area of the four additional basins is equal to that of the first four basins located on the west side of the river. With the additional basin area, the storage capacity of the SRF approximately doubled to a permitted volume of 6,500 acre-feet per year. Infiltration rates at the SRF have averaged approximately 2.3 ft/day under full-scale operations (Tucson Water, 2005). Two additional extraction wells were drilled in December 1997 through January 1998. These wells were drilled on the east side of the Santa Cruz River to help with the recovery of stored water generated by the new recharge basins. The wells were equipped and ready for operation in 2000. With the addition of these wells, the SRF is also fully capable of recovering the volume recharged in any given year.

Operations and Storage Balance

Storage balance is defined as the recharged volume of water available for recovery to meet customer demand for non-potable use and is calculated as the basin delivery volume minus physical losses (evaporation) minus recovery. The storage balance for the SRF from 1984 through 2004 is presented on Figure 3. The volumes reported in this paper differ from those reported in Tucson Water (1991) for several reasons. First, the volume of water recharged prior to the issuance of the initial USF and Water Storage permits is not included in the storage balance shown in Figure 3 (approximately 78.9 million gallons). Secondly, evaporation losses have been quantified and subtracted from the storage balance – these volumes were not deducted in the 1991 publication. Finally, minor errors in the volumes reported as recharged and recovered have been corrected over time.

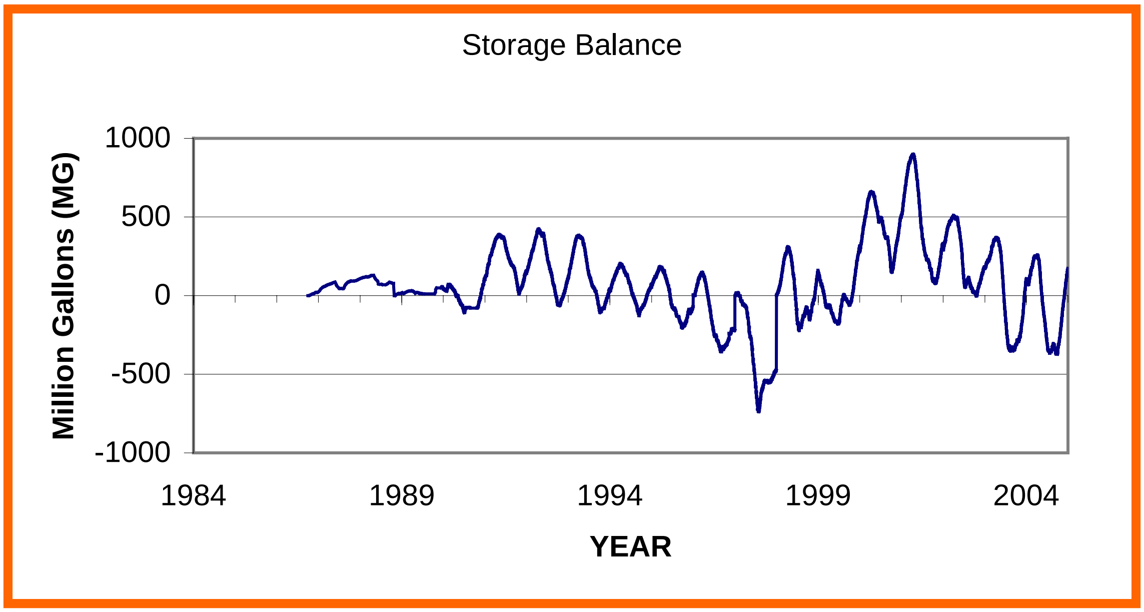

Figure 3. SRF Storage Balance (1984 – 2004)

As shown on Figure 3, the storage balance has a declining trend between 1993 and 1996 when demand was exceeding the existing capacities of the SRF and Reclaimed Water Treatment Plant. When the four additional recharge basins associated with the Full-Scale Phase were brought online, the overall storage balance increased. Prior to the Full-Scale Phase, the facility was operated so that the volume of water left in storage at the end of the peak demand season was minimal, but able to satisfy an emergency demand. Currently, the SRF is operated to store a sufficient volume of water to meet the peak season with a moderate volume left at the end.

Annual recharge operations are currently planned to recharge and recover 6,500 acre-feet each year. These trends are reflected in the annual volumes recharged and recovered for 1984-2004 (Figure 4). Also included on Figure 4 are the total annual deliveries to the Reclaimed Water System which include other sources of supply in addition to the SRF (Reclaimed Water Treatment Plant, recovery from Santa Cruz Phase I and II, potable augmentation, and the Randolph Park Reclamation Plant).

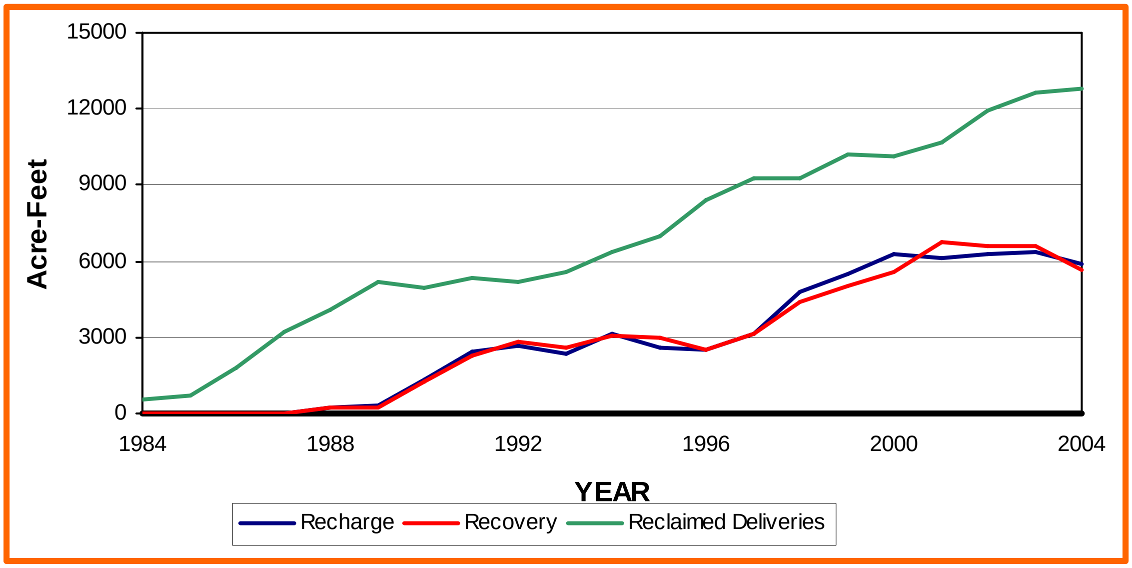

Figure 4. SRF Recharge, Recovery, and Total Reclaimed Deliveries (1984-2004)

Maintenance

The SRF are operated by using wet and dry cycles in the basins to maintain high infiltration rates. The wet portion of the cycle is operated by filling the basin to a depth of one to two feet for a period of about 3 days. At the end of each wet cycle, flow is tuned off and the remaining ponded effluent is allowed to infiltrate until the soil surface is dry. This is defined as the start of the dry cycle. The dry cycle usually lasts for a couple of days, allowing the basin to completely dry to manage algal growth. Desiccation cracks open on the basin floor which restore the infiltration pathways to the vadose zone.

Extended summer drying periods are scheduled to perform more extensive basin maintenance. The basins are typically taken offline for about one month each year and ripped to a depth of one to three feet. The upper 15 inches of the soil surface must be dry before the basin can be ripped or compaction may result. After ripping, furrows are constructed to increase the basin's exposed surface area. This process also serves to increase infiltration rates.

Due to the relatively brief duration of the wet cycles, vector control for mosquito populations is not required at the recharge basins. However, the wetlands facility provides a high potential for mosquito generation and is actively managed to reduce mosquito populations. Mosquito monitoring ("trapping") has been ongoing at the facility for a number of years and the current vector control program has evolved to a very effective combination of measures. The vector control program includes weekly monitoring throughout the year. A mosquito adulticide (*sumithrin at 2%*) is added to the wetlands one to three times per week during the mosquito season (generally May through October). A mosquito larvicide (*Bacillus thuringiensis israeliensis or Bacillus sphaericus*) is added weekly via a hydro-seeder and weekly via a miniature, remote-controlled helicopter. The hydro-seeder is most effective at reaching areas of the wetlands that underlie a vegetative canopy and the helicopter effectively treats the open water portions.

Because the wetlands provides a constant supply of water and the southern Arizona climate is quite warm, the potential growing season for vegetation at the wetlands is almost boundless. Trees that were pole-planted in 1997 have grown into tall, mature-looking stands. However, due to their ready access to water, they typically develop shallow root systems and can topple in high winds. Periodic tree thinning is done to address this issue as well as provide adequate sight lines for operation of the vector control helicopter. Shrub and bush vegetation must be constantly cut back to provide continued access to the wetlands, recharge basins, walkways, and support facilities. A private contractor is retained to keep up with this task. Finally, the wetlands vegetation itself can quickly close off the open water portions of the settling basins if left unattended. Mechanical removal has been attempted in the past; however, the most effective means has been the use of controlled burns. The Tucson Fire Department (and surrounding fire services) performs annual controlled burns on up to 1/3 of the wetlands area to help control vegetative growth and provide wildfire training for their crews.

Finally, biosolids accumulation in the settling basins of the Sweetwater Wetlands has recently required the implementation of a management program. No solids removal was conducted from 1997 through 2004. During this time, a significant volume of biosolids accumulated which began to affect the treatment capability of the wetlands. In 2005, a program to remove these biosolids was successfully conducted utilizing a trailer-mounted centrifuge system. This effort took several weeks but resulted in the restoration of full capacity to the wetland settling basins. The solids were waste-characterized, determined to be non-hazardous, and disposed of offsite in accordance with environmental regulations. In order to maintain more continuous wetland treatment capacity and prevent such a significant accumulation in the future, current plans are to perform biosolids removal on a biennial basis.

Water Quality and Soil Aquifer Treatment

Source water quality has been continuously monitored at the SRF for two main reasons. The first is a Tucson Water goal to quantify the changes in water quality which occur during recharge operations - soil aquifer treatment (SAT). The second reason is to remain within the compliance guidelines of the Aquifer Protection Permit (APP). This State of Arizona permit requires that source water quality remain below the maximum discharge limits for a variety of parameters. In the original APP, the parameters set for source water quality were predominately metals and organic volatiles. In the current APP, source water quality sampling is conducted mainly for metals, nitrogen species, biochemical oxygen demand, total dissolved solids, sulfate, and chloride.

The source water sampling point (“510B”) is located along the pipeline that conveys secondary effluent from the Roger Road Wastewater Treatment Plant to the Reclaimed Water Treatment Plant. Water sampled at 510B reflects the quality of secondary effluent prior to tertiary treatment or delivery to the recharge basins. The main function of the Reclaimed Water Treatment Plant is to reduce the turbidity level of the effluent through dual-media pressure filtration (silica sand and anthracite coal beds). Turbidity reduction is the main qualification that provides a tertiary treatment classification. The processes of SAT that occur in the recharge basins also significantly reduce turbidity; therefore, the recovered water meets tertiary treatment standards as well.

The source water for the SRF is primarily a sodium-bicarbonate water. Major anion concentrations have remained stable over time with a few exceptions. Sulfate concentrations increased temporarily between 1992 and 1994. This source water change was related to Tucson Water’s initial use of Colorado River water in the general potable distribution system. (Tucson Water initiated the direct delivery of Colorado River water in 1992. However, due to pervasive operational problems, this system was taken offline in 1994. The Utility changed its approach for using Colorado River water to the use of recharge and recovery and successfully brought this resource back into use in 2001.) Over the time the SRF has been in operation, the average sulfate concentration has been about 106 mg/L. The average concentrations for other major anions are bicarbonate at 218 mg/L and chloride at 90 mg/L. Major cation concentrations have been relatively stable over time. Sodium concentrations have an average of 116 mg/L. Calcium, potassium, and magnesium have averaged 48.7, 12.8, and 7.8 mg/L respectively.

Total dissolved solids (TDS) have remained somewhat stable over the duration of the facility history. During the time period of initial Colorado River water use, the average concentrations of TDS increased slightly. After the direct use of Colorado River water ceased in 1994, TDS concentrations returned to their historic patterns. The average annual concentration of TDS in the secondary effluent source water has been consistently around 550 mg/L in recent years.

The average annual total nitrogen concentration for secondary effluent entering the Reclaimed Water Treatment Plant and/or the SRF recharge basins has been 20.6 mg/L. The species contributing the largest fraction of total nitrogen is total kjeldahl nitrogen (TKN) which has an average annual concentration of 17.6 mg/L. TKN has fluctuated seasonally over the duration of the project ranging from 9.3 to 25.6 mg/L on an annual basis. Nitrite concentrations in 510B have remained very low during the project with an average annual concentration of 1.1 mg/L. The average annual concentration of Nitrate is 2.9 mg/L.

From 1987 through 1999, a bi-modal distribution trend was observed in the nitrogen species of 510B. A seasonal correlation is detected between TKN and nitrate. Nitrate values tend to increase during the warmer months of the years while TKN values tend to decline. This is attributed to the warmer climate creating an environment that is preferred by organisms that contribute to the nitrification process. As the nitrification rates increase, TKN concentrations decrease and nitrate concentrations increase (Tucson Water, 2005).

From 1993 through 2004, sample point 522 has functioned as the monitoring location for the Reclaimed Water System’s Wastewater Reuse Permit. The water sampled at this point is representative of the quality of water delivered to reclaimed water customers and is a blend of plant-treated and recharged/recovered effluent from the SRF. Sample point 522 is located at the booster station that pumps the blended water to the reclaimed water delivery system. The water may be a variable mixture of both sources or from one source only depending on operational requirements.

Nitrogen species results from sample point 522 are noticeably reduced from point 510B. The average annual total nitrogen concentration at point 522 is 14.7 mg/L. The species contributing the largest fraction of total nitrogen at point 522 is also TKN; however, it is reduced to an average concentration of 8.2 mg/L. Nitrate concentrations at point 522 are greater than at point 510B, with an average annual concentration of 6.2 mg/L. Denitrification processes associated with SAT at the recharge basins have contributed greatly to the reduction of total nitrogen and conversion to nitrate species in the delivered reclaimed water. Based on overall average annual concentrations, total nitrogen reduction throughout the duration of the facility has been approximately 29%. The conversion of TKN into nitrate and eventually nitrogen gas can be recognized in the concentration changes in these constituents from pre-recharge water quality to reclaimed product water quality.

Product water from the Reclaimed Water Treatment Plant is usually blended with water recovered from the extraction wells to manage turbidity. Under the Wastewater Reuse Permit, turbidity at sample point 522 has to be 5 NTU or lower. The filters at the plant can effectively remove approximately 50% of the turbidity measured in the secondary effluent, but this can often exceed 5 NTU. The stored water that is removed through the extraction wells consistently has a low turbidity. The blending of recovered water and plant effluent continues today to be an effective formula to remain within the compliance limits.

One additional water quality transformation of note concerns total organic carbon (TOC). TOC that is present in a water supply can react with chlorine used for disinfection and result in the formation of disinfection by-products. Effluent typically contains high levels of TOC and the reclaimed water delivered by Tucson Water is disinfected to protect human health. The SAT processes that are active during recharge are highly effective at removing TOC. At the SRF, TOC concentrations have been consistently reduced from 20 mg/L to less than 1 mg/L upon recovery (Thomure and Marra, 2005).

The Future of the Sweetwater Recharge Facilities

As Tucson Water's Reclaimed Water System grows over time, additional access to tertiary-treated effluent will be required. The increasing demand is not only within the Tucson Water service area, but also in areas served by others. For instance, Tucson Water will wheel the effluent owned by other entities such as the Town of Oro Valley through the Reclaimed Water System to their facilities. The expansion of constructed recharge facilities will be evaluated as a way to provide this additional supply. Currently, a series of possible ways to expand the existing SRF are being evaluated (Figure 5).

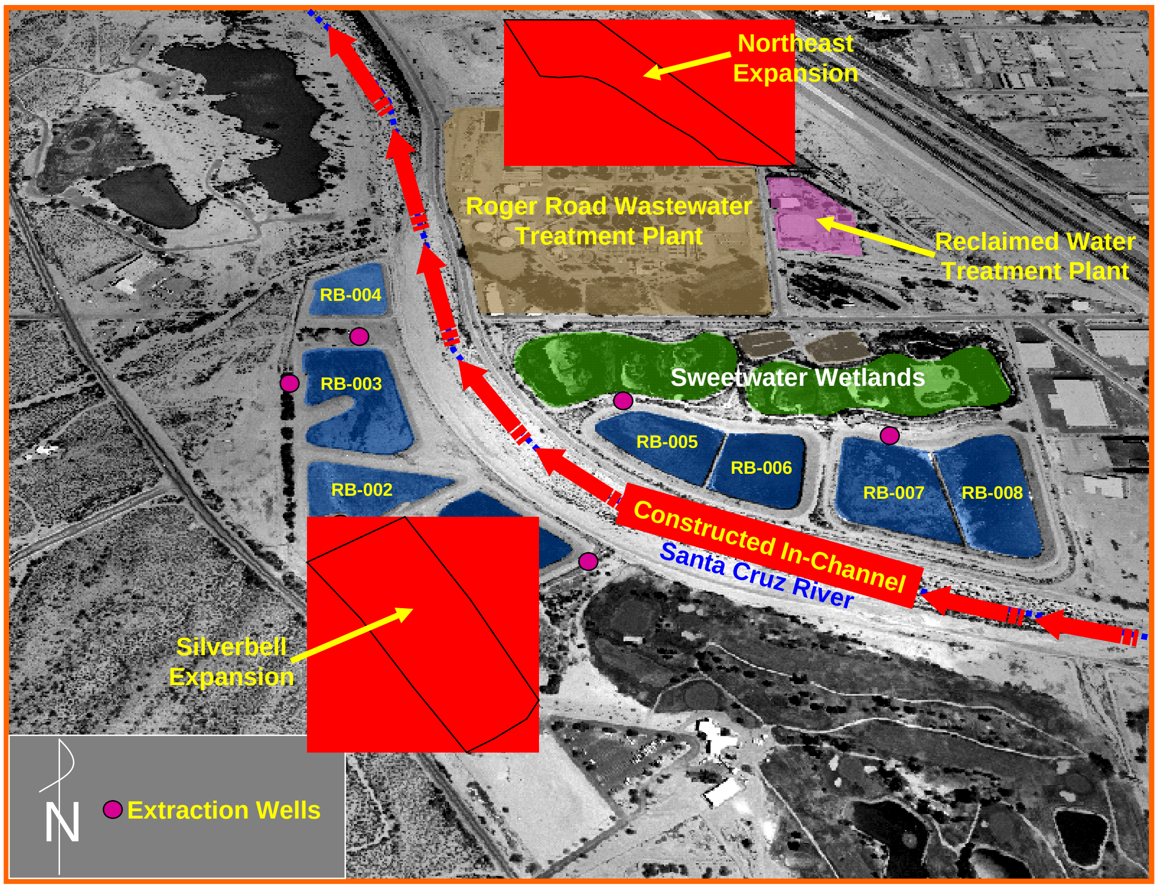

Figure 5. Potential Expansions of the SRF

Two off-channel areas have been identified for the possible construction of additional recharge basins – the Northeast Expansion and the Silverbell Expansion (Figure 5). The Northeast Expansion area has been investigated in previous years and has been determined to be a feasible location for additional recharge. In fact, an engineered design of a large recharge basin in this location was completed but never constructed. Concerns over the potential for creating perched water levels that could affect the operation of clarifiers at the Roger Road Wastewater Treatment Plant must be alleviated before expansion in this area could proceed. To date, there is no evidence that such impacts would occur. This location is the initial area being evaluated by Tucson Water for expansion.

The Silverbell Expansion area is actually an operating driving range for the City of Tucson's Silverbell Golf Course. As part of a redesign of the golf course, this area was identified as a possible location for additional recharge and preliminary investigations have been conducted. The initial test work is positive; however, the impacts to the golf course facility would need to be mitigated. In addition, an existing groundwater contamination plume is located immediately upgradient from this area and would need to be carefully studied prior to conducting recharge. The Silverbell area is being further evaluated in conjunction with the Northeast Expansion and is considered the second highest priority location.

In addition to the construction of additional off-channel facilities, the concept of implementing in-channel constructed recharge associated with the SRF is under consideration. While there are currently two managed recharge facilities permitted along the bed of the Santa Cruz River (Santa Cruz Phase I and Phase II), these facilities only yield recharge credits for 50% of the effluent that reaches the aquifer. The conversion of parts of the river channel to a constructed facility through the use of levees, T-berms, or similar structures would greatly increase the recharge rates and generate credits for 100% of the water recharged. However, performing significant work in the bed of the Santa Cruz River would introduce a wide range of additional permitting complexities that could extend the time frame of this expansion to several years. This concept is under active consideration; however, it is likely to be dependent on the positive or negative outcomes of the off-channel options discussed above.

Finally, even though a significant portion of Tucson Water's effluent will continue to be used to meet non-potable (reclaimed) demands, a large volume of effluent will be available for use to augment the potable water supply. As Tucson Water planners project the water needs for the community into the future, it is clear that the broader use of effluent will become critical. Over time, the community will need to make critical decisions about how to develop enough water supplies for the future including the possibility of using effluent for indirect potable reuse. The recharge process will be a critical factor in making effluent available for such a use both from a water quality standpoint through SAT and from a public acceptance standpoint by providing a clear buffer between the "effluent" source and proposed end use. The SRF may play a role in the eventual indirect potable reuse of effluent in addition to its traditional and continuing role in providing high quality reclaimed effluent for non-potable uses.

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