CHAPTER 1

Introduction

Chapter 1 - Introduction

The Pima County Regional Wastewater Reclamation Department (PCRWRD) commissioned the development of a master plan to identify the optimal strategy for the treatment of current and projected future wastewater flows to the Roger Road Wastewater Reclamation Facility (WRF) and the Ina Road WRF. Most importantly, the plan addresses the current and future regulatory requirements of the Arizona Department of Environmental Quality (ADEQ) to reduce the ammonia and nitrogen concentrations discharged into the Santa Cruz River by the year 2014 for the Ina Road WRF and the year 2015 for Roger Road WRF.

PCRWRD owns and operates two major wastewater reclamation facilities and a smaller wastewater reclamation facility in the metropolitan (Metro) area of Tucson, and manages a sewerage conveyance system that includes over 3,300 miles of sewer pipes, 66,000 manholes and 34 lift stations. Further, the County owns and operates eight (8) Non-Metropolitan (Non-Metro) wastewater reclamation facilities in areas of rapidly growing populations. The Non-Metro facilities were evaluated in the master plan for regulatory compliance, system performance and for consolidation or expansion to meet the future needs of the County. In addition, the County through the master planning activities sought to optimize current and future biosolids treatment and disposal as it relates to its wastewater treatment facilities.

In parallel to the master plan activities PCRWRD commissioned a system-wide odor control plan development to address the long lingering issues of wastewater infrastructure induced odors in the community. The odor control plan addresses the current and future needs for odor control, optimizes the operations of systems utilized for odor control and identifies future odor control system needs. Results of the system-wide odor control plan are incorporated into various project elements of the master plan.

1.1 Purpose of Study

The master plan purpose is twofold. First is to determine an optimal strategy for long-term flow/capacity management, recommend a treatment strategy for the increasing quantities of pollutants as wastewater flows increase in the future, identify existing facility rehabilitation needs, optimize solids handling and address the optimal methods to provide reclaimed water. Second is to develop a coordinated Capital Improvement Design and Construction Program, including estimates of construction costs, schedules and a recommended project delivery and funding strategy for implementation of resulting projects from the master plan development. These resulting projects are to be integrated into the overall PCRWRD Capital Improvement Program (CIP). As necessary, hydraulic and process modeling were used in the evaluation of alternatives.

PCRWRD recognizes the value of long-range planning in making timely, cost effective decisions. To that end, PCRWRD retained Greeley and Hansen LLC to create a master plan for future wastewater treatment in the PCRWRD service area. The master plan serves as a broad road map to the future activities. It identifies potential pathways, as well as obstacles to the implementation of PCRWRD's CIP. Through a detailed evaluation process, the best option is identified and selected for implementation, without precluding changes in direction that may be prompted by future needs. This master plan forecast

needs for wastewater treatment capacity throughout the PCRWRD service area, and identified the facilities required to meet those needs through the year 2030. The master plan builds upon numerous planning and engineering efforts previously performed for or by the PCRWRD. The plan identifies when wastewater treatment facilities will be upgraded and expanded, as well as how existing facilities will be integrated into future expansions or be decommissioned through the year 2030. The plan is based on current and potential future regulatory and PCRWRD customer requirements.

The plan recommends a comprehensive CIP with treatment component and system alternatives, phasing schedules and cost apportionments for future implementation of PCRWRD wastewater facilities needs. A series of facilitated workshops (consisting of PCRWRD staff, consultants and other stakeholders) were conducted to implement this study. The workshops were central to the decision making process for the development of the master plan. Key PCRWRD decisions were developed through a consensus process in facilitated workshops. The workshop summaries and presentations are provided on a CD, located in **Appendix A**. As the master plan developed, concurrent efforts focused on Strategy Development and CIP Development. The project elements associated with each of these efforts were:

- Strategy Development
  - Project Workshops/Public Meetings
  - Information Gathering, Regulatory/Customer Requirements/Permitting
  - Flow Projection/Capacity Needs
  - Treatment Plant Evaluations
  - Overall Treatment Strategy
  - Treatment Plan Recommendations
  - Conveyance System Evaluation
  - Non-Metro Plants Area Evaluation
  - Flow Management and Non-Metro Plants Area Treatment Plan Recommendations

- Capital Improvement Plan Development
  - CIP Elements Identification and Economic/Financial Analysis
  - CIP Delivery Methods Determination
  - CIP Phasing and Cost Schedules Preparation
  - Implementation Plan Development

1.2 General Background

Roger Road Wastewater Reclamation Facility (WRF)

The Roger Road WRF is the older of the two major metropolitan wastewater treatment facilities. It is a combination of several expansions and has a permitted capacity of 41 million gallons per day (mgd). Currently the average winter influent flow (peak season) is approximately 39.7 mgd. The facility is located at 2600 W. Sweetwater Drive, Tucson, Arizona 85705, just north of Prince Road between Interstate 10 and the Santa Cruz River. The Roger Road WRF was first operated in 1951 as a 12-mgd activated sludge facility and was expanded with a separate 13-mgd trickling filter plant in 1960. A

13-mgd activated sludge/contact stabilization facility was added in 1967. In 1979 the facility was consolidated into a single facility with the major biological treatment process consisting of two, 165-foot diameter by 26-foot deep, plastic media biofilters with return activated sludge capability. This increased the rated capacity to 41 mgd. The facility is required to continuously meet secondary treatment limits as set forth by ADEQ.

By-products (sludge) of wastewater treatment are thickened and anaerobically digested on site. Digested sludge meeting Class B biosolids criteria for agricultural land application disposal are conveyed via force main to the Ina Road WRF, where it is combined with digested biosolids from the Ina Road WRF. After thickening and dewatering biosolids are hauled and applied to agricultural land as a beneficial reuse soil amendment.

As flow and influent loadings have increased at the facility, the activated sludge tanks have been placed into continuous service. Prior to the late 1980s, the activated sludge tanks were used only during the winter months when the reaction rates slowed in the biofilters due to lower temperatures and higher influent loadings.

Before the effluent is released to the Santa Cruz River, a portion of the flow is pumped to reclaimed water treatment facilities owned and operated by Tucson Water. The reclaimed water facilities are located on the east side and adjacent to the Roger Road WRF. Flow to the reclaimed water facilities receives further treatment prior to distribution to reclaimed water users through an extensive regional pipeline distribution network.

For the Roger Road WRF process modifications and changes are required to lower ammonia and total nitrogen discharge levels to meet future effluent quality regulations. At a minimum, rehabilitation is needed to repair process units, replace equipment and structures that are beyond useful service life, address odor control and safety issues, and upgrade the facility to be compliant with environmental, regulatory, and building code requirements. An alternative to rehabilitating the aging Roger Road WRF is to replace the existing WRF. As the assessment of current conditions and systems were evaluated for the Roger Road WRF, consideration was given to the operational relationship between the Randolph Park Water Reclamation Facility (WRF) and the Ina Road WRF. Currently the Randolph Park WRF has a capacity of 3 mgd.

Ina Road WRF

The original Ina Road WRF was designed in 1973 and constructed from 1975 to 1977. The facility is located at 7101 North Casa Grande Highway, Tucson, Arizona 85743, just south of Ina Road, between Interstate 10 and the Santa Cruz River. The facility was designed to produce a treated effluent meeting secondary treatment quality requirements as set forth by ADEQ.. The original treatment plant uses a 25-mgd high-purity oxygen (HPO) Activated Sludge Process, sludge digestion and centrifuge thickening/ dewatering for solids handling and processing (to meet Class B biosolids agricultural land application disposal criteria), and a combined energy-recovery system for heating, cooling and on-site generation of electrical power. The energy–recovery system uses methane generated as a by-product of the solids treatment process. Modifications to the original design to enhance equipment performance and reliability were completed in 1990.

The headworks serving this facility, along with appropriate odor control facilities, were recently expanded to a capacity of 50 mgd. A Biological Nutrient Removal Activated Sludge (BNRAS) treatment works with a design capacity of 12.5 mgd was placed in service at the end of 2006. Effluent from the 25-mgd HPO treatment process and the 12.5-mgd BNRAS treatment process are combined prior to chlorination/de-chlorination disinfection and discharged into the Santa Cruz River. Current average winter influent flow (peak season) is approximately 23.8 mgd.

Process modifications/changes will be required to lower the ammonia and total nitrogen discharge levels to meet new discharge standards. Rehabilitation is needed to replace some equipment and upgrades are necessary for the facility to be compliant with future environmental, regulatory, and building code requirements. Other needed modifications include back-up power provisions, expanded plant laboratory facilities, improved personnel areas and a centralized laboratory facility.

1.3 Strategy Development

The master plan strategy development included the investigation of options and impacts of various treatment and conveyance configurations, while considering both major wastewater reclamation plants as one interconnected treatment system. This investigation included the evaluation of the transfer of all, or a transfer of a portion of the wastewater flow from the Roger Road WRF service basin area to the Ina Road WRF for treatment. Cost elements included new facilities, rehabilitation, odor control, nutrient removal, and future capacity needs. Studies and investigations included model-based evaluations, preliminary cost estimating, operation and maintenance (O&M) costs, an understanding/optimization of total community cost impacts (e.g., other water utility provider costs – Tucson Water, Metro Water, and Oro Valley Water), a pros/cons assessment of alternatives, and the generation of a net present value analysis.. All derived estimates and concepts were developed at a planning level, and based on existing published and PCRWRD information. An independent cost evaluation was conducted on treatment facilities costs. Based on a complete analysis, a recommended configuration was developed.

The following options were evaluated as part of the master plan.

1. "Existing Plan" option was for both plants to continue operating with Roger Road WRF at a somewhat reduced capacity (32 mgd) and Ina Road WRF at an increased capacity (50 mgd). Evaluations included characterization and projection of sewage strength, projected flows, optimization of plant operations, and value and worth of existing structures and systems.

2. Maintain a smaller wastewater treatment facility at the Roger Road WRF (20 mgd) to continue to provide effluent to the adjacent Tucson Reclaimed Water Treatment Plant, and direct the remainder of the influent flows and solids to the Ina Road WRF.

3. Transfer of all wastewater flow from the Roger Road WRF service basin area to the Ina Road WRF, followed by a decommissioning and closure of the Roger Road WRF. This option included reclaimed water conveyance facilities from the Ina Road WRF to the existing Tucson Reclaimed Water Treatment Plant adjacent the existing Roger Road WRF.

4. Each of the above options included an evaluation of an upgrade of the PCRWRD facilities to produce reclaimed water quality of Class A+, to allow decommissioning of the pressure filter system at Tucson Water Reclamation Facility. Implementation of this option would require an agreement between Tucson Water and PCRWRD.

"***Existing Plan"***
The plan under the Department's 2006 Metropolitan Area Facility Plan Update (Existing Plan) was to complete the necessary rehabilitation and process optimization at both facilities, construct the required process changes to meet the effluent limits for nutrient removal, incorporate enhanced odor control facilities at the Roger Road WRF and the Ina Road WRF, transfer all biosolids processing to Ina Road WRF, via a modified sludge line, develop a centralized biosolids processing facility with a potential to produce a Class A biosolids, and add a 28-mgd (average dry weather) gravity flow interconnect pipeline between the two facilities. A sub-option for additional consideration is to build a new water reclamation campus (WRC) to serve Roger Road WRF flows and abandon the existing facility.

Under this option and in the others below, water rights to the effluent are addressed in existing intergovernmental agreements among the City of Tucson (Tucson Water), the Conservation Effluent Pool (CEP), Southern Arizona Water Rights Settlement Act (SAWRSA), Pima County, and other reclaimed water owners.

"Transfer Some" Wastewater Flow, Leaving a Portion for Reclaimed Use
Based on economics or other issues such as reclaimed water use a smaller treatment facility at the Roger Road WRF (20 mgd) may be desirable, while directing the majority of the flows to the Ina Road WRF (62 mgd). Under this option some of the existing facilities would be modified to treat only a portion of the flow in the service basin area, while directing all wastewater process solids (primary solids, and waste activated sludge) along with the remainder of the plant influent to the Ina Road WRF. This would allow shutdown of a large portion of the facilities presently located at the Roger Road WRF, and reduce operations and maintenance expenses at this facility. A sub-option is to build a new facility to serve Roger Road WRF at reduced flows and abandoned the existing facility.

"Transfer All" Wastewater Flows to Ina Road WRF
In this option, all wastewater (82 mgd) is directed by gravity flow from the Roger Road WRF to the Ina Road WRF. The two facilities are approximately 5 miles apart, and the Roger Road WRF is located at a point approximately 75 feet higher in elevation than the Ina Road WRF. The transfer of flows could be achieved by a gravity flow pipeline. Significant plant expansion and process modifications at the Ina Road WRF would be required to accommodate the additional flows. All flows will need to meet the effluent limits for nutrient removal. This option would eliminate the treatment plant age and related odor issues at the Roger Road WRF.

Biosolids
Environmental Protection Agency (EPA) Part 503 Regulations lists various methods and approaches to achieve a Class B or Class A biosolids. Each option considered in the master plan includes the potential of processing biosolids to Class A. Consolidation of the biosolids processing and treatment centralizes operations, minimizes operations and maintenance expenses and enhances third party interest in biosolids

disposal. Furthermore, expanding the county-wide biosolids disposal market by securing additional disposal outlets are needed to provide a robust long term biosolids management program. Disposal practices of the biosolids generated from the wastewater facilities and a preliminary evaluation for producing marketable end products was conducted. In all cases obtaining Class A biosolids involves reducing vector attraction and pathogens through additional process treatment.

Further, each of the options addressed associated conveyance system modifications and the impact of reduced discharges from the Roger Road WRF on the Santa Cruz River riparian habitats.

Permits
The Roger Road WRF and Ina Road WRF operate under Arizona Pollution Discharge Elimination System (AZPDES) permit numbers AZ0020923 and AZ0020001, respectively, issued by the ADEQ. ADEQ operates the AZPDES program under a delegation agreement with U.S. EPA. Pursuant to state law, ADEQ also issues permits under a state-wide aquifer protection permit (APP) program. The Roger Road WRF and Ina Road WRF operate under APP permit numbers P-100655 and P-100630, respectively.

Compliance with permitting requirements for each of the options, including plant upgrades to either Class B+ or Class A+ reclaimed water and land setback requirements are part of the master plan program. Permits that regulate wastewater treatment systems and effluent quality include:

- National Pollutant Discharge Elimination System (NPDES)/AZPDES permits
- Aquifer Protection Permit (APP)
- Arizona (State) Surface Water Quality Standards
- State Reclaimed Water Quality Standards
- State Aquifer Water Quality Standards
- State Rule 2.05 General Permit: Capacity, Management, Operation and Maintenance of a Sewerage Collection System

For effluent disinfection the County facilities will need to meet Best Available Demonstrated Control Technology (BADCT) requirements in future expansions and upgrades. For planning purposes consideration is given to the status of regulations of emerging contaminants.

Flow Projection and Capacity Needs
Expected future flows and wastewater loads for the Pima County wastewater service areas were developed from population projections prepared by the Pima Association of Governments (PAG). In particular, the overall conveyance system capacity needs within and between the service basin areas of Roger Road WRF and Ina Road WRF through the year 2030 were evaluated. In addition, the population projections were utilized to project flow, loads, and capacity needs in the Non-Metro areas (areas beyond the Roger Road WRF and Ina Road WRF service basin areas).

Wastewater Treatment Process
Alternative treatment schemes for the removal of chronic toxicity caused by ammonia are evaluated to achieve the reduction of the amounts of ammonia and nitrogen concentrations discharged into the Santa Cruz River to comply with current and future environmental regulatory requirements. Detailed outlines

of the treatment facilities expansion, rehabilitation and nutrient removal process changes for future permit compliance are identified. Site layouts, including future setback requirements, and opinions of probable construction and O&M costs were identified for the most promising nutrient removal processes.

Expansion options include considerations for the production of Class B+ and the possibility of the production of Class A+ effluent water quality, to meet the nutrient effluent limits. For Roger Road WRF a determination of the facility closure requirements as required by the options, as well as, facility needs to allow the plant to remaining service were examined in detail. Plans showing processes remaining, as well as those that would be eliminated, and other modifications required to allow the plant to operate were developed

Plant Interconnect
Each of the alternatives involves a transfer of some flow from the Roger Road WRF service basin area to the Ina Road WRF. Capacities of the flow management structures between service basin areas and a new plant interconnect between the two plants were evaluated. Sizing of the plant interconnect, based on gravity flow, was developed for each option. Flow requirements were determined from existing and future populations served, flow allocation per capita and from the wet weather response in the conveyance system. Preliminary routing alignments were prepared to investigate various planning and design issues related to each alternative route.

Power Generation
Evaluation of the bio-gas utilization for engine driven equipment and power generation facilities at Roger Road WRF and Ina Road WRF was conducted. The advantages and disadvantages of onsite bio-gas utilization for engine driven equipment and power generation versus purchased power from the local utility were evaluated. Consideration was given to the costs of having power available from the local power utility in the event that onsite power outage occurs. For Roger Road WRF and Ina Road WRF a decision by Pima County is required to either continue the practice of bio-gas utilization for engine driven equipment and power generation onsite, or to purchase power from a local utility and to utilize bio-gas for heating and cooling functions, or to sell all bio-gas to a third party for commercial use. Through an expression of interest process Pima County invited the marketplace to address the potential of third party operations of its power utility or utilization of the biogas.

System-Wide Odor Control Plan
Odor abatement and control across the entire system is a major issue that faces the department as many odiferous compounds, primarily hydrogen sulfide, are generated from the conveyance and treatment of sewage. With respect to the sewerage conveyance system within the Tucson metropolitan area, wastewater generally flows from southeast to the northwest. Because both major treatment plants are located on the northwest side of Tucson, a portion of the wastewater travel time can exceed 24 hours. Over such long distances most of the oxygen available within the wastewater is depleted along the way. In turn, any sulfates present are reduced to sulfides, and hydrogen sulfide is generated.

The Department owns and operates chemical dosing units (CDUs) and one biofilter within the conveyance system to minimize the generation and emission of hydrogen sulfide gas. With continuing metro area in-fill development and growth in the Non-Metro areas the number of odor complaints is likely to increase unless additional efforts are taken to mitigate this issue across the system. Therefore, a

comprehensive, system-wide evaluation of the conveyance systems and treatment facilities to review the odor control strategies/efforts, industry technologies available for the control of odors, and development and generation of a comprehensive overall strategy for odor was commissioned by PCRWRD.

The odor control and abatement recommendations will provide for an integrated system-wide odor abatement strategy. Instead of focusing on the sewage conveyance system or on the treatment plant, odor control for the entire system will operate as a single unit process. In other words, the recommendations will ensure that odor control for the sewage conveyance system will work in concert with those used for the treatment facilities. Additionally, recommendations for odor control within the conveyance system will not adversely impact treatment operations. The recommendations for the conveyance system and treatment plants are included within the recommendations for the regional optimization master plan.

ADEQ Letter of Intent

The AZPDES operating permits for the Roger Road WRF and Ina Road WRF require the facilities to comply with ammonia removal standards by January 30, 2015 and January 30, 2014, respectively. The ammonia removal requirements are the impetus for the master planning process. In January 2007 PCRWRD submitted letters to ADEQ describing its intention to meet the proposed permit requirements for ammonia and total nitrogen at Roger Road WRF and Ina Road WRF. Using the information and data developed from the master plan studies and investigations, the correspondence identified the capacity and probable treatment approach at each site. .

1.4 Capital Improvement Plan Development

All of the Department's capital costs, including project costs recommended from this master plan, are evaluated in a 15-year CIP. Funding sources were identified as part of a Baseline Financing Plan that used traditional public financing vehicles including revenue bonds, connection charges, and revenue financed capital. A projection of operating and maintenance costs was developed that considered the effects of inflation, increased operating costs, increased demand, and the operational impact of the Department's CIP. Total revenue requirements, both operating and capital, were projected over the forecast period to assess the potential impacts on user rates and charges.

Capital Improvement Plan

From the master plan recommendations for wastewater facilities throughout the Pima County, project elements are identified for the capital improvement plan. The basic elements of the program are:

- Ina Road WRF rehabilitation/modifications/upgrades
- A new water reclamation campus
- Plant interconnect pipeline
- Support facilities
- Conveyance system augmentation
- Non-Metro area treatment facilities

Each of the elements is divided into multiple sub-elements that comprise the whole program. Capital costs on a sub-element basis are escalated to correlate with the schedule of design and construction. Each sub-element consists of costs for administration, engineering design, phased construction and startup.