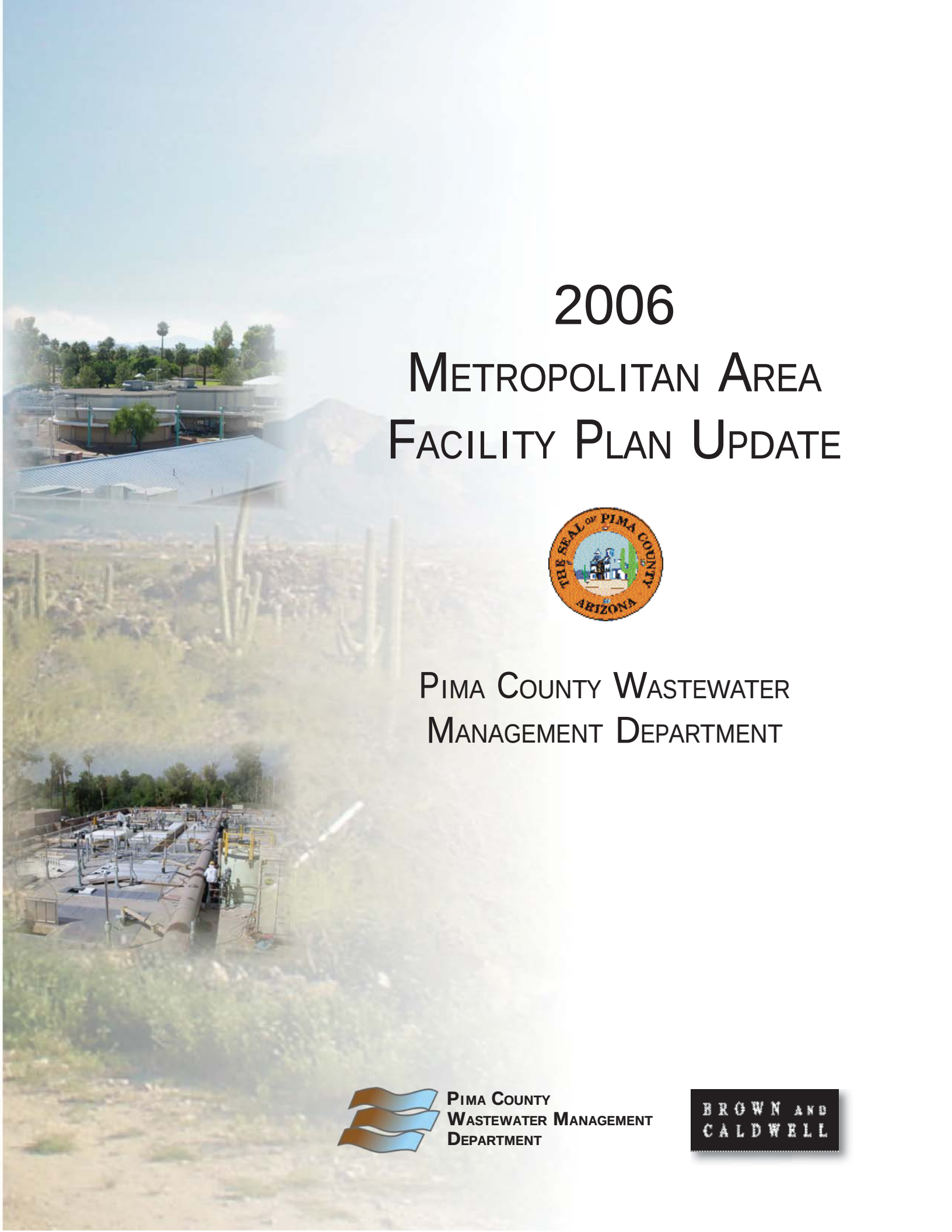

2006 Metropolitan Area Facility Plan Update

Pima County Wastewater Management Department

Pima County Wastewater Management Department

Brown and Caldwell

Foreword

The Draft Pima County Metropolitan Area Facility Plan Update was initially published in May 2005. The Facility Plan documents the long-range facility planning process for Pima County Wastewater Management Department (PCWMD) which establishes the capital improvement needs for the next 20 years based on the regulatory, expansion and rehabilitation requirements of the Metropolitan Area Facilities. This final draft is called the 2006 Pima County Metropolitan Area Facility Plan Update (Facility Plan).

Presentations and Comments

After publication of the draft Metropolitan Area Facility Plan Update, PCWMD staff initiated a comprehensive outreach program to present the contents and findings of the Facility Plan to all Pima County jurisdictions and other major stakeholders receiving sewer service from the Department. Presentations were made to:

- City of South Tucson.
- City of Tucson Department of Urban Planning and Design.
- City of Tucson Rio Nuevo Project.
- Coalition for Sonoran Desert Protection.
- Cortaro/Marana Irrigation District.
- Flowing Wells Irrigation District.
- Marana Water Utility.
- Metropolitan Domestic Water Improvement District.
- Oro Valley Water Utility.
- PAG Environmental Planning Advisory Committee.
- PAG Watershed Planning.
- Pima County Public Works Department Heads.
- Southern Arizona Home Builders Association (SAHBA).
- Town of Marana.
- Town of Sahuarita.
- Tucson Audubon Society.
- Tucson Regional Economic Organization (TREO).
- Tucson Water.

PCWMD requested comments and suggestions for improvements to the Facility Plan from all interested parties. The Department received comments both during the presentations and afterward. Most significant in this process were comments about:

- The Facility Plan's relationship to the other regional water and water quality plans being developed at the same time such as the Revised Pima County Association of Governments (PAG) 208 Plan and the City of Tucson's *Water Plan: 2000 - 2050*.
- The relationship of the population and flow data assumptions in the Facility Plan Update with those in the Revised PAG 208 Plan and Tucson's *Water Plan: 2000 - 2050*.
- The discussion of effluent in Chapter Six.
- Future plans for wastewater conveyance and treatment capacity in the HAMP and Southlands area.

The PCWMD followed up on these comments with a combination of joint work sessions and discussions with interested parties to produce the responses outlined in the following sections.

Comments on the Facility Plan's Relationship to the Revised PAG 208 Plan and Tucson's Water Plan: 2000 - 2050

PAG is currently completing a multi-year process to update and consolidate in one document the original 1978 PAG 208 and the subsequent 26 Amendments, Updates and related Regional Council actions. This update is supported by the involvement of PCWMD staff. The City of Tucson Water Department has developed Tucson's *Water Plan: 2000 - 2050*; and has embarked on a multi-year advanced planning process to use the water Plan to educate the community on the choices and issues which lie ahead for Tucson Water and its customers. These issues and choices include the alternative water sources available and the treatment and distribution issues associated with those sources. Comments were made on the need for some relationship and coordination with this entire advance planning for water resources, area-wide water quality planning and future wastewater infrastructure.

PCWMD's Response

- Scheduled presentations and small working group sessions with both PAG and Tucson Water on these planning efforts, which resulted in better mutual understanding of water/wastewater planning processes and specific issues/constraints for each agency.
- Exchanged comments and suggestions for changes in these Plans with PAG and Tucson Water staff and arranged with PAG and Tucson Water for presentations of these plans to the Wastewater Management Advisory Committees.
- Established a joint schedule with PAG for review of final drafts, parallel community outreach efforts and institutional approvals for the Facility Plan and PAG 208 Plan Revision documents Tucson's *Water Plan: 2000 - 2050* is on a much longer review and comment schedule.

In addition, a number of specific comments and suggestions for changes were made which are detailed, along with PCWMD's responses, in the following sections.

Specific Comments on Population and Flow Data Relationships throughout the Plan

Comments were received on the population and flow data in the Facility Plan such as:

- Population and flow projections should be consistent with Tucson's *Water Plan: 2000 - 2050.*
- Plan for a new treatment facility for Houghton Area (HAMP).
- Coordinate Facility Plan Update data with the PAG 208 Plan.
- Provide information on the present and future volume of effluent that more closely matches Tucson's *Water Plan: 2000 - 2050* and the PAG 208 Plan.

PCWMD's Response

- Included PAG and Tucson Water in a three-way reconciliation of population and flow data.
- PAG, Tucson Water and PCWMD have agreed to use the latest TAZ data.
- Established common basis for gallons per capita per day (GPCD), return flow and effluent volume calculations.
- Identified logical sewer basin boundaries for future septic system utilization forecasts.
- Extended the population/flow projection time-span for the Facility Plan to 2030 consistent with the TAZ data sets and Tucson's *Water Plan: 2000 - 2050*.

- Established a memorandum of agreement with Tucson Water so all current (PAG 208 Plan Revision, Tucson's *Water Plan: 2000 - 2050* and the Facility Plan) and future long range water/ wastewater planning will utilize a common population data set and common assumptions.

These changes are reflected in sub-chapters 3.4, 4.2, 5.2, 5.3 and 5.4.

Discussion of Effluent in Chapter 6 of the Facility Plan

Comments were received regarding the discussion of effluent in Chapter 6 such as:

- Lack of agreement with Tucson's *Water Plan: 2000 - 2050*.
- Uncertainty regarding Arizona's Assured Water Supply (AWS) rules.
- Need for clarification on the division of effluent among the Federal Government, Tucson Water, other Metropolitan Area water suppliers, the Conservation Effluent Pool, the Upper Santa Cruz Managed Recharge Project, the Lower Santa Cruz Recharge Project and the allocations set forth in the 1979 IGA and the 2000 Supplemental IGA.
- Reclaimed water delivery clarification.
- Differences in effluent quantity predictions need to be reconciled which is a similar issue raised in other comments.
- Tucson Water's issues with the water policy language throughout the Chapter but specifically on page 6-9.

PCWMD's Response

- Jointly working with Tucson Water staff to reach agreement on the population, portion of the population connected treatment facilities, the per capita generation of sewerage and the resultant quantities of effluent collected in 5 year increments in the period from 2005 to 2030.
- Meeting with Tucson Water's staff and jointly agreeing on the Facility Plan text which references Tucson Water planning issues and the *Water Plan: 2000 - 2050*.
- Meeting with Tucson Water's staff and jointly agreeing on the text referenced to the division of effluent among those entitled to a portion of the effluent.
- Agreeing with Tucson Water's staff on the language describing reclaimed water issues and Tucson Water's plans for reclaimed water utilization.
- Reviewing other language issues and resolving these issues to each party's mutual satisfaction.

These changes are reflected in Chapter 6.

Future Plans for Wastewater Conveyance and Treatment Capacity

In response to comments on the future plans for wastewater conveyance and treatment capacity particularly in the HAMP and Southlands area, the Department has:

PCWMD's Response

- Added a map reference to potential wastewater treatment facility site for the HAMP area.
- Used the updated TAZ population forecasts to revise wastewater flows in the HAMP and Southlands areas.
- Clarified that the Southlands is a device to determine wastewater quantities in the area and that the terminus of the Southlands is a "Collection Point" and not the location of a future Treatment Plant.

- Initiated joint planning with Tucson Water and City of Tucson Planning for water/wastewater infrastructure for HAMP area.

These changes are reflected in sub-chapter sections 5.2, 5.3 and 5.4.

Revised and Updated Narrative

PCWMD also updated several narrative sections of the Facility Plan to account for recent developments and events since the initial publication in May 2005:

- Chapter 3.1 (Regulatory) – updated to reflect the current issues and status of the ADEQ Triennial Review and resolution of the 2002 Speedway Sinkhole Incident and resulting Consent Decree.
- Chapter 7 (Biosolids) – updated to reflect PCWMD's involvement with the National Biosolids Partnership.
- Chapter 8 (CIP) – updated to reflect the revised five-year CIP prepared for the 2006-07 Financial Plan.
- Chapter 9 (Funding) – updated to reflect the revised five-year CIP prepared for the 2006-07 Financial Plan.

Other Department Initiatives in Response to the Plan

PCWMD has developed individual strategy documents for the Avra Valley, Marana and Corona Wastewater Treatment Facilities to define and establish the coordination and funding needed over the next three to five years to maintain and expand treatment capacity to provide service to the rapidly expanding population in these areas. In addition, once the Facility Plan is adopted, the Department will then proceed to an in-depth study of each Outlying Treatment Facility for the same 20 year advance planning period.

In addition, PCWMD's internal response to the Facility Plan projections and findings prompted the implementation of several major studies including a comprehensive look at the nitrification/denitrification (NdN) requirements of the new AZPDES permits for the Ina Road WPCF and the Roger Road WWTP, the rehabilitation needs of the aging Roger Road WWTP and the system-wide detection and prevention of odors from both conveyance and treatment facilities, with a special focus on the long-standing odor issue at the Roger Road WWTP.

2005 Black and Veatch Rate Study

In FY2004/05, PCWMD commissioned Black & Veatch to conduct a comprehensive study of rates and charges and cost of service. In July 2005, the Board of Supervisors approved significant increases in rates and charges to support required basic PCWMD O&M costs, address the increased treatment plant expansion costs, fund 2004 Bond Authorization Projects and initiate a proactive rehabilitation program.

Capital Planning Estimates

The ranges of estimated costs for the 2008 Authorization Bond projects are the best professional judgment of these costs available at this time. The results of the two major studies begun this year, the regionalization and NdN for the major Metropolitan Treatment Facilities and the system-wide Odor Control Evaluation, will significantly impact the cost estimates for these projects. Other project scopes depend upon the determinations made in these studies. As project scoping and cost data are defined, the Proposed 2008 Bond Authorization Program will be adjusted accordingly.

Going Forward

As is noted in the Executive Summary, this Facility Plan Update is envisioned as a "living document." What this means to PCWMD is the creation and maintenance of a continuous forward planning process wherein the facts and assumptions in the Facility Plan are reviewed every two years. This would allow for the preparation of an "update" document which would reflect changes in conditions on the ground and planning assumptions with a projection of how these changes would advance, delay or revise the projects noted in this draft of the Facility Plan.

In Closing

PCWMD wishes to thank all those agencies and individuals who attended our presentations and submitted so many thoughtful, helpful comments about the Facility Plan contents, findings and processes. Your assistance has been gratefully appreciated.

Pima County Wastewater Management Department
February 10, 2006

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4. Local Jurisdictions

- City of Tucson.
- Town of Oro Valley.
- Town of Marana.
- City of South Tucson.
- Town of Sahuarita.

5. Additional Information

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BROWN AND CALDWELL

Metropolitan Area Facility Plan Update

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LIST OF ACRONYMS

A&W	AQUATIC AND WILDLIFE PROTECTED USE
AAC	ARIZONA ADMINISTRATIVE CODE
ABF	ACTIVATED BIOFILTER
ABS	ACRYLONITRILE BUTADIENE STYRENE
ACOE	ARMY CORPS OF ENGINEERS
ACP	ASBESTOS CONCRETE PIPE
ACSC	AVIATION CORRIDOR TO SANTA CRUZ INTERCEPTOR
ACSE	AVIATION CORRIDOR TO SOUTHEAST INTERCEPTOR
ADEQ	ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY
ADF	AVERAGE DAILY FLOW
ADHS	ARIZONA DEPARTMENT OF HEALTH SERVICES
ADOT	ARIZONA DEPARTMENT OF TRANSPORTATION
ADWF	AVERAGE DRY WEATHER FLOW
ADWR	ARIZONA DEPARTMENT OF WATER RESOURCES
AF	ACRE FEET
AGI	AGRICULTURAL IRRIGATION PROTECTED USE
AGL	AGRICULTURAL LIVESTOCK WATERING PROTECTED USE
AMA	ACTIVE MANAGEMENT AREA
AMSA	ASSOCIATION OF METROPOLITAN SEWERAGE AGENCIES
APO	ADMINISTRATIVE PENALTY ORDERS
APP	AQUIFER PROTECTION PERMIT
AS	ARSENIC
AWWQRP	ARID WEST WATER QUALITY RESEARCH PROJECT
AWS	ASSURED WATER SUPPLIER
AZPDES	ARIZONA POLLUTANT DISCHARGE ELIMINATION SYSTEM
BADCT	BEST AVAILABLE DEMONSTRATED CONTROL TECHNOLOGY
BF/AS	BIOFILTER/ACTIVATED SLUDGE
BF/SC	BIOFILTER/SOLIDS CONTACT PROCESS
BER	BIOSOLIDS ENRICHMENT AND RECYCLING
BLM	BUREAU OF LAND MANAGEMENT (US DEPARTMENT OF INTERIOR)
BMPs	BEST MANAGEMENT PRACTICES
BNR	BIOLOGICAL NUTRIENT REMOVAL
BNRAS	BIOLOGICAL NUTRIENT REMOVAL ACTIVATED SLUDGE
BNROD	BIOLOGICAL NUTRIENT REMOVAL OXIDATION DITCH
BOD	BIOCHEMICAL OXYGEN DEMAND

LIST OF ACRONYMS (CONTINUED)

BTU/lb	BRITISH THERMAL UNIT/POUND
CAP	CENTRAL ARIZONA PROJECT
CCTV	CLOSED CIRCUIT TELEVISION
CDO	CANADA DEL ORO
CEC	CATION EXCHANGE CAPACITY
CEP	CONSERVATION EFFLUENT POOL
CERCLA	COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION AND LIABILITY ACT
CFM	CUBIC FEET PER MINUTE
CFR	CODE OF FEDERAL REGULATIONS
CG-85	CONSTRUCTION GRANTS 1985
CIP	CAPITAL IMPROVEMENT PROGRAM
CIPP	CURED IN PLACE PIPE
CMID	CORTARO-MARANA IRRIGATION DISTRICT
CMMS	COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM
CMOM	CAPACITY, MANAGEMENT, OPERATIONS AND MAINTENANCE
CRWWPS	CONTINENTAL RANCH WASTEWATER PUMP STATION
CWA	CLEAN WATER ACT
DAF	DISSOLVED AIR FLOTATION
DI	DUCTILE IRON
DIP	DUCTILE IRON PIPE
DMA	DESIGNATED MANAGEMENT AGENCY
DPA	DESIGNATED PLANNING AGENCY
EDW	EFFLUENT DEPENDANT WATER
EIS	ENVIRONMENTAL IMPACT STATEMENT
ENR	ENGINEERING NEWS RECORD
EPA	U.S. ENVIRONMENTAL PROTECTION AGENCY
EQA	ENVIRONMENTAL QUALITY ACT
ER	EMERGENCY RESPONSE
ESA	ENDANGERED SPECIES ACT
FBC	FULL BODY CONTACT PROTECTED USE
FEP	FACULATIVE/EVAPORATION PONDS
FOIA	FREEDOM OF INFORMATION ACT
FPS	FEET PER SECOND

LIST OF ACRONYMS (CONTINUED)

GAO	GENERAL ACCOUNTING OFFICE
GASB	GENERAL ACCOUNTING STANDARDS BOARD
GIS	GEOGRAPHIC INFORMATION SYSTEM
GPCD	GALLONS PER CAPITA PER DAY
GPD	GALLONS PER DAY
GPM	GALLONS PER MINUTE
GPM/SF	GALLONS PER MINUTE PER SQUARE FOOT
HAMP	HOUGHTON AREA MASTER PLAN
HDPE	HIGH DENSITY POLYETHYLENE
hP	HORSEPOWER
HPO	HIGH PURITY OXYGEN
HPI	HARRISON-PANTANO INTERCEPTOR
HUC	HYDROLOGIC UNIT CODE
IGA	INTERGOVERNMENTAL AGREEMENT
IHC	INCIDENTAL HUMAN CONTACT PROTECTED USE
IWC	INDUSTRIAL WASTEWATER CONTROL
KERP	KINO ENVIRONMENTAL RESTORATION PROJECT
LSCMRP	LOWER SANTA CRUZ MANAGED RECHARGE PROJECT
MADF	MAXIMUM AVERAGE DAILY FLOW
MBR	MEMBRANE BIOREACTOR
MBBR	MOVING BED BIOREACTOR
MBTA	MIGRATORY BIRD TREATY ACT
MCL	MAXIMUM CONTAMINANT LEVEL
MGD	MILLION GALLONS PER DAY
MG/L	MILLIGRAMS PER LITER
MLE	MODIFIED-LUDZACK ETTINGER
MLR	MIXED LIQUOR RECYCLE
MSGP	MULTI-SECTOR GENERAL PERMIT
MSL	MEAN SEA LEVEL
NAAQS	NATIONAL AMBIENT AIR QUALITY STANDARDS
NASSCO	NATIONAL ASSOCIATION OF SEWER SERVICE COMPANIES
NdeN	NITRIFICATION/DENITRIFICATION
NEPA	NATIONAL ENVIRONMENTAL POLICY ACT

LIST OF ACRONYMS (CONTINUED)

NPDES	NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
NPPO	NATIVE PLANT PROTECTION ORDINANCE
NRI	NORTH RILLITO INTERCEPTOR
NTU	NEPHELOMETRIC TURBIDITY UNITS
NWI	NORTHWEST INTERCEPTOR
NWO	NORTHWEST OUTFALL
O&M	OPERATION AND MAINTENANCE
ONH	OLD NOGALES HIGHWAY
OSHA	OCCUPATIONAL SAFETY AND HEALTH ACT
PAG	PIMA ASSOCIATION OF GOVERNMENTS
PCFCD	PIMA COUNTY FLOOD CONTROL DISTRICT
PCWMD	PIMA COUNTY WASTEWATER MANAGEMENT DEPARTMENT
PDWF	PEAK DRY WEATHER FLOW
PF	PEAKING FACTOR
PHF	PEAK HOURLY FLOW
PSA	PRESSURE SWING ADSORPTION SYSTEM
PSI	POUNDS PER SQUARE INCH
PTI	PANTANO INTERCEPTOR
PVC	POLYVINYL CHLORIDE
PWWF	PEAK WET WEATHER FLOW
RAS	RETURN ACTIVATED SLUDGE
RBC	ROTATING BIOLOGICAL CONTRACTOR
RCP	REINFORCED CONCRETE PIPE
RCRA	RESOURCE CONSERVATION AND RECOVERY ACT
SARA	SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT
SAWRSA	SOUTHERN ARIZONA WATER RIGHTS SETTLEMENT ACT
SCADA	SUPERVISORY CONTROL AND DATA ACQUISITION
SCC	SANTA CRUZ-CENTRAL INTERCEPTOR
SCE	SANTA CRUZ-EAST INTERCEPTOR
SCI	SANTA CRUZ INTERCEPTOR
SDF	SYSTEM DEVELOPMENT FUND
SDWA	SAFE DRINKING WATER ACT
SEI	SOUTHEAST INTERCEPTOR

LIST OF ACRONYMS (CONTINUED)

SRC	SOUTH RILLITO INTERCEPTOR-CENTRAL
SRF	STATE REVOLVING FUND
SRI	SOUTH RILLITO INTERCEPTOR
SRWC	SOUTH RILLITO INTERCEPTOR-WEST, CENTRAL LINE
SRWN	SOUTH RILLITO INTERCEPTOR-WEST, NORTH LINE
SRWS	SOUTH RILLITO INTERCEPTOR-WEST, SOUTH LINE
SSO	SANITARY SEWER OVERFLOW
SSIIP	SANITARY SEWER INSPECTION AND INVENTORY PROJECT
SWI	SOUTHWEST INTERCEPTOR
TAZ	TRAFFIC ANALYSIS ZONES
TBFMS	TUCSON BOULEVARD FLOW MANAGEMENT STRUCTURE
TDS	TOTAL DISSOLVED SOLIDS
TEP	TUCSON ELECTRIC POWER COMPANY
TMDL	TOTAL MAXIMUM DAILY LOADS
TPD	TONS PER DAY
TSCA	TOXIC SUBSTANCES CONTROL ACT
TSP	TOTAL SUSPENDED PARTICLES
TSS	TOTAL SUSPENDED SOLIDS
TVI	TANQUE VERDE INTERCEPTOR
TWAS	THICKENED WASTE ACTIVATED SLUDGE
USCMRP	UPPER SANTA CRUZ MANAGED RECHARGE PROJECT
VCP	VITRIFIED CLAY PIPE
VFD	VARIABLE FREQUENCY DRIVE
WAS	WASTE ACTIVATED SLUDGE
WET	WHOLE EFFLUENT TOXICITY
WIFA	WASTEWATER INFRASTRUCTURE PROJECTS
WMAC	WASTEWATER MANAGEMENT ADVISORY COMMITTEE
WPCF	WATER POLLUTION CONTROL FACILITY
WRF	WATER RECLAMATION FACILITY
WWPS	WASTEWATER PUMP STATION
WWTF	WASTEWATER TREATMENT FACILITY
WWTP	WASTEWATER TREATMENT PLANT

Executive Summary

The 2006 Pima County Metropolitan Area Facility Plan Update (Facility Plan) is Pima County Wastewater Management Department's (PCWMD) guide for continued development of the metropolitan area of the regional wastewater system. The Facility Plan evaluates the metropolitan area wastewater management needs for the 20-year planning period from 2006 to the year 2026 and recommends capital improvements to the interceptor sewer system and the three metropolitan treatment plants in order to meet these projected needs. The most recent Facility Plan for this area is the Metropolitan Area 201 Facility Plan Update prepared in June 1990, which covered the period from 1990 to 2010. Due to the rapid population growth and wastewater demand over the first decade of this period, PCWMD determined a Facility Plan Update was necessary earlier than originally scheduled.

PCWMD owns and operates a regional wastewater collection, conveyance, and treatment system serving Eastern Pima County as shown in Figure ES.1. The regional system consists of over 3,300 miles of sewer lines (of which 230 miles are major trunk lines or interceptors), 34 conveyance system lift stations, two major wastewater treatment facilities, a water reclamation facility, and eight smaller outlying treatment facilities. In order to protect the public health and meet its customers' short and long-term needs for wastewater collection, conveyance, treatment, and disposal, PCWMD has an ongoing program of wastewater facility planning and capital construction for the regional system. The Metropolitan Wastewater Planning Area (Planning Area) is the portion of the system tributary to the Metropolitan Treatment Facilities and will be the focus of this Facility Plan. However, brief descriptions and discussions of the Outlying Treatment Facilities are included for regional context. This executive summary briefly presents the major findings, conclusions, and recommendations of the Facility Plan.

PLAN GOALS

The Facility Plan goals are discussed in Chapter 1. The ultimate goal is to effectively serve the health and welfare of residents of Pima County and maintain this valuable asset which has been created over the years by the citizens of Pima County. The planning effort was designed to answer these questions:

- **How will growth affect the system?** Significant population growth is anticipated in the metropolitan area over the next 25 years. However, the amount, distribution and timing of growth within the metropolitan area will affect the extension of the collection system, the location of new treatment facilities, and improvements to existing treatment plants.
- **How will future regulatory changes impact the effluent quality requirements and the operations and maintenance of the treatment and conveyance systems?** Federal and State regulations and facilities permits are constantly changing and evolving based on local conditions and national/regional initiatives. The Facility Plan discusses these anticipated changes and the potential impacts on the conveyance and treatment operations of the Metropolitan Area system.

BROWN AND CALDWELL

- **How can the treatment and conveyance system be continuously rehabilitated?** As wastewater treatment and conveyance infrastructure across the nation has begun to age, the asset management concept has been a primary driver at many wastewater agencies to develop a systematic approach to identifying and rehabilitating the physical facilities. As part of this report, extensive condition assessments were conducted at the major treatment facilities. These evaluations, together with assessments of the conveyance systems, identify treatment and conveyance rehabilitation needs for the next twenty years. In addition, State and Federal regulations will place higher demands on inspection, maintenance and replacement/rehabilitation of the conveyance system as a means of reducing Sanitary Sewer Overflows (SSOs) and odors, while preserving the value and functionality of the assets. Immediate and long-term rehabilitation programs for both conveyance and treatment facilities are included in the Plan.
- **How will the growth, regulatory and rehabilitation requirements be funded?** The financing of wastewater projects can no longer rely on Federal grants to meet a portion of their funding requirements. The use of voter-approved funds for capital projects is very critical in making system improvements in a timely and cost-effective manner. Additionally, user and connection fees must reflect the total costs of operation and expansion of the system, respectively.

In summary, this Facility Plan is organized to describe the wastewater system in Pima County, to forecast growth within the Planning Area, to identify the regulatory and institutional drivers that impact the collection, treatment and disposal of effluent and biosolids, to describe the current status and proposed future of the conveyance and treatment systems, and to identify the proposed long-range Capital Improvement Program (CIP) for the metropolitan area over the 20-year planning period and funding source. The long-range CIP projects include treatment plant expansions/rehabilitations, major conveyance system improvements, and related activities. Based on the long-range CIP in the Facility Plan, PCWMD staff annually revises and publishes a 5-Year CIP, which identifies immediate capital improvement needs, associated costs, and schedules for implementation. Additionally, the Facility Plan is utilized with PCWMD's Annual Financial Plans.

PLANNING AREA

The Facility Plan focuses on the Metropolitan Area of Eastern Pima County. The Planning Area is described in Chapter 2 and is defined for this Facility Plan as the sewer system tributary to Ina Road Water Pollution Control Facility (WPCF), Roger Road Wastewater Treatment Plant (WWTP) and the Randolph Park Water Reclamation Facility (WRF). Chapter 2 includes discussion of the physical and environmental characteristics of the Planning Area as they relate to the conveyance and treatment of wastewater.

Located in Eastern Pima County, the Planning Area is constrained by mountains on most sides. Surface runoff generally flows northward and westward through the basin. The Santa Cruz River is the major surface drainage channel in the Planning Area and flows northward to the Planning Area's western boundary. The two major treatment plants, Roger Road WWTP and Ina Road WPCF, are located in low-lying areas on the western edge of the basin. The effluent from these two treatment facilities is:

- Discharged to the Santa Cruz River.
- Reused through PCWMD and the City of Tucson Reclaimed Water Systems.
- Recharged to the aquifer.

Area soils, outside of stream channels, have, at best, moderate infiltration rates. The effects of the infiltration characteristics are low natural groundwater recharge rates and relatively high volumes

of surface runoff. There may be other areas in Planning Area that may prove highly conductive for recharge using surface spreading methodologies, dependent on local site conditions. The infiltration rates in the area impact land requirements for effluent to recharge groundwater.

Conducting detailed archaeological surveys of proposed conveyance system routes or new wastewater treatment plants prior to construction will aid in the preservation of archaeological resources.

PROJECT DRIVERS

Chapter 3 discusses the four primary external drivers impacting the Facility Plan. They include: regulatory drivers, institutional drivers, asset management, and population effects. PCWMD recognizes these drivers have a significant individual and grouped influence on the direction of planning for the future.

Regulatory Drivers

Major regulatory areas impacting Facility Plan are Federal, State and local regulatory programs for water quality including surface water discharges, groundwater discharges, and reuse activities; Federal and State regulatory programs for biosolids production and disposal; and Federal, State and local regulatory programs for air quality regulations.

All these regulatory program mandates, as well as specific facility permits issued under these programs, impact the future regulatory requirements of the metropolitan wastewater system. These potential impacts include: ammonia and total nitrogen removal requirements at the treatment plants, future regulations for effluent-dependent waters, Capacity Management and Operations Maintenance (CMOM) regulations for the conveyance system, and biosolids regulations. Thus, regulatory requirements will be significant drivers for new CIP projects and CIP implementation schedules.

Asset Management

Pima County has an ongoing asset management program. Asset management is gaining importance in effective management of wastewater facilities as new CMOM regulations are being formulated at the State and Federal levels. With the adoption of General Accounting Standards Board (GASB) 34, wastewater utilities have to follow mandatory financial standards when reporting on the financial health of an agency. PCWMD maintains and preserves its wastewater assets through scheduled maintenance, replacement and/or rehabilitation projects.

Institutional Drivers

Pima County has many institutional constraints, including: Statutory Authority, Intergovernmental Agreements (IGAs), Bonding and Covenants, and Litigation and Settlements. As authorized by the Arizona Legislature, Pima County owns and operates a sewer system. Pima County, as the designated management agency (DMA) by the Pima Association of Governments (PAG), has adopted wastewater ordinances and entered into IGAs with the local jurisdictions in support of the 208 Plan mandate to provide for the regionalization of wastewater services in Pima County. Under the 1979 IGA with the City of Tucson, Pima County retains 10 percent of the effluent from its treatment facilities and 90 percent is owned by the City of Tucson. The total effluent available from the treatment plants to the City and County is subjected to settlements with the Federal government. The City's share is further divided among other local water providers. Details of these divisions are found in Chapter 6. This agreement also requires Pima County to maintain the effluent quality in accordance with the Federal National Pollutant Discharge Elimination System (NPDES) and the State of Arizona Pollutant Discharge Elimination System (AZPDES) discharge standards.

In addition, PCWMD operates as an enterprise fund to devote all its revenues to the operation, maintenance, rehabilitation/replacement and expansion of the regional wastewater system. PCWMD charges new users for connecting to the system and collects sewer fees from users. PCWMD has secured funding for large projects both through selling bonds and obtaining public infrastructure loans. As a result, PCWMD is required to maintain its operations in compliance with covenants to the bond purchasers and the public financing authorities.

In summary, PCWMD operates within the institutional framework established by PAG, by way of the DMA designation and 208 Plans, as well as the State enabling legislation, including the bonding authorization, and IGAs with local jurisdictions.

Population Effects

The population in the Planning Area is growing at a rate of 2.2 percent per year. This Facility Plan uses population forecasts developed by PAG to predict growth. Officially adopted PAG population projections for Pima County were utilized for developing Planning Area population and wastewater flow projections. The Facility Plan Model, a GIS and Excel spreadsheet model, was developed as part of this Facility Plan to predict future population trends and their effects upon PCWMD's conveyance and treatment systems. The Planning Area population is projected to grow by about 11 percent between 2005 and 2010, 10 percent between 2010 and 2015, 9 percent between 2015 and 2020, 8 percent between 2020 and 2025, and 8 percent between 2025 and 2030. A summary of the Planning Area's population in 5-year increments from 2005 through 2030 is presented in Table ES.1. The Pima County population is expected to grow from 916,026 in 2005 to 1,496,045 in 2030. This equates to wastewater collection and treatment

Table ES.1 Planning Area Population Projections

Year	PAG Eastern[3] Pima County Population	Total[1] Population in PCWMD Sewer Basins	Roger Road WWTP Sewer Basin Population	Ina Road WPCF Sewer Basin Population	Total[2] Population in the Outlying Sewer Basin
2000		767,855	489,399	243,238	35,218
2005	916,026	837,571	520,536	256,164	60,871
2010	1,023,332	928,849	563,158	269,565	96,125
2015	1,141,690	1,031,142	607,065	283,032	141,046
2020	1,259,689	1,133,129	650,791	296,398	185,940
2025	1,378,155	1,235,513	694,750	309,895	230,868
2030	1,496,045	1,337,400	738,416	323,233	275,750

1. Roger Road, Ina Road, Avra Valley and Marana Treatment Plants and Southlands Area.
2. Avra Valley and Maran Treatment Plants and Southlands Area
3. PAG Data - November 22, 2005 (for Pima County)

improvements to handle a total of 85.05 MGD Average Daily Weather Flow (ADWF) in 2030. Based on the PCWMD (for Pima County) planning criteria of 85 gallons per capita per day, the wastewater conveyance and treatment facilities will need to handle an additional 1 MGD ADWF for every 11,765 new residents served. The flow projections from Chapter 3 are compared to PCWMD's treatment and conveyance system capacity in Chapters 4 and 5. These comparisons allow effective management of the wastewater flow and planning for the conveyance and treatment system improvements based on capacity requirements needed to address planned growth.

CONVEYANCE SYSTEM

Chapter 4 focuses on PCWMD's conveyance system, including sewer lines, manholes, diversion structures and lift stations. These systems service the Pima County Metropolitan Area and the outlying facilities. Portions of the system date back to 1900 and include nine different pipe materials. The Drivers, discussed in Chapter 3, with the biggest impact on the conveyance system are asset management, regulatory requirements and population effects. The asset management driver relates to rehabilitation and replacement projects to maintain the integrity of the system. The regulatory driver for conveyance relates to the CMOM requirements. The population growth in the Planning Area dictates the capacity expansion needs. The institutional framework driver has negligible impact on the future conveyance system.

In 2003, PCWMD commissioned a conveyance condition assessment as part of its on-going asset management program to evaluate 230 miles of trunk and interceptor sewers 15 inches or greater in diameter. This assessment was performed utilizing the National Association of Sewer Service Companies (NASSCO) condition codes ranging from "excellent" (Class 1) to "immediate attention required" (Class 5). The resulting list of prioritized rehabilitations and replacements derived from this condition assessment are summarized in Chapter 4 Conveyance and in Chapter 8 CIP.

The major area of concern is the unlined reinforced concrete pipe. While only constituting 2 percent of the entire conveyance system, this pipe material is prone to failure in arid conditions with long wastewater travel times in the sewers. Hydrogen sulfide gas is released and causes significant corrosion of the concrete ranging from three to five inches within the pipeline. Segments of the conveyance system were rated as "poor" (Class 4) or "immediate attention required" (Class 5). The portions of the conveyance system with these ratings include Aviation Corridor, Canyon del Oro, Old Nogales Highway, Pantano, Santa Cruz, South East, South Rillito, Southwest and the Tanque Verde Interceptors. Those segments rated Class 5 have been, or are being, immediately repaired as they are identified. Class 4 segments are scheduled to be rehabilitated with the $15 million 2004 Bond Project for Conveyance System Rehabilitation or with System Development Funds as needed. All other segments were rated at a "fair" or "good" condition and recommended for re-evaluation on an ongoing basis. Additional rehabilitation/replacement needs for the conveyance system include 1,500 manholes, several siphon boxes, and many of the lift station wet-wells.

In addition, future conditions were analyzed based on the population effects driver. The capacity limitations involving the metropolitan area conveyance system's large diameter pipe (greater than 15 inches in diameter) identified by the Facility Plan Model are surprisingly few. Most growth is currently in the areas on the edges of the metropolitan area, in areas served by the (satellite) Outlying Treatment Facilities or basins on the extreme upstream reaches of the Metropolitan Conveyance System. The conveyance systems in the outlying areas were not initially included in this Facility Plan scope of work; however, a brief description and discussion of current and future conditions is included for context with the metropolitan area system.

Conveyance System Recommendations

- CCTV and condition assessment for over 3,100 miles of sewer lines on an on-going basis
- Develop comprehensive CMOM program, including an asset management program
- Rehabilitate 1,500 manholes
- Rehabilitate portions of the collection system with Grade 4 "Poor" and higher
- Perform engineering studies on interceptors identified by the model as having potential capacity issues

The Facility Plan Model identifies two classes of capacity problems, Red and Orange, as shown in Figure ES.3 and ES.4. The Orange classification identifies sections of the interceptor that may have a capacity problem and suggests an engineering study be commissioned to determine the severity of the problem. A Red classification indicates the sewer is forecasted to be flowing at higher than 85 percent of its capacity and corrective action should be instituted immediately. Only a few Red or Orange conditions were found for the 2005-2010 period. Those segments will be upgraded through the $25 million 2004 Bond Authorization Project for the construction of the Santa Cruz Interceptor: Prince to Franklin. The early identification of potential capacity problems for the years 2010 and beyond will allow PCWMD to institute corrective actions on a priority basis.

TREATMENT SYSTEMS

The Metropolitan Tucson Planning Area is defined for the Facility Plan as the sewer system that is tributary to the metropolitan area facilities. However, since PCWMD treats wastewater flows at three facilities in the Metropolitan Area and at eight smaller facilities in outlying communities within Pima County, the Facility Plan includes a brief description and discussion of the eight outlying treatment facilities for context with the metropolitan area. Chapter 5 is divided into current and future conditions for the Metropolitan Area Treatment Facilities, current and future conditions for the Outlying Treatment Facilities and Treatment Modeling.

Metropolitan Area Treatment Facilities – Current Conditions

The Metropolitan Tucson wastewater treatment facilities are the Roger Road WWTP, the Ina Road WPCF and the Randolph Park WRF. The Roger Road WWTP is a trickling filter and activated sludge facility with a capacity of 41 MGD average dry weather flow (ADWF). Ina Road WPCF is a 25 MGD high purity oxygen activated sludge system and a new 12.5 MGD biological nutrient removal activated sludge facility capable of nitrification/denitrification. The Randolph Park WRF is a 3 MGD Membrane Bioreactor facility capable of producing denitrified Class A reuse water for discharge into the Tucson Water Reclaimed Water System.

Condition assessments were performed at the Roger Road WWTP and Ina Road WPCF to identify deficiencies. The Roger Road WWTP, because it is the older facility, had the most deficiencies identified for improvement. Corrections to the existing Ina Road WPCF were less significant.

Metropolitan Area Treatment Facilities – Future Conditions

Capacity expansion of any of the Metropolitan Area Treatment Facilities is not anticipated until the later stages of the planning period. Population growth is projected to be the greatest in the Roger Road WWTP Tributary Area; therefore, addressing the treatment concerns in this area is a high priority. To achieve this, the Plant Interconnect project, funded in the 2004 Bond Authorization Project, will allow increased flows to the Roger Road WWTP to be transported and treated at the Ina Road WPCF. This is demonstrated by the “Managed Flows” in Table ES.2 which depicts wastewater flow balancing between the metropolitan area wastewater treatment facilities.

Nitrification/denitrification of the original 25 MGD Ina Road WPCF is a significant project in this planning period and will need to be followed by nitrification/denitrification at the Roger Road WWTP during the same period.

A wastewater treatment/water reclamation facility in southeastern Tucson is also identified and anticipated sometime between 2010 and 2020. Until adequate wastewater flow is available in the area, initial flows will be transported through the Pantano and/or Southeast Interceptors.

Table ES.2 Managed Flows

Wastewater Managed Flows to the Roger and Ina Treatment Plants											
	Roger Road WWTP System						Ina Road WPCF System				
	Roger Rd WWTP Tributary System Total Population on Sewer	Randolph WRP	Plant Interconnect	Tucson Blvd Flow Management to Ina	Total Flow Treated at Roger Road WWTP MGD	Total Home Flow in Roger System MGD	Ina Rd WPCF Tributary System Total Population on Sewer	Plant Interconnect	Tucson Blvd Flow Management from Roger	Total Flow Treated at Ina WPCF MGD	Total Roger and Ina MGD
	(Estimate for 2000)						(Estimate for 2000)				
2000	459,598	0.00	0.00	0.00	42.72[1]	42.72[1]	198,821	0.00	0.00	18.58[1]	61.3[1]
2005	503,037	0.00	0.00	-5.35	39.36	44.71	225,142	0.00	5.35	22.74	62.1
2010	529,568	3.00	0.00	-5.35	38.60	46.95	233,150	0.00	5.35	23.39	65.0
2015	569,202	3.00	-18.66	0.00	28.63	50.29	243,099	18.66	0.00	37.50	69.1
2020	604,536	3.00	-17.85	0.00	32.42	53.27	253,056	17.85	0.00	37.50	72.9
2025	640,506	3.00	-17.07	0.00	36.24	56.31	262,811	17.07	0.00	37.50	76.7
2030	714,919	3.00	-27.67	0.00	32.05	62.72	284,957	27.67	0.00	50.00[2]	85.05

1. Flows taken from plant records for the year 2000.
2. Following the 2026/9 12.5 MGD expansion of Ina Road WPCF to 50 MGD capacity.

Based on evaluation of flows to the metropolitan area treatment facilities, PCWMD currently does not anticipate beginning to plan for treatment expansions at the Ina Road WPCF before 2020. Figures ES.5 and ES.6 graphically depict the metropolitan area treatment system current operations (2005) and future operations (2030), respectively.

PCWMD will consider moving all the biosolids treatment at the two metropolitan facilities to the Ina Road WPCF and evaluating the potential for producing Class A Biosolids treatment. It is anticipated PCWMD will prepare an assessment of the most effective biosolids treatment options for the Ina Road WPCF in conjunction with consolidation of biosolids treatment from the Roger Road WWTP.

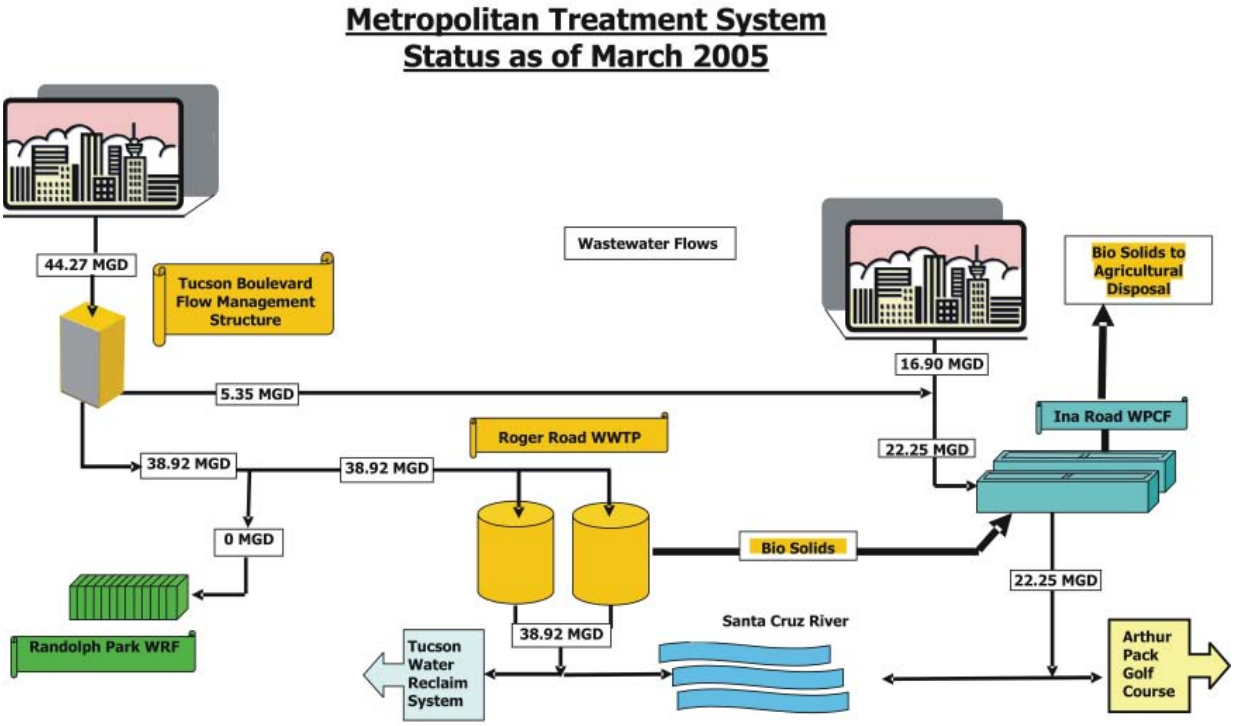
Outlying Treatment Facilities – Current Conditions

The Outlying Treatment Facilities are smaller capacity plants located throughout eastern Pima County. A condition assessment was performed at each of these facilities to determine the short and long-term deficiencies at the Avra Valley, Corona de Tucson, Fairgrounds, Green Valley, Marana, Rillito Vista, Arivaca Junction and Mount Lemmon WWTFs.

Outlying Treatment Facilities – Future Conditions

Population is the critical driver for improvements at the eight Outlying Treatment Facilities. Numerous large residential developments are being proposed throughout the PCWMD service area. This population growth is of greater concern at the smaller capacity treatment facilities, ranging from less than 0.01 MGD to 4.1 MGD, due to the greater capacity impacts from increasing populations. Capacity expansions and upgrades to facilities are recommended to improve capacity and operational performance, especially at the Avra Valley, Corona de Tucson and Marana WWTFs.

Figure ES.5 Metropolitan Treatment System Status as of March 2005



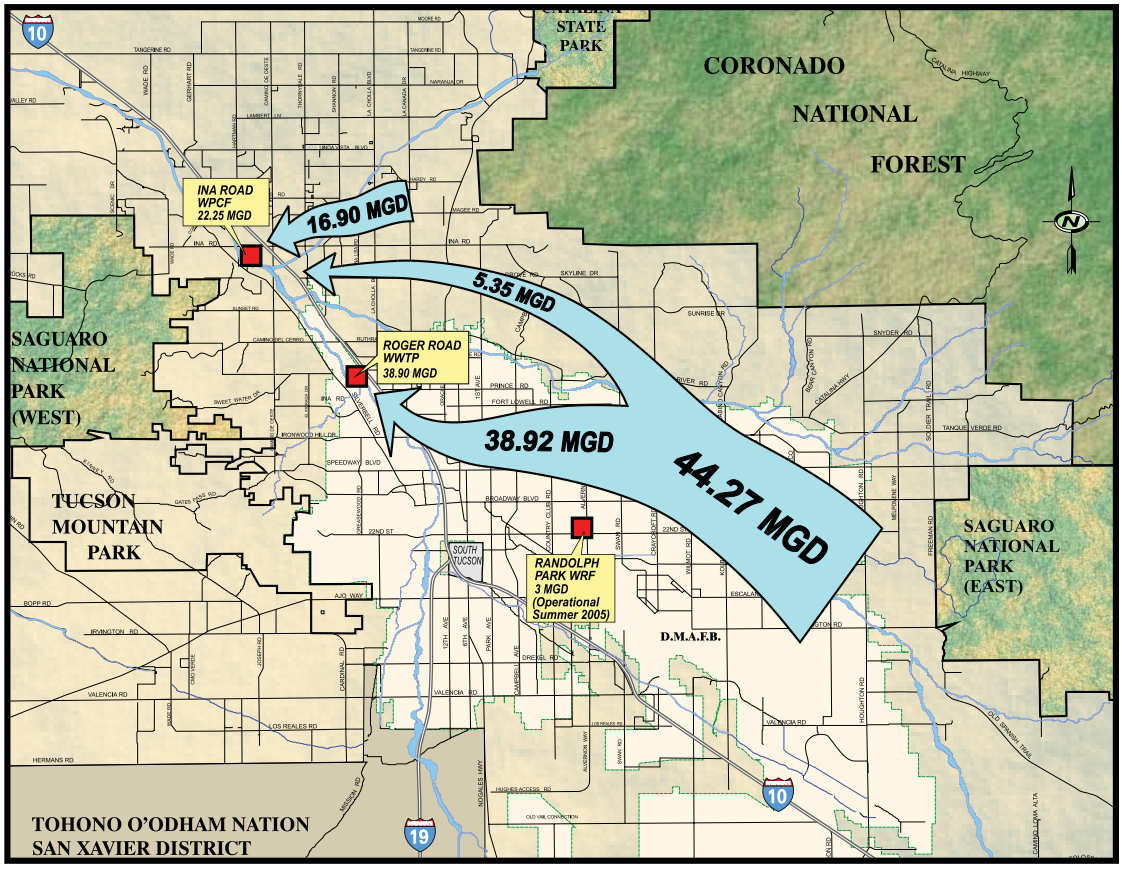
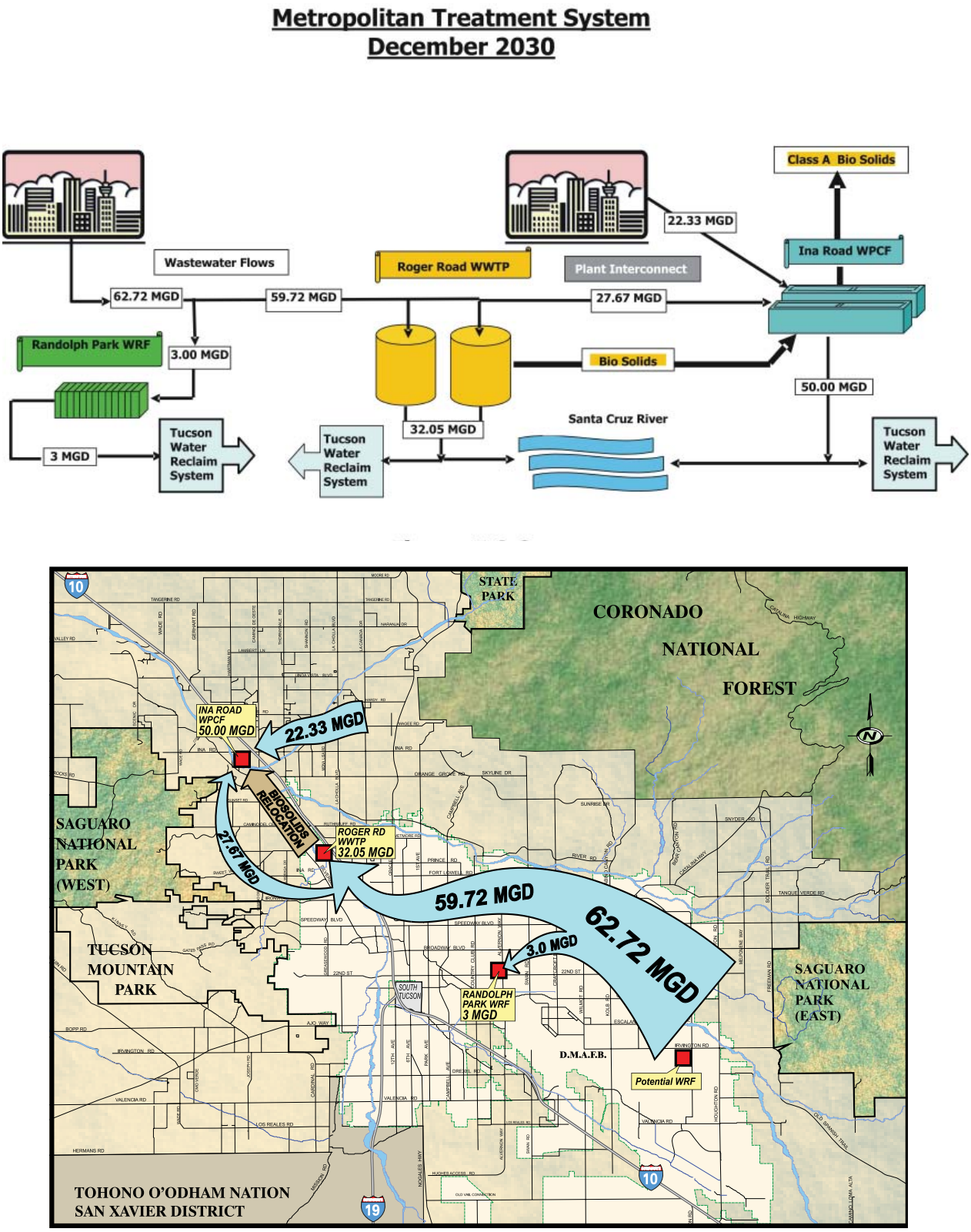


Figure ES.6 Metropolitan Treatment System December 2030



Going forward, PCWMD will review the Pima Association of Governments population forecasts as they are issued. The Facility Plan Model will be updated with this information to assess impacts on the conveyance system and treatment capacity. PCWMD will work closely with the jurisdictions and area developers to anticipate growth for the outlying areas and update the Facility Plan, as necessary, to facilitate the schedule and funding for these capacity expansions.

Treatment Modeling

To evaluate the wastewater treatment processes and potential capacity at the Roger Road WWTP and Ina Road WPCF, PCWMD commissioned a process modeling effort utilizing Hydromantis, Inc. using their GPS-X model. This process model was developed and calibrated to simulate process functioning and facility capacity. It also simulates the treatment capacity under a range of regulatory effluent quality requirements. Seven different capacity scenarios were developed focusing on process modifications at the metropolitan facilities. Each of the scenarios was evaluated against performance indicators and cost-effectiveness of the treatment process modifications. Results of the analysis will be used to guide operational strategies and investigations at the facilities.

Treatment System Recommendations

- Place the new 3 MGD Randolph Park WRF and 12.5 MGD Ina Road WPCF in service in 2005.
- Rehabilitate Ina Road WPCF in accordance with Chapter 5.1 recommendations.
- Construct the Plant Interconnect between Roger Road WWTP and the Ina Road WPCF expeditiously to relieve flow at the Roger Road WWTP.
- Initially transport flow tributary to the Roger Road WWTP for treatment at the expanded Ina Road WPCF.
- Convert the main electrical transformer at the Roger Road WWTP from a Delta to a Wye system.
- Convert the Roger Road WWTP away from plant generated gas to electric driven motors.
- Modify the Roger Road WWTP so half the facility can be taken out of service to facilitate rehabilitation and upgrade.
- Rehabilitate/upgrade the portion of the Roger Road WWTP that is off-line following the Chapter 5.1 recommendations.
- Upgrade the powerhouse to total methane gas turbine generators to utilize gas generated by the Ina Road WPCF.
- Rehabilitate/upgrade of the first half of the Roger Road WWTP and then the remaining half.
- In 2020, begin engineering to expand the Ina Road WPCF to 50 MGD.
- Initiate the 2004 bond project, Ina Road WPCF Denitrification, and determine necessity of additional funds to nitrify/denitrify the 25 MGD HPOAS train.
- Evaluate/implement nitrification/denitrification at the Roger Road WWTP.

EFFLUENT REUSE

Effluent reuse, as discussed in Chapter 6, will play a significant role in water and environmental policies and practices in Pima County during the planning period. As the major producer of effluent in Eastern Pima County, PCWMD will have a major role in these issues. While PCWMD is the major producer of effluent, the 1979 IGA with the City of Tucson dictates that after the allocations in the Southern Arizona Water Rights Settlement Act (SAWRSA), which provides the United States with the first 28,200 acre feet (AF) of effluent, the remaining effluent is then allocated to Tucson Water and PCWMD. In recent years, Tucson Water received 90 percent of the remaining effluent; currently equaling 36,000 AF. PCWMD receives the remaining ten percent, which is currently around 4,000 AF. Tucson Water shares approximately eight percent of its allotment with the Metropolitan Domestic Water Improvement District (Metro Water), and five percent with Oro Valley Water Utility. PCWMD receives the remaining ten percent, which is currently around 4,000 AF. Under the 2000 Supplemental IGA, up to 10,000 AF of effluent is available in a Conservation Effluent Pool for environmental restoration projects.

The Tucson Water's *Water Plan: 2000 - 2050* will also play a significant role in development of effluent policy in the greater Tucson area. PCWMD will continue to work toward the goal of using its effluent in the most beneficial manner possible and collaboration with Tucson Water in areas of mutual benefit. Pima County is presently using its allotment or participating in projects such as:

- Ed Pastor Kino Environmental Restoration Project.
- County Parks (including Arthur Pack Golf Course).
- High Plains Project.
- Lower Santa Cruz Managed Recharge Project.

Other environmental restoration projects are envisioned to help make beneficial use of the remainder of Pima County's allotment of effluent including:

- Tres Rios del Norte Project.
- Paseo de Las Iglesias.
- Canoa Ranch.
- Black Wash.

Effluent Reuse Recommendations

- Collaborate with Tucson Water's Water Plan: 2000 - 2050 in areas of mutual benefit.
- Collaborate with the other water providers and local citizens groups on recharge, reuse and water conservation activities.
- Develop regional reclaimed water policy and effluent utilization practices.
- Work closely with the other Pima County agencies to identify and coordinate existing and potential effluent utilization opportunities.

BIOSOLIDS

Biosolids management is discussed in Chapter 7. The PCWMD biosolids management program involves anaerobic digestion at the Roger Road WWTP and Ina Road WPCF and conveyance to the centralized biosolids handling facility (Regional Biosolids Facility), for moisture reduction, storage, handling and disposal. The recommended future biosolids improvements include off-loading all solids treatment to Ina Road WPCF. This will include pumping undigested solids from Roger Road WWTP to Ina Road WPCF. In addition, the Facility Plan recommends conversion of anaerobic digestion facilities to produce Class A biosolids.

For an effective biosolids management program, PCWMD should explore and plan for establishing Class A biosolids production facilities. It should also diversify the land application/disposal program to include mine tailings in addition to agricultural lands. In the future, as the need for urban land increases, and farmland is converted to residential areas, land application sites will become increasingly scarce. To enhance reuse options, it is recommended that the biosolids facilities be upgraded to allow production of Class A biosolids.

A comprehensive study to determine the most cost-effective methods for processing of biosolids, as well as the best option for the processing location(s), is recommended. This study will evaluate:

- Types of solids handling facilities which should remain at Roger Road WWTP.
- Solids pumping facilities from Roger Road WWTP to the Ina Road WPCF.
- Odor control in and around both the Roger Road WWTP, Ina Road WPCF and the Regional Sludge Management Facility.
- Upgrades at the Ina Road WPCF to enhance solids content as well as produce Class A biosolids.
- Available local uses for Class A biosolids in various disposal forms.
- Options for solids handling at Outlying Treatment Facilities.

Biosolids Recommendations

- Perform a comprehensive biosolids management study
- Rehabilitate the existing biosolids facility at the Ina Road WPCF
- Relocate the biosolids handling at Roger Road WWTP to the Ina Road WPCF and centralize the biosolids processing at the Ina Road WPCF
- Upgrade the treatment process for biosolids to produce Class A pathogen-free biosolids.
- Develop an increased diversity of biosolids disposal systems, including land application and mine tailings
- Participate in the National Biosolids Partnership Environmental Management System (best practices) program.

CAPITAL IMPROVEMENT PROGRAM

The long-range Capital Improvement Program (CIP) for PCWMD is described in Chapter 8 and reflects an overall integrated vision of the future of the system. The immediate goals of the long-range CIP are to complete the 1997 bond projects, begin implementation of the 2004 Bond Authorization funds, and initiate planning for the proposed 2008 Bond Authorization for future projects. The major goals of the long-range CIP are to plan, design and construct the following projects between 2006 and 2026:

- Redistribute flows to the major metropolitan facilities through design and construction of the Plant Interconnect from the 2004 Bond Authorization Project. The three metropolitan area treatment facilities will have a combined capacity of 94.0 MGD ADWF with projected flows of 76. MGD by 2025.
- Initiate improvements at the Roger Road WWTP which include significant process improvements, building and structural upgrades, denitrification, odor reductions and relocation of solids handling to the Ina Road WPCF.
- Initiate improvements at the Ina Road WPCF, which include denitrification of the original 25 MGD plant (funded with 2004 Bond Authorization and augmented by another allocation in the 2008 Bond Authorization), a new lab/administration building, an electrical upgrade, significant miscellaneous rehabilitation, upgrading, and the addition of 12.5 MGD of treatment capacity at the end of the planning period.
- Address major conveyance needs in the Santa Cruz (funded with 2004 Bonds) and the Park/18th Street Interceptors (future bonding).
- Develop conveyance system rehabilitation and a proactive CMOM program (partially funded by the Miscellaneous Conveyance Rehabilitation project in the 2004 Bond Authorization).
- Address capacity and treatment issues in the outlying facilities including Marana, Corona de Tucson and Avra Valley WWTFs.

Detailed CIP project schedules and proposed funding, in 5-year increments, are included in Chapter 8 and a comprehensive fold-out chart for the entire 20 year period is included at the end of Chapter 8.

FUNDING

Chapter 9 details the various funding sources for PCWMD to operate the wastewater system, perform preventative maintenance, provide for capital rehabilitation, and construct capacity and facilities process improvements. PCWMD was established as an enterprise fund in the County financial structure – a utility operation funded by the revenue it generates from fees charged for its services. Revenues are collected and transferred to Pima County's Finance Department where they are organized and allocated according to the flow of funds adopted in the Board of Supervisors Resolution 1991-138. The principal sources of revenue are Sewer User Fees and Sewer Connection Fees paid by customers of the system as established and modified by ordinances authorized by the Board of Supervisors. Major capital improvements to the system are generally funded by Sewer Revenue Bonds through bond sales or WIFA loan following authorization by the voters.

Preliminary benchmarking reports indicate some common factors regarding PCWMD's fees:

In 2005, the Black & Veatch evaluated the cost of service for existing users and new connections to the wastewater system and made two significant findings:

- **User Fee Rates:** Pima County's user fees show up consistently among the lowest in any of the surveys for agencies of similar size and mission nationwide.
- **Connection Fee Rates:** Pima County is now collecting a reasonable amount of funding from the development industry for growth related expenses.

FACILITY PLAN AS A LIVING DOCUMENT

PCWMD's Facility Plan was developed with multiple assumptions regarding the need and schedule for rehabilitation, replacement and capacity management. PCWMD performed an extensive evaluation of the existing treatment and conveyance systems to document these assumptions and has a program to continuously review new data and re-examine the validity of the assumptions.

Going forward, the Facility Plan will be revised on a periodic basis to incorporate changes, validate these assumptions and conduct a "reality check" on projected conditions. The Facility Plan is a living document to guide PCWMD through the expected growth and regulatory environment over the next 20 years. The ultimate goal is to effectively serve the health and welfare of residents of Pima County and maintain this valuable asset which has been created over the years by the citizens of Pima County.

Funding Recommendations

- Continue User/Connection Fees as the major revenue sources.
- Other fees and charges should augment revenue.
- Accounting/fund structure should be transparent to source and uses of funds.
- Fund debt service for rehabilitation capital projects through User Fees.
- Develop contingency plans for connection fee shortfalls.
- Adopt modified Raftelis Financial Benchmarks as part of PCWMD's financial goals.
- Incorporate financial goals and forecasts (Capital and O&M) into PCWMD's business plan.
- Implement automation and cost-saving capital construction and treatment process concepts should be an important part of the business plan.
- Implement $150 million 2004 Bond Authorization.
- Obtain Bond authorizations for 2008 ($245 to $355 million), 2012 ($225 to $275 million) and 2016/20 ($325 to $400 million) for a total of $795 to $1,030 million, assuming $10 million annually for capital rehabilitation funded from operating revenue to fund an approximate $1.4 billion 20-year CIP.
- Emphasize capital replacement and rehabilitation to drive approximately 37 percent of the total 20-year $1.4 billion CIP.
- Regulatory upgrades will generate approximately 22 percent of the total expenditures.
- Treatment and conveyance capacity increases will account for approximately 41 percent of the remaining expenditures.

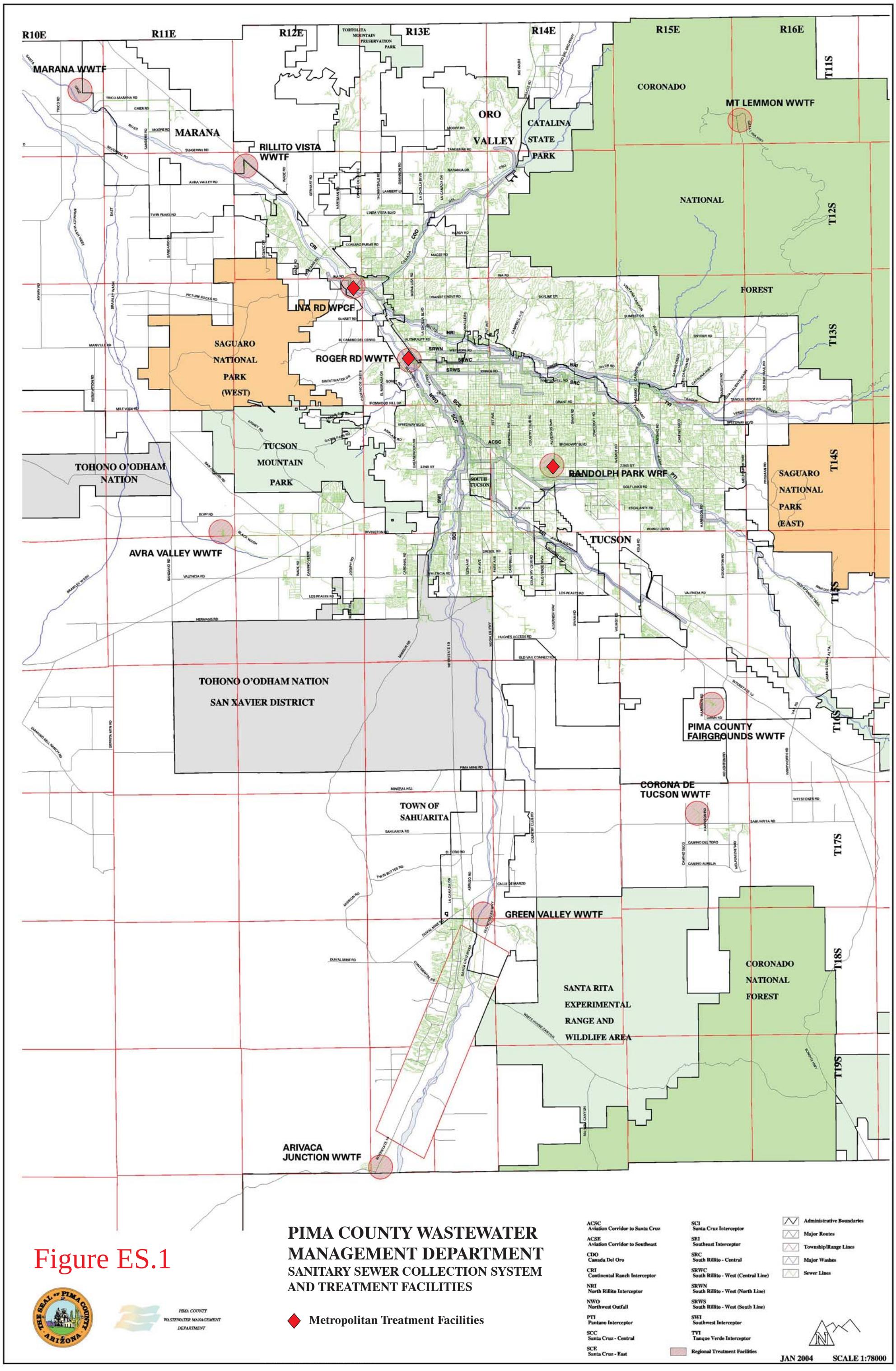


Figure ES.1

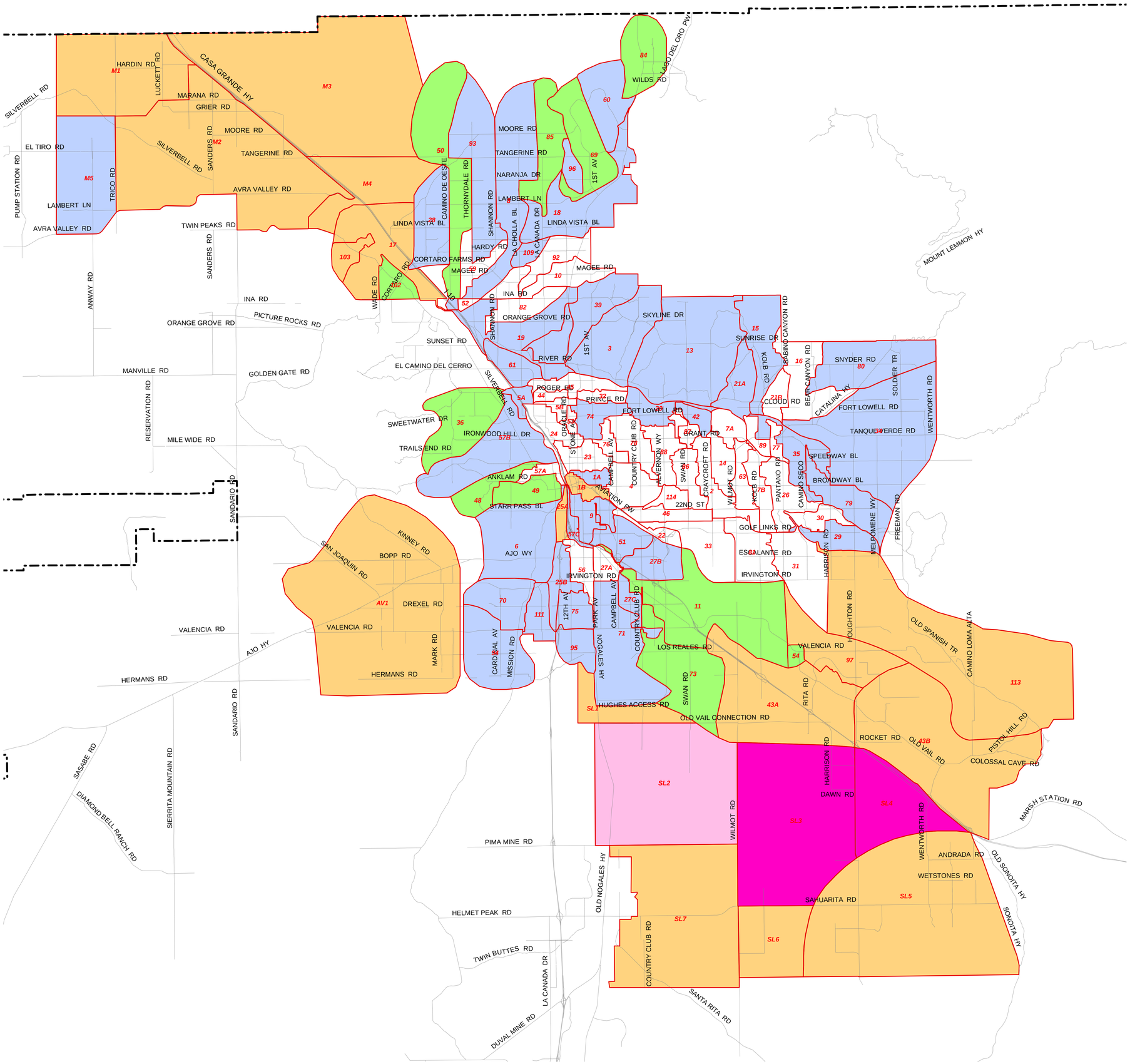
PIMA COUNTY WASTEWATER MANAGEMENT DEPARTMENT
SANITARY SEWER COLLECTION SYSTEM AND TREATMENT FACILITIES

Metropolitan Treatment Facilities

PIMA COUNTY WASTEWATER MANAGEMENT DEPARTMENT

Population Increase By Sewer Basin For Years 2005 - 2030

2005 TAZ Data



Basins

Major Streets

> 1000% Increase

500 - 1000% Increase

100 - 500% Increase

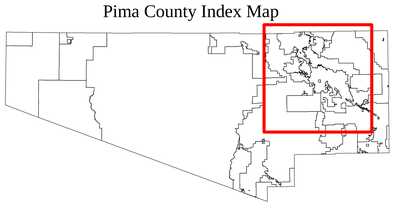
50 - 100% Increase

10 - 50% Increase

< 10% Increase

Figure ES.2

Pima County Index Map



Index Map Scale 1:1,500,000

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N

Scale 1:90,000

Pima County Department of Transportation

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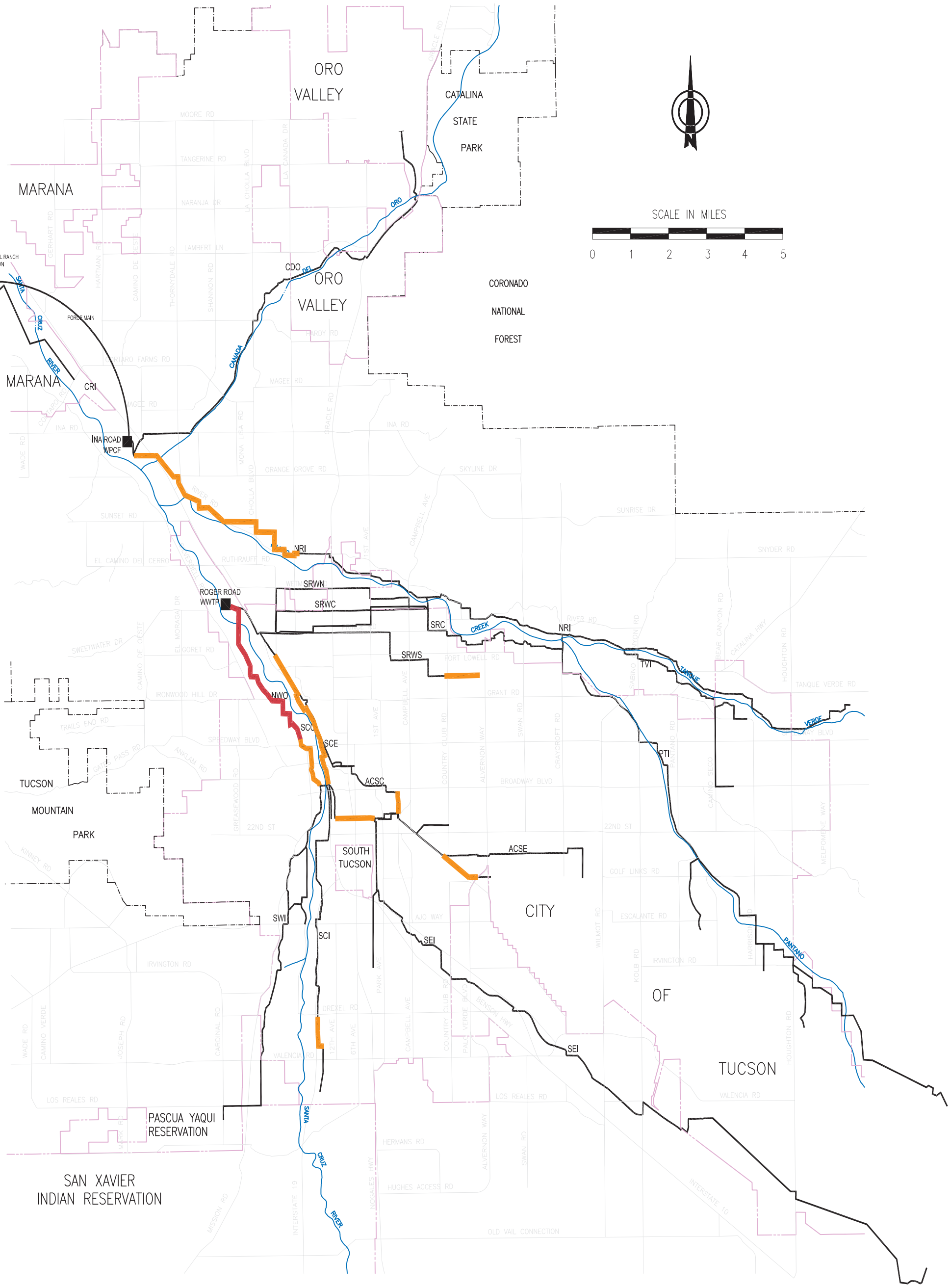
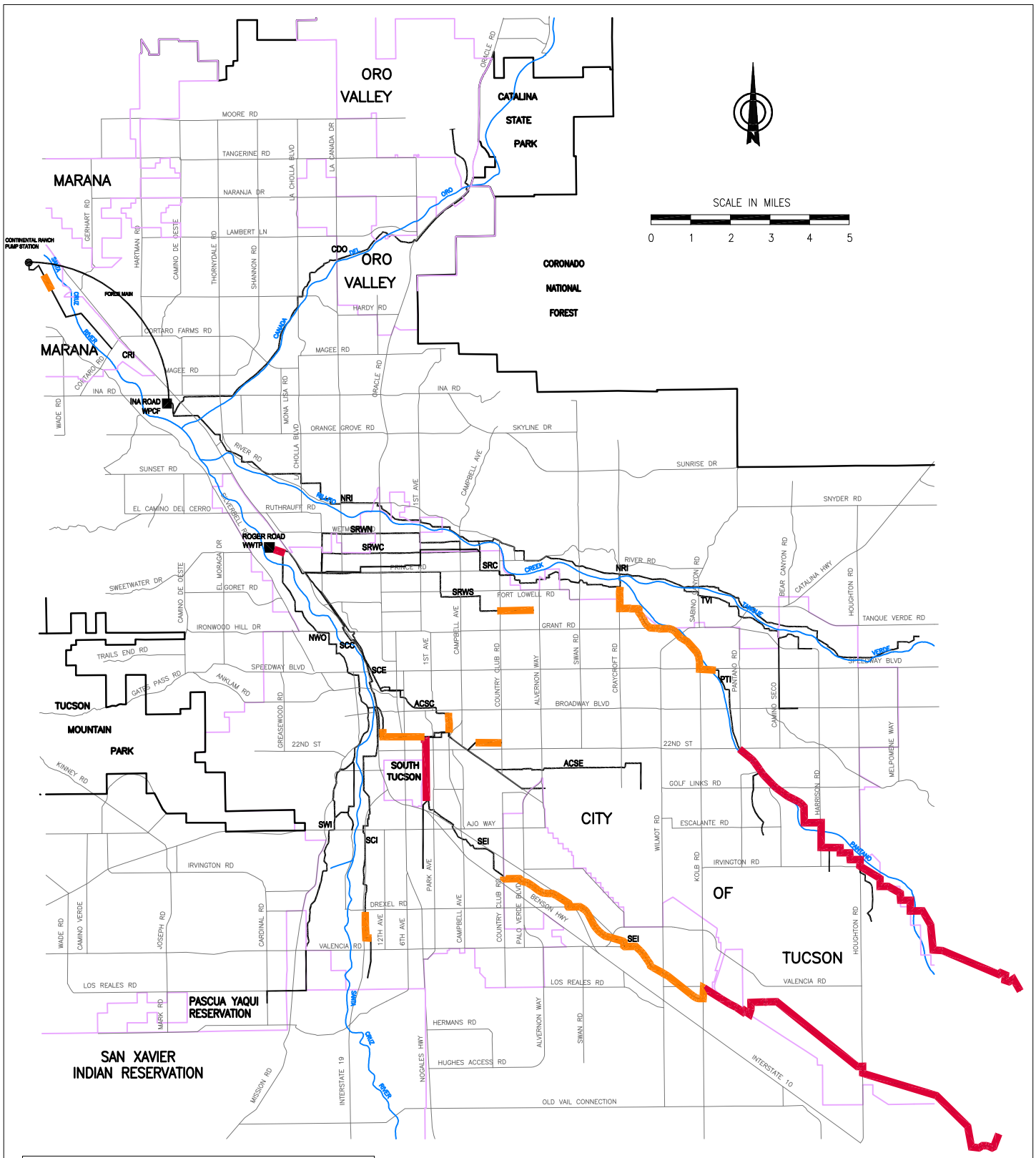
THE SEAL OF PIMA COUNTY ARIZONA

pygmyowl4/projects/wwm8/mxds/pop_increase.mxd mp 11/23/2005



Pima County Wastewater Management Department
Facility Plan Update

Figure ES.3
Interceptor Issues 2005



LEGEND

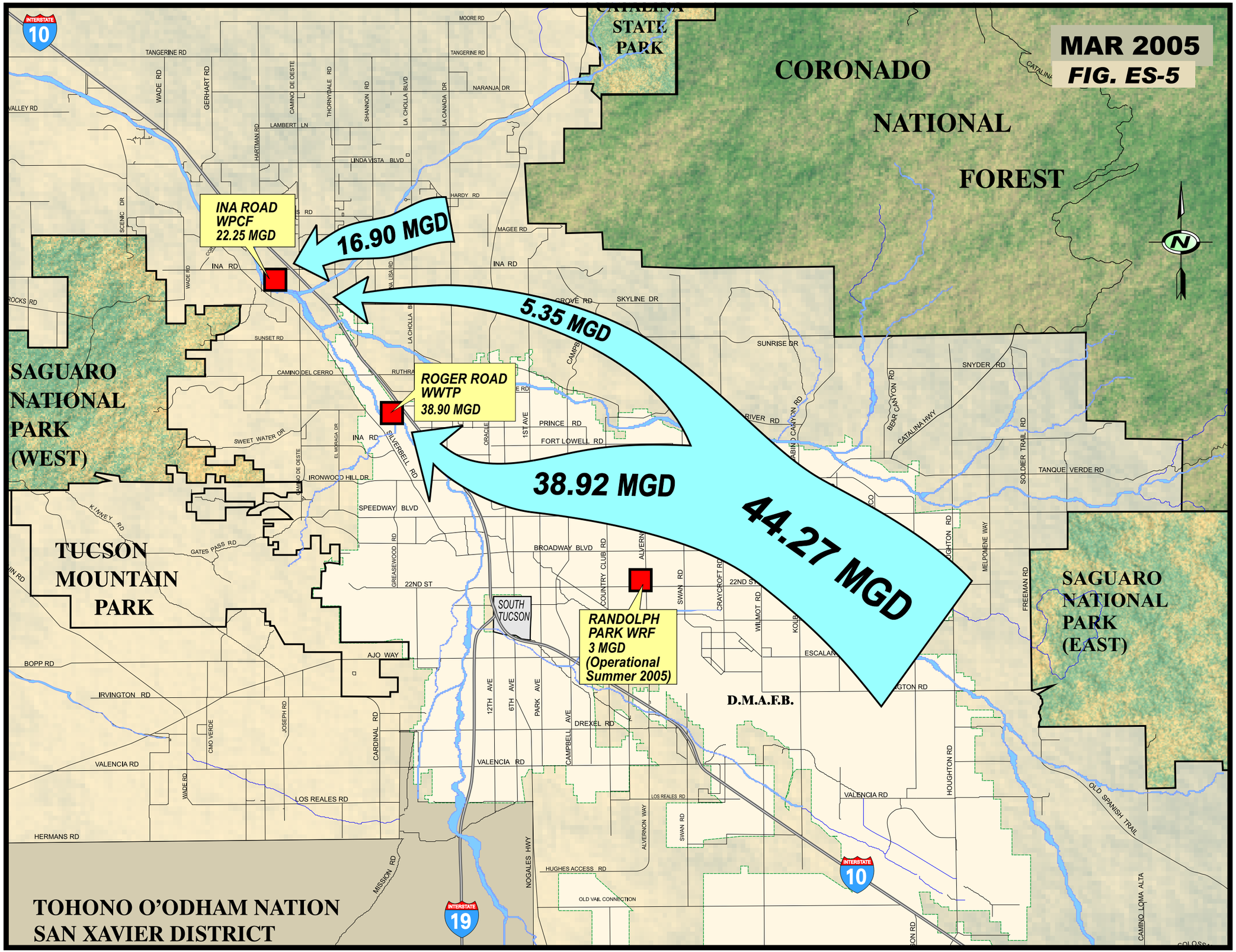
DEFICIENT (Calculated Basin Exit Flow is Greater Than 85% of Full Pipe Capacity at the Basin Exit)

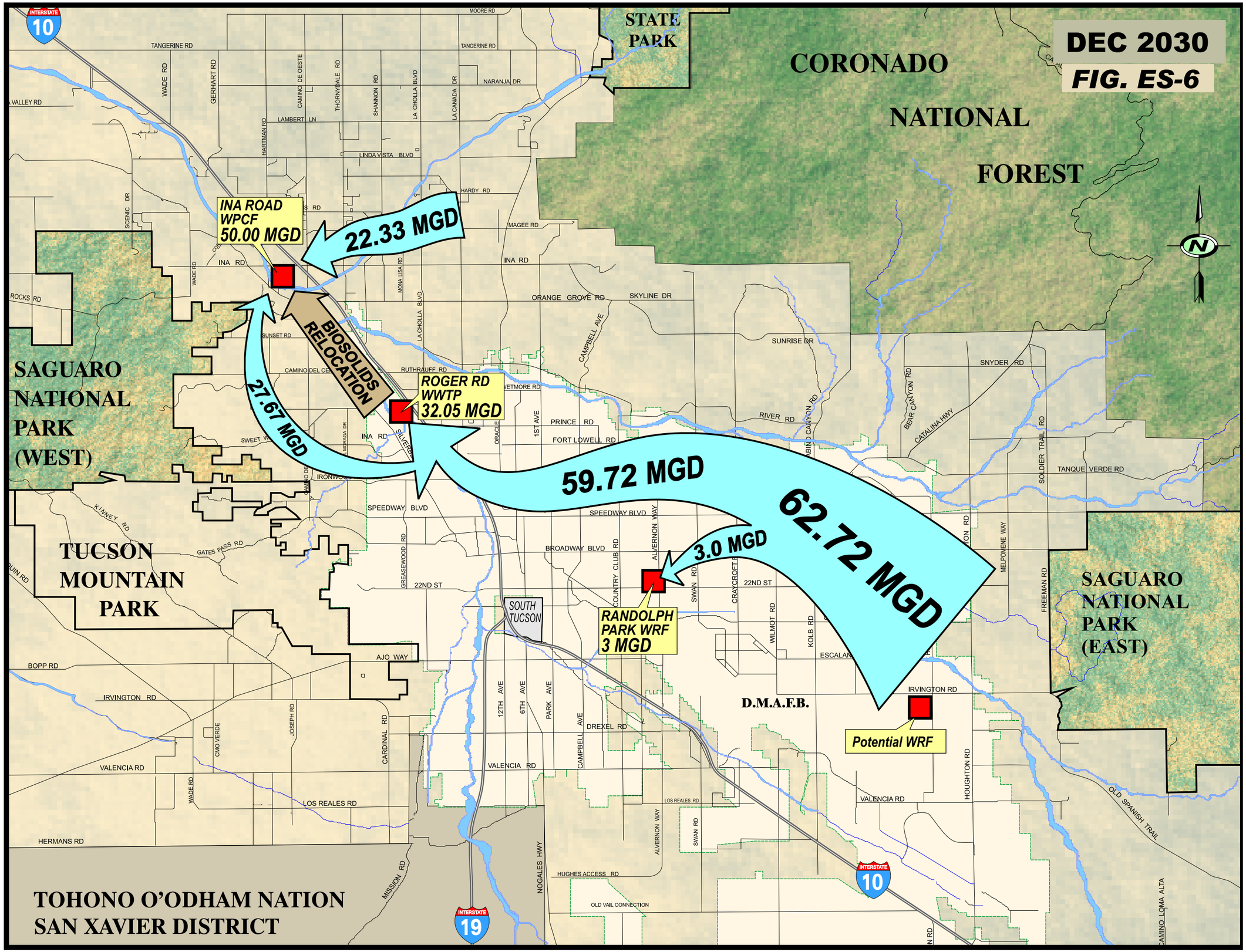
FURTHER (Calculated Basin Inlet Flow is Greater Than 85% of Full Pipe Capacity Somewhere Within the Basin)

Pima County Wastewater Management Department
Facility Plan Update

Figure ES.4

Interceptor Issues 2030


MAR 2005
FIG. ES-5
CORONADO NATIONAL FOREST
CATALINA STATE PARK
SAGUARO NATIONAL PARK (WEST)
TUCSON MOUNTAIN PARK
SAGUARO NATIONAL PARK (EAST)
D.M.A.F.B.
TOHONO O'ODHAM NATION SAN XAVIER DISTRICT
SOUTH TUCSON
INA ROAD WPCF 22.25 MGD
ROGER ROAD WWTP 38.90 MGD
RANDOLPH PARK WRF 3 MGD (Operational Summer 2005)
16.90 MGD
5.35 MGD
38.92 MGD
44.27 MGD
INTERSTATE 10
INTERSTATE 19
TANGERINE RD
MOORE RD
NARANJA DR
LAMBERT LN
LINDA VISTA BLVD
HARDY RD
MAGEE RD
INA RD
GROVE RD
SKYLINE DR
SUNSET RD
SUNRISE DR
CAMINO DEL CERRO
SNYDER RD
RIVER RD
PRINCE RD
FORT LOWELL RD
SWEET WATER DR
IRONWOOD HILL DR
TANQUE VERDE RD
SPEEDWAY BLVD
BROADWAY BLVD
22ND ST
GATES PASS RD
KINNEY RD
AJO WAY
BOPP RD
IRVINGTON RD
DREXEL RD
VALENCIA RD
LOS REALES RD
HERMANS RD
HUGHES ACCESS RD
OLD VAIL CONNECTION
OLD SPANISH TRAIL
CAMINO LOMA ALTA
WADE RD
GERHART RD
CAMINO DE OESTE
THORNYDALE RD
SHANNON RD
LA CHOLLA BLVD
LA CANADA DR
HARTMAN RD
SCENIC DR
SILVERBELL RD
ORACLE
1ST AVE
EL MIRAGA DR
GREASEWOOD RD
COUNTRY CLUB RD
ALVERNON
SWAN RD
CRAYCROFT RD
WILMOT RD
KOLB
ESCALANTE
BEAR CANYON RD
CATALINA HWY
SOLDIER TRAIL RD
MELPOMENE WAY
FREEMAN RD
HOUGHTON RD
CARDINAL RD
CMO VERDE
JOSEPH RD
12TH AVE
6TH AVE
PARK AVE
CAMPBELL AVE
ALVERNON WAY
NOGALES HWY
MISSION RD
N


DEC 2030
FIG. ES-6
CORONADO NATIONAL FOREST
STATE PARK
SAGUARO NATIONAL PARK (WEST)
TUCSON MOUNTAIN PARK
SAGUARO NATIONAL PARK (EAST)
D.M.A.F.B.
TOHONO O'ODHAM NATION SAN XAVIER DISTRICT
INA ROAD WPCF 50.00 MGD
ROGER RD WWTP 32.05 MGD
RANDOLPH PARK WRF 3 MGD
Potential WRF
BIOSOLIDS RELOCATION
22.33 MGD
27.67 MGD
59.72 MGD
3.0 MGD
62.72 MGD
SOUTH TUCSON
INTERSTATE 10
INTERSTATE 19
N

Chapter 1 Introduction

Pima County Wastewater Management Department (PCWMD) operates the Pima County regional wastewater system. The 1979 Intergovernmental Agreement (IGA) integrated the separately operated wastewater systems of the City of Tucson and Pima County into a single system operated by Pima County. The combined Metropolitan Area system, at that time, consisted of the Roger Road Wastewater Treatment Plant (WWTP), the Ina Road Water Pollution Control Facility (WPCF), and the Randolph Park Water Reclamation Facility (WRF), as well as approximately 1,200 miles of collection pipelines. The Roger Road WWTP, originally placed in service by the City of Tucson in 1951, has since been expanded several times to its present 41 million gallons per day (MGD) capacity. The Ina Road WPCF, originally placed in service by Pima County in 1977, is being expanded to 37.5 MGD. The collection system has grown to over 3,300 miles of sewer lines.

The 2006 Pima County Metropolitan Area Facility Plan Update (Facility Plan) addresses the Metropolitan Area which is essentially the area tributary to the treatment facilities at Ina Road WPCF and Roger Road WWTP. The outlying facilities, operated by PCWMD at Marana, Avra Valley, Mount Lemmon, Corona de Tucson, Pima County Fairgrounds and Green Valley, are not tributary to either the Roger Road WWTP or Ina Road WPCF, but will be discussed within the report to provide a comprehensive description of the Department's facilities.

PCWMD annually develops and revises a Five-Year Capital Improvement Program (CIP) which identifies specific planning, design and construction projects to meet the existing and projected facility needs. This CIP is based on a detailed annual review and evaluation by PCWMD staff of the needs for conveyance system rehabilitation and expansion, treatment plant repair/rehabilitation and expansion, and system wide upgrades to meet current regulatory requirements. The Five-Year CIP generally follows the recommendations contained in the Facility Plan. The Facility Plan is the master planning document of PCWMD which periodically examines the status of the system of the Metropolitan Area and then forecasts the projects required to meet predicted expansion, regulatory requirements and rehabilitation needs. This document is the second update of the original Facility Plan initially developed for the Department in 1978 and first updated in 1990.

The 1978 Facility Plan was prepared in accordance with Section 201 of Public Law 92-500, the 1972 version of The Federal Water Pollution Control Act. Public Law 92-500, Section 201 dictated the format and contents of the 1978 Facility Plan. The stated objectives of that Plan were:

- Develop specific sewerage improvement projects to meet all applicable State and Federal requirements and provide the desired level and quality of wastewater service in the most cost effective manner.
- Define the most cost effective regional wastewater management system to meet the short and long term needs of both Pima County and the City of Tucson.

- Develop an economical and orderly staged construction program for future facilities.
- Evaluate the eligibility of the recommended projects for State and Federal grant funding and the capability of the City to fiscally support the sewerage facilities.

The 1990 Metropolitan Area 201 Facility Plan Update was developed in accordance with Federal facility planning regulations and guidelines contained in the Environmental Protection Agency (EPA) guidance document entitled, Construction Grants, 1985 (CG-85), and the Pima Association of Government's (PAG) Area Wide Wastewater Management Plan Point Source Update for the Metropolitan Basin, and was adopted in 1985. The general goals of that plan were:

- Provide a wastewater management system that is compatible with and protects the environment.
- Promote cost effective wastewater management and environmental benefits.
- Protect surface water and ground water quality, consistent with Federal and State laws and regulations.
- Provide a comprehensive 201 Facility Plan for a long-range planning period that complies with all Federal, State and local laws, ordinances, regulations and requirements and meets the needs of the wastewater management system and the community it serves.

The 2006 Facility Plan is based on the objectives, goals and information contained in its two predecessor documents. However, it will not be limited to the rigid regulatory format of these documents. The completion of the Federal program of grant funding for wastewater projects has alleviated the necessity of following the previous rigid format.

The 2006 Facility Plan presents PCWMD's vision of the Metropolitan Area Wastewater System through the year 2026. The ultimate goal is to effectively serve the health and welfare of residents of Pima County and maintain this valuable asset which has been created over the years by the citizens of Pima County. The Facility Plan is designed to answer the following questions:

- **How will growth affect the system?** Significant population growth is anticipated in the Metropolitan Area over the next 20 years. However, the amount, distribution and timing of growth within the Metropolitan Area will affect extension of the collection system, location of new treatment facilities, and improvements to existing treatment plants.
- **How will future regulatory changes impact the effluent quality requirements and the operations and maintenance of the treatment and conveyance systems?** Federal and State regulations and facility permits are constantly changing and evolving based on local conditions and national/regional initiatives. The Facility Plan discusses these anticipated changes and the potential impacts on the conveyance and treatment operations of the metropolitan system.
- **How can the treatment and conveyance system be continuously rehabilitated?** As wastewater treatment and conveyance infrastructure across the nation has begun to age, the asset management concept has been a primary driver at many wastewater agencies to develop a systematic approach to identifying and rehabilitating the physical facilities. As part of this report, extensive condition assessments were conducted at the major treatment facilities. These evaluations, together with assessments of the conveyance systems, identify treatment and conveyance rehabilitation needs for the next 20 years. In addition, Federal and State Capacity, Management, Operations and Maintenance (CMOM) regulations will place higher demands on inspection, maintenance and replacement/rehabilitation of the conveyance

system as a means of reducing Sanitary Sewer Overflows (SSOs) and odors, while preserving the value and functionality of the assets. Immediate and long-term rehabilitation programs for both conveyance and treatment facilities are included in the Facility Plan.

- **How will the growth, regulatory and rehabilitation requirements be funded?** The financing of wastewater projects can no longer rely on Federal grants to meet a portion of their funding requirements. The use of voter-approved funds for capital projects is very critical in making system improvements in a timely and cost effective manner. Additionally, user and connection fees must reflect the total costs of operation and expansion of the system respectively.

This Facility Plan is organized to present the wastewater system in Pima County; to forecast growth within the Metropolitan Area; to identify the regulatory and institutional issues that impact the collection, treatment and disposal of effluent and biosolids; to describe the current status and proposed future of the conveyance systems; and to identify the proposed short and long-range CIP for the Metropolitan Area over the 20-year planning period.

Chapter 2 Planning Area Characteristics

CHAPTER OVERVIEW

The Pima County Metropolitan Area Facility Plan (Facility Plan) will focus on the Metropolitan Tucson Wastewater Planning Area (Planning Area). The Planning Area is defined for this Facility Plan as the sewer system tributary to Ina Road Wastewater Pollution Control Facility (WPCF), Roger Road Wastewater Treatment Plant (WWTP) and the Randolph Park Water Reclamation Facility (WRF). To successfully plan for the future, it is important to have knowledge of the physical and cultural characteristics of the Planning Area, as they relate to the conveyance and treatment of sewage.

The Planning Area is located within the Sonoran Desert and has a climate typical to the lower elevations in the American Southwest. The planning area is constrained by mountains on most sides. Surface runoff generally flows northward and westward through the basin. The Santa Cruz River is the major surface drainage channel in the Planning Area and flows northward to the Planning Area's western boundary. The two major treatment plants, Roger Road WWTP and Ina Road WPCF are located in low-lying areas on the western edge of the basin. The effluent from these two treatment facilities is:

- Discharged to the Santa Cruz River.
- Reused by PCWMD and the City of Tucson Reclaimed System.
- Recharged to the aquifer.

The three main elements of the Planning Area are physical characteristics, cultural characteristics and population/land use. Important elements of the physical characteristic are reuse or effluent and the geology of the Planning Area. Effluent discharged to the Santa Cruz River provides year around flows downstream.

Area soils, outside of stream channels, have, at best, moderate infiltration rates. The effects of the infiltration characteristics are low natural groundwater recharge rates and relatively high volumes of surface runoff. Other areas in Planning Area may prove highly conductive for recharge using surface spreading methodologies, dependent on local site conditions. The infiltration rates in the area impact land requirements for effluent to recharge groundwater. Reuse water supplies golf courses, schools and other private and public uses throughout the basin and replace precious groundwater for these uses.

Archaeology is an important issue in the cultural characteristics. Conducting detailed archaeological surveys of proposed conveyance system routes or new wastewater treatment plants prior to construction will aid in the preservation of the archaeological resources.

Finally population and land use impact the timing and size of future improvements. The current general employment trend in the Planning Area is increased employment in the service and hotel/ lodging sectors. High technology manufacturing has been strong. The long-term outlook predicts continued growth with firms immigrating to the area to take advantage of the favorable climate, the labor force, and the low cost of living. The Planning Area population is projected to grow by about 11 percent between 2005 and 2010, 10 percent between 2010 and 2015, 9 percent between 2015 and 2020, 8 percent between 2020 and 2025, and 8 percent between 2025 and 2030.

SUB-CHAPTER 2.1 PLANNING AREA CHARACTERISTICS

Chapter 2.1 provides general descriptions of the physical and cultural characteristics of the Planning Area, as well as the outlying areas served by Pima County Wastewater Management Department (PCWMD).

The characteristics of the Planning Area include:

- Physical Characteristics.
  - ✓ Geography.
  - ✓ Geology.
  - ✓ Hydrogeological conditions.
  - ✓ Surface hydrology.
  - ✓ Climate.
  - ✓ Air quality.
  - ✓ Biotic communities.
- Cultural Characteristics.
  - ✓ Archeology.
  - ✓ Economic base.
  - ✓ Employment trends.
- Population and Land Use.
  - ✓ Land uses.
  - ✓ Population trends.

Pertinent to the area are such elements as physical, cultural characteristics and historical wastewater treatment practices.

Physical Characteristics

Geography

The Planning Area is located in Eastern Pima County (Tucson Valley Basin). Elevations in this basin range from 3,720 feet in the southeast to 2,030 feet in the northwest. The basin floor is generally level, and there are several primary and secondary drainage channels draining to the northwest. These channels convey surface runoff northward and westward through the basin.

The Tucson Basin is roughly ringed by (clockwise from the north) the Santa Catalina, Tanque Verde, Rincon, Empire, Santa Rita, Sierrita, Tucson and Tortillita Mountains. The Santa Catalina, Rincon, Tucson and Tortillita ranges abut the Planning Area. The generally gentle slope of the basin floor tends to increase rapidly as it nears the various mountains ranges.

The two major metropolitan wastewater treatment facilities, Roger Road WWTP and Ina Road WPCF, are located in low lying areas on the western edge of the basin to take advantage of the gravity flow provided by the shape and slope of the basin. See Figure 2.1.1.

The Randolph Park WRF is more centrally located within the basin, and requires a lift station to convey wastewater flow to the facility.

Geology

The mountains surrounding the Tucson Basin are composed of metamorphic, sedimentary, and intrusive igneous rock extending beneath the alluvial material filling the basin. This impermeable material provides a physical boundary that forms the area's groundwater basins.

Over time, erosion or weathering of the mountainous areas has resulted in the deposition of alluvium up to 7,000 feet thick in areas south and southeast of Tucson. A stratigraphic section through the basin reveals, from the ground surface downward, superficial deposits (primarily stream channel and terrace deposits) of the Fort Lowell Formation, the Tinaja beds, and the Pantano Formation. The Pantano Formation is composed primarily of Catalina granite and gneiss, ranging from loosely packed to weakly cemented into place. The Tinaja beds are a series of beds composed of Catalina gneiss changing to volcanics with increasing depth, ranging from sandy gravel along the basin's margins to gypsiferous clayey silt and mudstone in the center of the basin. The thickness of each unit varies throughout the basin, with the deeper beds generally thicker than those overlying them.

The basin is interwoven with deep geologic faults, which are considered to be inactive. Evidence of inactivity is provided by the deformations observed in the Pantano Formation and the Tinaja beds, but generally absent from the younger Fort Lowell Formation. Seismic activity is not anticipated to affect any operational facilities.

Characteristics of the alluvium on the basin floor could potentially present obstacles during and after construction of new wastewater management facilities. Calcium carbonate lenses, known locally as caliche, are interspersed throughout the Planning Area. The caliche lenses vary in thickness and aerial extent and may be encountered anywhere within the basin.

The combined effects of groundwater extraction and the introduction of surficial loads may result in subsidence in the unconsolidated upper alluvium. Alluvium with high clay content may be subject to swelling when it is wetted. The unconsolidated material can be easily eroded, particularly during the summer's short duration, high intensity rains and subsequent runoff events referred to as monsoons. Detailed geotechnical investigations during design phases will decrease the probability of any of these potential problems affecting new wastewater facilities.

The uppermost alluvial deposits within the Tucson basin contain most of the groundwater extracted and used in the Metropolitan Area. Most in-service wells penetrate the upper Tinaja beds. Very few wells penetrate the middle and lower units of the Tinaja beds or the Pantano Formation beneath them. The three geological units, though possessing unique lithological and hydraulic characteristics, are hydraulically connected and comprise a single aquifer.

Soils

Soils in the Planning Area are primarily the results of fluvial deposition of weathering products from the surrounding mountains. Soil particle sizes typically decrease as distance from the mountain fronts increases. Organic residue does not typically accumulate on and near the soil surface.

Area soils have, at best, moderate infiltration rates. Infiltration rates tend to decrease near the mountains and are generally lower in the extreme southeastern and northeastern portions of the Planning Area. The effects of the soils' infiltration characteristics are low natural groundwater recharge rates and relatively high volumes of surface runoff.

Site-specific soil characteristics will require field studies for complete, specific definitions. Soil mapping to date has been done in a generalized manner. Potentially critical parameters may not be apparent on existing maps and should be identified in design phases.

Hydrogeology

Until the 1990s, the Metropolitan Tucson Area relied entirely on groundwater to meet all potable water needs. This total dependency on groundwater combined with a continually increasing population has resulted in a declining water table and groundwater overdraft. Since the 1990s:

- The City injected CAP water during direct delivery from 1992 to 1994.
- The City has recharged CAP water via surface spreading basins since 1997.
- The blend of groundwater and recharged CAP water has been utilized by Tucson Water as a supply source since 2001.
- The main goal of these efforts is to reduce reliance on groundwater, which will serve to stabilize groundwater levels and reduce the potential for additional lane subsidence. In some areas, groundwater levels in the regional aquifers have already begun rising.

In 1940, 85 percent of the groundwater recovered was used for irrigation purposes. Since that time, water usage patterns have undergone significant change. The peak year for agricultural use occurred in 1976, which at approximately 325,000 acre feet per year (AF), represents 66 percent of the total pumped that year. Ground water pumping in the Tucson Basin reached its peak in 1975/76. By 1980/81, agricultural pumping within the Tucson Basin had been reduced to approximately 180,000 acre feet approximately 55 percent of the overall usage. However, as agriculture usage has decreased, industrial and municipal usage has increased in accordance with population growth within the Planning Area.

In 1980, the Arizona Groundwater Management Act was enacted. As part of this policy, Active Management Areas (AMA) were established and the goal of safe-yield was established (volume of groundwater-recovered equal to the volume of water recharged). The Arizona Groundwater Management Act encourages the Tucson AMA to reach this goal by 2025. This requires the community to look at other sources such as:

- Utilization of Arizona's allocation of Colorado River Water.
- Effluent reuse to offset groundwater withdraws (primarily golf courses).
- Recharge.
- Conservation.

Data from Arizona Department of Water Resources (ADWR) indicates in 2000, the Tucson AMA utilized 326,103 AF of water broken down as follows: for agricultural irrigation (105,041 AF), for municipal use (159,649 AF), industrial use (17,978 AF), and for mining use (43,435 AF).

In an effort to reduce groundwater demand, the Tucson AMA began taking deliveries of Colorado River water from the Central Arizona Project (CAP) in 1992. CAP allocations were divided among four major municipal water providers, Tucson Water (135,966 AF), Metropolitan Domestic Water Improvement District (8,858 AF), Flowing Wells (4,354 AF), and Oro Valley Water Utility (6,748 AF).

In order to reach the assured water supply rules objectives, several utilities are currently recharging both CAP and effluent into storage facilities. Presently, Tucson Water is recharging 60,000 AF annually of CAP water and is in the process of finalizing a recharge application with ADWR to increase this by an additional 20,000 AF annually. Tucson Water plans for recharge are set forth in Tucson Water's *Water Plan: 2000-2050* to which the reader is referred for further details. Metropolitan Domestic Water Improvement District is utilizing their allocation through either recharging or trading with existing agricultural groundwater permit holders.

Reuse of effluent is an important component in the overall safe-yield objectives. PCWMD recently completed an advanced 3 MGD combination biological nutrient removal (BNR)/immersed membrane water reclamation facility (Randolph Park WRF). This facility is permitted for Class A effluent and will supply the Tucson Water Reclaimed System with Class A effluent; however it is capable of producing Class A+ effluent for future delivery.

Tucson Water has one of the most extensive reclaimed water systems in the United States, and Oro Valley is currently developing its own reclaimed water distribution system. These systems will supply golf courses, schools and other private and public uses throughout significant portions of the Tucson and Avra Valley Basins.

Depths to groundwater vary from about 50 feet along Tanque Verde Wash in the northeastern portion of the Planning Area to about 450 feet in the southeastern and north-central portions of the Planning Area. Depths to groundwater have steadily increased throughout the Planning Area since the early 1940s. The water table is deep enough that infiltration into the wastewater conveyance system is considered negligible, except during significant rainfall events.

Natural recharge of the aquifer occurs primarily along the mountain fronts and in stream channels in response to precipitation events. Under flow, the influx of groundwater from another basin occurs primarily along the Planning Area's southern boundary and along the Canada del Oro Wash in the northeastern portion of the Planning Area. Incidental recharge occurs as a secondary product of human activities and includes turf irrigation (parks and golf courses) and discharge of secondary effluent into the Santa Cruz River from the Roger Road WWTP and the Ina Road WPCF. The local municipalities within the metro vicinity of the Tucson AMA are collecting groundwater storage credits.

Surface Hydrology

The main drainage channels within the Planning Area are ephemeral streams, fed by precipitation and snowmelt from higher elevations. Numerous secondary channels serve as tributaries to the primary drainage channels. These channels are generally entrenched, though not as deeply as the larger channels. The natural channels combine into a dendritic drainage pattern. The pattern has been slightly modified by construction. Many streets were designed and constructed to serve as temporary channels. Runoff in the streets is typically discharged into natural channels.

Drainage channel floors within the basin provide most of the area's aquifer recharge. Precipitation during the winter season usually occurs over a widespread area and lasts from one to several days and is of low intensity. Runoff resulting from these storms flows slowly through the drainage channels, which facilitates recharge. Recharge rates decrease as the season progresses due to sediment deposition, which plugs many of the surface voids, impeding infiltration.

Summer storms are highly localized, typically lasting from a few minutes to an hour, and precipitation can be extremely intense. Runoff from these storms flows rapidly through the channels. The rapid flow rates are less conducive to recharge than the slower winter flows. Summer flows are able to carry a large sediment load and effectively scour channel bottoms re-establishing higher infiltration rates.

Occasionally, flash floods flow through the drainage system. Impacts of these floods are generally limited to temporary closure of roadway crossings. More severe flooding has occurred in the Planning Area. Unusually high surface flows were recorded in 1915, 1921, 1929, 1935, 1940, 1965, 1979, 1983 and 1993. Over bank flow did not occur in the urbanized portions of the Planning Area during the 1983 flood event. Channel cutting did occur in the urban areas. Erosional processes caused

millions of dollars worth of damage to private property, roadways, bridges and public utility networks. Extensive erosion-controlling channel improvements have subsequently been implemented.

The Santa Cruz River is the major surface drainage channel in the Planning Area. The river flows northward near the Metropolitan Area's western boundary. The Pantano Wash and Tanque Verde Wash drain the area's southeastern and eastern extents respectively. The Rillito River, originating at the confluence of Pantano and Tanque Verde Washes, provides surface drainage for the north-central portion of the Planning Area before discharging into the Santa Cruz. The area between the Santa Catalina and Tortillita Mountains is drained by the Canada del Oro Wash that also flows into the Santa Cruz River. All of the primary drainage channels are well entrenched.

The Santa Cruz River originates as a small southerly flow in the San Rafael Valley, looping down into Mexico, and then back up into the United States. Historically, the Santa Cruz was a perennial stream until it reached Tubac, where it went subsurface. From the late 1800s to the mid-1900s, the Santa Cruz reemerged in the San Xavier Mission area. Perennial flow in these sections of the Santa Cruz River maintained marshes, or cienegas. These segments of lush vegetation and plentiful water were localized and the other segments of the channel were characterized as dry, sandy riverbed (Betancourt and Turner 1985). The two major regional treatment plants discharge effluent into the Santa Cruz River channel, providing year around flows downstream from these plants. These two metropolitan plants are sited within the boundaries of the floodplain of the Santa Cruz River. Both plants, however, are at elevations greater than the anticipated 100-year flood event.

Climate

The Metropolitan Tucson Area is located within the Sonoran Desert and has a climate typical to the lower elevations in the American Southwest. Winters are mild and generally dry. The summer season typically lasts from May through September. During this period the daytime temperatures are generally above 100 degrees.

Almost one-half of the annual precipitation occurs during the summer months. Orographic, convectional air currents give rise to isolated thunderstorms. The remainder of the annual precipitation occurs primarily during the winter. Pacific storms occasionally travel far enough southward to bring slow moving, gentle storms to the Tucson area.

Drought conditions have been in affect since approximately 1997. While drought conditions are generally temporary, they have been known to last as long as 40 years. In comparison to the last seven years, the winter of 2005 brought more precipitation. While this could mean an end of the drought period, it will take several years of like precipitation to return to normal.

The general wind pattern within the Planning Area consists of light southeasterly winds in the morning and light northwest winds in the afternoons. Variations to the general pattern are introduced by the diurnal mountain-valley thermal gradients; superadiabatic air currents associated with summer thunderstorms and frontal storm systems altering regional airflow.

Air Quality

Topographic conditions of the Tucson Basin affect the area's air quality, particularly during the winter months. Thermal inversions trap pollutants (primarily vehicular combustion byproducts). Inversions occur year round, but are more persistent during the winter months.

Vehicular emissions are the primary sources of gaseous atmospheric pollutants. State mandated emissions inspections and improved automobile emission controls have reduced carbon monoxide levels below the higher levels observed during the early to mid-70s. The volume of vehicular traffic has steadily increased, leading to the required use of oxidant-containing fuels (e.g. gasohol) during

the winter months. The methanol added to the gasoline provides for more complete combustion and fewer combustion byproducts.

Particulates in the air are primarily the results of earth disturbing activities. Reduced particulate concentrations were achieved by paving unpaved streets and roads, reducing allowable speeds on the remaining unpaved roadways, and enacting and enforcing strict dust control levels at construction sites.

Biotic Communities

Three principal plant communities are found within the Planning Area: creosote bush, the palo verde-saguaro, and the riparian-woodland. Each plant community has an associated animal community, ranging from minuscule insects to large game animals and predators. These communities overlap in transition zones. As a response to environmental stress, animal species may relocate and adapt to a non-typical plant community. In the highly urbanized portions of the Planning Area, the natural plant and animal communities have been largely displaced and replaced by non-indigenous species.

The creosote bush community occupies most of the gently sloping basin floor in the undeveloped southern, southeastern and northwestern portions of the Planning Area. As slopes increase near the eastern, northern and western Planning Area boundaries, the creosote bush community yields to the palo verde-saguaro community. The riparian-woodland community is most apparent along Tanque Verde and Pantano Washes and their tributary washes and in isolated incidences along the Santa Cruz River and their tributary washes.

Archaeology

The Arizona State Museum has conducted general and site-specific archaeological surveys within the Planning Area. Archaeological findings to date indicate that the area's earliest inhabitants were the hunting and gathering Indians, who inhabited the area about 7000 B.C. Hunting and gathering groups were replaced by the agriculturally oriented Hohokam, who inhabited the Tucson Basin from about 500 to 1400 A.D. Pima Indians inhabited the basin from about the 1600s until Spanish settlement began in the mid-nineteenth century. Artifacts from each of the Tucson Basin's inhabitants have been found.

Existing archaeological records for the area suggest that potentially significant archaeological sites remain undiscovered within this large Planning Area. Conducting detailed archaeological surveys of proposed conveyance system routes or new wastewater treatment plants prior to construction will aid in the preservation of the archaeological resources.

Cultural Characteristics

Economic Base

The economic base of the Planning Area has gradually shifted away from agriculture and copper mining toward high technology and service industries. Education, military and government services play important roles in maintaining the Planning Area's economic base. Tourism and recreation have become increasingly important to the economic base.

Employment Trends

The ten major employers within the Planning Area are the University of Arizona, Raytheon Missile Systems, State of Arizona, Davis-Monthan Air Force Base, Tucson Unified School District, Pima County, City of Tucson, Wal-Mart Stores Inc. and the Carondelet Health Network. These are followed by, Tohono O'Odham Nation, TMC HealthCare, University Medical Center Corp., Pasqua Yaqui Tribe, U.S. Border Patrol, Pima Community College, Sunnyside Unified School District, Northwest Medical Center and Fry's Food and Drug Stores.

Governmental activities are focused in downtown Tucson, as is a significant portion of the finance, real estate and insurance sector. The trade and service sectors are widely scattered throughout the Planning Area. Manufacturing is generally concentrated along Interstate 10 and adjacent to the Union Pacific railroad tracks. Employment within the construction sector generally follows a cyclic pattern, with years of high activity followed by years of low activity.

The current general employment trend in the Planning Area is for increased employment in the service and hotel/lodging sectors. High technology manufacturing has been strong with Raytheon being the most notable in this sector. The long-term outlook predicts continued growth with firms immigrating to the area to take advantage of the favorable climate, the semi-skilled to skilled labor force, and the low cost of living.

Population and Land Use

Land Uses

Land use within the Planning Area is determined by the planning and zoning agencies of the incorporated communities and, in unincorporated areas, by the Pima County Department of Planning and Development Services.

Sonoran Desert Conservation Plan

The Sonoran Desert Conservation Plan, which received the American Planning Association's 2002 Outstanding Planning Award, covers a 59 million-acre portion of the Sonoran Desert ecosystem in Pima County, Arizona - one of the fastest growing counties in the U.S. The County Administrator and Board of Supervisors initiated the plan in 1998 in response to conservation needs for a handful of rare species, most significantly the federally listed cactus ferruginous pygmy owl. The purpose of the plan is to ensure the long-term protection of "the heritage and natural resources of the west in Pima County." The Sonoran Desert Conservation Plan contains six areas of focus: Protection of Critical Habitat, Biological Corridors, and Mountain Parks, Riparian Restoration, Historic and Cultural Preservation and Ranch Land Conservation. Over 205 reports have been produced, including a mapped conservation reserve design that prioritizes the protection of the region's biodiversity by applying the six areas of focus above. In the future, Pima County plans to apply for a multi-species Habitat Conservation Plan permit under the U.S. Endangered Species Act to allow less protections for 55 federally listed species in exchange for habitat protection in the conservation reserve system.

The effort has created a partnership among more than a dozen local, state, and federal land management agencies that together have authority over 97 percent of the 59-million-acre planning area. It has involved more than 5,200 participants in various committees, task forces, advisory groups and study teams. The process has been open to the public and based on partnerships. The Pima County Board of Supervisors led the effort, coordinating with 12 major government land managers and about 40 community groups.

In December 2001, Pima County incorporated the Sonoran Desert Conservation Plan into its comprehensive land use plan. The comprehensive land use plan addresses many problems caused by urban sprawl, such as a declining tax base, land consumption, water availability, and a loss of cultural identity. It prescribes the Sonoran Desert Conservation Plan to address natural and cultural resource protection and incorporates the conservation reserve design into a Conservation Lands System categorizing future land use in all unincorporated lands in the planning area. The land use categories in the Conservation Lands System include: Important Riparian Areas, Biological Core Areas, Scientific Research Management Areas, Multiple Use Management Areas, Recovery Management Areas, Agriculture within Recovery Management Areas and Critical Landscape Connections.

The planning process generated a series of policy changes and conservation achievements. Over the last few years a series of ordinances were passed that seek to protect biological resources while maintaining better quality urban design. Ordinances include buffer overlay zones around biological preserves, hillside development restrictions, riparian habitat mitigation, native plant protection, conservation subdivisions, big box store limitations and home design standards. The research and inventory work of the plan generated the scientific and historical justification for two new Bureau of Land Management areas: the Ironwood National Monument and Las Cienegas National Conservation Area. Also, Pima County acquired and protected substantial ranch and parklands and riparian areas. Finally, many policies were adopted that introduced and institutionalized standards in the built environment for growth areas, mixed use development, inclusionary and mixed income programs, transit oriented development to promote the neighborhood unit, concurrency based on level of service standards, infrastructure service area boundaries and water conservation. (Compiled from Biodiversity Partners website www.biodiversitypartners.org).

Population Trends

The population of the Metropolitan Planning Area has steadily increased since the late 1940s, growing to 265,660 in 1960, 431,400 in 1980, and 843,746 in 2000. This trend is expected to continue throughout the 20-year planning period covered by this Facility Plan Update. Pima Association of Governments (PAG) June 2005 Population Growth Forecast for the Planning Area projects an increase in population of about 11 percent between 2005 and 2010, 10 percent between 2010 and 2015, 9 percent between 2015 and 2020, 8 percent between 2020 and 2025 and 8 percent between 2025 and 2030.

SUB-CHAPTER 2.2 METROPOLITAN PIMA COUNTY SEWER HISTORY

The first public sanitary sewers in Pima County were installed in Tucson in 1900, and the first wastewater treatment facility was constructed in 1928. Prior to construction of the treatment facility, wastewater was used directly for farm irrigation. In 1951 Phase 1 of the City of Tucson's Roger Road WWTP began operation, and in 1961 the Pima County Sanitary District #1 installed the first wastewater treatment lagoon at the Ina Road WPCF site. This sanitary district was dissolved in 1968 and replaced with the Pima County Department of Sanitation, which was later renamed the Pima County Wastewater Management Department in 1978.

In 1974, the City of Tucson and Pima County created, through an intergovernmental agreement, the Metropolitan Utilities Management Agency. The City and County created this agency to coordinate the operations of water and sewerage systems within the Tucson city limits and the unincorporated areas of Pima County (PAG, 1975). However, the City of Tucson and Pima County continued to operate their respective sewerage systems. The joint agency was dissolved in 1976.

Also in 1974, the Governor of Arizona designated Pima Association of Governments (PAG) as the Designated Planning Agency (DPA) for Pima County. The PAG 208 Plan was completed in 1978, and it identified both Pima County and the City of Tucson as Designated Management Agencies responsible for sewerage facilities. However, the EPA preferred a single management agency, and the 1978 PAG 208 Plan recommended consolidation of sewage treatment programs in the metropolitan area.

In 1979, the ownership and all responsibilities for the construction, operation, and maintenance of the City of Tucson's sewerage systems were transferred to Pima County. In recognition of the pending consolidation of facilities, the PAG Regional Council passed resolution 78-12-07 in December 1978 requesting the Governor designate Pima County as the single 208 Designated Management Agency (DMA) for municipal wastewater treatment and sewer system operations. This designation is noted in a 1980 amendment to the 1978 PAG 208 Plan.

The 1979 IGA, transferring the sewerage system, stipulated the City of Tucson would own and have unilateral control over the use and disposition of effluent discharged from metropolitan treatment facilities. The IGA stated that Pima County was entitled to up to 10 percent of the effluent for use on County parks, golf courses and recreational facilities. A supplemental IGA between Pima County and the City of Tucson was negotiated in 2000. It addressed control of effluent from non-metropolitan facilities, access by other water providers to effluent derived from their water supplies, and establishes a conservation pool of up to 10,000 AF per year for use of effluent in habitat conservation plans or other approved projects.

Pima County remained the sole DMA in the PAG planning area until March 1999, when the PAG Regional Council approved a 208 Plan Amendment designating the Town of Sahuarita as a management agency. The area designated for the new Sahuarita DMA encompassed the incorporated Town of Sahuarita limits excluding areas already served by Pima County. No additional DMAs have been proposed.

Early Operational History

Pima County and City of Tucson have a history of wastewater collection and treatment activities dating to the beginning of the 20th century. The Metropolitan Area system has progressed significantly from the initial collection system of several miles utilizing raw wastewater irrigation as treatment to the present 3,300 miles of interceptors and 69 MGD of advanced wastewater treatment capability. A chronology of early 20th Century activities is shown in Table 2.1.1.

Table 2.1.1 Operational History of Pima County and City of Tucson Wastewater Collection and Treatment Systems

Year	Operational History
1900	Installed first sewer on Main Avenue between 17th Street and St. Mary's Road. Raw wastewater was used for irrigation.
1917	Installed 30-inch outfall paralleling Southern Pacific Railroad tracks from St. Mary's Road north to Sunshine Lane and west across Santa Cruz River. Raw wastewater was still used for irrigation.
1928	Constructed primary treatment plant at outfall terminal. Primary effluent was used for irrigation.
1942	Enlarged and improved existing primary plant. Primary effluent still used for irrigation.
1948	Formed Sanitary District, resulting from a study to handle problems within the County and outside city limits.
1951	Constructed a 12 MGD activated sludge treatment plant and put into operation at West Sweetwater Drive near highway (present site of the Roger Road WWTP). Old, primary plant abandoned and flows diverted to new plant through a 42- and 48-inch outfall sewer extending from Sunshine Lane.
1955	Sold balance of effluent for irrigation use.
1960	Completed expansion of facilities to increase combined treatment capacity to 24 MGD. New plant was a high-rate trickling filter in parallel with existing plant.
1968	Completed expansion of facilities to increase combined treatment capacity to 36.9 MGD. New plant was activated sludge treatment in parallel with other two plants.

Recent Operational History

In the early 1970s, to protect the public health and to conserve water resources in the water-conscious Tucson area, a comprehensive review of the water, wastewater, and refuse handling was undertaken. A study was authorized by PAG and resulted in "A Regional Plan for Water, Sewage, and Solid Waste Management." The report concluded that the most economical way to meet the wastewater treatment needs of the rapidly growing Tucson Metropolitan area would be to construct a regional treatment facility at the Ina Road WPCF to the north and west of Tucson. In addition, the PAG study recommended reusing the wastewater generated at the local and regional treatment plants whenever economically and institutionally possible.

This recommendation led to the construction of the 25 MGD Ina Road WPCF in 1975. This plant replaced Pima County's existing treatment facility, which was comprised of 22 acres of oxidation ponds. The plant was constructed as a high-pressure pure oxygen (HPO) activated sludge system and was operated by Pima County. As part of the PAG report recommendations, a 1.5 MGD plant was constructed by the City of Tucson at Randolph Park in 1975 to utilize treated effluent for irrigation of the park's two golf courses and also to relieve capacity issues on the wastewater conveyance in the area.

A major milestone was achieved in 1979 regarding a regional approach to wastewater conveyance, treatment and reuse. An Intergovernmental Agreement (IGA) with the City of Tucson gave Pima County the responsibility to construct all capital projects and maintain and operate the facilities necessary to insure compliance with existing Federal (EPA) and State (ADEQ) wastewater requirements.

Pima County completed its first major plant retrofit at the Roger Road WWTP in 1982 by modifying the high-rate trickling filter (Plant 2) to bio towers and increasing the capacity of Plant 2 from 12 MGD to 30 MGD. At the same time, the two activated sludge treatment systems, Plants 1 and 3, were taken off line. This resulted in a reduction in the total net capacity of Roger Road WWTP from 36.9 MGD to 30 MGD. The activated sludge plants were taken off line due to operational problems.

To improve handling efficiencies of digested sludge (biosolids) generated at the Roger Road WWTP and Ina Road WPCF, a 5.3-mile sludge force main was constructed in 1987. Since its startup, all sludge thickening and disposal operations for both the Roger Road WWTP and Ina Road WPCF have been conducted at the Ina Road WPCF.

It became apparent in the late 1980s and early 1990s that capacity at the Roger Road WWTP needed to be increased. Prior to any major plant improvement, the plant operators utilized Plant 3 activated sludge processes during known periods of high flow to ensure the effluent from the Roger Road WWTP was within permit limits. The first major retrofit was accomplished in 1997 after the installation of additional primary and secondary digesters, two more primary clarifiers, and other components to the activated sludge process. The resulting capacity was 11 MGD for the activated sludge system with a net capacity of 41 MGD at the Roger Road WWTP. At present, the activated sludge portion of the Roger Road WWTP facility is utilized for supplemental treatment during a majority of the year in order to produce a high quality effluent for delivery to the Tucson Water reclaimed water system.

In 1996, the Randolph Park WRF was taken out of service and reclaimed irrigation water for the park was provided by the City of Tucson's reclaimed water distribution system utilizing effluent from the Roger Road WWTP.

In 2003, the Randolph Park WRF underwent a major upgrade and expansion to produce 3 MGD of effluent for reuse with an ADEQ reuse classification of A. The plant utilizes an activated sludge membrane bioreactor (MBR) treatment process. The effluent from the Randolph Park WRF is discharged to the Tucson Water Reclaimed Water System for beneficial reuse, such as golf course irrigation and riparian restoration.

Currently, the Ina Road WPCF is in the final construction phase of being expanded by 12.5 MGD with a new process train to run parallel to the existing pure oxygen activated sludge plant. The new train will be a biological nutrient removal (BNR) system (via nitrification-denitrification) using anoxic and aerobic basins. This activated sludge treatment system has the objective of denitrification of the 12.5 MGD resulting in a net reduction of nitrogen in the Ina Road WPCF discharges to the Santa Cruz River.

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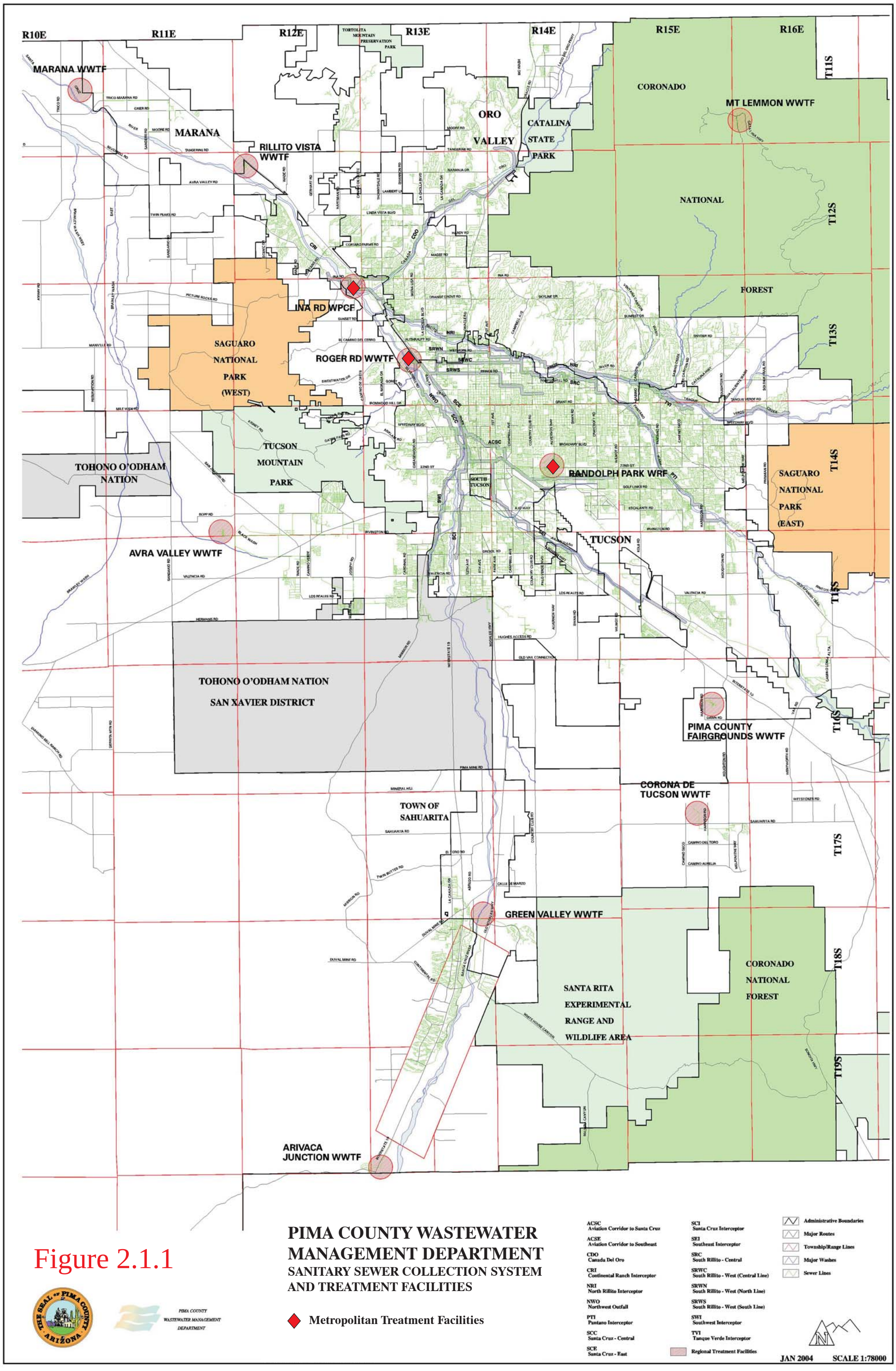


Figure 2.1.1

Chapter 3 Facility Plan Drivers

CHAPTER OVERVIEW

Pima County Wastewater Management Department (PCWMD) recognizes that various drivers influence the direction a utility can take when planning and managing assets. Four drivers were identified as having the potential to impact the overall planning process. These include: regulatory drivers, institutional drivers, asset management, and population effects. Chapter 3 discusses each driver as it relates to the planning process. The future system improvements are evaluated against these drivers in Chapters 4 and 5.

Regulatory Drivers

Major regulatory drivers impacting PCWMD Facility Planning are Federal, State and local regulatory programs for water quality including surface water discharges, groundwater discharges and reuse activities; Federal and State regulatory programs for biosolids production and disposal; and Federal, State and local regulatory programs for air quality regulations.

The relevant programs and permits for Pima County Wastewater include the Arizona Pollution Discharge Elimination System (AZPDES) for effluent quality and biosolids, Arizona Aquifer Protection Permit Program (APP) for groundwater discharge, Arizona Reclaimed Water permits, and the Pima County Department of Environmental Quality permit for air quality. PCWMD maintains and updates, as necessary, permits associated with the wastewater treatment and collection system. Pima County meets current permit requirements.

All these regulatory program mandates, as well as specific facility permits issued under these programs, impact the future regulatory requirements of the Metropolitan Wastewater Treatment System. These potential impacts include: ammonia and total nitrogen removal requirements at the treatment plants; future regulations for discharges to effluent-dependent waters; Capacity, Management, Operations and Maintenance (CMOM) regulations for the conveyance system; and biosolids regulations. Thus, regulatory requirements will be significant drivers for new Capital Improvement Program (CIP) projects and CIP implementation schedules.

Asset Management

Pima County has an ongoing asset management program. Asset management is gaining importance in effective management of wastewater facilities as new CMOM regulations (ADEQ R18-9-C305, 2.05 General Permit) are being formulated at the Federal and State level. With the adoption of General Accounting Standards Board (GASB) 34, wastewater utilities have to follow mandatory financial standards when reporting on the financial health of an agency. Maintaining the integrity of the wastewater treatment and collection systems is an important part of improving the overall operation of the wastewater system. PCWMD maintains and preserves its wastewater assets through periodic maintenance, replacement or rehabilitation projects.

Institutional Drivers

Pima County has many institutional constraints. These constraints include:

- Statutory Authority.
- Intergovernmental Agreements (IGAs).
- Bonding and Covenants.
- Litigation and Settlements.

Pima County is unusual in that it is specifically authorized by State legislation to own and operate a sewer system. Pima County is designated as the wastewater management authority by the Pima Association of Government (PAG) and has adopted wastewater ordinances and entered into IGAs with the local jurisdictions in support of the 208 Plan mandate to provide for the regionalization of wastewater services in Pima County. Under the 1979 IGA with the City of Tucson, Pima County retains 10 percent of the effluent from its metropolitan area treatment facilities and 90 percent is owned by City of Tucson. This agreement also requires Pima County to maintain the effluent quality in accordance with Federal and State discharge standards.

PCWMD operates as an enterprise fund. This allows the Department to devote all its revenues to the operation, maintenance, and expansion of the regional wastewater system. PCWMD charges new users for connecting to the system and collects sewer fees from users. The Department has secured funding for large projects both through selling bonds and obtaining public infrastructure loans. As a result, PCWMD is required to maintain its operations in compliance with covenants to the bond purchasers and the public financing authorities.

PCWMD is also constrained by litigation settlements. Water Rights to effluent in Pima County are impacted by a settlement agreement in the case of United States v. City of Tucson, No. CV 75-039 TUC FRZ. The litigation in this case was resolved via passage and adoption of Public Law 108-451 (also known as the Southern Arizona Water Rights Settlement Act) and various implementing agreements. As the ultimate settlement of the case, the law anticipates that 28,200 acre-feet of effluent annually will be made available to the Bureau of Reclamation.

In summary, PCWMD operates within the institutional framework established by PAG, by way of the DMA designation and 208 Plans, as well as, the State enabling legislation, including the bonding authorization and IGAs with local jurisdictions.

Population Effects

The population in the Planning Area is growing at a rate of 2.2 percent per year. The 2006 Metropolitan Area Facility Plan Update (Facility Plan) uses population forecasts developed by PAG to predict growth. The population in eastern Pima County is expected to grow from 916,026 in 2005 to 1,496,045 in 2030. This equates to Metropolitan Area (Roger, Ina and Randolph treatment plants and tributary areas) wastewater collection and treatment improvements to handle a total of 85.05 million gallons per day (MGD) in 2030 based on a GIS model (The Model) developed specifically for the Facility Plan by Pima County. The Model was calibrated based on collection system and treatment plant flow monitoring. The Model will be updated by PCWMD for continuous use in analysis of improvements to the wastewater system. Based on the PCWMD planning criteria of 85 gallons per capita per day, the facilities will need to handle an additional 1 MGD Average Dry Weather Flow (ADWF) for every 11,765 new residents served by PCWMD.

The flow projections from Chapter 3 are compared to the current operating systems within PCWMD's treatment and collection system in Chapters 4 and 5. These comparisons allow Pima County to effectively manage the wastewater flow and plan collection and treatment system improvements based on capacity requirements to address planned growth.

SUB-CHAPTER 3.1 REGULATORY DRIVERS

The purpose of Sub-Chapter 3.1 is to discuss the regulatory drivers influencing PCWMD facility planning activities. Primary regulatory drivers include surface water, groundwater (or aquifer) and reclaimed water regulations. Other regulatory drivers include programs such as biosolids and air quality. For the most part, surface water protection and air quality requirements are governed by State of Arizona regulations administered by the Arizona Department of Environmental Quality (ADEQ), many which have their genesis in Federal Clean Water Act (CWA) requirements. In contrast, groundwater and reclaimed water quality requirements are governed solely by State of Arizona state-specific regulations.

Facility Compliance Status

Currently, PCWMD holds 38 permits to operate the facilities providing wastewater treatment services to Pima County residents. PCWMD is in compliance with existing Federal, State and local permit requirements, and is the recipient of numerous awards from the Association of Metropolitan Sewerage Agencies (AMSA) for its compliance history. For example:

- Roger Road WWTP –Gold Award in 1989; Silver Awards in the following years: 1987, 1990, 1991, 1992, 1995, 1998, 2000, 2001 and 2005.
- Ina Road WPCF –Silver Awards in 1990, 1991, 1994, 1996, 1999, 2001, 2003 and 2005.
- Gold Awards for the Avra, Green Valley and Marana treatment facilities in 2005.

Future Regulatory Compliance

Mandatory regulatory compliance requires a sustained program effort. Frequent changes in regulations result in changes in the discharge requirements associated with each of PCWMD's facility discharge permits. Maintaining compliance in all facilities all the time remains a constant challenge. To facilitate this effort, facility plans, such as this one, must be regularly updated so Pima County can project its capital expenditure needs in the 20-year planning horizon.

Changes in environmental regulations, associated permit renewals and facility expansion plans all contribute to an ever changing regulatory landscape for the Department. Currently renewals of the AZPDES permits for the two largest metropolitan treatment facilities, the Ina Road WPCF and Roger Road WWTP, are in process with ADEQ since their expiration in November of 2004. Specific requirements for nitrification/denitrification improvements at both facilities as well as acute and chronic Whole Effluent Toxicity (WET) testing for potential in-stream toxicity to the aquatic environment are being included in the renewed permits. These requirements will require substantial improvements to both facilities and are discussed in more detail in the last section of this chapter.

Arid West Water Quality Research Project

As already noted, surface water quality regulations are constantly evolving. However, the foundation for many of these regulations is based on national guidelines with limited applicability to arid West waters, especially effluent-dependent and ephemeral waters. Effluent-dependent waters (aquatic environments created as a result of the discharge of treated effluent to an otherwise dry or intermittent streambed) represent unique aquatic ecosystems. EPA, through the Arid West Water Quality Research Project (AWWQRP), is funding interdisciplinary research in this area. Pima County was selected to manage the AWWQRP based on its experience with these extreme arid West conditions.

Research conducted to date has noted how arid West waters contrast markedly with the relatively stable aquatic habitats characteristic of Midwestern and Eastern regions. In the arid West, aquatic communities are largely controlled by the physical conditions that tend to be harsh and extremely variable. Effluent-dependent waters, such as the Santa Cruz River in the Planning Area, represent unique stream ecosystems consisting of a highly variable ephemeral system into which effluent flow introduces significant changes in ecosystem characteristics. For example, as was demonstrated in the AWWQRP-funded Habitat Characterization Study, the physical and chemical template established by the discharge of effluent exerts important controls on the potential composition of the aquatic community. Accordingly, gaining an understanding of what is attainable in effluent-dependent waters such as the Santa Cruz River ultimately may have a significant influence on establishing appropriate surface water quality regulations in the future. A brief description of all the research activities conducted by the AWWQRP is provided in Appendix A.

Permitted County Wastewater Facilities

PCWMD currently operates twelve permitted wastewater treatment facilities. The permits required for each facility are dependent on how the facility disposes its effluent. Effluent is discharged or reused in the following ways:

- Surface Water: Requires an Arizona Pollutant Discharge Elimination System (AZPDES) permit.
- Groundwater: Requires an Aquifer Protection Permit (APP).
- Reuse: Requires a Reclaimed Water Permit (but may be issued as part of an APP).

In addition to these discharge-permitting options, each facility may also need to comply with stormwater discharge, air quality and biosolids regulations.

Of the twelve permitted PCWMD facilities, seven hold permits to discharge treated effluent to surface waters under the jurisdiction of the CWA ("jurisdictional waters"). Most of these facilities have aquifer protection permits and several have permits for reuse of treated wastewater. The remaining facilities do not discharge to jurisdictional waters, but have other applicable permits (e.g., aquifer protection or reuse) as shown in Table 3.1.

Table 3.1 Pima County Permits and Jurisdictional Waters Receiving Treated Effluent

WWTP Conveyance System	AZPDES	APP	Reclaimed Water	Storm Water / Air Quality	Jurisdictional Waters
Arivaca Junction WWTF	N/A	P-100640	R-105345		
Avra Valley WWTF	AZ0024121	P-100642	R-105498	AZMSG-6893	Black Wash
Corona De Tucson	N/A	P-100644			
Green Valley WWTF		P-100629	R-100629	AZMSG-6894	Santa Cruz River
Ina Road WPCF	AZ0020001	P-100630	R-100630	AZ0020001/1903	Santa Cruz River
Kino Ecosystem Restoration Project	AZ0025291	[1]	[1]		Santa Cruz River
Marana WWTF	AZ0020001	P-100631	R-100631		Santa Cruz River
Mt. Lemmon WWTF	AZ0022250	P-100345		[1]	Unnamed Wash
Pima County Fairgrounds	N/A	P-100634			
Randolph Park WRF	AZ0025383	P-103617	[1]		Santa Cruz River
Rillito Vista WWTF		P-100636			
Roger Road WWTP	AZ0020923	P-100655	R-105471	AZ0020923/1913	Santa Cruz River
Wastewater Conveyance System		General Permit 1.10			

[1] Other Agencies hold associated APP or Reuse permits.
[2] Other Federal permits apply.

Treatment: Regulatory Requirements

The choice of where and how to discharge treated effluent determines which permits are necessary for facility operation. Each of these permits contains treatment requirements based on the final or end use of the water. It is important to recognize the primary regulatory driver for treatment requirements is not the permit per se, but the requirements established to protect the end use of the treated effluent. For example, if the treated effluent is discharged to jurisdictional water, the treatment requirements are dependent on the uses of that waterbody. Similarly, if the treated effluent is reused, then the treatment requirements depend upon the type of reuse. Following is a brief discussion of the regulatory programs that ultimately dictate the treatment requirements established in each facility's discharge permit.

Surface Water Protection

Surface water protection requirements and activities are currently one of the primary regulatory drivers dictating treatment requirements at PCWMD facilities. Water quality standards establish the basis for effluent quality requirements. These requirements evolve as the standards are revised approximately every three years. Often these requirements become more stringent with passing time. In addition, ADEQ regularly assesses water quality in jurisdictional waters. If the State identifies a water quality impairment in a surface water receiving treated effluent, a strong likelihood exists that treatment requirements will become more stringent. The following section discusses these regulatory drivers.

Surface Water Quality Standards – The 1972 Clean Water Act (substantially amended in 1987), and previous amendments of the Water Pollution Control Act of 1948, provides the current framework for surface water quality regulation in the United States and Arizona. The objective of the CWA is "to restore and maintain the chemical, physical, and biological integrity of the Nation's water"

(Section 101(a)). CWA Section 303 requires states to establish water quality standards for all surface waters under CWA jurisdiction. ADEQ administers this duty for Arizona.

Surface water quality standards include three components - designated uses, water quality criteria and an anti-degradation policy. ADEQ has established designated uses on jurisdictional waters throughout Arizona, which must be protected when treated effluent is discharged. PCWMD facilities that are permitted to discharge to jurisdictional waters and the uses which must be protected include:

- **Avra Valley WWTF** - Black Wash; Aquatic & Wildlife (ephemeral), Partial Body Contact.
- **Green Valley WWTF** - Santa Cruz River (Tubac Bridge to Roger Road WWTP Outfall); Aquatic & Wildlife (ephemeral), Partial Body Contact, Agricultural Livestock.
- **Ina Road WPCF** - Santa Cruz River (Roger Road WWTP Outfall to Baumgartner Road); Aquatic & Wildlife (effluent-dependent water), Partial Body Contact.
- **Kino ERP** – Santa Cruz River (Tubac Bridge to Roger Road WWTP Outfall); Aquatic & Wildlife (ephemeral), Partial Body Contact, Agricultural Livestock.
- **Marana WWTF** – Santa Cruz River (Roger Road WWTP Outfall to Baumgartner Road); Aquatic & Wildlife (effluent-dependent water), Partial Body Contact.
- **Mount Lemmon WWTF** – Unnamed Wash; Aquatic & Wildlife (ephemeral), Partial Body Contact.
- **Roger Road WWTP** - Santa Cruz River (Roger Road WWTP Outfall to Baumgartner Road); Aquatic & Wildlife (effluent-dependent water), Partial Body Contact.

Water quality criteria are established to protect the designated uses and include both narrative and numeric criteria. The narrative criteria generally require all waters, regardless of the designated uses, be “free from pollutants in amounts or combinations” that could have various adverse effects, such as being “toxic to humans, animals, plants, or other organisms.” The numeric criteria provide protection for each of the designated uses; the numeric thresholds vary depending on the type of receptor (e.g., humans, fish or wildlife).

The anti-degradation policy defines how the State implements water quality criteria to protect designated uses, for example through the establishment of a discharge permit. The policy, which is actually a regulation, separates waters into three tiers: Tier 1 applies to all surface water to provide a minimum level of protection; Tier 2 applies to waters where the water quality exceeds the applicable water quality standards; and Tier 3 are waters designated as “unique” or outstanding national resource waters and no degradation of water quality is allowed.

ADEQ published final draft anti-degradation implementation procedures in November 2004. These procedures define how the anti-degradation policy is implemented in practice. Under this draft all jurisdictional waters to which PCWMD discharges are classified as Tier 1 waters. Accordingly, as long as the effluent discharged to these waters meets the applicable water quality standards, does not cause a violation of the standards, and meets applicable Best Available Technology requirements, the discharge may be permitted.

Water Quality Assessment

The CWA requires states to assess water quality data every two years to evaluate water quality standards attainment in jurisdictional waters. If adequate data from a waterbody shows the applicable standards are not attained, then the waterbody is found to be impaired and placed on the state 303(d) List or “Impaired Waters List.” Waters which have insufficient water quality data to place them on the impaired waters list, but have sufficient data to indicate a potential water

quality concern, are placed on the State's Planning List. Planning List waters become the priority for additional monitoring.

Total Maximum Daily Loads (TMDLs) typically are developed for impaired waters. Through the TMDL development process, regulators evaluate the cause of water quality standards non-attainment. The resulting TMDL establishes a plan to achieve water quality standards in the listed water – typically through activities intended to reduce pollutant loads. If a wastewater facility discharges to the impaired water, a common outcome of the TMDL process is more stringent effluent limitations, which require upgrades to treatment facilities.

ADEQ published its most recent Impaired Waters and Planning Lists in 2004. These lists will be updated in 2006. Currently, none of the waters receiving effluent discharge from PCWMD facilities are listed as impaired. However, three segments are on ADEQ's Planning List and will be subject to increased monitoring. These segments are:

- **Santa Cruz River, Roger Road WWTP to Rillito Wash** – This segment was assessed as "inconclusive" based on a lack of data to sufficiently assess attainment of the uses. Data were lacking for Escherichia coli, pH and dissolved metals (copper, cadmium, and zinc).
- **Santa Cruz River, Canada del Oro to Hydrologic Unit Code (HUC) Boundary 15050303** – This segment was assessed as "attaining some uses" and placed on the State's 2004 Planning List because of concerns regarding total residual chlorine concentrations. The specific data that resulted in this finding are published in ADEQ's 2004 Integrated 305(b) Assessment and 303(d) Listing Report. Two sample results were available for assessment. Of these two samples, one data result (480 µg/L) exceeded the aquatic life and wildlife acute and chronic criteria for total residual chlorine (11 µg/L and 5 µg/L, respectively).
- **Santa Cruz River, HUC Boundary 15050303 to Baumgartner Road** - This segment was assessed as "inconclusive" based on a lack of data to sufficiently assess attainment of the uses. Data were lacking for Escherichia coli, pH and dissolved metals (copper, cadmium, and zinc).

Aquifer Protection Regulations

State regulations require the operation of a wastewater treatment facility cannot cause an excedence of a groundwater quality standard. These standards are generally equivalent to the Federal maximum contaminant levels (MCLs) established to protect drinking water supplies. Compared to the surface water quality standards, the MCLs are relatively static, and only rarely change. Accordingly, more certainty exists regarding regulatory expectations for the protection of groundwater.

Reclaimed Water Regulations

An alternative to direct surface water discharge of treated effluent is to reclaim the water for reuse. Wastewater effluent that is treated and directly land applied for beneficial use, termed "direct reuse," must meet specific requirements for reclaimed water. ADEQ has established three primary classes of reclaimed water: A, B and C. Classification is based on treatment technologies that yield a particular effluent quality. For two of these classes, A and B, additional "+" classes (A+ and B+) have been established to recognize treatment technologies that result in reclaimed water nitrogen concentrations of < 10 mg/L. A decision on the treatment technology that should be applied to effluent to produce a particular quality of reclaimed water is dependent on the end use.

Other Applicable Regulatory Programs

There are other regulatory programs which affect treatment requirements either within the treatment facility or associated with the wastewater conveyance system. These programs include, but may not be limited to, wastewater pretreatment, biosolids handling, stormwater management and air quality. Although the cumulative regulatory requirements of these programs are significant from a

management standpoint, none of these programs are currently important regulatory drivers with regards to treatment facility expectations for the quality of the discharged effluent.

Facility Operation: Permit Requirements

PCWMD facility discharges are subject to three major permit programs: Arizona Pollution Discharge Elimination System (AZPDES), APP and Reclaimed Water. The applicability of these permit programs depends on the point of discharge. While these permit programs have technology-based requirements affecting the design and operation of wastewater facilities, it is the water quality-based permit requirements with the greatest impact on facility planning. Primarily, the regulatory programs, as previously noted, drive these requirements. Of these programs, it is the surface water protection requirements that ultimately have the greatest impact on permit requirements. Following is a brief description of the permit requirements associated with the operation of PCWMD facilities.

Arizona Pollutant Discharge Elimination System (AZPDES) Permits

Discharges to jurisdictional waters require an AZPDES permit. These permits require compliance with “technology-based” limits for certain constituents (e.g., biochemical oxygen demand and total suspended solids, and, where necessary, “water quality-based limits”). Water quality-based limits are required where it is determined the effluent discharge has a reasonable potential to cause an excedence of a receiving water quality standard. Because effluent-dependent waters are created by the effluent discharge, applicable water quality-based effluent limits are typically equivalent to the water quality criteria.

AZPDES permits also require WET testing to implement the narrative toxics criterion. Through the use of indicator test species, WET tests are intended to assess the cumulative or synergistic toxic effects associated with the effluent discharge. The most commonly used WET test species include: a fish (Pimephales promelas, fathead minnow); water flea (Ceriodaphnia dubia or Daphnia magna); and a green algae species (Selenastrum capricornutum). WET testing may assess both short-term, acute effects (mortality endpoint) and long-term, chronic effects (growth and reproduction endpoints).

AZPDES permits are generally valid for a 5-year period, but may be amended at any time if the circumstances that formed the basis of the original permit application change (i.e., as a result of the establishment of a more stringent water quality standard).

Aquifer Protection Permits

Aquifer Protection Permits are required for any discharge of wastewater either directly or indirectly to groundwater. Permits are issued either as individual or general permits. PCWMD facilities generally require individual permits, which include specific treatment performance requirements for new and existing facilities, as well as, a broad requirement to apply “best available demonstrated control technology” (BADCT).

Permit requirements for new facilities differ from requirements for existing facilities. If an existing facility is expanded or facility operations are changed, such as increased design flow, significant increase in pollutant discharge, or re-designation of point of compliance, the new facility permitting requirements are applied to the modified facility.

Reclaimed Water Permit

Currently, all PCWMD Reclaimed Water Permits are general permits. Effluent discharges permitted under the AZPDES or APP programs that are subsequently reused (i.e., withdrawn from an aquifer or receiving water at some point downstream of the discharge) are not considered direct reuse and do not require a separate Reclaimed Water Permit.

Three general permit categories are recognized. Type 1 applies to the use of gray water; Type 2 permits cover individual facilities; and Type 3 permits cover various situations including reclaimed water blending facilities, reclaimed water agents and specific gray water situations where the Type 1 general permit does not apply. Most PCWMD facilities, producing water for reuse, will be covered under the Type 2 General Permit. Permit requirements depend upon the quality of the effluent and the intended type of reuse.

Other Permit or Compliance Requirements

As noted, operation of wastewater facilities requires compliance with a number of other programs. Some of these programs require permits, but others are self-implementing and only require compliance with reporting requirements. Primary examples include:

- **Biosolids –** The biosolids program is self-implementing and imposes requirements on the generators of biosolids as well as the entities that further treat, distribute, or use the biosolids. In Arizona both the EPA and ADEQ have regulatory requirements for biosolids handling; however, ADEQ has received from EPA the complete jurisdiction of the biosolids program. Currently, compliance includes the submission of an annual report to both ADEQ and EPA. Biosolids program requirements are discussed in detail in Chapter 7.
- **Air Quality –** Permit requirements depend on how the discharging facility is classified (i.e., as a major or minor source). Currently, the Ina Road WPCF is classified as a Class I, major source, but the Roger Road WWTP is permitted as a Class II, synthetic minor source. In addition, the PCWMD also has two permits for portable engine generators. Appendix B contains additional information regarding air quality program requirements.
- **Stormwater Management –** Wastewater facilities are required to comply with Stormwater Quality Regulations. This program is currently administered under the Federal Multi-Sector General Permit (MSGP), but ADEQ is currently developing its own MSGP general permit. The MSGP is self-implementing through the filing of a Notice of Intent and establishment of a stormwater management plan for each facility. The major treatment facilities, Roger Road WWTP and Ina Road WPCF, have their stormwater requirements contained in their individual AZPES permits.

Facility Planning: Future Regulatory Drivers

The focus of this chapter has been on regulatory drivers – the regulatory requirements that drive facility treatment and operations requirements. The protection of jurisdictional waters (i.e., waters subject to CWA requirements) has been, and will continue to be, the most significant regulatory driver for PCWMD facilities. AWWQRP research is helping create a better understanding regarding alternatives to implement CWA requirements in arid West waters. However, the pace of regulatory change in surface water protection requirements, many of which are driven by the EPA, remains fast. These evolving requirements, as well as the regulatory changes anticipated in other regulatory programs expected to influence facility planning in the near term, are described below.

Regulatory Change

Surface Water Regulations

The regulations applicable to the protection of surface waters are never static and can be somewhat unpredictable. However, participation in ADEQ's water quality standards program (through participation in the Triennial Review process) and the impaired waters program (through participation in rulemaking activities and preparation of the biannual Impaired Waters List) will allow PCWMD to monitor likelihood of regulatory change. Following is a discussion of current key issues associated with each program with the potential to impact PCWMD facilities.

Triennial Review - Changes to the surface water quality standards occur about once every three years during the triennial review of water quality standards (CWA requirement). Changes to the standards, which affect water quality-based effluent limits, ultimately get translated into permit requirements; however, permit changes typically occur during a permit renewal rather than immediately after a change occurs in the standards. ADEQ is currently conducting its triennial review and expects to establish revised water quality standards in 2006. Anticipated revisions with the potential to impact PCWMD permits include:

- **Ammonia Water Quality Criteria** – Currently, no ammonia criteria are applicable to effluent-dependent waters. However, in the current triennial review, ADEQ is proposing to adopt both acute and chronic ammonia criteria. These criteria would likely be similar to the existing criteria applied to warm waters: acute - 10 to 20 mg/L ammonia -N, for pH in the range of 7.5 to 8.0; chronic - 2 to 3 mg/L ammonia N at pH of 7.5 to 8.0 and a temperature of 20 degrees C. Establishment of these criteria will require some PCWMD facilities to be upgraded to include nitrification/denitrification.
- **Adoption of Anti-degradation Implementation Procedures** - ADEQ's November 2004 final draft procedures establish effluent-dependent and ephemeral waters as Tier 1 waters. This designation greatly simplifies the application of anti-degradation requirements to PCWMD facilities. No baseline water quality analysis will be required to demonstrate the issuance of an AZDPES permit could result in the degradation of water quality. Instead, as is currently the case, the permit only must address compliance with water quality standards. PCWMD will need to track the finalization of the anti-degradation procedures to verify this approach is approved.
- **Adoption of Nutrient Criteria for Nitrogen and Phosphorus** – ADEQ is currently developing nitrogen and phosphorus criteria for lakes and has indicated it may eventually establish nutrient criteria for other waters including effluent-dependent waters. The Ina Road WPCF AZPDES permit currently includes a total nitrogen limit of 8 mg/L as part of a pilot study investigation. The aquifer protection permits for Ina Road WPCF and Roger Road WWTP include limits of 10 mg/L nitrate -N, with alert levels of 8 mg/L nitrate -N, but adoption of nutrient criteria could reduce allowable nitrogen levels below 8 mg/L nitrate -N. It is also not clear whether the ADEQ will establish phosphorus criteria, because it is currently believed that nitrogen is the limiting nutrient. Although no effort is underway in the current triennial review to establish nutrient criteria on waters to which PCWMD facilities discharge, PCWMD will need to monitor this issue closely in subsequent triennial reviews.
- **Narrative "Bottom Deposits" Criterion** - ADEQ is developing implementation procedures to address the narrative standard prohibiting pollutants that "settle to form bottom deposits that inhibit or prohibit the habitation, growth, or propagation of aquatic life." It is unknown what these procedures will contain or how they will be implemented in a practical sense. However, it is likely that the procedures will focus on controlling sediment inputs to surface waters and will rely on the use of a reference condition to identify where sediment load concerns exist. Until it is known how ADEQ intends to identify and measure concerns regarding bottom deposits, it is unclear how these procedures may impact Pima County. It is possible a new sediment criteria could result in more restrictive limits for total suspended solids discharged to surface water from PCWMD's wastewater treatment facilities, although the current focus of ADEQ's efforts is controlling sediment loads from stormwater discharges.
- **Narrative Biological Integrity Standard** – In the current triennial review, ADEQ plans to adopt a new narrative criterion to address the biological integrity in surface waters designated as warm water or cold water. The implementation procedures will rely on the use of reference conditions established separately for warm and cold water wadeable streams. At this time,

ADEQ does not plan to apply the proposed narrative biological standard to effluent-dependent or ephemeral waters. However, it is possible ADEQ could expand the applicability of this narrative in the future, but to do so will require establishing an appropriate reference condition for the biological communities in these waters. Currently, ADEQ is not developing these reference conditions.

- **Water Quality Assessment and Preparation of Impaired Waters List** – The methods by which ADEQ assesses jurisdictional waters and prepares the Impaired Waters List are dictated by State regulations and subject to EPA oversight. Placement of a waterbody on the Impaired Waters List can have significant impact on the operation of a wastewater facility. Accordingly, the preparation of this list and activities intended to modify the regulations that determine how this list is developed must be carefully monitored. ADEQ has proposed changes to the Impaired Waters regulations. If adopted as currently proposed in June 2006, the changes will significantly alter the listing methodology. The proposed changes also eliminate the Planning List, which serves as a notice to affected watersheds that the area is under enhanced scrutiny. The concept of a Planning List is a recommendation of the National Research Council to provide a means of ascertaining which waters are truly impaired. Removal of the Planning List could result in many more waters being listed as impaired and requiring a TMDL. Currently, three segments of the Santa Cruz River, to which PCWMD facilities discharge, are on the Planning List. These waters were placed on this list because insufficient data were available to make an impairment finding. If the regulatory changes result in these waters being placed instead on the Impaired Waters List, the potential impact to PCWMD facilities is significant.

Aquifer Protection Permit Regulations

Capacity, Management, Operations and Maintenance Permits - ADEQ has established a new general permit for CMOM (R18-9-C305, 2.05 General Permit) in the APP program. This program allows for a sequenced improvement of the conveyance system over a 10-year period. Compliance actions for sewage overflows under the CMOM program weigh the scope and progress of the maintenance program and conveyance system improvements. Accordingly, this new permit will allow for a planned improvement to the conveyance system in exchange for ADEQ consideration in accommodating small sewage overflows which do not pose a hazard to human health or the environment.

PCWMD's best option is to plan to participate in the CMOM program. Elements of this permit program will require expenditure of funds include:

- 10-year timeframe for the participant to fully maintain system capacity.
- Addressing management of upstream sewage systems - even those not under County jurisdiction, which may require establishment of agreements with tribal nations.
- Comprehensive maintenance plan with mandatory maintenance requirements.
- Mandatory scheduled cleaning cycles.
- Handling of emergencies without altering the cleaning cycle.
- Reporting requirements for sewage system releases.
- Capacity sizing criteria.

Odor Control – ADEQ has also modified the APP regulations to include a section on odor control major modifications of existing and new wastewater facilities. This rule states "The owner or operator of a sewage treatment facility shall not operate the facility so that it emits an offensive odor on a persistent basis beyond the setback distances specified in subsection (I)." At this time there does not appear to be measurable criterion specified for the enforcement of this rule. Older facilities,

such as the Roger Road WWTP, some force mains and some lift stations may be periodically out of compliance with the new rule regardless of PCWMD's on-going efforts to correct odor problems.

Potential Permit Changes

Issues related to AZPDES Permitting

The AZPDES permits for PCWMD's two major treatment facilities, Ina Road WPCF and Roger Road WWTP, have been modified in the renewal process to include new and/or more restrictive limits for various constituents. Currently, the renewed Ina Road WPCF copper limit is an acute value of 30 µg/L. The proposed Roger Road WWTP permit copper limit is 25 µg/L. Each of these permits contains a copper limit variance in order to give the Department time to investigate if a site specific copper limit is appropriate, given the nature of the discharged effluent and the receiving water characteristics. Pending the results of site specific studies, an interim limit of approximately 30 µg/L will be applied together with a 5-year compliance schedule. Ammonia and nitrogen removal from effluent discharge in the large and older wastewater plants has been an ongoing discussion of EPA and ADEQ for many years. Depending on the temperature and pH of the effluent, and the resulting exposure, ammonia can be harmful to aquatic species. Nitrates, in an aquatic setting, can promote alga growth and in an anaerobic setting, also convert to ammonia. However, for the last 20 years, the Ina Road WPCF and Roger Road WWTP facilities have been effectively "grandfathered in" due to their age into permit conditions appropriate to their level of technology. It should be noted, in response to the ongoing discussions with EPA and ADEQ, PCWMD has included nitrification/denitrification (NdeN) processes in the construction of its new 12.5 MGD treatment train at the Ina Road WPCF and obtained voter authorization for a 2004 Bond Project to install NdeN processes for the remaining 25 MGD treatment train at the Ina Road WPCF. In addition, all the larger outlying facilities, Green Valley WWTF, Avra Valley WWTF and Marana WWTF have NdeN processes. The same discussions regarding NdeN improvements are in a preliminary stage at the Roger Road WWTP.

In addition to the NdeN improvements, ADEQ has moved permit requirements from the Acute Standards generally used in past EPA issued NPDES permits to Chronic Standards, now regularly used in AZPDES permits. Acute Standards are generally regarded as those standards protecting short-term exposure to aquatic habitat. Chronic Standards are generally regarded as those standards protecting chronic, or long-term exposure to aquatic habitat. In addition to WET testing, chlorine removal is now required on all wastewater discharges to Waters of the U.S. due to the negative effects of chlorine to aquatic life. It should be noted, as ADEQ places more stringent limits on AZPDES permit requirements for PCWMD wastewater facilities, the pretreatment program (Industrial Wastewater Control or IWC) must reassess levels of pollutants which can be discharged into the conveyance system. If more stringent requirements are needed, local industries will have to upgrade pretreatment, at a potentially significant cost to those users. The IWC group itself must also expand in order to inspect and sample more frequently to provide the necessary stringent quality control on the discharge to the wastewater treatment plants.

Conclusions

Based on the regulatory drivers discussed in this sub-chapter, PCWMD should consider the following actions:

- Set as a goal the production of B+ or higher reuse water at all facilities by the end of the planning period.
- Address odor control at all wastewater facilities.
- Install Biological Nutrient Removal at both the Ina Road WPCF and the Roger Road WWTP during this planning period.

- ✓ The BNR for 25 MGD at Ina is included as Phase I and II from 2005-2014.
- ✓ The BNR for Roger Road WWTP will be phased in by 2015.

- Implement CMOM program for conveyance facilities and enhanced asset management for all facilities.
- Develop strategies for emerging environmental issues of significance, such as endocrine disrupters.
- Maintain strong relationships with EPA, the Federal Water Quality Coalition, ADEQ and others to have a proactive role in reviewing and configuring regulations and initiatives to reflect arid West conditions.
- Continue to support the work of the AWWQRP to assist regional water and wastewater agencies in applying national water quality regulations to the special conditions of the arid West.
- Develop a Class A biosolids process.

SUB-CHAPTER 3.2 INSTITUTIONAL FRAMEWORK

The following sub-chapter identifies the institutional and legal framework within which PCWMD operates, ranging from the Clean Water Act to Intergovernmental Agreements.

Clean Water Act

The objective of the Clean Water Act [33 U.S.C. § 1251 et. seq.] is to restore and maintain the chemical, physical and biological integrity of the Nation's waters. Pursuant to this objective, Congress declared it is the national policy that area-wide wastewater treatment management planning processes be developed and implemented to assure adequate control of sources of pollutants in each State.

Regional Water Quality Planning - the 208 Plan Process

To implement the Clean Water Act, the Governor of Arizona designated the Pima Association of Governments (PAG) as the regional water quality-planning agency for all of Pima County (excluding tribal lands) in 1975. As a result, PAG is responsible for administering the area wide wastewater treatment planning objectives outlined in the Clean Water Act [Section 208] in Pima County. Through PAG, local, State and tribal governments coordinate transportation, environmental quality and population growth planning efforts.

As PAG explains its role in this process,

> 208 Planning refers to Area-wide Water Quality Management Planning, which is required under Section 208 of the Clean Water Act. The development and implementation of the 208 Area wide Water Quality Management Plan, which includes all of Pima County except tribal lands, ensures that a regional approach is taken to water quality planning. The 208 Plan thus provides unified policy and management direction for control and utilization of wastewater in Pima County. The current 208 Plan consists of a document published in 1978 and all of the subsequent amendments to that document.
>
> Through the 208 Planning process, all local jurisdictions, (including Pima County, the cities of Tucson and South Tucson, and the Towns of Marana, Oro Valley, and Sahuarita), the business community, various industries, environmental groups, public interest groups, and the general public have an opportunity to participate in regional planning for water quality protection. Planning for the treatment of municipal wastewater is a key part of 208 planning. The 208 Plan identifies all of the existing wastewater treatment facilities in Pima County, as well as any facilities that have been proposed as part of approved plans.
>
> The 208 Plan emphasizes the regionalization of wastewater treatment, and discourages the proliferation of small, privately owned treatment facilities. Concerns about potential impacts to water quality, and long-term reliability of small plants also lend support to the concept of regionalization of wastewater treatment.
>
> It is 208 Plan policy to treat all wastewater in regional facilities, except for remote areas or areas where it can be clearly demonstrated that a small plant is environmentally and economically preferable to regional treatment from the point of view of the public good.

Regional Water Quality Management - The Designated Management Agency

PCWMD was designated as the wastewater management agency for most of eastern Pima County. PAG works closely with PCWMD and ADEQ to ensure implementation of the 208 Plan in Pima County.

The fact that PCWMD has been designated as the wastewater management agency authority under the Area Wide 208 Plan is due in part to the 1979 Merger of the City of Tucson and Pima County wastewater systems. In the State of Arizona, towns, municipalities and improvement districts generally perform wastewater treatment management. Pima County's authority to construct and operate a regional sewage system is derived from A.R.S. § 11-264, subsection (4):

> *Any county with a population between five hundred thousand and one million persons according to the most recent United States decennial census may purchase, construct or operate a sewage system, including the collection, transportation, pumping, treatment and disposal of sewage, and charge fees and levy taxes therefore, provided the county secures the assent by resolution of the governing bodies of those incorporated cities and towns representing not less than one-half of the population of the county prior to purchase, construction or operation of a sewage system, provided that once an initial assent is given no further assent is necessary to operate or improve the system.*

The legislature also conferred on Pima County the authority to issue revenue bonds for sewer projects. Pima County has implemented the regional sewer system by entering into intergovernmental agreements (IGAs) with the local jurisdictions, including the Cities of Tucson and South Tucson, and the Towns of Sahuarita, Marana, and Oro Valley. The essential terms of these agreements are the local jurisdictions' consent to Pima County's operation of regional sewer facilities, their grants to Pima County of access to their rights-of-way for the purposes of operating the regional system, and their consent to require service and design to Pima County requirements and standards. Pima County has also maintained working relationships and agreements for sewer service with the Tohono O'odham and Pasqua Yaqui governing bodies and is actively engaged in planning activities with these entities.

Pima County's intergovernmental agreement with the City of Tucson imposes additional requirements. These requirements arose out of the City of Tucson's transfer of its sewer system to Pima County to form a large percentage of the regional system. The obligations under the agreement with the City of Tucson, and the supplemental agreements that have followed, include the following terms:

1979 IGA

The IGA states all effluent from the Metropolitan Area treatment plants will remain under the unilateral control of the City except that Pima County is entitled to 10 percent of the effluent for use only on County parks, golf courses and recreational facilities and also for the Cortaro Marana Irrigation District. The Metropolitan Area is defined as an area that is or may be served by the Roger Road WWTP, Ina Road WPCF or Randolph Park WRF facilities, or by any collection and treatment facilities constructed which are physically integrated into the metropolitan sewerage system. The 1979 IGA further provides that Pima County maintain effluent quality at the Metropolitan Area treatment plants in accordance with Federal and/or State standards for discharge into waters of the United States. The City cannot require treatment in excess of NPDES permit standards and agrees to provide any additional treatment in excess of these standards in order to meet reuse plans.

2000 Supplemental IGA

The City of Tucson and Pima County entered into the Supplemental IGA, agreeing that effluent is an important long-term renewable source of water in the Tucson Active Management Area and the costs of treating it to Reclaimed Water standards should be borne by the users. The Supplemental IGA provides that up to 10,000 acre feet of effluent per year should be reserved for use in riparian projects with additional amounts to be made available if agreed to by both parties. The details of the use of this effluent in a conservation effluent pool agreement are currently being negotiated

with the City. Provisions have been included in the IGA to allow other water providers reasonable access to effluent so long as they pay all associated costs. (See Chapter 6 for details.)

The Supplemental IGA also provided that the City of Tucson waive its right to unilateral control over the use and disposition of effluent discharged from PCWMD's treatment plants in Non-metropolitan Areas, provided that if any of the effluent is put to a use, other than public use, that treatment and distribution costs are not passed on to City or County taxpayers within the City of Tucson. Pima County agrees to charge a fee per acre foot which is not less than the City's actual average per acre operating cost of production/treatment of reclaimed water during the previous fiscal year.

Additionally, through the Supplemental IGA, the City of Tucson and Pima County have agreed to restore the Randolph Park Treatment Plant (now the Randolph Park WRF) to operating use.

Implementation of the Regional Sewer System

As noted previously, Pima County, as the designated wastewater management authority, has adopted wastewater ordinances and entered into IGAs with the other local jurisdictions in support of the 208 Plan mandates to provide for the regionalization of wastewater services. Pima County is pursuing formal IGAs with the Tohono O'odham and Pasqua Yaqui nations for the sewer service being provided to these entities. Pima County has also entered into an agreement with Pinal County to provide sewer service to one development located just across the Pima County line, which is topographically tributary to Pima County's sewer system. PCWMD is a party to numerous master sewer service agreements and individual sewer service agreements, which the Department uses to plan, allocate and track capacity demand on conveyance and treatment facilities.

PCWMD operates as an enterprise fund. This allows the Department to devote all its revenues to the operation, maintenance, and expansion of the regional sewer system through a segregation of its funds from the general funds of Pima County and from other Pima County departments. The Department is accordingly in a position to establish the proper amounts that users should be charged for using the system and that new users should be charged for connecting to the system. The Department has used this financial independence to secure funding for large projects both through selling bonds and obtaining public infrastructure loans. As a result, PCWMD is required to maintain its operations in compliance with covenants to the bond purchasers and the public financing authorities.

Litigation Constraints

PCWMD is also constrained by the following litigation and settlements:

United States v. City of Tucson, No. CV 75-039 TUC FRZ. As the ultimate settlement of the case, the law anticipates that 28,200 acre-feet of effluent annually will be made available to the Bureau of Reclamation for purposes of resolving the litigation. (Also known as the Southern Arizona Water Rights Settlement Act.) The litigation in this case is being resolved via passage and adoption of Public Law 108-451 and various implementing agreements.

Financial Constraints

PCWMD establishes and maintains the sewer user fee and user charge system within the requirements of the Clean Water Act, under the auspices of the Arizona Department of Environmental Quality, which has been given primacy by the United States. The Department is also subject to the requirements of Resolution 1991-138, which sets out the bond covenants for the issuance of sewer revenue bonds.

Planning Constraints - Concurrency

To address the issues of infrastructure development in the rapid-growth areas of eastern Pima County, the Pima County developed and implemented a policy of concurrency – that is, that actual development cannot occur until available public infrastructure has the capacity to accommodate service demands caused by the new development. To accomplish this, PCWMD conducts concurrency reviews according to the Pima County policy. However, implementing the concept of concurrency has a very different impact on PCWMD than other Pima County departments. First, PCWMD has always required developers to install, at their expense, the entire sewer conveyance system for the development, as well as any off-site public sewer necessary to connect to the regional public sewer conveyance and treatment system. Second, PCWMD increases capacity at the major Metropolitan Treatment Facilities in major expansions of multiple millions of gallons per day, not just the capacity needed by individual developments. However, at the significantly smaller outlying treatment facilities, special problems are created by the speed and size of development impacting the available capacity of the existing base facility. Another constraint is that, as a regional entity that serves multiple jurisdictions as well as unincorporated Pima County, concurrency does not address all decisions related to the need for or provision of capacity and service. For these reasons, PCWMD is performing concurrency reviews on a case-by-case basis, especially in regard to the smaller outlying facilities, and working closely with Pima County Development Services and individual developers to accomplish the goals of the concurrency policy.

PCWMD has incorporated these policies into its operational and planning activities, including design and construction of interceptors and treatment facilities.

Environmental Constraints

In addition to the Clean Water Act, PCWMD operates under and must remain in compliance with numerous Federal and State mandates, including the National Environmental Policy Act (NEPA), the Federal Endangered Species Act (ESA), the Migratory Bird Treaty Act (MBTA), the Arizona Native Plant Law, the City of Tucson Native Plant Ordinance, the Town of Marana Native Plant Permit, the Town of Oro Valley Environmentally Sensitive Land Ordinance, and the Pima County Native Plant Protection Ordinance (NPPO).

Conclusion and Recommendations

PCWMD operates within the institutional framework established by PAG, by way of the DMA designation and 208 Plans, as well as, the State enabling legislation, including the bonding authorization, and the IGAs with local jurisdictions. Based on the discussion in this chapter, it is recommended PCWMD:

- Collaborate with City of Tucson in implementing the Long Range Water Plan in areas of mutual interest.
- Hold periodic IGA and sewer service review meetings with all the municipalities in PCWMD's service area, similar to the ongoing monthly meetings with the City of Tucson.
- Upgrade the working relationships with the Pasqua Yaqui Tribe and the Tohono O'odham Nation to the Intergovernmental Agreement level.
- Continue to work with other Pima County Departments and local jurisdictions on concurrency, Sonoran Desert Conservation Plan goals, and the beneficial reuse of effluent.

SUB-CHAPTER 3.3 ASSET MANAGEMENT

Sub-chapter 3.3 discusses the concept of asset management as applied to public water and wastewater agencies such as PCWMD. The concept of asset management is familiar to anyone owning or responsible for property, including homes, cars and boats as well as office buildings, apartments and factories. The asset must be maintained and preserved through scheduled periodic maintenance, replacement of failing or aging components and rebuilding/remodeling as needed for the asset to continue to serve its purpose. For public utilities like PCWMD, this responsibility is reinforced by both "best practices" standards in the wastewater industry and the fiduciary obligations to the holders of revenue bonds who require the system to function effectively in order to provide repayment for their investments.

Over the last several years, however, almost every water and wastewater industry conference, seminar and newsletter has highlighted asset management due to several significant recent developments. These include mandatory financial standards for government operations issued by the Government Accounting Standards Board (i.e. the GASB-34 standard) and proposed Federal and State regulations prohibiting Sanitary Sewer Overflows (SSOs) and requiring Capacity, Management, Operations and Maintenance (CMOM) programs. In addition, State and Federal Regulators have been issuing Consent Orders to public utilities mandating hundreds of millions of dollars of repair and rehabilitation construction as well as Enforcement Orders with multi-million dollar fines - all revolving around the alleged failure of the public utility to perform effective asset management. This sub-chapter will briefly review the concept of asset management, discuss each of these recent developments, note the present plans and activities of PCWMD in regards to these issues and make recommendations for asset management planning and implementation going forward.

General Accounting Office Comprehensive Asset Management Report

There are a number of policy papers and professional articles discussing the rationale for asset management but among the most significant is the General Accounting Office (GAO) Comprehensive Asset Management Report published in June 1999. The GAO Report details how Comprehensive Asset Management will help ensure the integrity of the Nation's infrastructure through a concerted effort to improve the management of key assets along with significant investment in maintaining, rehabilitating and replacing these assets. A summary of the document follows.

According to recent Federal government (EPA) studies:

1. Water and wastewater utilities need to invest billions of dollars towards their capital infrastructure over the next two decades.
2. If utilities maintain their current spending levels, financing the necessary investments is problematic.
3. Forty-one percent of wastewater utilities do not generate enough revenue from user rates and other local sources to fully cover their cost of providing service.
4. Fully one-third of the utilities:
   - ✓ Deferred maintenance because of insufficient funding.
   - ✓ Had 20 percent or more of their pipelines nearing the end of their useful life.
   - ✓ Lacked basic plans for managing their capital assets.
5. Each year, the Federal government makes available billions of dollars to assist local communities finance wastewater infrastructure projects (WIFA). Congress is considering a number of infrastructure related proposals, including requirements for local utilities to have Comprehensive Asset Management as a means of protecting the Federal government's investment.

The GAO Report goes on to note that asset management involves: collecting detailed information on assets, analyzing the information to set priorities, performing risk/criticality analyses, integrating data and decision making and linking strategy for addressing infrastructure needs to budgets and capital improvement plans.

PCWMD has already determined that asset management is a vital tool in operating the regional wastewater system. Work on asset management goals and objectives is in place or being accomplished and will be discussed later in this sub-chapter. It should be noted, there are many methods to accomplish these asset management goals and objectives - ranging from the elaborate processes adopted by Australia and New Zealand governments to the use of standard accounting/ asset inventory systems and engineering condition assessments. However, it is also important to highlight the financial, physical and regulatory requirements mentioned previously in order to communicate the total context of this issue for PCWMD.

Financial Requirements: GASB-34

GASB-34, adopted in June 1999, creates a financial reporting requirement for governments to document that the assets under their control, frequently purchased or constructed with tax free general obligation or revenue bonds, are accounted for, valued appropriately, and replaced as necessary for their functional purpose to be achieved. A certification, in annual audits and financial reports, is required to demonstrate that funding is available and utilized for the rehabilitation and replacement of components of these assets as appropriate. Pima County and PCWMD are implementing the Synergen system to accomplish the requirements of GASB-34.

Physical Requirements: Capacity, Management, Operations and Maintenance Programs for Conveyance Systems

The EPA and many State regulatory agencies have been, for the past decade, drafting and soliciting comments on new requirements to be added to wastewater agency federal and state discharge permits to improve the “capacity, management, operation, and maintenance” of municipal sanitary sewer collection systems and to improve public notification of SSOs. The rationale for the proposed rules is to reduce health and environmental risks caused by exposure to raw sewage, improve the performance of treatment facilities, and protect the Nation’s collection system infrastructure by enhancing and maintaining system capacity, reduce equipment and operational failures, and extend the life of sewage treatment equipment.

These rules would require governments which operate municipal wastewater collection systems to develop procedures to improve system capacity, perform long-term planning for investments in infrastructure, develop better documentation and asset management procedures and then share all of this information with stakeholders. It is important to note the Federal and State discharge permits, from the origin of the Clean Water Act in 1972 to date, have been chiefly concerned with the discharge of wastewater from treatment facilities and are very strict about the quality of the discharge and inappropriate spills or discharges of insufficiently treated wastewater. The SSO regulatory initiatives would extend this policy and related rules to all parts of the collection system and regulate backups from manholes to roads and alleys under the same provisions as spills and discharges from treatment plants into waters of the United States. These proposals place a very different regulatory context on a previously non-regulatory event – overflows from manholes. Instead of a simple operational response to clear the blockage and mop up the spill, an overflow becomes a regulatory event that must be reported, investigated and may be sanctioned with monetary or criminal penalties. The CMOM program concept was developed in response to the proposed SSO rules. The program would primarily help an agency eliminate or significantly minimize potential SSOs so the agency would run the collection system in the same very controlled

manner as the treatment facilities. In addition, an agency could use the CMOM program as an affirmative defense against sanctions should there be an overflow event. The fact that the agency had an aggressive maintenance program (i.e. CMOM program) would hopefully be considered when the agency was reporting or being investigated for conveyance spills or SSOs so the sanctions potentially would not be as severe as those for an agency which had no program.

Regulatory Requirements: Permits, Rulemaking, Enforcement Orders, Consent Orders

While the EPA has been moving at a very deliberate speed in advancing the SSO regulations nationally – and may never actually accomplish making the SSO concept part of the national Clean Water Act regulatory structure - many states have moved far more aggressively to incorporate these concepts into their individual regulatory structures. States, which have been delegated primacy under the Clean Water Act, have great flexibility in how they interpret the mandates of the CWA. SSO requirements for wastewater system maintenance and capital replacement can be, and have been, incorporated into discharge permits for treatment facilities, operational and capacity requirements for conveyance lines, enforcement orders for permit violations and consent orders. In the Southwest, both the cities of Phoenix and San Diego have recently been the recipients of enforcement orders requiring the governing bodies to make significant expenditures of funds for system maintenance, repair and rehabilitation. And, as noted earlier in this Chapter, ADEQ has establihed a new general permit for CMOM (R18-9-C305, 2.05 General Permit) in the APP Program.

Implications for PCWMD

PCWMD has initiated the following activities in regards to asset management to respond to GASB–34, the potential CMOM regulations from the State and Federal (R18-9-C305, 2.05 General Permit) regulatory agencies and the “best practices” standards for wastewater utilities:

- PCWMD has adopted a geographic grid system for conveyance maintenance ensuring that, while daily work orders are fulfilled for specific problems, a systematic routine of grid-by-grid inspections and cleaning means all areas of the system receive proactive maintenance.
- A comprehensive GPS survey of the conveyance system was undertaken to locate all 60,000 manholes and clean-outs as well as the invert elevation and condition of the manholes.
- Closed circuit television inspection (CCTV) coverage of 230 miles of the interceptor system equal to or greater than 15 inches in diameter was completed and a condition assessment on this data performed. The condition assessment helped to reveal both maintenance and capital rehabilitation issues.
- As part of this Facility Plan, a condition assessment of the Roger Road WWTP and Ina Road WPCF was conducted.
- Also as part of this Facility Plan, a conveyance capacity/population model (Facility Plan Model) was prepared and calibrated that relates existing interceptor capacity to projected population and flows. (See Chapter 4 for the results of this analysis).
- PCWMD has prepared a draft CMOM plan for system operation and maintenance addressing in detail the requirements of the program.
- PCWMD is implementing the Synergen system of asset identification and valuation and will be among the first Pima County Departments to come into compliance with the standards of GASB-34.
- The net effect of the enhanced area maintenance program from 2000 to date has been to reduce the number of SSOs by 50 percent.

- PCWMD staff has been, and will continue to be, very active in permitting, rulemaking and regulatory processes, both at the State, regional and national levels.

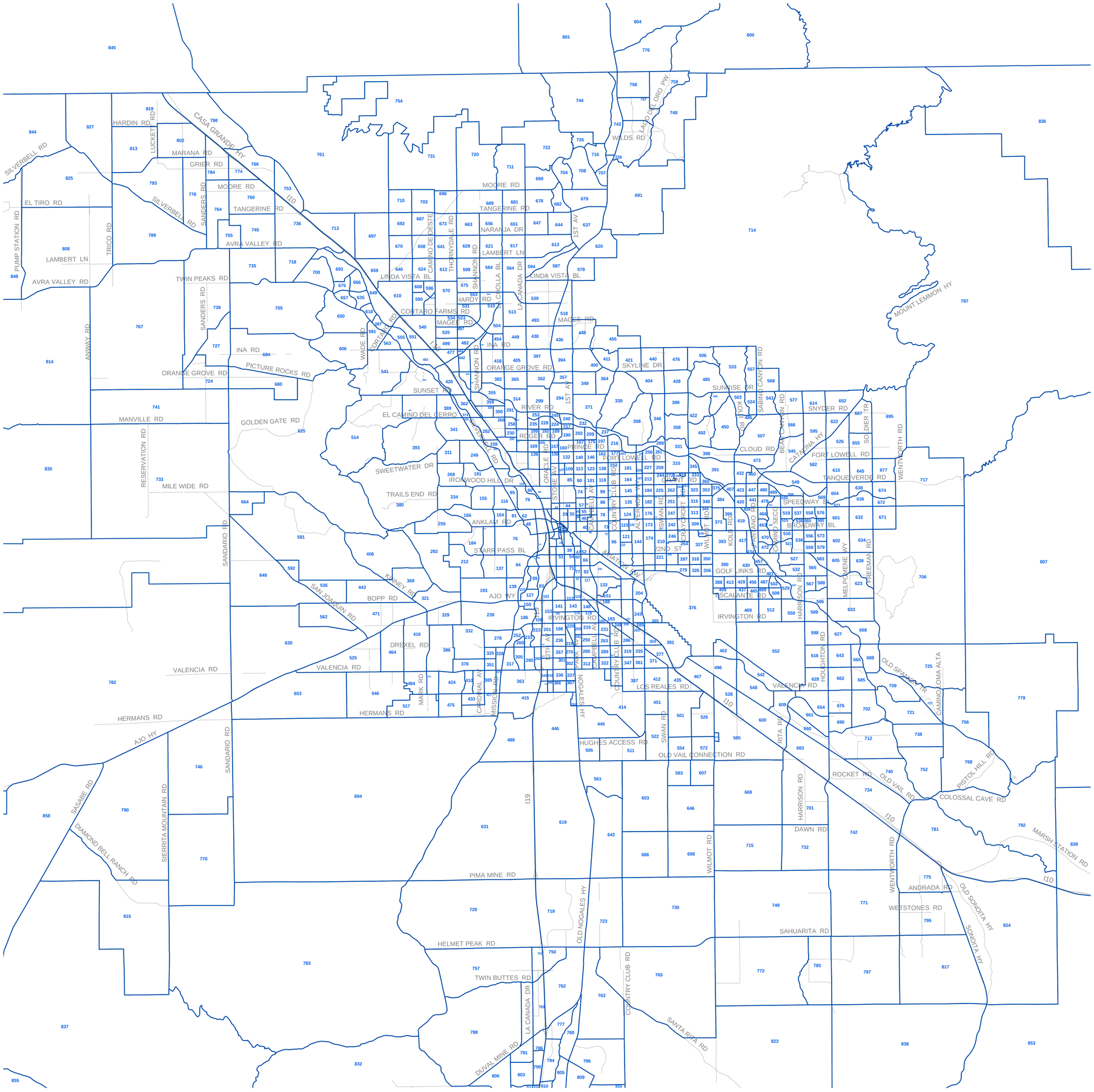
Conclusions and Recommendations

There is no "one-stop" resolution for these comprehensive asset management issues. Asset management can be and is being accomplished by PCWMD in a number of ways. A solid foundation has been laid through the work order based maintenance program; introducing reliability centered maintenance concepts can further enhance the effort. As PCWMD goes forward, the existing aggressive maintenance program needs to be augmented by the conveyance and treatment condition assessments, the implementation of the Synergen accounting/asset inventory program, and the implementation of the draft CMOM program. The existing Capital Improvement Program information and projections need to be augmented by the capital replacement/rehabilitation needs documented through the condition assessments, and this Facility Plan. Both the operating and capital budgets and internal financial planning of PCWMD need to target system maintenance, condition assessment identification and capital rehabilitation.

Based on the discussions in this chapter, the Department should:

- Continue to engage in a vigorous proactive program of maintenance and inspection for its conveyance systems. This would include the SCADA and CCTV/condition assessment programs for the entire 3,300 miles of sewer on an ongoing basis.
- Initiate an intensive capital rehabilitation program to rehabilitate conveyance lines with significant issues.
- Utilize the Synergen system and the GASB-34 certification to establish a budget benchmark for the amount of capital rehabilitation needed per year for both conveyance and treatment.
- Develop an internal system of condition assessment to determine which assets need replacement each year and incorporate those projects in the five year CIP.
- Expand the condition assessment program developed for conveyance to the treatment facilities.

Traffic Analysis Zones

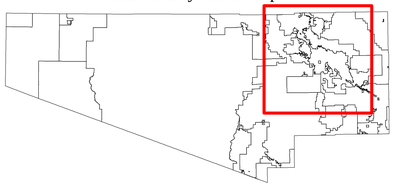


TAZ Zones

Major Streets

Figure 3.4.1

Pima County Index Map



Index Map Scale 1:1,500,000

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Scale 1:90,000

Pima County Department of Transportation

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THE SEAL OF PIMA COUNTY · ARIZONA

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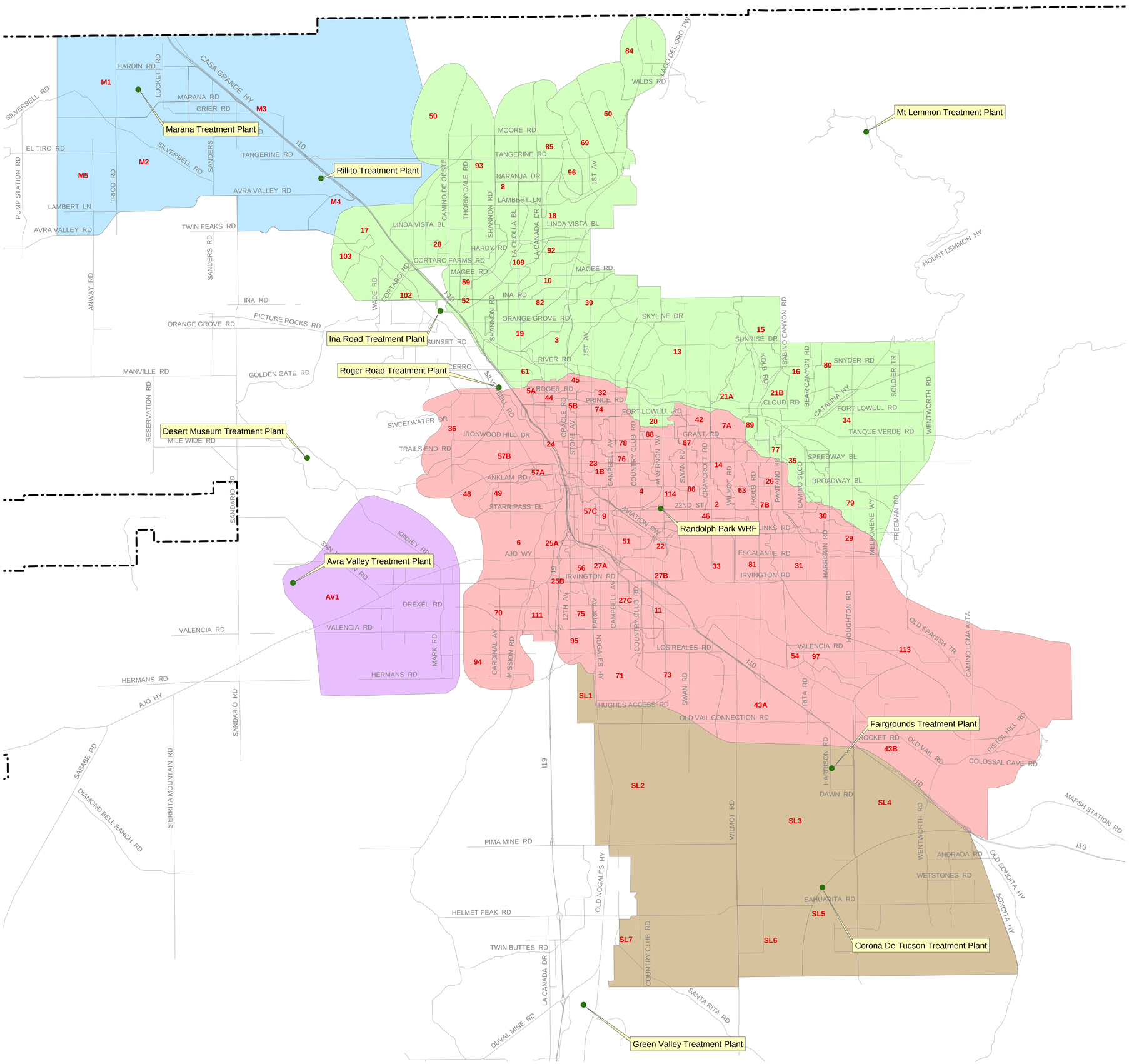
11/22/2005

Sewer Basins



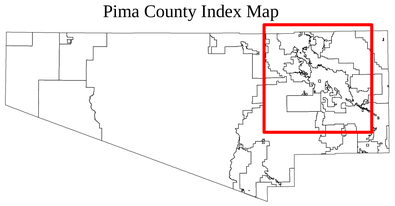
Treatment Plants

BASINS

- Avra Valley
- Ina Road
- Marana
- Roger Road
- South Lands
- Major Streets

Figure 3.4.2

Pima County Index Map



Index Map Scale 1:1,500,000

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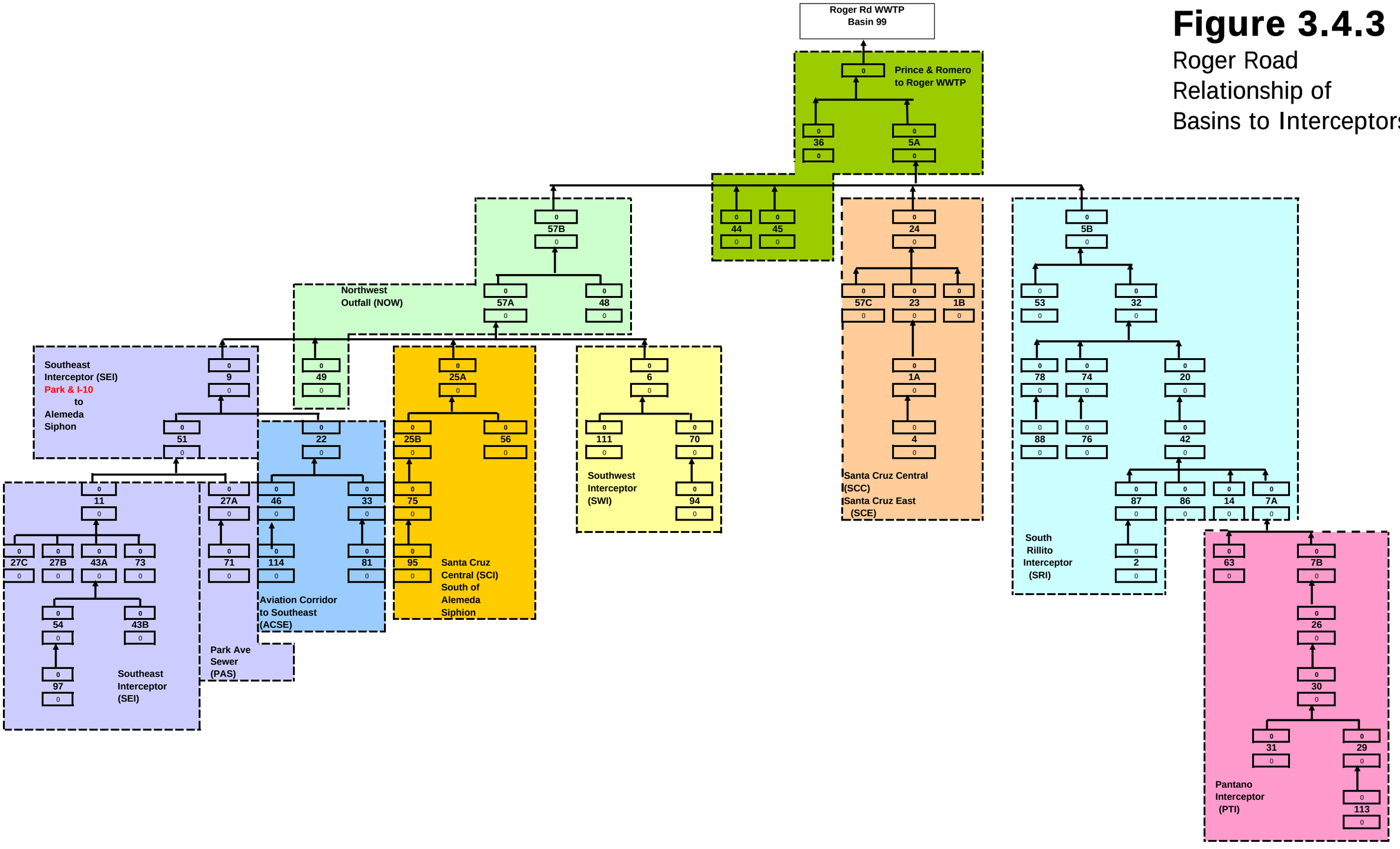
Figure 3.4.3

Roger Road
Relationship of
Basins to Interceptors



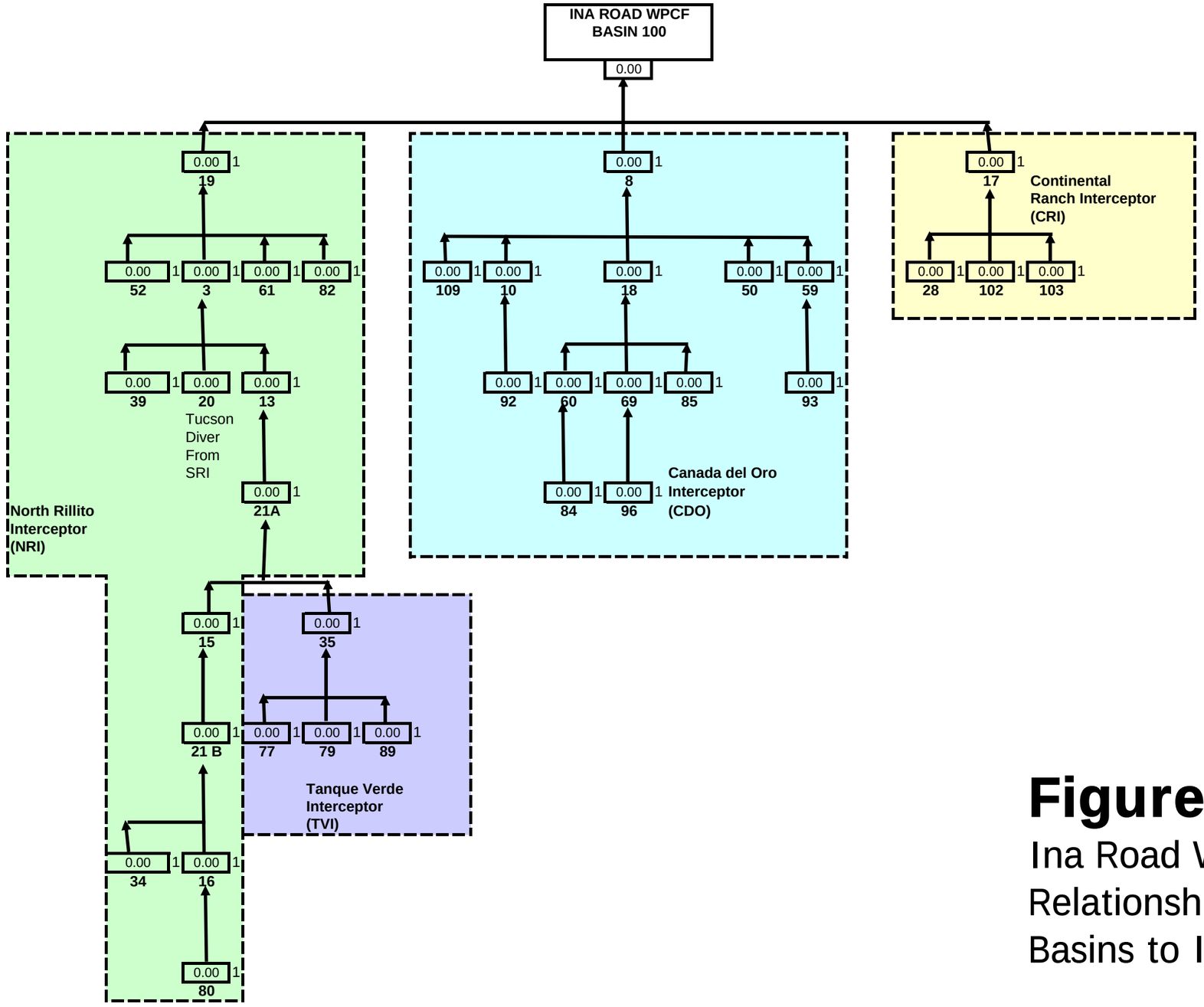


Figure 3.4.4

Ina Road WPCF
Relationship of
Basins to Interceptors

Figure 3.4.5

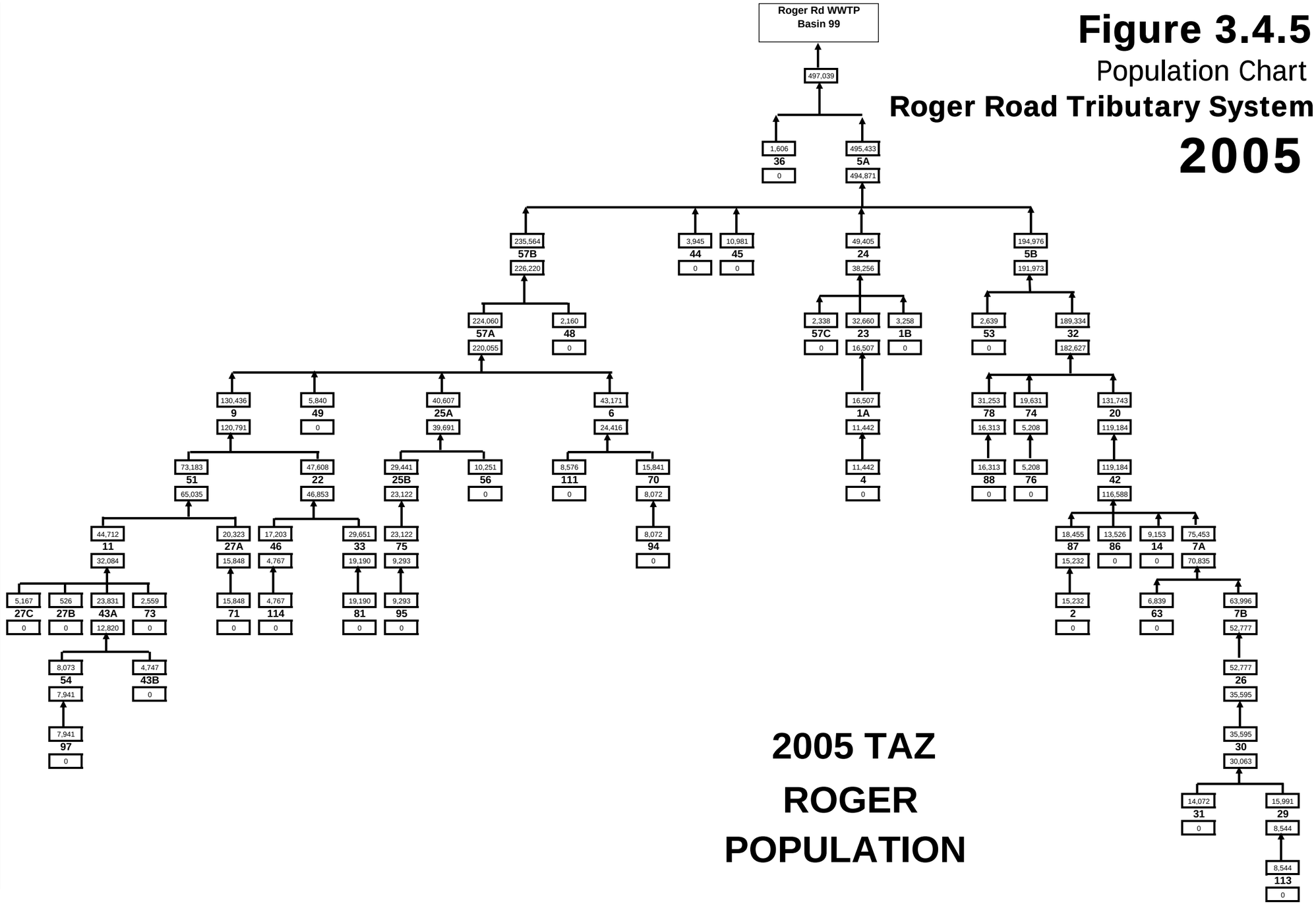
Population Chart

Roger Road Tributary System

2005

Basin No.	Population on sewer 2005	Upstream Population on sewer	Peak Factor
1A	5,066	16,507	***1.77***
1B	3,258	3,258	***2.07***
2	15,232	15,232	***1.78***
4	11,442	11,442	***1.83***
5A	561	495,433	***1.40***
5B	3,003	194,976	***1.49***
6	18,755	43,171	***1.64***
7A	4,618	75,453	***1.58***
7B	11,219	63,996	***1.60***
9	9,645	130,436	***1.52***
11	12,628	44,712	***1.64***
14	9,153	9,153	***1.86***
20	12,559	131,743	***1.52***
22	755	47,608	***1.63***
23	16,152	32,660	***1.68***
24	11,148	49,405	***1.63***
25A	916	40,607	***1.65***
25B	6,319	29,441	***1.69***
26	17,182	52,777	***1.62***
27A	4,475	20,323	***1.74***
27B	526	526	***2.62***
27C	5,167	5,167	***1.97***
29	7,447	15,991	***1.78***
30	5,532	35,595	***1.67***
31	14,072	14,072	***1.80***
32	6,707	189,334	***1.49***
33	10,461	29,651	***1.69***
36	1,606	1,606	***2.24***
42	2,596	119,184	***1.53***
43A	11,011	4,747	***1.99***
43B	4,747	23,831	***1.72***
44	3,945	3,945	***2.03***
45	10,981	10,981	***1.83***
46	12,436	17,203	***1.76***
48	2,160	2,160	***2.17***
49	5,840	5,840	***1.95***
51	8,148	73,183	***1.58***
53	2,639	2,639	***2.12***
54	133	8,073	***1.89***
56	10,251	10,251	***1.85***
57A	4,004	224,060	***1.47***
57B	9,345	235,564	***1.47***
57C	2,338	2,338	***2.15***
63	6,839	6,839	***1.92***
70	7,768	15,841	***1.78***
71	15,848	15,848	***1.78***
73	2,559	2,559	***2.13***
74	14,423	19,631	***1.75***
75	13,829	23,122	***1.72***
76	5,208	5,208	***1.97***
78	14,940	31,253	***1.68***
81	19,190	19,190	***1.75***
86	13,526	13,526	***1.80***
87	3,224	18,455	***1.75***
88	16,313	16,313	***1.77***
94	8,072	8,072	***1.89***
95	9,293	9,293	***1.86***
97	7,941	7,941	***1.89***
99	0	497,039	***1.40***
111	8,576	8,576	***1.88***
113	8,544	8,544	***1.88***
114	4,767	4,767	***1.99***

Tucson Diversion Peaking Factor ***1.17***



2005 TAZ ROGER POPULATION

Figure 3.4.6

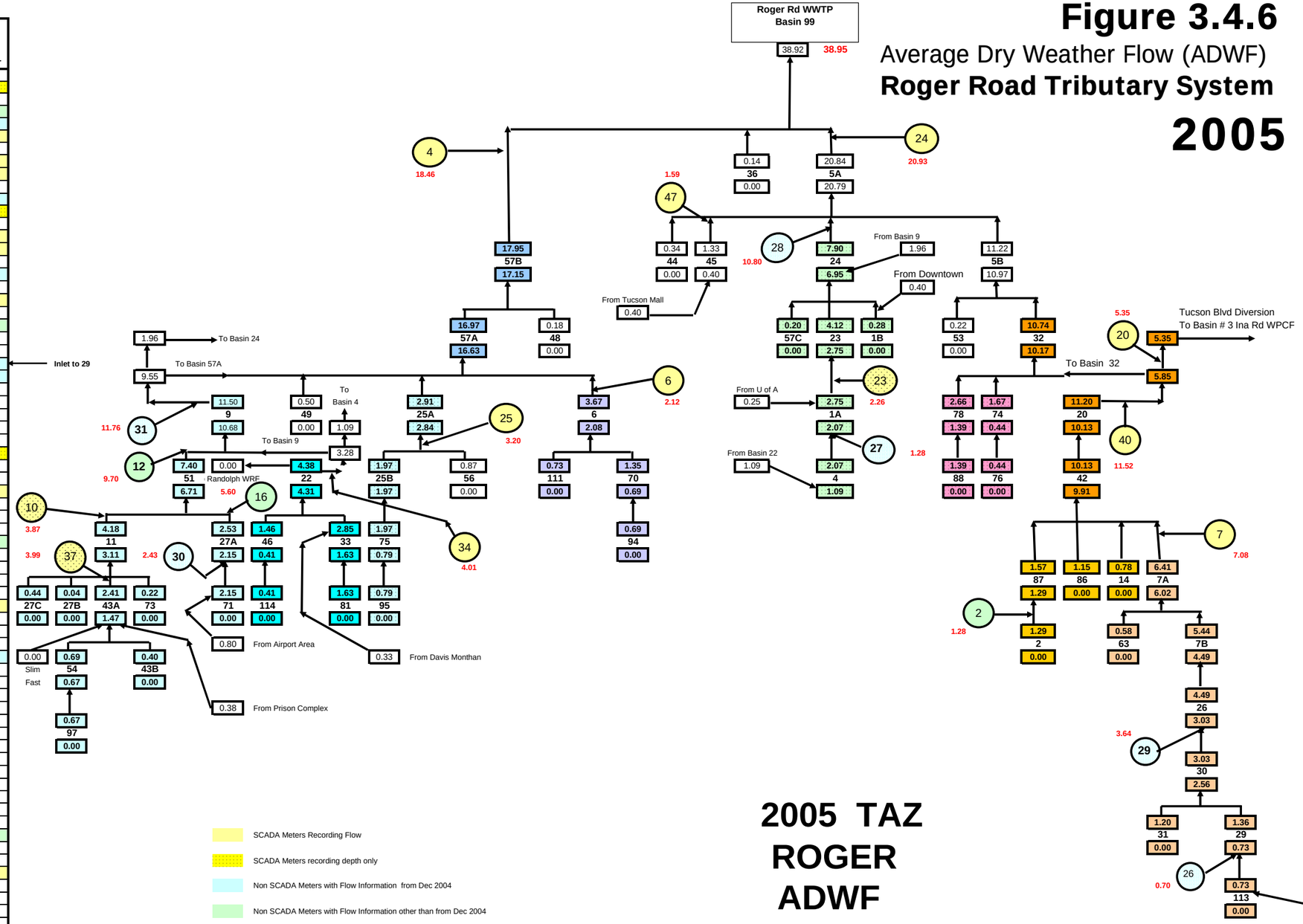
Average Dry Weather Flow (ADWF)

Roger Road Tributary System

2005

Basin No.	Basin Population 2005	Gal per Day per person	Basin Flow ADWF	% of Population on Septic	InterCeptor ADWF mgd	METERS Dec 2004 Readings ADWF	METERS Dec 2004 Readings Number
1A	5,066	85	0.43	0.0%	2.75	2.26	23
1B	3,258	85	0.28	0.0%	0.28		
2	15,232	85	1.29	0.0%	1.29	1.28	2
4	11,442	85	0.97	0.0%	2.07	1.28	27
5A	561	85	0.05	0.0%	20.84	20.93	24
5B	3,003	85	0.26	0.0%	11.22		
6	20,839	85	1.59	10.0%	3.67	2.12	6
7A	4,618	85	0.39	0.0%	6.41	7.08	7
7B	11,219	85	0.95	0.0%	5.44		
9	9,645	85	0.82	0.0%	11.50	11.76	31
11	14,031	85	1.07	10.0%	4.18	3.87	10
14	9,153	85	0.78	0.0%	0.78		
20	12,559	85	1.07	0.0%	11.20	11.52	40
22	755	85	0.06	0.0%	4.38	4.01	34
23	16,152	85	1.37	0.0%	4.12		
24	11,148	85	0.95	0.0%	7.90	10.80	28
25A	916	85	0.08	0.0%	2.91		
25B	6,319	85	0.54	0.0%	1.97	3.20	25
26	17,182	85	1.46	0.0%	4.49		
27A	4,475	85	0.38	0.0%	2.53	5.60	16
27B	526	85	0.04	0.0%	0.04		
27C	5,167	85	0.44	0.0%	0.44		
29	7,447	85	0.63	0.0%	1.36	0.70	26
30	5,532	85	0.47	0.0%	3.03	3.64	29
31	14,072	85	1.20	0.0%	1.20		
32	6,707	85	0.57	0.0%	10.74		
33	10,461	85	0.89	0.0%	2.85		
36	3,213	85	0.14	50.0%	0.14		
42	2,596	85	0.22	0.0%	10.13		
43A	12,235	85	0.94	10.0%	2.41	3.99	37
43B	9,494	85	0.40	50.0%	0.40		
44	3,945	85	0.34	0.0%	0.34		
45	10,981	85	0.93	0.0%	1.33	1.59	47
46	12,436	85	1.06	0.0%	1.46		
48	2,160	85	0.18	0.0%	0.18		
49	5,840	85	0.50	0.0%	0.50		
51	8,148	85	0.69	0.0%	7.40	9.70	12
53	2,639	85	0.22	0.0%	0.22		
54	133	85	0.01	0.0%	0.69		
56	10,251	85	0.87	0.0%	0.87		
57A	4,004	85	0.34	0.0%	16.97		
57B	11,681	85	0.79	20.0%	17.95	18.46	4
57C	2,338	85	0.20	0.0%	0.20		
63	6,839	85	0.58	0.0%	0.58		
70	8,631	85	0.66	10.0%	1.35		
71	15,848	85	1.35	0.0%	2.15	2.43	30
73	2,694	85	0.22	5.0%	0.22		
74	14,423	85	1.23	0.0%	1.67		
75	13,829	85	1.18	0.0%	1.97		
76	5,208	85	0.44	0.0%	0.44		
78	14,940	85	1.27	0.0%	2.66		
81	19,190	85	1.63	0.0%	1.63		
86	13,526	85	1.15	0.0%	1.15		
87	3,224	85	0.27	0.0%	1.57		
88	16,313	85	1.39	0.0%	1.39		
94	13,454	85	0.69	40.0%	0.69		
95	9,293	85	0.79	0.0%	0.79		
97	8,359	85	0.67	5.0%	0.67		
99	0	85	0.00	0.0%	38.92		
111	9,027	85	0.73	5.0%	0.73	0.11	11
113	11,392	85	0.73	25.0%	0.73		
114	4,767	85	0.41	0.0%	0.41		
20A	Tucson Blvd diversion to Basin 3		5.35		5.35	5.35	20
	Sliim Fast discharge to Basin43A		0.00				
	Prison Dsischarge from S. Wimot		0.38				
	Extra Flow from the U of A			0.25			
	Extra Flow from Downtown to Basin 1B			0.40			
	Extra flow from Airport & Industrial Zones			0.80			
	Extra flow from Davis Monthan & Industrial Area			0.33			
	Randolph Park WRF			0.00			
	% Diversion from Basin 9 to Basin 24			17.0%			
	% Diversion from Basin 22 to Basin 4			25%			
	Tucson Mall flow to Basin 45			0.40			

1 Randolph Park WRF at the end of 2005 at 0.0 mgd to calibrate model. Online in Jan 2006.



2005 TAZ ROGER ADWF

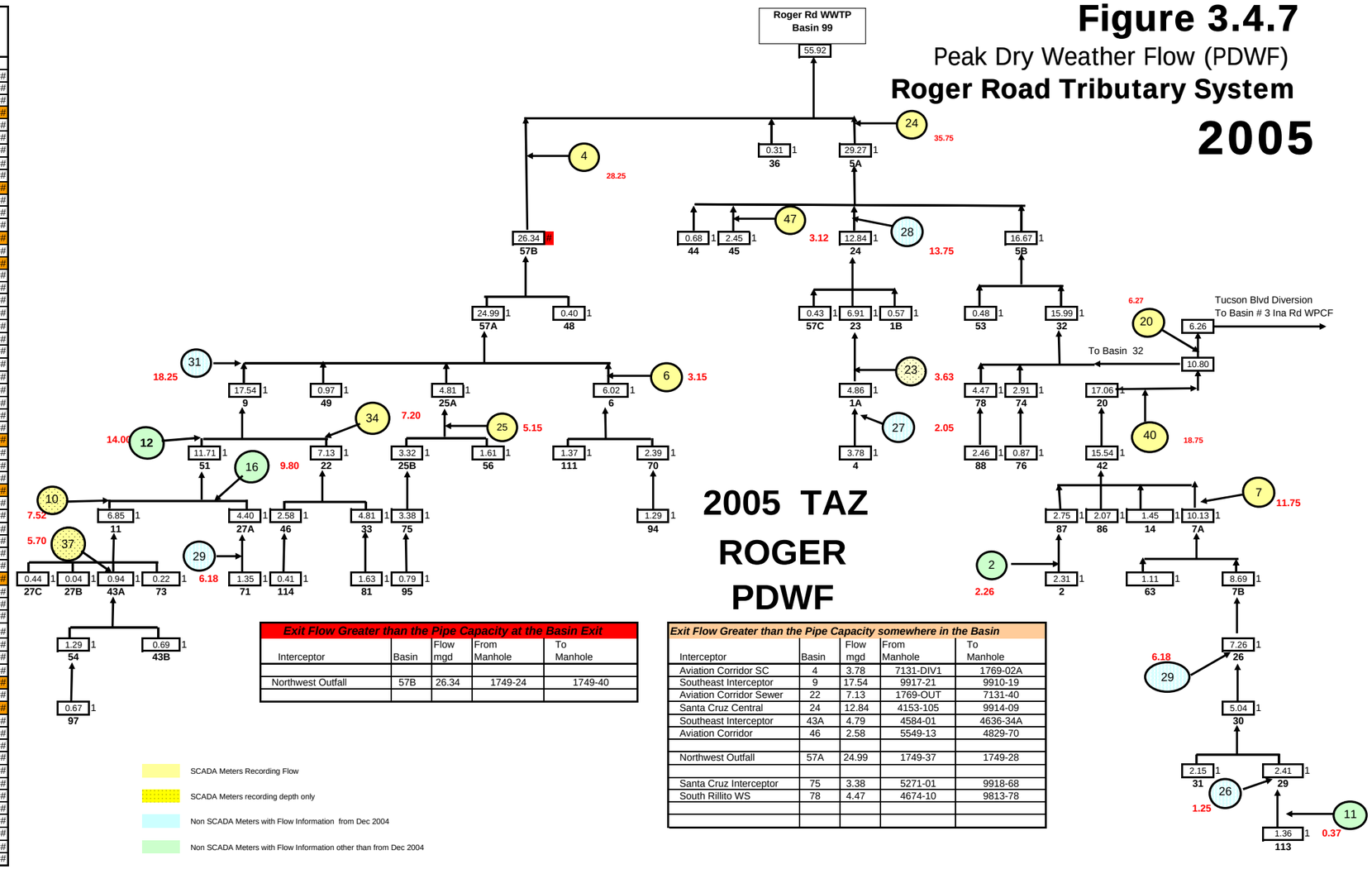
Figure 3.4.7

Peak Dry Weather Flow (PDWF)

Roger Road Tributary System

2005

Basin No.		Basin Population 2005	Interceptor Flow ADWF	Basin Flow ADWF	Peak Factor	PDWF mgd	CAPACITY 85% Full Pipe Capacity ENTER	CAPACITY 85% Full Pipe Capacity EXIT	METERS PDWF	METERS Mtr No	Over Exit Capacity Indicator	Over Enter Capacity Indicator	
1A		5,066	2.75	0.43	1.77	**4.86**	5.93	10.11	**3.63**	**23**	5.24	1.07	##
1B		3,258	0.28	0.28	2.07	**0.57**	1.70	9.40			8.83	1.13	##
2		15,232	1.29	1.29	1.78	**2.31**	2.98	3.66	**2.26**	**2**	1.35	0.67	##
4		11,442	2.07	0.97	1.83	**3.78**	2.37	6.67	**2.05**	**27**	2.89	(1.41)	##
5A		561	20.84	0.05	1.40	**29.27**	50.80	129.12	**35.75**	**24**	99.85	21.54	##
5B		3,003	11.22	0.26	1.49	**16.67**	62.93	50.80			34.13	46.25	##
6		18,755	3.67	1.59	1.64	**6.02**	9.65	16.94	**3.15**	**6**	10.92	3.62	##
7A		4,618	6.41	0.39	1.58	**10.13**	15.95	22.92	**11.75**	**7**	12.79	5.83	##
7B		11,219	5.44	0.95	1.60	**8.69**	13.35	15.95			7.27	4.67	##
9		9,645	11.50	0.82	1.52	**17.54**	15.95	64.16	**18.25**	**31**	46.62	(1.58)	##
11		12,628	4.18	1.07	1.64	**6.85**	17.94	22.94	**7.52**	**10.00**	16.10	11.09	##
14		9,153	0.78	0.78	1.86	**1.45**	0.00	6.53			5.08	(1.45)	##
20		12,559	11.20	1.07	1.52	**17.06**	36.35	43.32	**18.75**	**40**	26.26	19.29	##
22		755	4.38	0.06	1.63	**7.13**	6.51	12.02	**7.20**	**34**	4.88	(0.62)	##
23		16,152	4.12	1.37	1.68	**6.91**	10.11	14.29	5.13	23	7.38	3.20	##
24		11,148	7.90	0.95	1.63	**12.84**	6.57	29.68	**13.75**	**28**	16.84	(6.27)	##
25A		916	2.91	0.08	1.65	**4.81**	9.97	34.16			29.35	5.16	##
25B		6,319	1.97	0.54	1.69	**3.32**	4.00	6.83	**5.15**	**25**	3.50	0.68	##
26		17,182	4.49	1.46	1.62	**7.26**	16.13	14.65			7.39	8.87	##
27A		4,475	2.53	0.38	1.74	**4.40**	7.68	12.37	**9.80**	**16**	7.97	3.29	##
27B		526	0.04	0.04	2.62	**0.12**	0.00	2.93			2.82	(0.12)	##
27C		5,167	0.44	0.44	1.97	**0.87**	0.00	3.12			2.25	(0.87)	##
29		7,447	1.36	0.63	1.78	**2.41**	3.41	4.82	**1.25**	**26**	2.41	1.00	##
30		5,532	3.03	0.47	1.67	**5.04**	10.05	10.05	**6.18**	**29**	5.01	5.01	##
31		14,072	1.20	1.20	1.80	**2.15**	0.00	3.41			1.26	(2.15)	##
32		6,707	10.74	0.57	1.49	**15.99**	79.93	62.93			46.94	63.94	##
33		10,461	2.85	0.89	1.69	**4.81**	7.79	8.81			4.00	2.97	##
36		1,606	0.14	0.14	2.24	**0.31**	0.00	1.70			1.39	(0.31)	##
42		2,596	10.13	0.22	1.53	**15.54**	45.18	42.61			27.07	29.64	##
43A		11,011	2.41	0.94	1.99	**4.79**	4.59	11.85	**5.70**	**37**	7.06	(0.20)	##
43B		4,747	0.40	0.40	1.72	**0.69**	0.00	4.17			3.47	(0.69)	##
44		3,945	0.34	0.34	2.03	**0.68**	2.31	7.15			6.47	1.63	##
45		10,981	1.33	0.93	1.83	**2.45**	3.06	13.52	**3.12**	**47**	11.07	0.61	##
46		12,436	1.46	1.06	1.76	**2.58**	2.41	3.88			1.30	(0.17)	##
48		2,160	0.18	0.18	2.17	**0.40**	0.00	1.95			1.55	(0.40)	##
49		5,840	0.50	0.50	1.95	**0.97**	0.00	3.04			2.08	(0.97)	##
51		8,148	7.40	0.69	1.58	**11.71**	12.98	12.98	**14.00**	**12**	1.27	1.27	##
53		2,639	0.22	0.22	2.12	**0.48**	0.00	1.12			0.65	(0.48)	##
54		133	0.69	0.01	1.89	**1.29**	16.01	13.70			12.41	14.72	##
56		10,251	0.87	0.87	1.85	**1.61**	0.00	2.52			0.91	(1.61)	##
57A		4,004	16.97	0.34	1.47	**24.99**	17.70	27.15			2.16	(7.29)	##
57B		9,345	17.95	0.79	1.47	**26.34**	27.15	24.77	**28.25**	**4**	(1.58)	0.80	##
57C		2,338	0.20	0.20	2.15	**0.43**	0.00	3.90			3.47	(0.43)	##
63		6,839	0.58	0.58	1.92	**1.11**	0.00	4.29			3.18	(1.11)	##
70		7,768	1.35	0.66	1.78	**2.39**	6.60	9.65			7.25	4.20	##
71		15,848	2.15	1.35	1.78	**3.82**	0.00	7.88	**3.49**	**30**	4.06	(3.82)	##
73		2,559	0.22	0.22	2.13	**0.46**	0.00	10.05			9.58	(0.46)	##
74		14,423	1.67	1.23	1.75	**2.91**	7.05	6.48			3.56	4.13	##
75		13,829	1.97	1.18	1.72	**3.38**	2.71	3.72			0.34	(0.67)	##
76		5,208	0.44	0.44	1.97	**0.87**	0.00	1.52			0.65	(0.87)	##
78		14,940	2.66	1.27	1.68	**4.47**	3.81	5.40			0.93	(0.66)	##
81		19,190	1.63	1.63	1.75	**2.85**	0.00	3.18			0.33	(2.85)	##
86		13,526	1.15	1.15	1.80	**2.07**	0.00	6.60			4.53	(2.07)	##
87		3,224	1.57	0.27	1.75	**2.75**	3.66	8.77			6.02	0.90	##
88		16,313	1.39	1.39	1.77	**2.46**	0.00	3.80			1.34	(2.46)	##
94		8,072	0.69	0.69	1.89	**1.29**	0.00	3.90			2.61	(1.29)	##
95		9,293	0.79	0.79	1.86	**1.47**	0.00	2.71			1.24	(1.47)	##
97		7,941	0.67	0.67	1.89	**1.28**	0.00	7.81			6.53	(1.28)	##
99		0	38.92	0.00	1.40	**54.65**	78.20	78.20			23.55	23.55	##
111		8,576	0.73	0.73	1.88	**1.37**	0.00	5.29			3.92	(1.37)	##
113		8,544	0.73	0.73	1.88	**1.36**	0.00	3.94	**0.37**	**11**	2.57	(1.36)	##
114		4,767	0.41	0.41	1.99	**0.81**	0.00	1.09			0.28	(0.81)	##
20A				5.35	1.17	**6.26**			**6.27**	**20**			##



Exit Flow Greater than the Pipe Capacity at the Basin Exit				
Interceptor	Basin	Flow mgd	From Manhole	To Manhole
Northwest Outfall	57B	26.34	1749-24	1749-40

Exit Flow Greater than the Pipe Capacity somewhere in the Basin				
Interceptor	Basin	Flow mgd	From Manhole	To Manhole
Aviation Corridor SC	4	3.78	7131-DIV1	1769-02A
Southeast Interceptor	9	17.54	9917-21	9910-19
Aviation Corridor Sewer	22	7.13	1769-OUT	7131-40
Santa Cruz Central	24	12.84	4153-105	9914-09
Southeast Interceptor	43A	4.79	4584-01	4636-34A
Aviation Corridor	46	2.58	5549-13	4829-70
Northwest Outfall	57A	24.99	1749-37	1749-28
Santa Cruz Interceptor	75	3.38	5271-01	9918-68
South Rillito WS	78	4.47	4674-10	9813-78

SCADA Meters Recording Flow

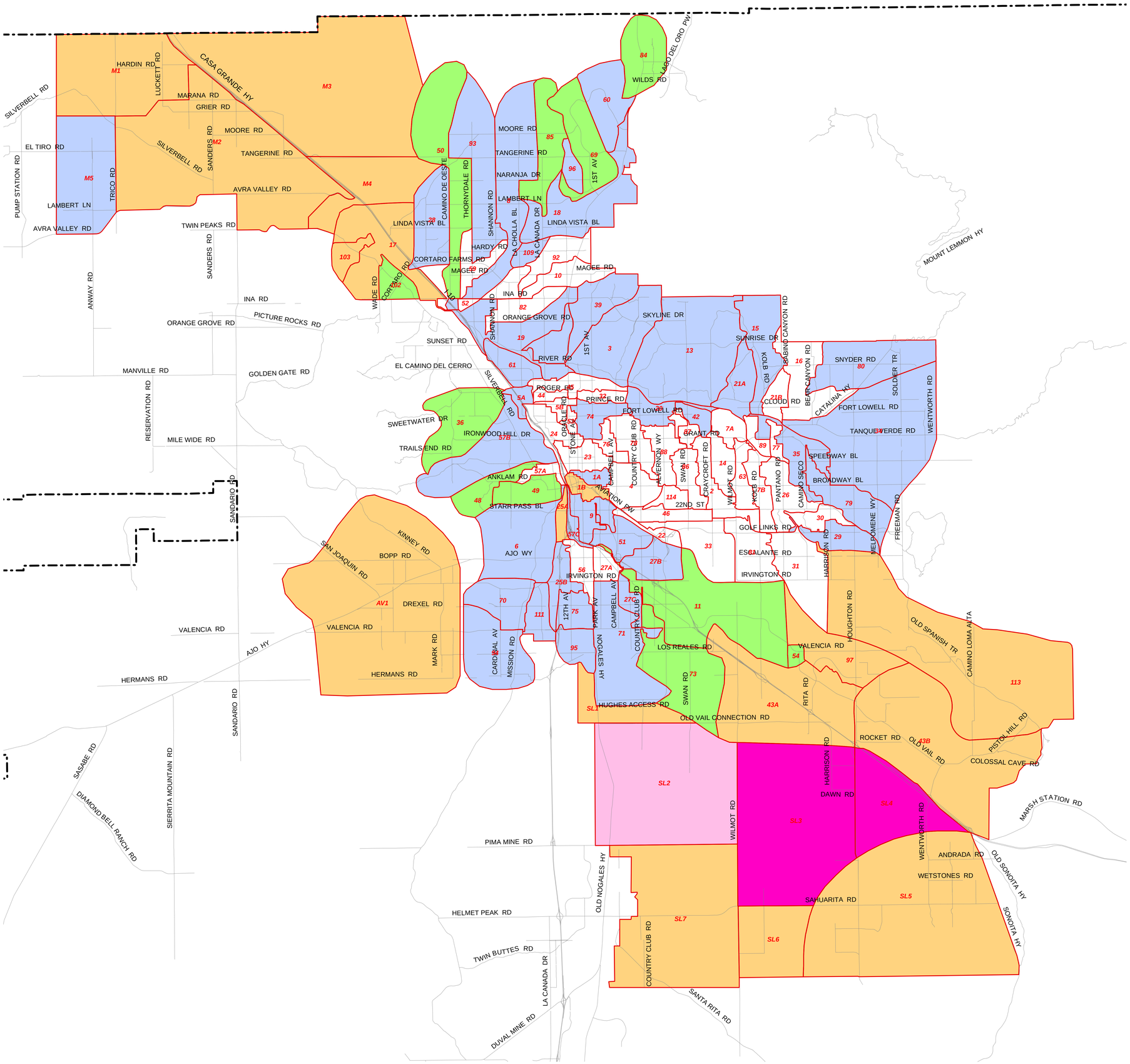
SCADA Meters recording depth only

Non SCADA Meters with Flow Information from Dec 2004

Non SCADA Meters with Flow Information other than from Dec 2004

Population Increase By Sewer Basin For Years 2005 - 2030

2005 TAZ Data



Basins

Major Streets

> 1000% Increase

500 - 1000% Increase

100 - 500% Increase

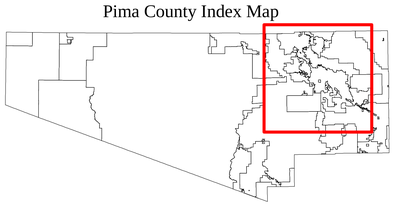
50 - 100% Increase

10 - 50% Increase

< 10% Increase

Figure 3.4.8

Pima County Index Map



Index Map Scale 1:1,500,000

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Scale 1:90,000

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pygmyowl4/projects/wwm8/mxds/pop_increase.mxd mp

11/23/2005

SUB-CHAPTER 3.4 POPULATION EFFECTS

The Facility Plan's primary purpose is to provide the PCWMD with a document for development of long-range plans for Pima County's sewerage system. The development of long-range plans for PCWMD relies upon the projection of the magnitude and location of future population, which results in sewage flows to the Conveyance System being conveyed to downstream Treatment Plants. These flows are primarily dependent upon population size, growth and distribution. The Facility Plan Model (the Model) has been developed to meet the need to predict future population trends and their effects upon PCWMD's Conveyance and Treatment systems.

The Facility Plan Model

The Model utilizes population forecasts developed by Pima Association of Governments (PAG) to predict population growth within the area served by PCWMD's metropolitan and outlying treatment plants. PAG population forecasts are a consensus developed by the planning agencies of local governmental authorities of Pima County. Planners from Pima County, Tucson, Oro Valley, Marana, Sahuarita and South Tucson are consulted and assist PAG in arriving at the forecasts. The planners consider land use and zoning among the many factors influencing development and population concentrations. These forecasts are presented as individual population forecasts for each of the Transportation Analysis Zones (TAZ) developed by the Pima Association of Governments (PAG). The TAZ population forecasts are reviewed and updated as needed to reflect significant variation from the previously published information. The data in the PAG "2002 Population Handbook," published in July 2002, was recently updated (October 2004) to include actual development variations occurring since 2002 and influencing the individual TAZ tract forecasts.

The TAZ forecasts predict the population in each TAZ zone in 5-year intervals, from the years 2000 through 2030. The TAZ zones are the specific geographic areas developed by PAG staff. Statistical data, including population, is assigned to each zone from census data, in this case for the 2000 base year. The population forecast for succeeding five year intervals based upon input from the planning staffs of the participating county and municipal entities. The TAZ zones vary size from several square blocks within the city to tens of square miles in less populated outlying areas of the County. The location of each TAZ zone is identified within the Pima County GIS system and available from the GIS database. (See Figure 3.4.1) The population is spread equally throughout each TAZ zone by dividing the TAZ zone population by the TAZ zone area to arrive at a population density per unit of area.

The Model utilizes population forecasts developed by PAG to predict growth within the PCWMD sewer basins, as well as in areas served by outlying treatment plants. The Model, using GIS capabilities, translates population growth per TAZ zone to population growth per sewer basin. The description of how the County GIS system accomplishes this translation is presented in the Appendices.

The Sewer Basin

The Model considers two types of sewer basins; sewer basins tributary to the Roger Road WWTP and Ina Road WPCF; and sewer basins tributary to the Outlying Wastewater Treatment Facilities (WWTFs). Basins tributary to the Outlying WWTFs are labeled with an alphanumeric designation on the Sewer Basin map. Basins tributary to the Roger Road WWTP and Ina Road WPCF are labeled with a numeric designation on the Sewer basin map. (See Figure 3.4.2)

Sewer basins tributary to the Roger Road WWTP and Ina Road WPCF treatment plant/tributary area, are the portions of the actual pipe network ultimately emptying into the treatment facilities. The sewer basin numbering presented in Figure 3.4.2 is a random assignment and not indexed to either treatment facility. The treatment plant tributary area ends with the sewer basin emptying into each treatment plant. The Model considers only sewer basins whose discharge pipe is 15 inches in diameter or larger.

The sewer basins emptying to Roger Road WWTP are Basin 57, the Northwest Outfall (NWO) Basin 5A, the combined flow of the South Rillito Interceptor (SRI), the Santa Cruz Central (SCC) and Santa Cruz East (SCE) Interceptors and Basin 36, the pumped discharge from the Tucson Mountain Foothills (see Figure 3.4.3). The sewer basins emptying to Ina Road WPCF are Basin 17, the Continental Ranch Wastewater Pump Station (WWPS) discharge; Basin 19, the North Rillito Interceptor (NRI) and Basin 8, the Canyon del Oro Interceptor (CDO) (see Figure 3.4.4).

The Model determines basin discharge flow by identifying the flow from an upstream contributing basin, calculating the flow within the basin under consideration and summing the two flows to arrive at basin discharge flow. There are three classes of basins; those with no upstream basin, those that have both an upstream and downstream basin and those that discharge into the treatment plant as described in the previous paragraph. Basins, such as Basin 71 (serving the area northwest of the airport) have no upstream basin and empty to a downstream basin at a single point. The location of a discharge manhole, identified by PCWMD's Engineering Planning Section as the basin outlet, and then tracing the branching pipes from this point until the branching pipes terminate determine the basin's area. A second class of basin, such as Basin 3 NRI, conveys upstream basin discharge through Basin 3, adds the flow of Basin 3 and discharges the flow at its discharge manhole.

The pipe connecting the inlet and discharge manholes, in this case the NRI, is shown diagrammatically in Figure 3.4.4. Basin 3 also has a sewer basin drainage area of its own consisting of the pipes less than 15 inches in diameter that empty into the Interceptor between basins 3's upstream and downstream manhole. These pipes are also traced upstream through their branching pipes until termination, thereby defining the basin.

Sewer basins tributary to the Outlying treatment plants have been developed independently of an actual sewer pipe network. The primary purpose of these conceptual sewer networks is to facilitate prediction of average daily flow to each outlying treatment plant over the next twenty-five years (until the year 2030). As the sewer network in these areas is largely undeveloped, sewer basin areas were assigned based on topography and estimated population growth. Referring to the sewer basin map, Figure 3.4.2, the actual Marana WWTF is shown with five tributary basins, M1, M2, M3, M4 and M5. The actual Avra Valley WWTF is shown with a single tributary basin, AV1. The remaining Outlying facility, the Southlands Collection Point, is more complex. The Southlands Collection Point is referred to as the Southlands WWTF in this Facility plan to increase the readability of the text and does not infer that a treatment plant is planned in this location.

The Southlands WWTF has been conceptualized to serve the area roughly between I-19 east to the Sonoita highway and from a mile south of Sahuarita Road north to a mile south of I-10. The location of the Southlands WWTF is in the vicinity of the Hughes Access Road and Old Nogales Highway. This is an idealized (not actual) site, being the low point in the Southlands drainage area. The Southlands WWTF has seven tributary basins SL1, SL2, SL3, SL4, SL5, SL6 and SL7. Basin SL5 is the area considered feasible to empty into the Corona de Tucson WWTF. The sewer network shown for SL5, as well as the other basin in the Southlands, is imaginary.

The consideration of SL5 as a separate basin allows prediction of future flows to the Corona de Tucson WWTF. The average flow to the Southlands WWTF includes SL5, as though Corona de Tucson did not exist, to facilitate prediction of total future flows in the Southlands WWTF tributary area.

The Model consists of a GIS and an Excel module. The GIS module is used to translate TAZ zone population to sewer basin population. The Excel module uses the sewer basin population to determine both Average Dry Weather Flow (ADWF) and Peak Dry Weather Flow (PDWF). The GIS module identified flows in each basin and accumulated flows to the treatment plants. This module worked with no problems for most cases, however at the time of model development, no reasonably effective way could be found for the GIS module to accommodate the numerous flow splits, such as the Tucson Boulevard Diversion, nor the unusual flow additions such as from the Prison complex on South Wilmot Road.

The Excel module considers existing as well as future Outlying WWTFs and the Roger Road WWTP and the Ina Road WPCF separately. Further, the model considers each five-year period from 2005 to 2030 as a separate case. Each five-year period is presented in three flow charts; one each for Population, Average Dry Weather Flow and Peak Dry Weather Flow. (See Figures 3.4.5, 3.4.6, and 3.4.7 for Roger Road WWTP in the year 2005).

Population Chart

The Population flow chart (Figure 3.4.5) contains a table and hierarchical line diagram of the basin. The relevant Treatment Plant is at the apex of its branching basin system. The population for each basin, determined in the GIS module, is modified to present the number of people in each basin connected to the PCWMD sewer system and then shown in the table on the left side of the flow chart. The box below the basin number in the line diagram contains the total population on sewer upstream of the basin entrance while the box above the basin number contains the total population on sewer upstream of the basin discharge manhole (population of the upstream basins, plus the population of the basin under consideration.) The column "Upstream Population" identifies the total population upstream of the subject basin's discharge manhole.

This population is used as input to the Peaking Factor Formula as defined in the Arizona Administrative Code Title 18 Environmental Quality, Chapter 9 (R18.9-9-E 301.4.01.Cii.) Department of Environmental Quality Water Pollution Control, Article 3 Aquifer Protection Permits, Part E, Type 4 General Permits, 4.01 General Permit: Sewage Collection Systems, D. Design Requirements, General Provisions, C. Use for gravity sewer lines as appropriate, "Any point in a sewer collection system can accommodate a peak flow for all population upstream from that point as tabulated in the following formula":

The use of this formula resulted in the Peaking Factors displayed in Table 3.4.1.

Table 3.4.1 Peaking Factors

Upstream Population	Peaking Factor
1,001 to 10,000	PF = (6.330 x p - 0.231) + 1.094
10,001 to 100,000	PF = (6.177 x p - 0.233) + 1.128
More than 100,000	PF = (4.500 x p - 0.174) + 0.945
PF = Peaking Factor	
p = Upstream Population	

The population connected to the PCWMD sewer system is critical for determining the proper flow in the conveyance system and to the treatment plants. The percentage of each basin's population on septic systems was estimated by overlaying the sewer pipe network on aerial photos of the basin and noting the houses not connected to the sewer pipes. These people were then subtracted from the 2005 basin populations. The total population growth in each basin beyond 2005 is considered connected to the sewer system and the population growth is added to the 2005 population on sewers to arrive at the number of people in each basin for 2010, 2015, 2020 2025 and 2030. The population growth information, contained in Table 3.4.2., by contrast is total number of people residing in the sewer basin regardless of whether they are connected to the sewer.

ADWF Chart

Figure 3.4.6 is arranged in the same hierarchical format as the Population Chart. The table at the left side of the Figure reads the population chart to obtain the basin population. The basin Flow ADWF is the product of the basin population multiplied by the gallons per day per person multiplied by (1 minus the percentage of the population in the basin on septic systems). The wastewater flow used in this analysis is 85 gallons per day per person gallons customized for each basin to account for newer homes with more efficient toilets and other factors considered significant. The percentage of population on septic systems in the year 2005 is also a variable and can be customized for each basin based on available data. The model considers that no population increases after 2005 will be on septic systems but that all population increases will be served by the PCWMD system. Similar to the Population chart, the box below the basin number contains the ADWF at the basin inlet and the upper box contains the outlet ADWF culminating in the ADWF to the Roger Road WWTP. The ADWF at the basin outlets are also listed in the table.

The chart also contains the features that the present GIS module could not adequately account for. Note that the chart allows for flow inputs from sources other than population alone. The influx of daytime population to the central city area (Basin 1B), the University (Basin 1A) and Davis Monthan (Basin 33) and its effect on the sewer system are considered as well as other large inputs from the prison complex (Basin 43A), and the airport (airport and Hughes plant, Basin 71). The Excel module also handles flow splits and flow diversions such as the Tucson Boulevard Flow Management Structure (TBFMS) (Basin 20), the Alameda Siphon flow split between the NWO and the SCC (Basin 24), the Aviation Corridor flow split at Kino Boulevard to the SCE (Basin 4.) The Excel module also considers the effects of the Randolph Park Water Reclamation Facility (WRF). The additional flows into the system are the best estimates of the PCWMD Engineering Division while the flow splits are either the results of meter readings or diversion board placement obtained from the PCWMD Operations Division.

The final features contained in the table and on the flow chart are meter readings. The meter readings are from November and December 2004 only and are color coded as follows:

- Yellow — SCADA meters recording flow MGD.
- Shaded Yellow — SCADA meters recording depth only (inches).
- Blue — Non SCADA meters with flow from Nov-Dec 2004 (MGD).
- Green — Non SCADA meters with flow from dates other than Nov-Dec 2004.

The meters' location in relation to the basin hierarchy is shown on the flow chart. The meter readings are only shown on the 2005-year flow charts, as the readings recorded in 2004 only have validity for 2005. These meter readings could not be used to validate flow forecast 5 to 25 years in the future.

The meters provided the actual recorded flow against which the estimated flow determined by the model was evaluated. These readings provided the information to calibrate the model, which then was felt to have strong validity as it reflected that the theoretical flows closely corresponded to the actual metered flows.

PDWF Chart

This chart (Figure 3.4.7) is arranged in the same hierarchical format as the previous two flow charts. The major variation is that the chart only shows the Peak Dry Weather Flow (PDWF) at the basin discharge. The basin population and peaking factors are those determined in the Population Flow Chart. The basin interceptor flow is obtained from the ADWF Flow Chart. The PDWF at each basin exit is calculated by multiplying the previously determined ADWF by the Peaking Factor determined in the Population Flow Chart. The capacity of the pipe at the entrance and exit from each basin are "full pipe" capacities obtained from a system capacity map included in the 1990 Facility Plan that has been revised to reflect changes in the system since 1990 (See Figure 4.2.1). The PDWF meter readings are taken from the same meters and at the same time as the ADWF readings. The PDWF meter reading selected for use in the table varies from the absolute peak meter reading in many cases. The actual meter readings are recorded at one-minute intervals throughout the day. An examination of these recordings often shows the maximum-recorded peak value is a single recording far in excess of neighboring recorded values. The peak value used in the table is a flow recording higher than 99 percent of all the readings taken.

The column in the table titled "Capacity, 85 percent of full pipe capacity" is the capacity of the pipe at 85 percent of full pipe capacity [75 percent depth (d) divided by pipe Diameter (D).] The rationales for using the 85 percent value as an alert value are:

- 15 percent of the pipe capacity is available for Rainfall Derived Inflow and Infiltration (RD I/I).
- The 85 percent notification provides time for PCWMD to initiate and complete corrective action.

The column titled "Over Exit Capacity Indicator" gives the result of subtracting the PDWF calculated from the value of the 85 percent full capacity of the pipe at the basin exit. A negative number will cause the cell containing this result to turn red if the PDWF exceeds basin exit capacity. The negative number also causes the cell adjacent to the basin PDWF in the flow chart to turn red. The adjacent column titled "Over Enter Capacity Indicator" is the remainder from subtracting the basin PDWF from the 85 percent of full capacity of the pipe at the entrance to the basin. The cell in the column immediately to the right of this remainder will be colored orange if the PDWF exceeds the entrance capacity of the basin and the entrance capacity is not zero. A basin without an upstream basin has an entrance flow of zero. These indicator warnings are a signal that this basin should be checked by PCWMD Engineering to verify or discount the warning.

Conclusions and Recommendations

The Facility Plan Model is not an exact replica of the sewer system as are PCWMD's sewer hydraulic software models. The Facility Plan Model is a simplified capacity model. The model takes license with reality in several instances in regards to Interceptor routing. The GIS system ties the basin together by connecting the entrance manhole to exit manhole and not necessarily along the actual interceptor path. The model cannot accurately consider a basin with multiple outlets and therefore the most dominant exit manhole for each basin was chosen (example Basin 14 discharge along Craycroft Road). The model considers the multiple pipes in Basin 32 and 5B as a single pipe [the South Rillito Interceptor (SRI) from Tucson Boulevard along Pastime, Roger and Prince Roads]. The capacity assigned to this section is that of the 60-inch pipe along Pastime Road whose capacity far exceeds the flow in this basin.

Although not specifically discussed here, the system tributary to Ina Road WPCF functions in a similar manner to what has been described here. The Ina Road WPCF model is more straightforward than the Roger Road WWTP model in that there are no diversions of flow and only the addition of flow to the North Rillito Interceptor (NRI) at Tucson Boulevard from the diversion of SRI flow. The only feature unique to the Ina Road WPCF system is that the Continental Ranch WWPS is considered as the inlet manhole to the Ina Road WPCF. The force main is not considered as it is well beyond the capabilities of this model. The metered flow into the Continental Ranch WWPS is actually the flow recorded by Operations during Nov-Dec 2004.

Table 3.4.2 presents a comparison of PAG's population forecasts with the population in the basin tributary to the Roger, Ina, Avra and Marana treatment plants and "the Southlands" area (i.e., Population in Sewer Basin). These are total numbers, not just the people connected to the PCWMD sewer system.

Table 3.4.2 Population Comparisons

Year	PAG Eastern Pima County Population	Total[1] Population in PCWMD Sewer Basins	Roger Road WWTP Sewer Basin Population	Ina Road WPCF Sewer Basin Population	Total[2] Population in Outlying Sewer Basins
2000	767,855	489,399	243,238	35,218	
2005	916,028	837,571	520,536	256,164	60,871
2010	1,023,332	928,849	563,158	269,565	96,125
2015	1,141,690	1,031,142	607,065	283,032	141,046
2020	1,259,689	1,113,129	650,791	296,398	185,940
2025	1,378,155	1,235,513	694,750	309,895	230,868
2030	1,496,045	1,337,400	738,416	323,233	275,750

1. Roger Road, Ina Road, Avra Valley and Marana Treatment Plants and Southlands Area.
2. Avra Valley and Marana Treatment Plants and Southlands Area.

The additional information relating to the findings for ADWF to the treatment plants and PDWF in the conveyance system is found in Chapters 5 and 4, respectively.

The Facility Plan Model converted the October 2004 PAG TAZ zone information for the years 2005, 2010, 2015, 2020, 2025 and 2030 into sewer basin populations for those years. The basin population forecasts also include the percentage increase in population in each basin from 2005 to 2030. This same information is presented graphically in Figure 3.4.8. The model then

modified these basin population figures to arrive at the population associated with each sewer and resulting ADWF flows to the treatment plants and PDWF in the conveyance systems.

PCWMD plans to utilize the Facility Plan Model to update the Conveyance System and Treatment Plant flow projections as PAG issues updated forecasts, but at planned intervals every two years. The Model will be updated to operate entirely within the GIS environment in the near future, which will permit closer integration with PAG data. PAG is planning to change from TAZ zone forecasting to a system of population forecasting for each acre of land in Pima County. This will permit accounting for zoning and land use in forecasting. The ease and timeliness of model update accuracy will also be facilitated by the increase in the number of SCADA meters installed in the collection system that can be used for model calibration.

See the following Figures 3.4.1 to 3.4.8.

Chapter 4 Conveyance System

CHAPTER OVERVIEW

Chapter 4 focuses on Pima County Wastewater Management Department's (PCWMD) conveyance system, including sewer lines, manholes, flow management structures and lift stations. These systems service the Pima County Metropolitan Area and the cities of Tucson and South Tucson; the towns of Marana, Oro Valley and Sahuarita; and unincorporated communities such as Summerhaven, Arivaca Junction, Avra Valley, Green Valley, Corona de Tucson and Catalina as well as Pima County. Portions of the system date back to 1900 and include nine different pipe materials.

The planning drivers discussed in Chapter 3 with the biggest impact on the conveyance system are asset management and population effects. The asset management driver for the conveyance system relates to rehabilitation projects to maintain the integrity of the system. The regulatory driver for conveyance relates to the Capacity, Management, Operations and Maintenance (CMOM) program. The population growth in the Planning Area dictates capacity expansion needs. The institutional framework driver has negligible impact on the future conveyance system.

In 2003, PCWMD commissioned a collection system condition assessment as part of their on-going asset management program to evaluate about 230 miles of trunk and interceptor sewers. This assessment was performed utilizing the National Association of Sewer Service Companies (NASSCO) condition codes ranging from "excellent" to "immediate attention required." The resulting list of prioritized rehabilitations and replacements derived from this condition assessment are summarized in this Chapter 4 Conveyance and in Chapter 8 Capital Improvement Program (CIP).

The biggest areas of concern are segments of the collection system with unlined reinforced concrete pipe. While these segments only constitute 2 percent of the entire collection system, this pipe material is prone to failure in arid conditions with longer travel times. Hydrogen sulfide gas causes significant corrosion of the concrete, which can result in piping failure. Segments of the collection system were rated as "poor" or "immediate attention required." The portions of the collection system with these ratings include portions of the Aviation Corridor, Canada del Oro, Old Nogales Highway, Pantano, Santa Cruz, South Rillito, Southwest and Tanque Verde Interceptors. Other segments included in the initial condition assessment were rated at a "fair" or "good" condition and were recommended for re-evaluation in 2008. Additional rehabilitation/replacement needs identified for the conveyance system include 1,498 manholes; several siphon boxes and many of the lift station wet-wells, which contain hydrogen sulfide corrosion.

In addition, future conditions were analyzed based on the population effects driver.

The capacity issues involving the conveyance system's large diameter pipe (greater than 15 inches) identified by the Facility Plan Model are minimal, given the age of the system. There are several reasons for the lack of conveyance capacity issues:

- The Metropolitan Conveyance System Interceptors modeled consist of mature basins within the urban area with little or no projected population growth.
- PCWMD in recent decades had the foresight to install interceptors with greater capacity than required by the capacity needs projected at that time. The additional capacity in a gravity sewer does not impair its efficiency and avoids curtailing its useful life due to inadequate capacity.
- Explosive growth is currently occurring in the areas on the edges of the Metropolitan Area, in areas served by the (satellite) Outlying Treatment Facilities or basins on the extreme upstream reaches of the Metropolitan Conveyance System. The conveyance systems in the outlying areas were not included in this 2006 Metropolitan Area Facility Plan Update (Facility Plan).

The Facility Plan Model identifies two classes of capacity problems, Red and Orange. The Orange classification identifies sections of the interceptor with potential capacity problems and suggesting only an engineering study to determine the severity of the problem.

A Red classification indicates that the sewer is forecasted to be flowing at higher than 85 percent of its capacity and corrective action should be instituted.

The model identifies nine (Orange) sections of interceptor for further study in 2005 and only one (Red) section, the Northwest Outfall, requiring corrective action. Capacity problems in the Northwest Outfall. It will disappear with the installation of the 2004 Bond Authorization funded Santa Cruz Interceptor, Prince to Franklin allowing the cessation of flow from the Southeast Interceptor being directed across the Santa Cruz River utilizing the Alameda Siphon to the Northwest Outfall.

The North Rillito Interceptor capacity problems will cease to be of concern with the installation of the 2004 Bond Authorization funded Plant Interconnect allowing the transfer of flow at the Tucson Boulevard Flow Management Structure.

The early identification of potential capacity problems for the years 2010 and beyond will allow PCWMD to institute corrective action.

SUB-CHAPTER 4.1 EXISTING CONVEYANCE FACILITIES

Pima County Wastewater Management Department owns and operates eight collection and treatment systems within a 370 ± square mile sanitary sewerage system service area in eastern Pima County. PCWMD's conveyance system includes 3,300 miles of public sanitary sewers including 60,000 manholes, 15 siphons, 4 flow management structures and 34 lift stations (4 inactive). These sewers are located in the cities of Tucson and South Tucson; the towns of Marana, Oro Valley, and Sahuarita; and unincorporated communities such as Summerhaven (Mt. Lemmon), Arivaca Junction, Avra Valley, Green Valley, Corona de Tucson, and Catalina. Approximately 230 miles are considered trunk or interceptor sewers, 15 inches internal pipe diameter and larger.

The Metropolitan Conveyance System dates from 1900 to the present and was built using various pipe materials including reinforced concrete (lined and unlined; centrifugally-spun; vertically cast and AZ factor), asbestos cement, ductile iron pipe (DIP), salt glazed clay pipe, vitrified clay pipe (VCP), plastic truss pipe, and polyvinyl chloride (PVC). The conveyance system materials are depicted in Figure 4.1.1a and the conveyance system age distribution in Figure 4.1.1b below. Of particular note is lined and unlined reinforced concrete pipe (RCP) represents only 2 percent of the conveyance system and clay pipe represents 48 percent of the system.

Figure 4.1.1a Pima County Collection System Materials Chart

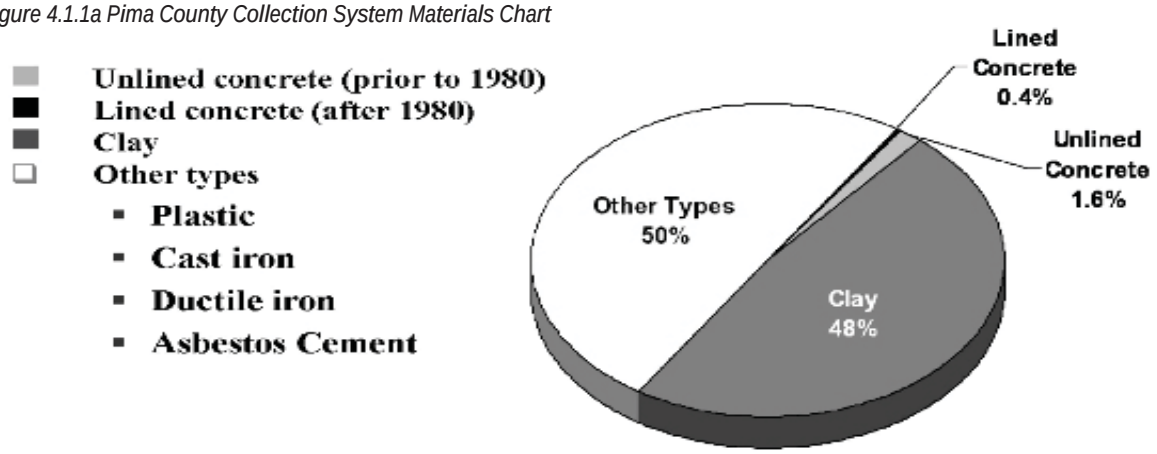
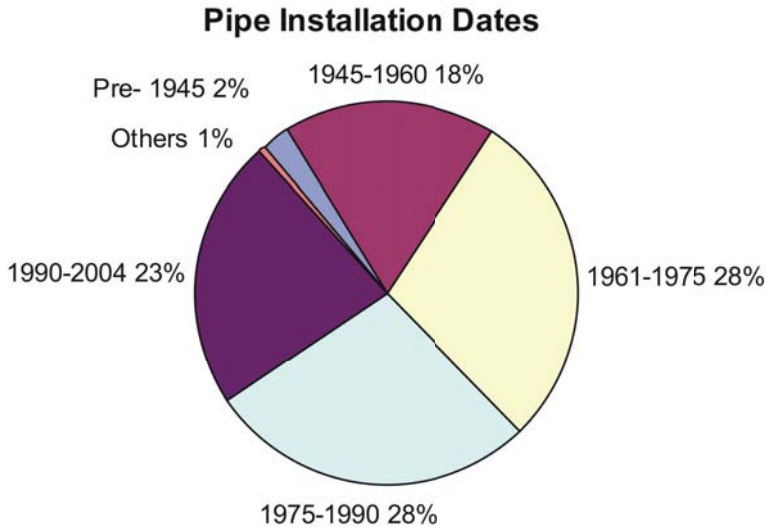


Figure 4.1.1b Pima County Collection System Age Distribution Chart



The largest of the systems is the Tucson Metropolitan System. The Metropolitan System conveys flow primarily by gravity to PCWMD's two major wastewater treatment plants, the Roger Road Wastewater Treatment Plant (WWTP) (41 MGD) and the Ina Road Water Pollution Control Facility (WPCF) (25 MGD with a 12.5 MGD expansion under construction). The Metropolitan Conveyance System presently transports approximately 62 MGD Average Dry Weather Flow (ADWF).

Existing Interceptor System and Condition Assessment

Outlined below is a description and condition assessment based on Closed Circuit Television (CCTV) inspections of trunk and interceptor sewers performed in 2003 by Brown and Caldwell in association with ProPipe. Brown and Caldwell provided condition assessment of both lined and unlined RCP, approximately 50 miles. After receiving pipeline assessment and certification program (PACP) training by Brown and Caldwell, PCWMD Design Section staff began to assess the remaining 180 miles (see Appendix C).

Each of the interceptors and trunk sewers were inspected utilizing the NASSCO defect codes. The condition grades depicted in Table 4.1.1 represent the overall grade of a reach, taking into account the severity of every defect code within that pipe.

Figure 4.1.2 depicts the interceptors and trunk sewers located within the Tucson Metropolitan system.

Table 4.1.1 NASSCO Condition Grades

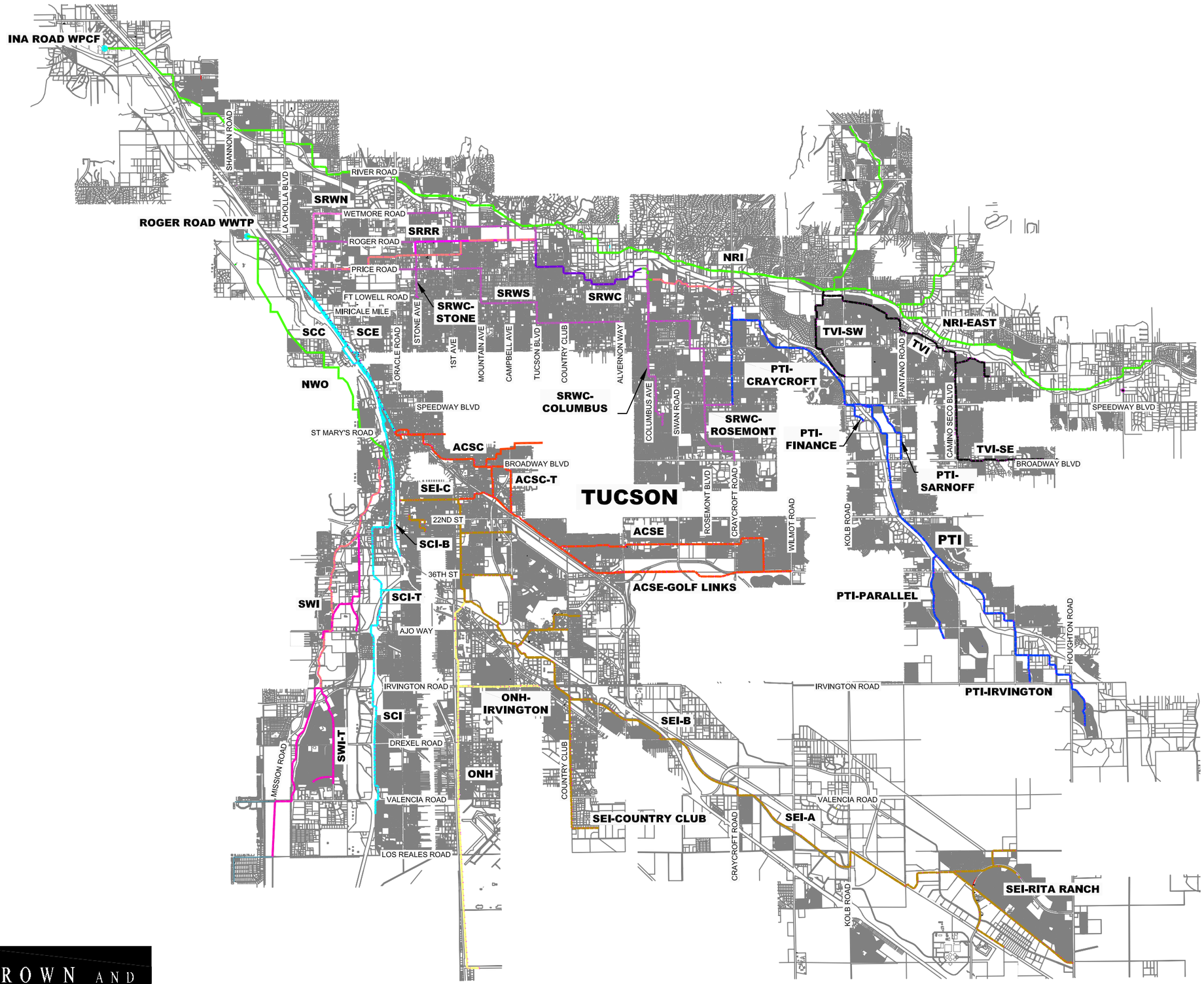
Condition Grade	Grade Description
1 - Excellent	No defects, condition like new, no evidence of any corrosion exhibited.
2 - Good	Minor and few moderate defects noted. Sound structure with little to no documentation of corrosion.
3 - Fair	Moderate defects that will continue to deteriorate. Rehabilitation monitoring is recommended.
4 - Poor	Severe defects that will become Grade 5 sewers within the near future. Rehabilitation is strongly recommended in the near future.
5 - Immediate Attention Required	Sewers require immediate rehabilitation or replacement.

Brief descriptions, history and condition assessment information are provided in the following paragraphs.

Aviation Corridor Interceptor

The Aviation Corridor Interceptor is segmented into two individual lines, which convey flows from the southeast portion of town to the Roger Road WWTP. The Aviation Corridor South Central (ACSC) conveys flow from the flow management structure located at 18th Street and Vine, northwest to the downtown area. The Aviation Corridor South East (ACSE) conveys flows to the Southeast Interceptor from Davis-Monthan Air Force Base, along the Aviation Corridor through the flow management structure.

The downtown portion consists of two major trunks taking flow from southeast of downtown and moving flows northwest to the Roger Road WWTP. One of the lines was originally installed in 1916; the line ranged from 20 to 24 inches in size and was predominantly concrete pipe construction. The other line was brought into the downtown area in 1927 with the addition of 24-inch lines paralleling the Aviation Corridor and the existing alignment downtown. Next, in 1940, the Eastside sewer interceptor was constructed and now the interceptor extended east to Palo Verde Road. In 1941, the system was extended via parallel 15-inch lines from the Davis-Monthan Air Force Base to the then existing sewer at Palo Verde, along the old Golf Links Road alignment. In 1965, a siphon was added to the interceptor at Golf Links and Dodge Road alignment to allow construction of the Tucson Diversion Channel. In 1975, a major trunk was added with a 24-inch line along 29th Street, this trunk extends from Country Club to Craycroft Road. The next significant feature to occur which



LEGEND

ACS - AVIATION CORRIDOR
- ACSC
- ACSC - TUCSON
- ACSE
- ACSE - GOLF LINKS

NRI - NORTH RILLITO
- NRI
- NRI - EAST

ONH - OLD NOGALES HIGHWAY
- ONH
- ONH - IRVINGTON

PTI - PANTANO
- PTI
- PTI - CRAYCROFT
- PTI - FINANCE
- PTI - IRVINGTON
- PTI - PARALLEL
- PTI - SARNOFF

SC - SANTA CRUZ
- SCC
- SCE
- SCI
- SCI - B
- SCI - T
- NWO - NORTHWEST OUTFALL

SEI - SOUTH EAST
- SEI - A
- SEI - C
- SEI - COUNTRY CLUB
- SEI - DOWNTOWN
- SEI - RITA RANCH

SR - SOUTH RILLITO
- SRRR
- SRWC
- SRWC - COLUMBUS
- SRWC - ROSEMONT
- SRWC - STONE
- SRWN
- SRWS

SWI - SOUTH WEST
- SWI
- SWI - T

TVI - TANQUE VERDE
- TVI
- TVI - SE
- TVI - SW

Figure 4.1.2

PIMA COUNTY INTERCEPTOR MAP

TUCSON, ARIZONA

SCALE : 1" = 10,000'

BROWN AND CALDWELL

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affected the interceptor was the realignment and replacement of the twin sewer configuration along the Aviation Corridor to allow the freeway improvement being done by the Arizona Department of Transportation (ADOT). The existing system was abandoned and replaced with a single sewer, north of the Aviation Corridor and paralleling the original alignment. This pipe replacement went to a 42-inch lined RCP. A flow management structure was also constructed at this time, located at 18th Street and Vine. This flow management structure has the ability to divert flows into the South East Interceptor (SEI) or divert flow north to the Santa Cruz East (SCE) Interceptor.

Aviation Corridor South Central Interceptor CCTV and Condition Assessment Summary

The ACSC Interceptor is 14,439 feet long and begins at a flow management structure located on Vine Avenue, south of 17th Street (see Figure 4.1.3). The line then travels northwest and ends at a manhole on the intersection of Davis Street and Anita Avenue. The flows from the ACSC system empty into the Santa Cruz East (SCE) Interceptor.

There are three (3) ACSC-T trunk segments feeding into the ACSC Interceptor. The ACSC-T with the three segments is 12,052 feet long. The ACSC-T Segment 1 begins at the intersection of 6th Avenue and 5th Street, then heads west on 5th Street and drains into the ACSC. The ACSC-T Segment 2 begins on Campbell Avenue, just north of the Aviation Parkway, then heads northwest and proceeds west along 12th Street and drains into the ACSC at Highland Avenue. The ACSC-T Segment 3 begins at the intersection of 9th Street and Cherry Avenue, and then heads west along 10th Street, proceeds south on Highland Avenue and flows into the ACSC on 12th Street. The ACSC-T1 trunk is 5,380 feet long. The ACSC-T1 begins at the intersection of Forgeus Avenue and 7th Street, then heads west on 7th Street and proceeds south on Norris Avenue, then heads west on 8th Street and proceeds south on Warren Avenue, then heads west on 9th Street and feeds into the ACSC-T Segment 3 on Cherry Avenue. A summary of CCTV inspected interceptor and trunk piping lengths based on pipe diameters is presented below:

Diameter	15”	16”	18”	20”	21”	24”	Total
Length (ft)	13,969	32	320	3,111	3,118	11,321	31,871

Along the ACSC, ACSC-T and ACSC-T1 alignments, there are five different types of piping materials that were used for construction. The predominant material is unlined reinforced concrete pipe rehabilitated with cured-in-place pipe (CIPP), in addition to DIP, VCP, PVC, and unlined non-reinforced concrete pipe (CP). The table presented below details the total CCTV inspected length of interceptor and trunk for each type of pipe material:

Pipe Material	CIPP	VCP	PVC	CP	DIP	Total
Length (ft)	11,321	10,281	2,549	7,688	32	31,871

A significant interceptor rehabilitation project was done in 1991 on a portion of the ACSC line. The line was rehabilitated with CIPP lining from downtown (Main and 4th Street) to Highland Avenue. In addition, in 2004 ACSE-T Segment was rehabilitated with CIPP from Highland and 12th Street north to 9th Street. This project was undertaken by PCWMD based on the results of the 2003 CCTV program. The majority are considered Grade 2 (Good) while the remainder are considered Grade 3 (Fair) requiring monitoring and CCTV re-inspection in 2008. The estimated cost for spot repairs for Grade 4 is $224,000 and for future rehabilitation of 18,001 linear feet of interceptor considered Grade 3 is $4.26 million.

Aviation Corridor South East Interceptor CCTV and Condition Assessment Summary

The ACSE Interceptor is 32,950 feet long and begins at a manhole located on the intersection of Sahuara Avenue and 28th Street (see Figure 4.1.4). The line then travels west on 29th Street,

heads west on Silverlake Road, then travels northwest along the north face of the Aviation Parkway, then crosses the Aviation Parkway and travels west on 18th Street and ends at a manhole on the intersection of Euclid Avenue and 18th Street at the SEI. The flows from the ACSE system can also empty into the ACSC Interceptor at 18th and Vine Street, and flow into the SCE Interceptor.

There is one trunk that feeds into the ACSE Interceptor, ACSE-T, which is 30,203 feet long. The ACSE-T begins at the intersection of Wilmot Road and Golf Links Road, then heads west on Golf Links Road. One segment of the ACSE-T proceeds north on Sahuara Avenue and drains into the ACSE Interceptor; the other segment proceeds west of Craycroft Road on Golf Links Road through the Davis-Monthan Air Force Base, south of Golf Links Road, then heads west across Palo Verde Road via the Palo Verde Siphon, then travels northwest along the north face of the Aviation Parkway and drains into the ACSE Interceptor at a manhole located southeast of Silverlake Road and the Aviation Parkway. A summary of CCTV inspected interceptor and trunk piping lengths based on pipe diameters is presented below:

Diameter	15”	18”	24”	30”	36”	42”	Total
Length (ft)	27,925	2,278	23,415	5,852	1,500	2,183	63,153

Along the ACSE and ACSE-T alignments there are four different types of piping materials that were used for construction. The predominant material is VCP, in addition to DIP, PVC, and T-Lock lined RCP. The table presented below details the total CCTV inspected length of interceptor and trunk for each type of pipe material:

Pipe Material	VCP	DIP	PVC	RCP w/ T-Lock	Total
Length (ft)	45,403	245	8,039	9,466	63,153

Based upon the CCTV investigation and condition assessment, two reaches are considered Grade 2 (Good) while the remainder is considered Grade 3 (Fair) requiring monitoring and CCTV re-inspection in 2008. The estimated cost for spot repairs for Grade 4 is $262,000 and for future rehabilitation of 55,114 linear feet of interceptor considered Grade 3 is $14.15 million.

Cañada Del Oro Interceptor

The Canada del Oro (CDO) Interceptor is divided into seven segmented lines, which convey flow from the Northwest portion of Tucson to the Ina Road WPCF. The central and downstream portion of the interceptor is also the oldest chronologically. The downstream portion starts at the Ina Road WPCF, travels east along Ina Road and then proceeds northeast along the CDO Wash alignment to the most upstream point, along Tangerine Road in Rancho Vistoso. The earliest date of construction for this segment is 1979. This segment of the CDO Interceptor also has unlined concrete pipe in the reaches from Interstate-10 (I10) east to the CDO Wash. There is another trunk to this line, which extends to the Town of Catalina, but it was not included in this interceptor CCTV inspection because of line size (12-inch).

The other segments were installed as part of offsite sewer improvements related to improvement districts. Growth of the CDO interceptor is segmented, directly related to the growth pattern in this portion of Tucson. A majority of the sewers were installed in the 1980s and 1990s. Some of the developments related to these sewers are: Rancho Vistoso, Copper Creek, Countryside, and the North First Avenue Sewer Improvement District. No siphons or flow management structures are associated with the CDO Interceptor. The latest addition to the interceptor group is the trunk installed as part of the offsite sewer improvements for the Dove Mountain development.

Cañada Del Oro Interceptor CCTV and Condition Assessment Summary

The main segments of the CDO Interceptor from north to south are CDO-B and CDO-A. (See Figure 4.1.5)

The CDO-B interceptor is 10,058 feet long and begins just north of the intersection of Rancho Vistoso Boulevard and the Big Wash in the Sun City Rancho Vistoso Development. The line flows under Big Wash then proceeds south along Vistoso Commerce Loop to Tangerine Road where it crosses below the road and drains into the upstream-most manhole of CDO-A.

CDO-A is 62,238 feet long and begins southwest of the intersection of the bridge on Tangerine Road and the Big Wash west of Oracle Road. The interceptor then proceeds under the Big Wash then runs south along the eastern edge of the Big Wash to the Oracle Road and the CDO Wash crossing bridge. At the bridge, the line passes below the CDO Wash then proceeds east under Oracle Road where it turn south and runs south again parallel to Oracle Road in the eastern utility right-of-way. The line then passes below the Oro Valley Country Club Golf Course where it again crosses under the CDO Wash. At the CDO Wash, the line then proceeds southwest along the northern bank until it reaches Ina Road. Thereafter, the line runs west along the eastern edge of Ina Road, cuts across I-10 and enters the inlet manhole at the Ina Road WPCF.

CDO-T1 is 28,797 feet long and is divided into three segments. Segment 1 begins northeast of the First Avenue and CDO Wash crossing bridge then heads southwest along Lambert Lane to empty into the CDO-A interceptor just north of the CDO Wash. Segment 2 of the CDO T1 begins 500-feet north of the intersection of Copper Creek and Naranja Drives then heads west on Naranja Drive. At the intersection of Naranja and La Cañada Drives the line proceeds south across Lambert Lane and drains into the CDO-A north of the CDO Wash. CDO-T1 Segment 3 begins at Lambert Lane west of La Cholla Boulevard and then proceeds south along La Cholla Boulevard and empties into the CDO-A interceptor at the intersection of La Cholla Boulevard and Overton Road.

CDO-T2 is 18,876 feet long and begins at the intersection of Palo Seco Road and Thornydale Road. The line runs south on Thornydale Road along the eastern utility right-of-way, then crosses below Thornydale Road and proceeds southwest along Orangewood Drive. At the intersection of Orangewood Drive and Oldfather Road, the line flows south along Oldfather Road and then drains into the CDO-A interceptor at the intersection of Ina and Oldfather Roads.

CDO-T3 is 12,031 feet long and is divided into three segments. CDO T-3 Segment 1 begins at the intersection of Oasis Road and Shannon Road and heads south on Shannon Road and then proceeds west through a subdivision along Canyon Break Trail. It then runs south through a wash across Sumter Drive and heads west just north of Linda Vista Boulevard and drains into the CDO-T-2 on Thornydale Road. Segment 2 begins just northeast of Cortaro Farms Road on Club Drive, then heads west along Cortaro Farms Road and drains into the CDO-T2 on Thornydale Road. Segment 3 begins on Oldfather Road, near the cross road of Barque Drive, then runs south on Oldfather Road and drains into the CDO T2 on Orangewood Drive.

CDO-T4 is begins at the intersection of Tangerine Road and Camino de Oeste and then proceeds south for 30,146 feet to drain into the CDO-A interceptor at the intersection of Ina Road and Camino de Oeste.

CDO-T5 is 3,224 feet long and begins in a drainageway west of Crimson Vista Drive and north of Pinnacle Vista Drive in the Dove Mountain community. The line then runs south through native desert and ends at Pump Station 8B6515 located at 5540 West Tangerine Road, north of Tangerine Road and west of Dove Mountain Boulevard.

CDO-T6 is 13,239 feet long and is divided into two segments. Segment 1 begins in a drainageway east of Paseo Montalban, north of Ina Road, and then runs west along Ina Road to drain into the CDO-A interceptor west of the CDO Wash on Ina Road. Segment 2 starts on La Cholla Boulevard near the cross street of Zarragoza Drive and heads south on La Cholla Boulevard. It drains into the CDO-T6 Segment 1 on Ina Road.

CDO-T7 is 8,612 feet long and begins at the intersection of Northern Avenue and Hardy Road, then heads in the west and southwesterly direction through the Ranchos de La Cañada subdivision and drains into a 12-inch line flowing west on La Cañada Drive and Emerine Drive. Flow from CDO-T7 eventually ends up in the CDO-A interceptor through 10 and 8-inch diameter lines which were not scheduled for assessment in the scope of this project. A summary of CCTV inspected interceptor and trunk piping lengths based on pipe diameters is presented below:

Diameter	15”	16”	18”	20”	21”	24”	30”	33”	36”	48”	Total
Length (ft)	77,095	1,464	18,885	270	26,732	19,199	18,728	1,828	11,160	11,860	187,211

Along the CDO and CDO trunk alignments there are four different types of piping materials that were used for construction. The predominant material is PVC pipe as well as to DIP, VCP, and unlined RCP. The table presented below details the total CCTV inspected length of interceptor and trunks for each type of pipe material:

Pipe Material	PVC	DIP w/unknown liner	VCP	RCP	Total
Length (ft)	74,711	42,279	61,800	8,431	187,221

A condition assessment was performed and in general the interceptor is considered Grade 2. A small portion of DIP is Grade 3 (Fair) or Grade 4 (Poor) at a few reaches, requiring future spot repairs. The estimated cost for spot repairs for Grade 4 is $1.12 million and for future rehabilitation of 7,953 linear feet of interceptor considered Grade 3 is $3.1 million.

North Rillito Interceptor

The North Rillito Interceptor (NRI) was collectively designed and constructed in the time period of 1967-1972. The driving factor in the interceptor development was two-fold: increased population growth in the North and Northeast portions of Tucson along with the design and construction of the new Ina Road WPCF. The Ina Road WPCF started construction in 1975 and was completed in 1977 with an initial capacity of 25 MGD.

The NRI conveys wastewater from the northern Metropolitan and Foothills area to the Ina Road WPCF. It was designed and constructed in phases under the name “North Rillito Interceptor Sewer” Contracts: 61 (Phase A, B, C & D) 68, 69 (Phase 1 & 2), 70, 71, 72 and 73. Along with the NRI, two trunks were added to the CCTV inspection project: the Ventana trunk (18-inch constructed circa 1980-90) and the Sabino trunk (15-inch constructed circa 1988).

The NRI has one siphon (Sabino Creek) and the Sabino Trunk has two siphons (Bear Creek and Cloud Road). All three siphons were cleaned and televised as part of this project. One augmentation project was completed on the Sabino Trunk; twin parallel 15-inch lines compose one portion of the trunk to the NRI.

In 1985, a project was issued to repair portions of the NRI along with restoring bank protection. Flood damage from the floods of 1983 caused the NRI replacements along the banks of the Tanque Verde Wash. In 1987, the NRI was modified to accommodate the new Orange Grove/Southern Pacific Railroad grade interchange. A series of growth spurred by off site development in the 1990s added portions of sewer to the Ventana and Sabino trunks.

North Rillito Interceptor CCTV and Condition Assessment Summary

The NRI flows east to west from the intersection of Tanque Verde Loop Road and Conestoga Avenue to the Ina Road WPCF headworks (see Figure 4.1.6). The NRI and associated trunks are 140,371 feet long and follows the alignment of the Rillito River and Tanque Verde Creek. The NRI is fed by two trunk lines along its alignment. The NRI-Sabino trunk is first along the NRI alignment. The NRI-Sabino trunk is 8,905 feet long and flows from north to south along Sabino Canyon Road alignment. The second trunk, NRI-Ventana, is 15,807 feet long and flows from north to south from the Ventana Resort area along the Sunrise and Kolb Road alignments. A summary of the NRI and trunk pipeline lengths and diameters is presented here.

Diameter (inches)	Length (ft)
15	33,231
18	14,057
21	4,775
24	594
27	7,501
30	11,342
33	13,341
36	19,274
39	23,551
42	10,540
48	2,165
Total	140,371

Along the NRI alignment there are seven different types of piping systems that were used for construction. A total of 30,263 feet of the interceptor is comprised of VCP), 11,234 feet is PVC pipe, 570 feet is DIP lined, 58,141 feet is RCP lined with T-Lock liner, 21,818 feet is unlined RCP, 15,248 is asbestos concrete pipe (ACP), and 3,097 is acrylonitrile butadiene styrene (ABS) Truss pipe. The table presented below outlines the pipe materials and their associated lengths.

Pipe Material	VCP	PVC	DIP	RCP Lined	RCP	ACP	ABS	Total
Length (ft)	30,263	11,234	570	58,141	21,818	15,248	3,097	140,371

Based upon the CCTV investigation and condition assessment, it was determined that the NRI Sabino and Ventana trunk sewers are Grade 2 (Good) and the remainder is considered Grade 3 (Fair) requiring monitoring and CCTV re-inspection in 2008. The estimated cost for future rehabilitation of 115,659 linear feet of interceptor considered Grade 3 is $29.8 million.

Northwest Outfall Interceptor

The NWO Interceptor was constructed in the mid-1960s utilizing mostly unlined 42 to 48-inch diameter reinforced concrete pipe. The interceptor extends approximately 5.0 miles from downtown Tucson north through several neighborhoods to the Roger Road WWTP (see Figure 4.1.7). The interceptor has two double-barrel siphon crossings of the Santa Cruz River. On September 7, 2002, two large sinkholes opened west of Interstate 10 in the middle of West Speedway Boulevard. A major sanitary sewer overflow (SSO) occurred that entered the Santa Cruz River through the storm drain system. The NWO emergency was the largest ever experienced by PCWMD and prompted rapid reassessment of PCWMD's construction project priorities. A small portion of the 35-year-old interceptor had been rehabilitated 5 years earlier and a design was in progress to rehabilitate the remaining segments of the interceptor. As a result of the emergency and the likely damage to segments of the interceptor downstream of the sinkholes, an emergency rehabilitation design and construction project utilizing CIPP technology was initiated for the entire alignment.

The rehabilitation project also included cleaning of two double-barrel siphons (Alameda and Sweetwater) and rehabilitation of the inlet and outlet siphon structures, as well as rehabilitating all manholes along the five mile alignment. As a result, the entire interceptor including the two siphon structures are considered Grade 2 (Good).

Old Nogales Highway Interceptor

This sewer is not recognized as an interceptor, but as a trunk sewer to the SEI. The line was constructed in 1968 with two additional phases constructed in 1974 and 1987. Because of the length and pipe diameter involved, the Old Nogales Highway (ONH) trunk sewer has been identified as an interceptor.

The limits of the trunk sewer extend from I-10 and Park Avenue to the Hughes Access Road, along the Old Nogales Highway alignment. One trunk was added to this group, which is the 15-inch diameter sewer along Irvington Road. The ONH trunk sewer has one siphon, known as the Veteran's siphon. The siphon is located due north of Ajo Way, near the Union Pacific Railroad. It contains three barrels (8-inch, 15-inch and 18-inch) and was constructed in 1968.

Old Nogales Highway Interceptor CCTV and Condition Assessment Summary

The ONH Interceptor system is approximately 41,000 feet long including 7,800 feet of trunk line that discharges into the main interceptor (see Figure 4.1.8). The ONH interceptor flows from south to north along the east side of Nogales Highway in an easement within the Union Pacific Railroad track right-of-way. The interceptor begins 550-feet east of the intersection of Hughes Access Road and the Nogales Highway and proceeds north to near the intersection of Park Avenue and I-10. The ONH-T begins at the intersection of Irvington Road and Benson Highway and proceeds west for 7,800-feet to a point of discharge into the ONH interceptor at 1st Avenue. A summary of interceptor and trunk pipe lengths and diameters is presented below:

Diameter	15"	18"	24"	30"	Total
Length (ft)	7,619	26,218	6,756	658	41,251

Along the ONH interceptor alignment there are two different pipe materials that were used for the construction, DIP and VCP. The table below shows the total CCTV inspected lengths of each pipe material.

Pipe Material	DIP	VCP	Total
Length (ft)	26,059	15,192	41,251

During CCTV inspection activities, it was found that the epoxy liner applied to the interior of the DIP is separating itself from the pipe at most joints and in some locations obstructing flow as well as impeding CCTV inspection. Based upon the CCTV inspection investigation and condition assessment, it was determined that the entire ductile iron portion is Grade 4 (Poor) requiring rehabilitation. The remainder is considered Grade 3 (Fair) requiring monitoring and CCTV re-inspection in 2008. The estimated cost for rehabilitation of 26,059 linear feet of interceptor considered Grade 4 and 15,192 linear feet of interceptor considered Grade 3 are $8.4 million and $3.9 million, respectively.

Pantano Interceptor

The Pantano Interceptor (PTI) was originally installed in 1975 under the plan name: City of Tucson Sewer Improvements Contract 281, Pantano Interceptor Sewer, Stage 1. When constructed in 1975, the line ranged in size from 36, 33 to 24-inches using predominantly VCP construction. The larger lines (33-inch and 36-inch) were RCP that was 300-degree protected with PVC lining. The interceptor was extended from Speedway to Golf Links Road, paralleling the Pantano Wash in 1991. Trunk lines were constructed in 1979 (21-inch Craycroft Road trunk sewer) and in 1989 (18-inch trunk line at Sarnoff Drive). The interceptor was again extended to its current limit of Irvington Road.

Wastewater generated in the Pantano Wash drainage basin is currently conveyed in the Pantano Interceptor to the South Rillito Interceptor (SRI) system at Craycroft Road. Flow can be re-directed at Craycroft Road into the NRI, but normally this crossing is not in use. This feature is listed as an inverted siphon in Craycroft Road, located at the Pantano Wash/Tanque Verde Creek confluence. The siphon does not have multiple barrels and identified inlet and outlet chambers similar to other inverted siphons located in the collection system.

Pantano Interceptor CCTV and Condition Assessment Summary

The total PTI system with interceptor and trunks is 102,048 feet long (see Figure 4.1.9). The PTI is approximately 63,582 feet long and flows from the southeast to the northwest. PTI begins just southeast of the intersection of Houghton and Irvington Roads in the Civano Subdivision and ends just north of the intersection of Craycroft Road and Sutler Lane where it empties into the North Rillito Interceptor. There are five trunks that feed into the PTI. Beginning on the south side of PTI, the first trunk is PTI-T2. The PTI-T2 trunk is 2,581 feet long and begins at the intersection of Irvington and Harrison Roads and proceeds north to empty into PTI at the intersection of Audrey and Millmar Roads. The second trunk from south to north is PTI-T1. PTI-T1 is 8,525 feet long and begins just south of the intersection of Escalante Road and Sarnoff Drive in Lincoln Park. The PTI-T1 trunk proceeds north from Lincoln Park to tie-into PTI at the intersection of Pantano Parkway and Hazeltine Lane. The third PTI trunk from south to north along PTI is PTI-T4. PTI-T4 is 16,918 feet long and runs along the east side of the Pantano Wash from the intersection of Hazeltine Lane and Pantano Parkway to just southeast of the intersection of Speedway Boulevard and Finance Center Drive. The fourth trunk line is PTI-T3. PTI-T3 is 2,360 feet long and begins at the intersection of Gateway Center Circle and Rosewood Street and empties into PTI at Speedway Boulevard and Finance Center Drive in the west side of Pantano Wash. The fifth trunk line reporting to PTI is PTI-Craycroft. PTI-Craycroft begins at the intersection of Craycroft Road and Speedway Boulevard and proceeds north for 8,082 feet in the Craycroft Road alignment to its termination point where it empties into PTI at the intersection of Craycroft Road and Glenn Street.

A summary of interceptor and trunk piping lengths and diameters is presented below:

Diameter	12”	15”	16”	18”	21”	24”	30”	33”	36”	Total
Length (ft)	2,804	23,920	231	29,934	7,973	4,872	12,598	10,197	9,519	102,048

Along the PTI and PTI trunk alignments there are four different types of piping materials that were used for construction. The predominant material is PVC in addition to runs of DIP, VCP, RCP with T Lock lining, and ACP. The table presented below details the total CCTV inspected length of interceptor and trunks with material and length for each type of pipe.

Pipe Material	PVC	DIP	VCP	RCP Lined	ACP	Total
Length (ft)	37,589	18,632	16,357	17,321	12,149	102,048

Based upon the CCTV investigation and condition assessment, PTI-T1 and T2 and the southeast extension from Houghton Road were determined to be Grade 2 (Good). The remainder is considered Grade 3 (Fair) requiring monitoring and CCTV inspection in 2008. In addition, 4 sections (924 feet) of DIP were deemed Grade 4 (Poor) requiring rehabilitation. The estimated cost for spot repairs on Grade 4 is $450,000 and for future rehabilitation of interceptor considered Grade 3 is $19.1 million.

Santa Cruz Central Interceptor

The Santa Cruz Central (SCC) Interceptor was originally constructed in 1950 for Pima County Sanitary District 1. The limits of the interceptor extend approximately from downtown Tucson

(Congress Street and I-10) to Prince Road and I-10. The interceptor parallels the Santa Cruz River and the Santa Cruz East interceptor and ranges from 24-inches to 42-inches in diameter. The interceptor was originally built with unlined RCP. The interceptor is further distinguished by the use of rectangular manholes and covers along the alignment. An abandoned Parshall flume used for flow monitoring was located just upstream of Fort Lowell Road on the alignment. Two lift stations discharge into this line via force mains.

Recent modifications to the line include ADOT improvements to downtown Tucson (1999), which included a pipe material change to T-Lock, lined RCP extending from Saint Mary's Road to Speedway Boulevard. A segment of unlined RCP was located downtown, on the first reach south of Saint Mary's Road. From this segment upstream to the Alameda siphon, the pipe has been replaced. At Grant Road the interceptor was moved to the west (two portions cross the freeway) to accommodate the Grant Road / I-10 freeway crossing in 1961. The line in the Grant Road / I-10 freeway crossing was again replaced in 1995 to accommodate more freeway construction.

Santa Cruz Central Interceptor CCTV and Condition Assessment Summary

The SCC Interceptor is 22,456 feet long and flows from south to north along the I-10 alignment (see Figure 4.1.10). The SCC interceptor piping consists of multiple diameter and material types. The CCTV inspection program identified multiple diameters of unlined RCP lengths that require immediate and near term attention. A summary of the SCC interceptor pipeline lengths and diameters is presented below:

Diameter	24"	27"	30"	39"	42"	Total
Length (ft)	2,113	3,948	10,701	813	4,881	22,456

Along the SCC interceptor alignment there are five different pipe materials that were used for the construction. A total of 11,162 feet of the interceptor is comprised of unlined RCP, 5,877 feet of lined RCP, 4,410 feet of PVC, 879 feet of DIP and 150 feet of steel pipe. The table presented below outlines the pipe materials and their associated lengths.

Pipe Material	RCP Unlined	T-Lock	Steel	DIP	PVC	Total
Length (ft)	11,140	5,877	150	879	4,410	22,456

Upon completion of interceptor CCTV and condition assessment, it was determined that 1,331 feet of unlined RCP was Grade 5 (requires immediate attention) and as a result was replaced in 2004. Additionally, 1,108 feet of unlined RCP is Grade 4 (Poor), which requires attention within five years; 6,897 feet of unlined RCP is Grade 3 (Fair), and the remainder is Grade 2 (Good). In addition to the unlined RCP that was assessed as Grade 5, there was 150 feet of steel pipe inspected that is severely tuberculated. This section of steel pipe was found below Miracle Mile and I-10 and was rehabilitated in 2004. The estimated cost for rehabilitation of 1,108 linear feet of interceptor considered Grade 4 and 9,580 linear feet of interceptor considered Grade 3 are $288,000 and $2.5 million, respectively.

Santa Cruz East Interceptor

The Santa Cruz East (SCE) Interceptor was originally constructed in 1916. The limits of the interceptor extend approximately from Downtown Tucson (Saint Mary's Road) to the Fort Lowell Road alignment. The interceptor parallels the Santa Cruz River and the Santa Cruz Central interceptor east of I-10. The 30-inch diameter concrete gravity main was then extended across the Santa Cruz at Fort Lowell Road to allow the western 90 acres of a farm to be irrigated with sewage in 1917.

Recent modifications to the line include realignment at Grant Road (1974), additional manholes added to the interceptor (1974) and ADOT improvements downtown Tucson (1999). The recent improvements included a pipe material change to T-Lock lined RCP. The interceptor from north of Speedway Boulevard to the Fort Lowell Road alignment has remained intact and is the original unlined RCP dating from the original date of construction in 1916.

Santa Cruz East CCTV and Condition Assessment Summary

The SCE interceptor is approximately 16,000 feet long and is constructed with 30 to 33-inch diameter piping and has a north/south alignment along the east side of I-10 (see Figure 4.1.11). The SCE interceptor starts at the intersection of Davis Street and Anita Avenue, and proceeds north to Fort Lowell Road and the Union Pacific Railroad, manhole 9914 09. In addition to the main interceptor there are two very short lateral connections to the SCC that were inspected and assessed under this project.

Along the SCE interceptor alignment there are three types of piping material used, with unlined reinforced concrete pipe being the predominant material in use. There are 12,048 feet of unlined RCP; 363-feet of CIPP lined RCP, 1,510-feet of T-lock-lined RCP and 1,629-feet of VCP.

The table below summarizes the material types and quantities:

Pipe Material	RCP	T-Lock	CIPP	VCP	Total
Length (ft)	12,048	1,510	363	1,629	15,550

Of the 12,048 feet of unlined RCP assessed there are 2,111 feet that were rated Grade 4 (Poor) and require attention within three years, and 8,057 feet that were rated Grade 3 (Fair) requiring monitoring and CCTV re-inspection in 2008. The estimated cost for rehabilitation of 2,111 linear feet of interceptor considered Grade 4 and 8,057 linear feet of interceptor considered Grade 3 are $541,000 and $2.1 million, respectively.

Santa Cruz Interceptor

The Santa Cruz Interceptor (SCI) was originally installed in 1954, under the plan name: Sanitary District No. 1, Santa Cruz Interceptor and A1, A2, A3, A4, A5, A6 Trunks. The interceptor was predominantly constructed of VCP, with shallow wash crossings encased in concrete. In 1962, the interceptor was modified to include a three-barrel siphon (15-inch, 18-inch, 21-inch) at the Julian Wash crossing. All pipe used in the construction of the siphon was VCP. The next significant modification occurred in 1963 with the construction of the new Nogales – Tucson Highway I-19. A portion of the 21-inch VCP was relocated to accommodate freeway construction. The replacement pipe material was VCP.

In 1985, additional work to I-19 at Irvington was done requiring sewer relocations. The work involved replacement of sewer with new ductile iron pipe, along with VCP. A new freeway sewer crossing was added in which 20-inch DIP was installed in a 36-inch steel casing. In 1995 ADOT work related to I-19 relocated and replaced portions of the 30-inch SCI and 21-inch SCI-B from downtown to Star Pass Boulevard. Very recent (2002) sewer relocation and replacement was noted at the most southern portion of SCI-B to accommodate the new I-19/I-10 traffic interchange.

Santa Cruz Interceptor CCTV and Condition Assessment Summary

The entire SCI system runs from south to north, and is approximately 47,118 feet long (see Figure 4.1.12). The SCI begins at the intersection of South Pinta Avenue and an easement between West Calle Medina and Calle Sevilla then proceeds north for approximately 5,370 feet using 18-inch diameter piping. At that point the interceptor is upsized to 20 and 21-inch diameter piping and

proceeds north for approximately 12,300 feet. At the intersection of West Ebner Place and South Lamar Avenue the interceptor increases in size to 24-inch diameter piping and proceeds north for 15,598 feet crossing Interstate 19 (I-19) twice before increasing to 30-inches on the west side of I-19. After crossing underneath I-19, but prior to increasing to 30-inches in diameter, the line crosses underneath the Julian Wash by means of the Julian Wash Siphon. The 30-inch line then proceeds north for approximately 13,850 feet before terminating at the Alameda Street siphon, on the east side of the Santa Cruz River and West Alameda Street.

The SCI-T trunk begins at the intersection of South 12th Avenue and West 40th Street as a 15-inch line. The line heads west for approximately 380 feet, decreases to 12-inches in diameter for another 370 feet, then increases to 15-inches for the final 630 feet prior to connecting to the SCI interceptor just west of the intersection of 40th Street and 16th Avenue.

The following table details diameters and lengths along the interceptor:

Diameter	15”	18”	20”	21”	24”	30”	Total
Length (ft)	1,885	8,245	458	15,893	6,432	14,205	22,456

The SCI interceptor is a combination of VCP, reinforced concrete lined CIPP, PVC and DIP. There is 39,270 feet of VCP, 6,860 feet of PVC, and 988 feet of DIP. A brief table showing the pipe material length breakdown is shown below.

Pipe Material	VCP	DIP	PVC	Total
Length (ft)	39,270	988	6,860	47,118

During the review of the CCTV logs and still photos by Brown and Caldwell some major defects along the interceptor were observed; the CCTV crew also encountered some sections of pipe with debris and structural damage. Based on the CCTV inspection and condition assessment, SCI-T is Grade 2 (Good) and the DIP (998 feet) is considered Grade 4 (Poor) requiring rehabilitation within one year. The remainder is Grade 3 (Fair) requiring monitoring and CCTV re-inspection in 2008. The estimated cost for spot repairs on Grade 4 is $541,000 and for future rehabilitation of 37,527 linear feet of interceptor considered Grade 3 is $9.1 million.

Southeast Interceptor

The Southeast Interceptor (SEI) conveys wastewater generated in the southeast portion of the Metropolitan Tucson Area to the downtown area. The SEI interceptor starts southeast of the Rita Ranch developed area and parallels I-10 to the downtown area. The interceptor consists of over 10 miles of sewer line, with RCP with a plastic liner as the predominant material of construction. A majority of the interceptor is 21-inches to 30-inches in diameter and was installed in the early to mid-1980s. The final phases of the interceptor were completed in 1986. The earliest date of construction for some of the downtown portions is 1927.

Southeast Interceptor CCTV and Condition Assessment Summary

The SEI inspected area is divided into three sections: SEI A, SEI B and SEI-C (see Figure 4.1.13). In addition, there are three trunk lines feeding the SEI from east to west: SEI Rita Ranch, SEI Country Club, and SEI-Downtown.

The first segment of the interceptor from east to west is SEI-A. The SEI-A segment of the interceptor is 25,969 feet long and begins at the intersection of Old Vail Road and the east-west Rita Ranch drainage way and ends 400 feet north of the intersection of Craycroft and Littletown Roads. The interceptor is constructed with a combination of cold tar epoxy coated DIP and T lock lined RCP. The second segment of the SEI is SEI-B. The SEI-B segment of the interceptor begins

at the intersection of Craycroft and Littletown Roads and proceeds west along the I-10 alignment for 34,525 feet to its termination point into SEI-C at the intersection of I-10 and Benson Highway. The final segment of the SEI is SEI-C. SEI-C begins at the intersection of I-10 and Benson Highway and proceeds west for 4,100 feet to its termination point into the Alameda Siphon. A summary of pipe lengths, diameters and constructed materials is presented in the following table:

4.1.2 Inspection Summary - SEI A/B/C

SEI-A					
Inspected Diameter (inches)	27	30	36	48	Total
Inspected Lenght (feet)	6,607	15,590	2,177	1,595	25,969
Pipe Material	DIP w/Cold Tar Epoxy		RCP w/T-Lock		Total
Length (feet)	229		25,740		25,969
SEI-B					
Inspected Diameter (inches)	30		36		Total
Inspected Length (feet)	19,169		15,356		34,525
Pipe Material	DIP w/Cold Tar Epoxy		RCP w/T-Lock		Total
Lenght (feet)	1,727		32,798		34,525
SEI-C					
Inspected Diameter (inches)	30		36		Total
Inspected Length (feet)	4,100		600		4,700
Pipe Material	DIP w/Cold Tar Epoxy		RCP w/T-Lock		Total
Length (feet)	4,100		600		4,700

The first trunk line from east to west is SEI-Rita Ranch. This line is approximately 33,950 feet long and is constructed with a combination of lined DIP, PVC and T-lock lined RCP. The SEI Rita Ranch trunk line flows to the SEI-A section of the SEI at two locations along the Rita Ranch drainage way east of Old Vail Road. The second trunk line is the SEI Country Club trunk which reports to the SEI-B section of the interceptor. The SEI-Country Club trunk is approximately 15,091 feet long and is constructed with PVC piping. The SEI Country Club trunk line flows from north to south and discharges to the SEI-B section of the SEI 100 feet south of the intersection of Country Club and Irvington Roads. The third and final trunk line reporting to the SEI is SEI-Downtown. The SEI-Downtown trunk is divided into four separate lines that discharge to the SEI-C section of the SEI. The SEI-Downtown trunk flows to the SEI-C segment of the SEI at the intersections of: the Campbell Avenue on-ramp to I-10; Euclid Avenue and 36th Street; Euclid Avenue and 25th Street; and, Main Avenue and 36th Street. The total length for all four sections of the SEI Downtown trunk is 22,110 feet and the trunk is constructed with VCP, PVC, lined DIP and non-reinforced concrete pipe. A summary of pipe lengths, diameters, and constructed materials is presented in the table below for the listed trunk lines:

4.1.3 Inspection Summary - SEI Rita Ranch, Country Club and Downtown

SEI-Rita Ranch					
Inspected Diameter (inches)	18	21	24	30	Total
Inspected Length (feet)	26,214	3,831	2,607	1,298	33,950
Pipe Material	DIP	DIP w/Cold Tar Epoxy	PVC	RCP w/T-Lock	Total
Length (feet)	8,827	13,892	9,933	1,298	33,950
SEI-Country Club					
Inspected Diameter (inches)	15	18	21	24	Total
Inspected Length (feet)	2,606	5,567	2,826	4,092	15,091
Pipe Material	VCP				Total
Lenght (feet)	15,091				15,091
SEI-Downtown					
Inspected Diameter (inches)	12	15	16		Total
Inspected Length (feet)	1,003	20,991	16		22,110
Pipe Material	VCP	PVC	DIP	CP, Non-Reinforced	Total
Length (feet)	21,367	479	116	148	22,110

Review of the CCTV video reveals that all of the RCP installed in the SEI is lined and in fair condition (Grade 3). However, there are numerous reaches of DIP with failing liners requiring rehabilitation. In addition, it was noted that over 100 manholes along the SEI and trunks have a high level of corrosion and should be scheduled for rehabilitation. The estimated cost for spot repairs on Grade 4 is $920,000 and for rehabilitation of 140,000 linear feet of interceptor considered Grade 3 is $39.1 million.

South Rillito Roger Road Interceptor

The South Rillito Roger Road (SRRR) Interceptor was originally installed in 1965 under the plan name; Roger Road Interceptor. The interceptor parallels the Roger Road alignment and is part of the South Rillito Interceptor system that conveys wastewater from the mid-town (Tucson Boulevard) area to the Roger Road WWTP. The interceptor was predominantly composed of unlined RCP and ranged from 30 to 33-inches in size until it was rehabilitated in 1998 with CIPP.

In 1975, the interceptor was connected from Roger Road to Prince Road via an alignment along Romero Road with 30-inch VCP. The next modification to the interceptor occurred in 1997 with the completion of a new flow management structure at the intersection of Roger Road and Tyndall Avenue. This flow management structure was added with the construction of a new 66-inch parallel interceptor (South Rillito West Central [SRWC]) in Roger Road. This unique structure allows the 66-inch line to go under the 30-inch line and continue south on Tyndall Avenue. The portion of the SRRR interceptor over the 66 inch line is a 24-inch DIP reach with a controlling gate valve. There is also another 24-inch DIP reach with a gate valve which allows flows south into the 66-inch line.

A one-foot hydraulic jump was encountered and documented in the CCTV survey and as-builts confirm the installation of the jump to clear the top of the 66-inch SRWC Interceptor.

South Rillito Roger Road Interceptor CCTV and Condition Assessment Summary

The SRRR Interceptor system is approximately 24,975 feet long (see Figure 4.1.14). The SRRR Interceptor begins at the intersection of Tucson Boulevard and Allen Road. From that point the line runs north for approximately 1,334 feet, using VCP to Roger Road where the sewer line turns and heads west for 16-feet using 8-inch diameter PVC piping. At that point the interceptor is upsized to 30-inch diameter RCP/CIPP and continues west along Roger Road approximately 10,312 feet to Stone Avenue, where the line is upsized again to 33-inch diameter VCP. The 33 inch diameter VCP interceptor continues west along Roger Road for 7,926 feet to the intersection of Roger and Flowing Wells Roads. At Roger and Flowing Wells Roads the interceptor decreases to 30-inch diameter VCP piping and continues to its completion at the intersection of Romero and Prince Roads; a distance of approximately 5,387 feet. Pipe diameter lengths are shown in the table below:

Diameter	8”	15”	24”	30”	33”	Total
Length (ft)	16	1,334	59	15,040	7,926	24,975

The SRRR interceptor is a combination of VCP, RCP/ CIPP, DIP, and a short section of PVC piping. There are 4,012 feet of VCP, 20,947 feet of CIPP, and 16 feet of PVC. A brief table showing the pipe material length breakdown is shown below.

Pipe Material	VCP	CIPP	DIP	PVC	Total
Length (ft)	4,012	20,888	59	16	24,975

Review of the CCTV video reveals that all of the RCP installed in this interceptor has been rehabilitated using the CIPP method. The entire interceptor is rated Grade 2 (Good), except for the ductile iron pipe which is Grade 4 (Poor) requiring rehabilitation. The estimated cost for spot repairs on Grade 4 is $23,000.

South Rillito West Central Interceptor

The downstream portions of the South Rillito West Central (SRWC) Interceptor were constructed in 1975 with the Prince Road Interceptor project. Within that project a small section of 48-inch (originally constructed in 1950) was abandoned. The SRWC Interceptor is part of the larger South Rillito interceptor system. When comparing original dates of construction with other similar sized interceptors (including those in the South Rillito system) the SRWC has the most recent date of construction.

After the downstream section was constructed in 1975 (upgraded in size and pipe material), the next improvement to the South Rillito system was the extension east of the interceptor from Tucson Boulevard to Columbus Boulevard in 1980. In 1983, the interceptor was again extended east from Columbus Boulevard to the Belvedere alignment and then in 1990 the last extension east, Belvedere to Craycroft Road, was constructed. In 1985, a major street improvement to Stone Avenue was conducted and a 24-inch north/south trunk to the South Rillito interceptor system was added. SRWC-T Stone is the nomenclature used to describe this trunk and it is included within this interceptor grouping.

In the 1990s a series of three improvements were done to the South Rillito interceptor system which provided the inception of a third leg (SRWC) of the South Rillito system. It added capacity by adding a 66-inch line from the Tucson Boulevard flow management structure to the Prince Road/I-10 interchange. Also included with the segmented improvements was the reconstruction of the Tucson Boulevard flow management structure itself.

South Rillito West Central Interceptor CCTV and Condition Assessment Summary

The SRWC Interceptor flows east to west from Craycroft Road to the Roger Road WWTP headworks (see Figure 4.1.15). The interceptor is 53,825 feet long and follows the alignment of the Rillito River. The SRWC Interceptor is fed by three trunk lines along its alignment. The SRWC-Rosemont is the first trunk along the SRWC alignment. The SRWC-Rosemont trunk is 27,534 feet long and flows from south to north along Rosemont Boulevard, beginning at the intersection of Broadway Boulevard and Craycroft Road and terminating into the SRWC interceptor at the intersection of Columbus Boulevard and Bullrush Lane. The second trunk, SRWC-Columbus, is 13,050 feet long and flows from south to north, beginning at the intersection of Columbus Boulevard and Fourth Street and terminating into the SRWC interceptor at Columbus Boulevard and Bullrush Lane. The Columbus and Rosemont trunks run parallel along Columbus Boulevard from Glenn Street to their termination points at Bullrush Lane. The third trunk line feeding the SRWC interceptor is the SRWC-Stone trunk. The SRWC Stone trunk is 4,011 feet long and flows from south to north along Stone Avenue, beginning at the intersection of Stone Avenue and Fort Lowell Road and terminating into the SRWC interceptor at the intersection of Stone Avenue and Pastime Road. A summary of the SRWC interceptor and trunk pipeline lengths and diameters is presented below:

Pipe Material	VCP	PVC	DIP	RCP Lined	RCP	Total
Length (ft)	37,188	6,292	1,769	19,585	33,586	98,420

Along the SRWC interceptor alignment there are five different pipe materials that were used for construction. A total of 37,188 feet of the interceptor is comprised of VCP, 6,292 feet is PVC pipe, 428 feet is DIP lined, 34,922 feet is RCP lined with T-Lock liner and 19,590 feet is unlined RCP that has been rehabilitated with CIPP lining. The table presented below outlines the pipe materials and their associated lengths.

Diameter	15”	18”	21”	24”	48”	54’	66”	72”	78”	Total
Length (ft)	16,030	19,396	8,469	1,293	14,322	16,026	21,221	132	1,531	98,420

Based upon the CCTV investigation and condition assessment, it was determined that the interceptor is mostly Grade 2 (Good) with the remainder Grade 3 (Fair) requiring monitoring and CCTV investigation/condition assessment in 2008. The estimated cost for spot repairs on Grade 4 is $130,000 and for future rehabilitation of 21,422 linear feet of interceptor considered Grade 3 is $5.4 million.

South Rillito West North Interceptor

The downstream portion of the South Rillito West North (SRWN) Interceptor was constructed in 1950 under the Prince Road (PR) Interceptor project. This segment was on Prince Road, extending to Romero Road. The interceptor is part of the larger South Rillito Interceptor system that conveys wastewater from the mid-town (Tucson Boulevard) area to the Roger Road WWTP.

In 1995, a portion of the interceptor was rehabilitated utilizing cure-in-place technology. The project was titled “Romero Road/Wetmore Road Sewer Rehabilitation.” The line was rehabilitated from Prince/Romero to Wetmore/Oracle Roads.

South Rillito West North Interceptor CCTV and Condition Assessment Summary

The SRWN Interceptor flows east to west from the intersection of Campbell Avenue and Roger Road to Prince Road and I-10 for approximately 28,700 feet (see Figure 4.1.16).

The interceptor begins as an 18-inch diameter line at the intersection of Campbell Avenue and Roger Road and runs 1,530 feet north along Campbell Avenue to Limberlost Road where it turns

and travels west for 5,090 feet to First Avenue. At First Avenue, the line travels north for 1,203 feet to Wetmore Road. At Wetmore Road, the SRWN increases in diameter from 18-inches to 24 inches for 104 feet, then decreases to 21-inches at Wetmore Road. The interceptor travels west along Wetmore Road for approximately 5,124 feet before increasing diameter once more to 24 inches, just prior to Oracle Road. The line continues at a diameter of 24-inches for 4,656 feet to just before Flowing Wells Road, where the line increases to 30-inches diameter. The line continues for 3,169 feet to Romero Road, where it turns south along Romero Road for 5,267 feet to Prince Road. At Romero Road and Prince Road the 30 inch diameter line turns west for approximately 2,089 feet until discharging into the SCE 54 inch interceptor at Prince Road and Interstate 10. A summary of the SRWN interceptor and trunk pipeline lengths and diameters that have been inspected is presented below:

Diameter	18”	21”	24”	30”	Total
Length (ft)	8,055	5,157	4,882	9,574	27,668

Along the SRWN interceptor alignment there are five different pipe materials that were used for construction. A total of 11,890 feet of the interceptor is comprised of VCP, 7 feet is PVC pipe, 104 feet is lined DIP, 12 feet is RCP with T-lock liner and 14,226 feet is CIPP-lined RCP. An outline of the inspected pipe materials and their associated lengths is presented below:

Pipe Material	VCP	PVC	DIP	RCP w/T-Lock	CIPP	Total
Length (ft)	13,199	7	104	12	14,346	27,668

Based upon the CCTV investigation and condition assessment, it was determined that the interceptor is mostly Grade 2 (Good) with the remainder Grade 3 (Fair) requiring monitoring and CCTV investigation/condition assessment in 2008. The estimated cost for spot repairs on Grade 4 is $74,000 and for future rehabilitation of 13,200 linear feet of interceptor considered Grade 3 is $3.6 million.

South Rillito West South Interceptor

The South Rillito West-South (SRWS) interceptor was originally constructed in 1950. The SRWS Interceptor begins at the intersection of Alvernon Way and Glenn Street and proceeds west for 3,200 feet with 18-inch diameter piping. The interceptor then changes to 21-inches diameter piping for 11,700 feet as it proceeds west on Glenn Street, then turns north onto Tucson Boulevard and goes west again on Hedrick Street. At the intersection of Hedrick Street and Mountain Avenue the interceptor diameter changes from 21 inches to 24 inches and proceeds north to Prince Road then west on Prince Road for 6,000 feet. At that point the interceptor is upsized again to 27 inches and proceeds west for the final 13,300 feet to where the interceptor ends at Prince Road and Romero Road.

This line was originally named the Prince Road (PR) Interceptor and constructed for Sanitary District 1. The line was originally constructed of unlined reinforced concrete pipe from Prince Road and Romero Road roughly to the intersection of Campbell Avenue and Hedrick Street. On the east side of Campbell to the end of the interceptor surveyed vitrified clay pipe was used as the pipe material.

The next significant event to happen to this interceptor was the emergency repair after a pipe collapse in 1990 at the intersection of Prince Road and Oracle Road. The 27-inch diameter unlined RCP was replaced with 24-inch diameter PVC (C-900) for two reaches (9813-21 to 9813-22 to

9813-23). After this event the rest of the interceptor was rehabilitated using CIPP methods. The rehabilitation was broken into 3 segments: Romero Road to Stone Avenue (1992), Prince Road/ Stone Avenue to Hedrick Street (1993) and Mountain Avenue to Campbell Avenue (2000). The interceptor surveyed contained no sections of unlined RCP after the rehabilitation projects were completed.

The SRWS interceptor begins at the intersection of Alvernon Way and Glenn Street and proceeds west for 3,228 feet with 18-inch diameter piping (see Figure 4.1.17). The interceptor then changes to 21-inches diameter piping for 11,771 feet as it proceeds west on Glenn Street, then turns north onto Tucson Boulevard and goes west again on Hedrick Drive. At the intersection of Hedrick Drive and Mountain Avenue the interceptor diameter changes from 21-inches to 24-inches and proceeds north to Prince Road, then west on Prince Road for 5,996 feet. At that point, the interceptor is upsized again to 27-inches and proceeds west for the final 13,250 feet to where the interceptor ends at the intersection of Prince and Romero Roads. Pipe diameter lengths are shown in the table below:

Pipe Material	VCP	CIPP	DIP	PVC	Total
Length (ft)	5,623	27,078	113	1,431	34,245

The SRWS interceptor is a combination of vitrified clay pipe (VCP), reinforced concrete lined cured in place pipe (CIPP), polyvinyl chloride pipe (PVC) and ductile iron pipe (DIP). There is 5,623 feet of VCP, 27,078 feet of CIPP, 1,431 feet of PVC, and 113 feet of DIP. A brief table showing the pipe material length breakdown is shown below:

Diameter	18”	21”	24”	27”	Total
Length (ft)	3,228	11,771	5,996	13,250	34,245

Based upon the CCTV investigation and condition assessment, it was determined that the interceptor is predominately Grade 2 (Good) with the remainder Grade 3 (Fair) requiring monitoring and CCTV investigation/condition assessment in 2008. The estimated cost for future rehabilitation of 10,275 linear feet of interceptor considered Grade 3 is $2.6 million.

South West Interceptor

The South West Interceptor (SWI) was originally installed in 1963, under the plan name “Freedom Homes District Sewer Improvements”. When constructed in 1963, the line was 21 inches in size and was predominantly VCP construction. This line was a trunk connecting to the SCI which crossed the West Branch of the Santa Cruz with a siphon and crossed the Santa Cruz via a small lift station and force main. The Santa Cruz crossing was along the Flowing Wells Cross Cut Road, just south of what now exists as Starr Pass Boulevard. In 1974, the downstream portion of the SWI was constructed under the plan name “Contract 89, 1973 Del Sol Sewerage Project.” The line was 27 inches in size and of VCP construction.

In 1977 the entire interceptor was completed with larger diameter pipe starting at Congress Street and extending south to Valencia Road. Also in 1977, the siphon and lift station were removed from the Santa Cruz trunk and flows were redirected to the SWI. In the early to mid-1980s, additional trunks to the SWI were added to accommodate residential development occurring in the area.

South West Interceptor CCTV and Condition Assessment Summary

The SWI flows south to north from the intersection of Los Reales and Mission Roads to tie into the NWI west of the Alameda Siphon at the intersection of Linda Avenue and Alameda Street (see Figure 4.1.18). The interceptor is 39,032 feet long and follows the alignment of Mission Road.

The SWI is fed by four trunk lines along its alignment. The SWI-T I is the first trunk along the SWI alignment. The SWI-T I is 11,300 feet long and flows from south to north along the Midvale Park Road alignment. The second trunk, SWI-T II is 13,380 feet long and flows from south to north along the Santa Cruz River alignment. The third trunk, SWI-T III, is 5,620 feet long and runs along Los Reales Road and Cardinal Avenue. The fourth trunk line feeding the SWI is the SWI-T IV trunk. The SWI-T IV trunk is 3,326 feet long and flows from west to east along Valencia Road. A summary of the SWI and trunk pipeline lengths and diameters is presented below:

Diameter	18”	21”	24”	27”	30”	33”	Total
Length (ft)	16,472	3,096	9,148	4,591	9,907	11,765	72,674

Along the SWI and trunk system there are four different pipe materials that were used for construction. A total of 39,688 feet of the system is comprised of VCP, 9,305 feet is PVC pipe, 2,009 feet is DIP lined and 21,672 feet is RCP lined with T-Lock liner. The table presented below outlines the pipe materials and their associated lengths is presented below:

Pipe Material	VCP	PVC	DIP	RCP Lined	Total
Length (ft)	39,688	9,305	2,009	21,672	72,674

There are multiple reaches of T-locked RCP piping that have weld failures and holes. This is a common condition in the Pima County system. Based upon the CCTV investigation and condition assessment, it was determined that the interceptor is predominately Grade 3 (Fair) requiring monitoring and CCTV investigation/condition assessment in 2008. Two small reaches are Grade 4 (Poor) requiring immediate attention and the remainder is Grade 2 (Good). The estimated cost for spot repairs on Grade 4 is $396,000 and for future rehabilitation of 50,239 linear feet of interceptor considered Grade 3 is $13.7 million.

Tanque Verde Interceptor

The Tanque Verde Interceptor (TVI) was installed in 1980, under the plan name: Tanque Verde Interceptor Sewer – Indian Ridge Terrace to Camino Seco. When constructed in 1980, the line ranged in size from 33, 30, 24 and 21 inches in size and was composed of VCP, DIP, and unlined RCP construction. The interceptor is aligned along the south bank of the Tanque Verde Wash. Trunks to the interceptor were constructed earlier, these are the: Sanitary District No. 1 – Contract No. 42 (1960), Sanitary District No. 1 – Contract 61B (1968), Sanitary District– Contract No. 73 (1968) and the Camino Seco Trunk Sewer (1986).

Future plans from PCWMD include a Capital Improvement Project (CIP) to extend and connect the interceptor from the existing Rillito Wash crossing west into the South Rillito interceptor system at Craycroft Road. Also planned improvements are to extend the interceptor east from Camino Seco to Tanque Verde Loop.

Wastewater generated in the southern portion of the Tanque Verde Wash drainage basin is currently conveyed to the North Rillito Interceptor. The Rillito Wash crossing is a gravity line crossing, located north of the Tucson Country Club Estates (West of Sabino Canyon Road).

Tanque Verde Interceptor CCTV and Condition Assessment Summary

The TVI system inspected length, including trunks, is approximately 47,571 feet and flows from the southeast to the northwest (see Figure 4.1.19). The Tanque Verde Interceptor is 20,797 feet long and begins on Wrightstown Road, just east of Spanish Moss Avenue. The line then travels

northwest and ends just north of the Tanque Verde Creek at a manhole, in a drainage way, just south of Riverbend Circle. The flows from the TVI system empty into the North Rillito Interceptor.

There are two trunks that feed into the TVI, the TVI-T Southeast and TVI-T Southwest. The TVI-T Southeast trunk is 17,573 feet long and begins just east of Shadow Brook Place on Broadway Boulevard and proceeds north on Camino Seco to the TVI, across Wrightstown Road but south of the Tanque Verde Creek. The TVI-T Southwest trunk is 9,201 feet long and begins east of Kolb Road and South of Corto Caravaca, then heads northwest along the east bank of the Pantano Wash and crosses Tanque Verde Road, then heads north through the Tucson Country Club Estates and flows into the TVI, just south of the Tanque Verde Creek. A summary of CCTV inspected interceptor and trunk piping lengths based on pipe diameters is presented below:

Diameter	18”	20”	21”	24”	27”	30”	33”	Total
Length (ft)	26,774	737	2,151	10,046	1,650	4,679	1,534	47,571

Along the TVI and TVI trunk alignments there are four different types of piping materials that were used for construction. The predominant material is PVC in addition to DIP, VCP, and unlined RCP. The table presented below details the total CCTV inspected length of interceptor and trunks for each type of pipe material:

Pipe Material	PVC	DIP w/ unknown liner	DIP w/double mortar lining	VCP	Unlined RCP	Total
Length (ft)	19,916	2,425	6,015	9,201	10,014	47,571

The DIP found on the TVI system has two types of linings, one is unknown and the other is double mortar lining. The corrosion characteristics of the DIP on eighteen (18) reaches of the TVI were similar to that of unlined RCP spalling which raised doubts on the type of pipe material. After conferring with PCWMD and researching the as-builts, it was confirmed that the 18 reaches comprised DIP but with an unusual lining for sewer systems, i.e. double mortar lining. Double mortar lining is generally used in potable water conveyance systems.

Based upon the CCTV inspection and condition assessment, it was determined that the interceptor is predominately Grade 2 (Good) with the remainder Grade 3 (Fair) requiring monitoring and CCTV investigation/condition assessment in 2008. The estimated cost for spot repairs on Grade 4 is $90,000 and for future rehabilitation on approximately 30,000 linear feet of interceptor considered Grade 3 is $8.7 million.

Sewer Manholes

Pima County Wastewater Management Department has a service area extending over 370 square miles. The entire system contains approximately 60,000 manholes and cleanouts with a significant number (estimated 20 percent) of these located in non-pavement portions of Tucson. This number of manholes combined with the location in challenging terrain makes the Pima County collection system unique. Manhole construction dates from 1900 to present. Materials used include concrete, brick and pre-cast concrete.

Pima County is nearing completion of the sanitary sewer Inspection and Inventory Project. Approximately 45,400 of the 60,000 manholes are complete. A total of 1,498 manholes, or 3.3 percent, have been identified in need of rehabilitation at a cost of $4.5 million. The total anticipated number of manholes to be rehabilitated based on 3.3 percent is 1,980. The total cost for rehabilitation could be as high as $5.9 million.

Siphons

Pima County's conveyance system has 15 identified siphons. These siphons convey flow under natural depressions and drainage ways. The largest siphons cross the metropolitan Tucson water ways; the Santa Cruz and Rillito Rivers. The siphons usually contain an upstream and downstream structure along with multiple barrels to convey the flows. Siphon barrel size varies from a minimum of 6 inches to a maximum of 39 inches. Material types vary ranging from VCP, DIP and RCP.

In 2002-2003 twelve of the fifteen siphons were cleaned and inspected as part of the CCTV Interceptor inspection. Three siphons (Alameda, Sweetwater, and Tucson Boulevard) have been rehabilitated in the last couple of years. Several existing upstream and downstream siphon boxes showed damage from hydrogen sulfide damage and should be rehabilitated.

Lift Stations

Pima County topography varies in the Tucson Metropolitan Area from 1,800 feet mean sea level (MSL) to approximately 3,900 feet MSL mirroring the pressure service area for the County's largest water supplier, Tucson Water. Because of the elevation changes in the metropolitan area, lift stations in some areas are required to direct flows to the gravity trunk and interceptor system.

Pima County Wastewater Management Department operates and maintains a total of 33 lift stations, four of which are presently inactive. The lift station pumps range in size from 1 horsepower (hp) at Mission to 600 hp at Continental Ranch. The Continental Ranch lift station is the largest and is a regional facility with a rated pump capacity of 6.0 MGD.

In 2003, PCWMD completed a CIP project to provide a SCADA system for remote monitoring and control of the lift stations. Many lift station wetwells require rehabilitation along with conveyance upgrades such as site lighting, potable water service and enclosure upgrades.

Table 4.1.4 Existing Interceptor System Condition Assessment Rehabilitation Costs

Interceptor Detail		Grade 4 (Poor)	Grade 3 (Fair)
CODE	Description	($)	($)
ACSC	Aviation Corridor to Santa Cruz	224,000	4,260,000
ACSE	Aviation Corridor to South East	262,000	14,150,000
CDO	Canada del Oro	1,120,000	3,100,000
NRI	North Rillito Interceptor	0	29,800,000
ONH	Old Nogales Highway	8,400,000	3,900,000
PTI	Pantano Interceptor	450,000	19,100,000
SCC	Santa Cruz Central	288,000	2,500,000
SCE	Santa Cruz East	541,000	2,100,000
SCI	Santa Cruz Interceptor	546,000	9,700,000
SEI	South East Interceptor	920,000	39,100,000
SRRR	South Rillito Roger Road	23,000	0
SRWC	South Rillito West Central	130,000	5,400,000
SRWN	South Rillito West North	74,000	3,600,000
SRWS	South Rillito West South	0	2,600,000
SWI	South West Interceptor	396,000	13,700,000
TVI	Tanque Verde Interceptor	90,000	8,700,000
	Total	13,469,000	161,710,000

Major Flow Management Structures

Flow management structures in the PCWMD conveyance system are specialized structures that can change flows from incoming interceptors into outgoing interceptors. Flow control is managed amongst interceptors and the two major wastewater treatment plants by changing weir boards or moving gated valve positions within the

structure. Four major flow management structures are located in the conveyance system: Alameda Street, 18th and Vine Streets, Tucson Boulevard, and Craycroft Road.

Alameda flow management structure. Incoming 42-inch SEI, outgoing 42-inch NWO and 24 inch SCC. This structure is located in the downtown area and flow management of all flows is tributary to the Roger Road WWTP.

18th and Vine Streets flow management structure. Incoming 42-inch ACSE, outgoing 21 inch ACSC and 33-inch ACSE. This structure is located midtown near the Aviation Corridor. Flow management of all flows is tributary to the Roger Road WWTP treatment basin.

Tucson Boulevard flow management structure. Incoming 36-inch SRWC, outgoing 54 inch SRWC and 36 inch NRI. This structure is located north of midtown, adjacent to the Rillito River. Flow management of flows can shift approximately 5.35 MGD from the Roger Road WWTP to the Ina Road WPCF.

Craycroft Road flow management structure. Incoming 36-inch PTI, outgoing 24-inch NRI and 48-inch SRWC. This structure is located adjacent to the Rillito River and Craycroft Road. Flow management of flows can shift approximately 2 MGD from the Roger Road WWTP to the Ina Road WPCF.

Numerous smaller redwood board and concrete weir structures exist throughout the conveyance system to manage flow.

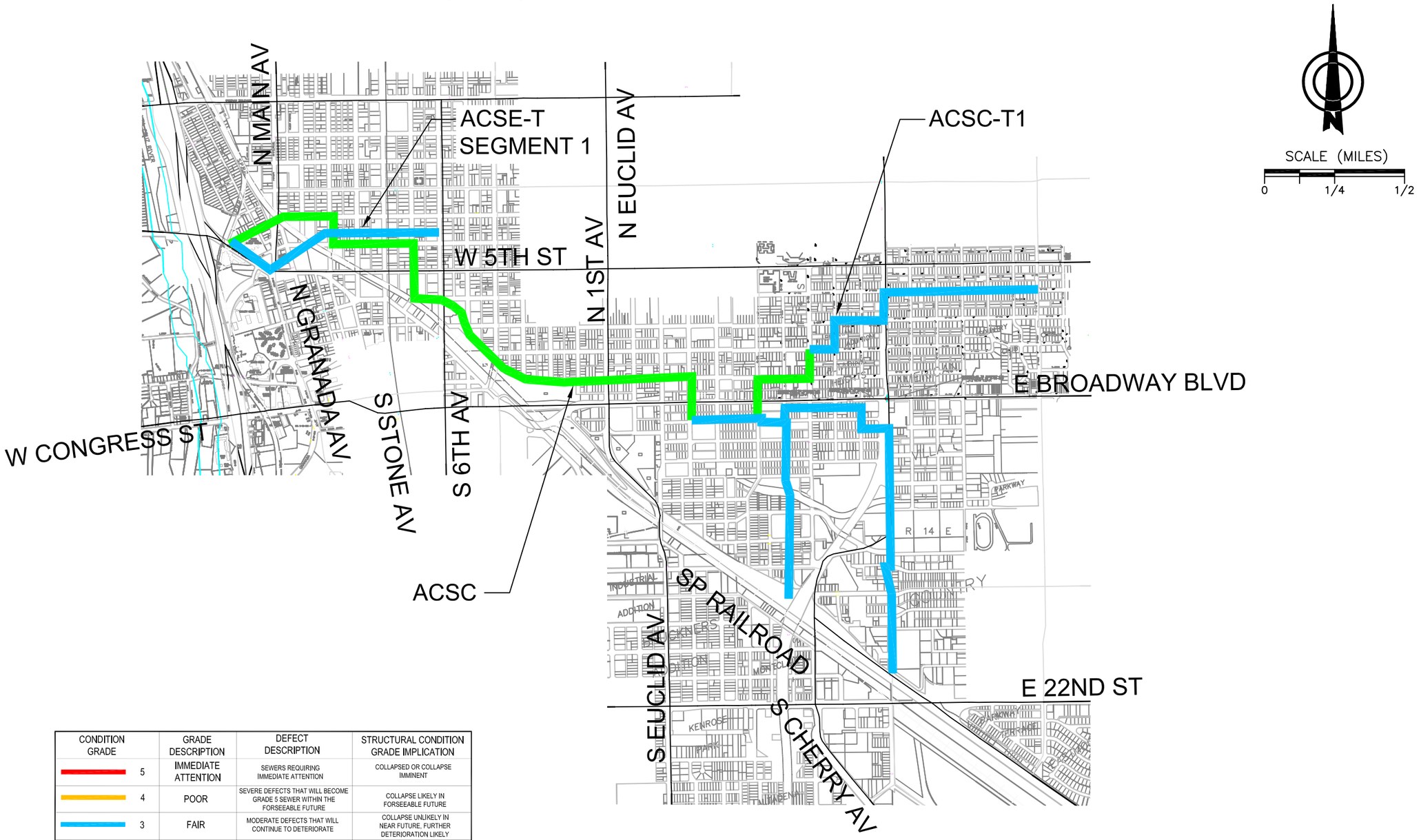
Summary and Recommendations

Although 230 miles of interceptor systems were CCTV inspected in 2003, there remains 2,935 miles of unknown system conditions. It is recommended that the CCTV program be enhanced within the next ten years to achieve total system condition assessment/evaluation. The CCTV program will continue to provide data to address and prioritize system features as well as prioritize future rehabilitation/repair projects of varying magnitude. Additionally, enhancement of the CCTV program will contribute to conformance with Capacity, Management, Operations, and Maintenance (CMOM) regulations (ADEQ R18-9-C305, 2.05) General Permit and strengthen PCWMD's Asset Management Program.

Pima County Wastewater Management Department needs to engage an aggressive manhole rehabilitation program. To date, there are nearly 1,500 documented manholes requiring rehabilitation, resulting from efforts of the Sanitary Sewer Inspection and Inventory Project (SSIIP).

Quantitative dollar amounts of Grade 3 and 4 rehabilitation for the evaluated interceptors are provided in Table 4.1.2 and are reflected in the CIP, Table 8.1. The Grade 4 rehabilitation projects need to be accomplished as soon as possible. The Grade 3 rehabilitation projects are anticipated for completion over the next 20 years based on CCTV/condition assessments every five years, with the first scheduled in 2008. In addition, manhole rehabilitation/replacement is anticipated to be between $4.5 and $6.0 million based upon final completion of the manhole database project.

AVIATION CORRIDOR TO SANTA CRUZ (ACSC) INTERCEPTOR SYSTEM



CONDITION GRADE	GRADE DESCRIPTION	DEFECT DESCRIPTION	STRUCTURAL CONDITION GRADE IMPLICATION
5	IMMEDIATE ATTENTION	SEWERS REQUIRING IMMEDIATE ATTENTION	COLLAPSED OR COLLAPSE IMMINENT
4	POOR	SEVERE DEFECTS THAT WILL BECOME GRADE 5 SEWER WITHIN THE FORSEEABLE FUTURE	COLLAPSE LIKELY IN FORSEEABLE FUTURE
3	FAIR	MODERATE DEFECTS THAT WILL CONTINUE TO DETERIORATE	COLLAPSE UNLIKELY IN NEAR FUTURE, FURTHER DETERIORATION LIKELY
2	GOOD	MINOR AND FEW MODERATE DEFECTS	MINIMAL NEAR-TERM RISK OF COLLAPSE, POTENTIAL FOR FURTHER DETERIORATION

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Figure 4.1.3
AVIATION CORRIDOR TO SANTA CRUZ (ACSC) INTERCEPTOR SYSTEM

AVIATION CORRIDOR TO SOUTHEAST (ACSE) INTERCEPTOR SYSTEM

CONDITION GRADE	GRADE DESCRIPTION	DEFECT DESCRIPTION	STRUCTURAL CONDITION GRADE IMPLICATION
5	IMMEDIATE ATTENTION	SEWERS REQUIRING IMMEDIATE ATTENTION	COLLAPSED OR COLLAPSE IMMINENT
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Figure 4.1.4
AVIATION CORRIDOR TO SOUTHEAST (ACSE) INTERCEPTOR SYSTEM

CANADA DEL ORO (CDO) INTERCEPTOR SYSTEM

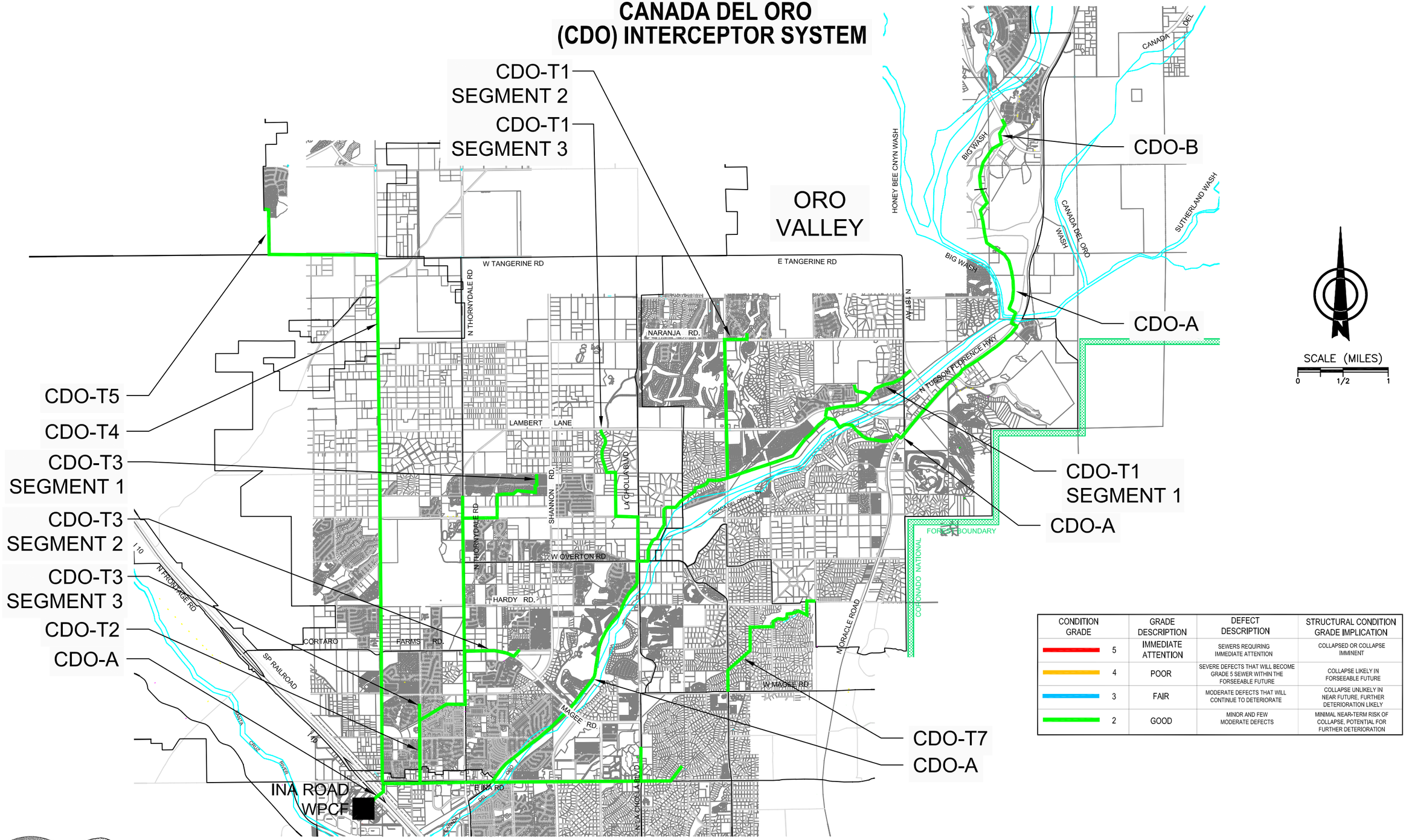

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Figure 4.1.5
CANADA DEL ORO
(CDO) INTERCEPTOR SYSTEM

NORTH RILLITO INTERCEPTOR (NRI) SYSTEM

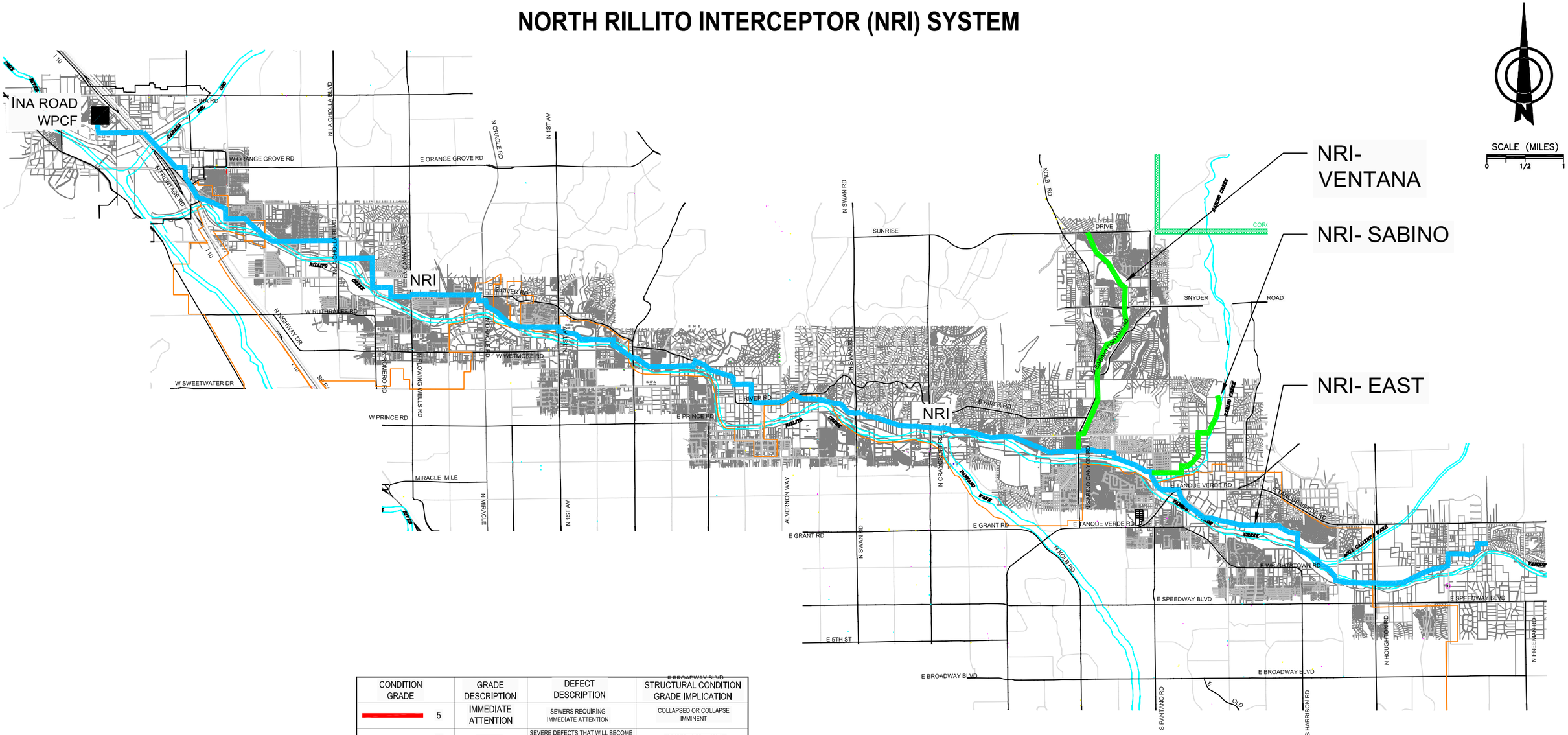

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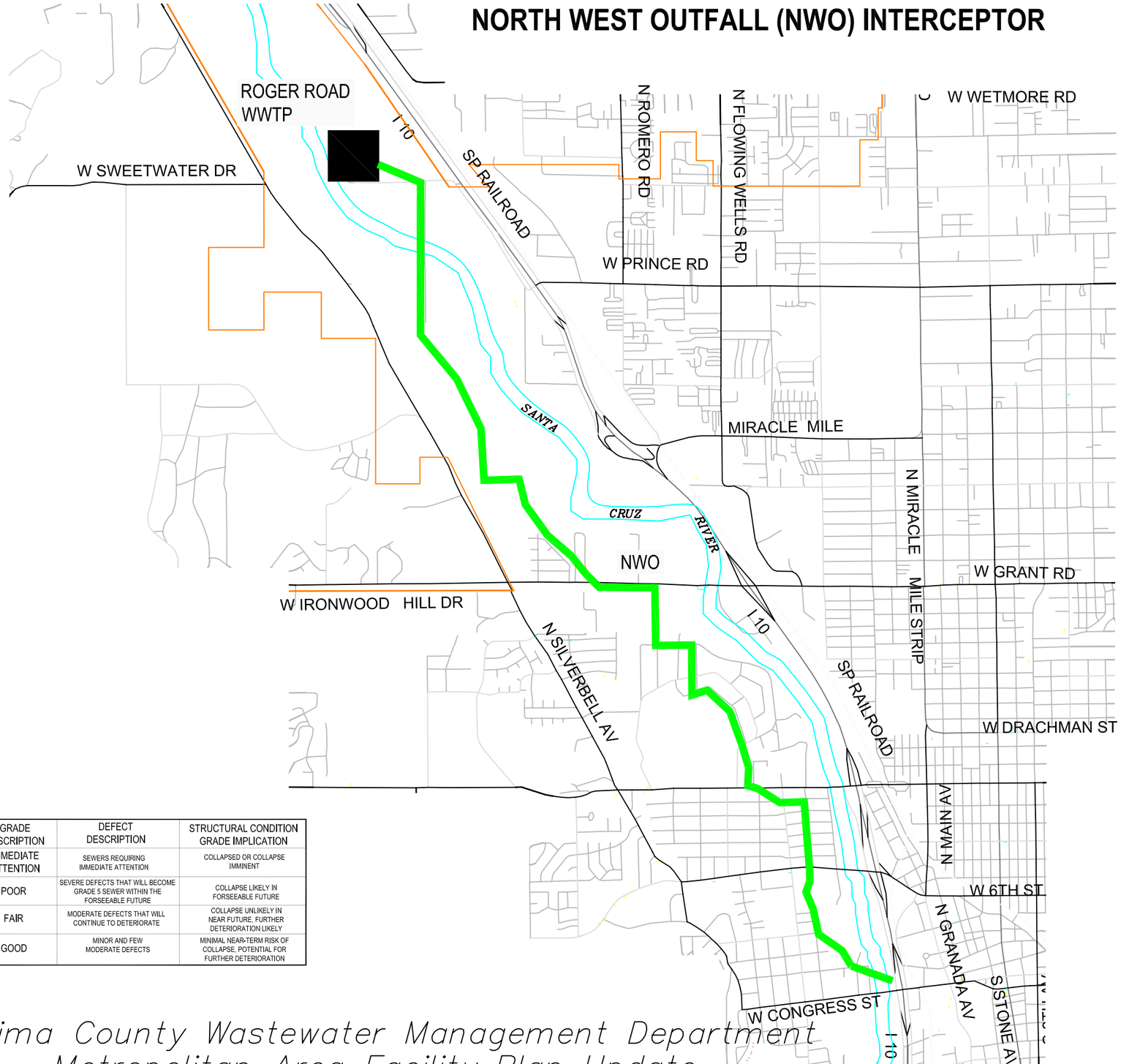
Figure 4.1.6
NORTH RILLITO
INTERCEPTOR (NRI) SYSTEM

NORTH WEST OUTFALL (NWO) INTERCEPTOR



SCALE (MILES)

0 1/2 1

CONDITION GRADE	GRADE DESCRIPTION	DEFECT DESCRIPTION	STRUCTURAL CONDITION GRADE IMPLICATION
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Figure 4.1.7

NORTH WEST OUTFALL (NWO) INTERCEPTOR

OLD NOGALES HIGHWAY (ONH) INTERCEPTOR

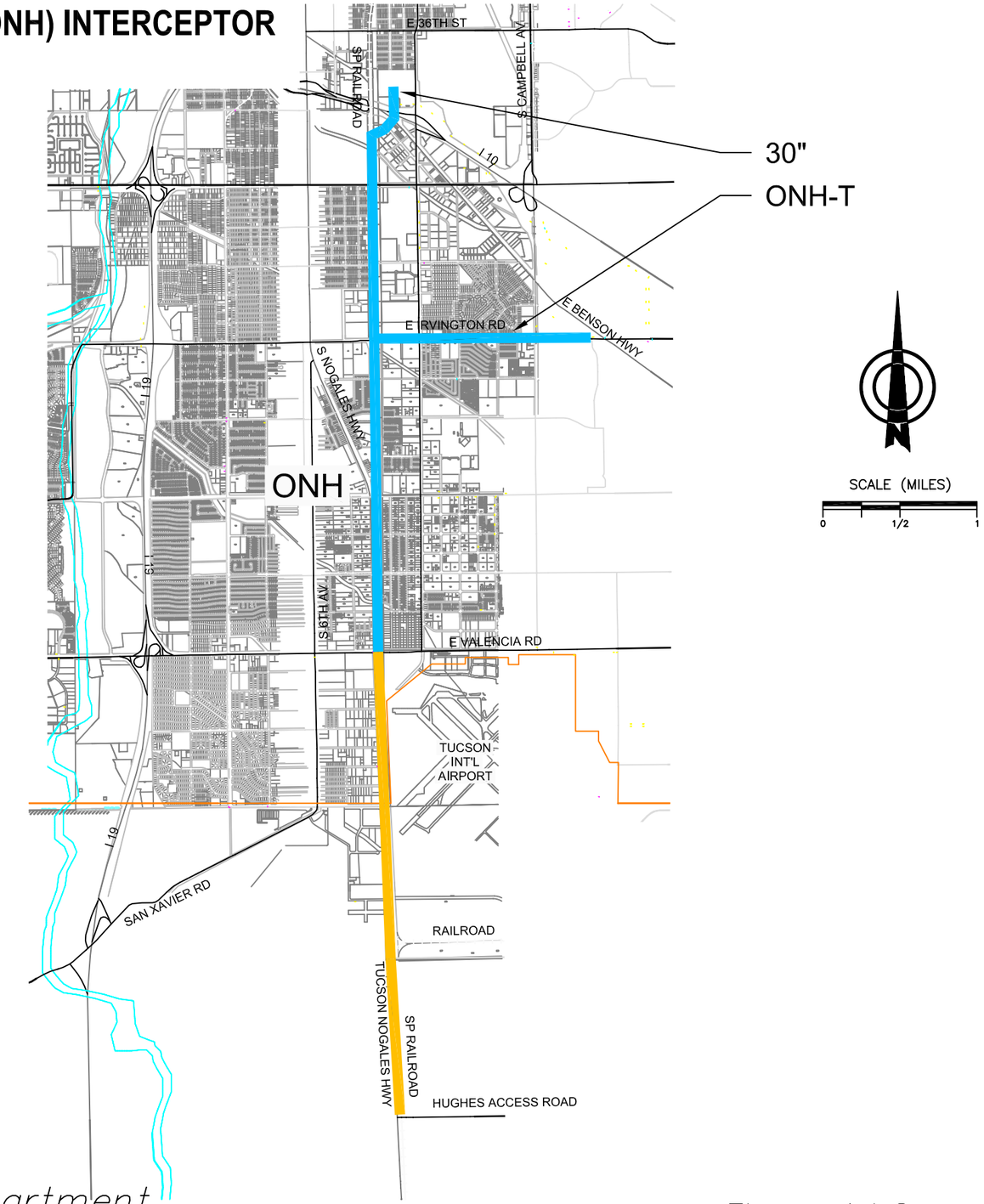

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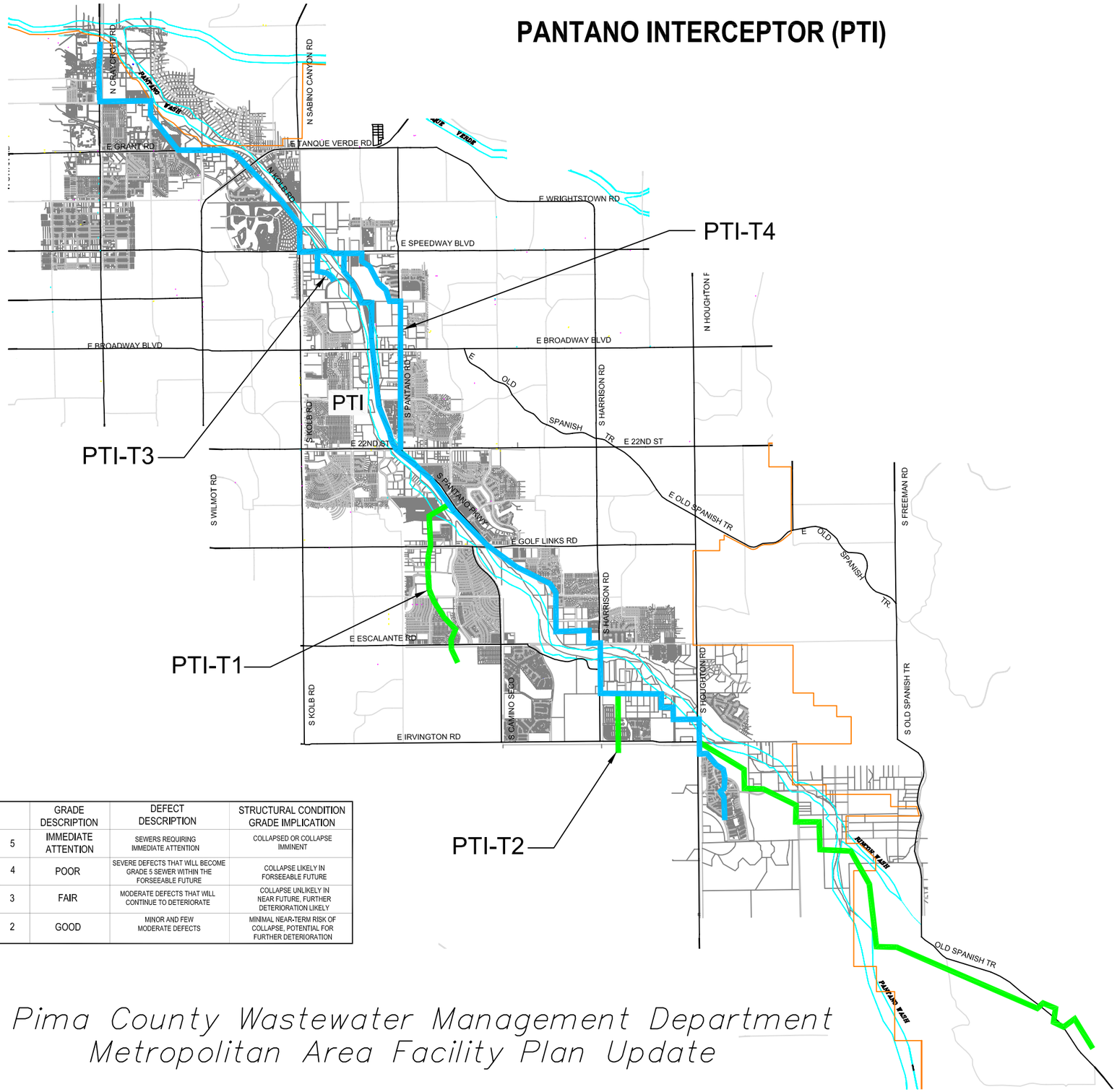
Figure 4.1.8

OLD NOGALES HIGHWAY (ONH) INTERCEPTOR

PANTANO INTERCEPTOR (PTI)



SCALE (MILES)
0 1/2 1

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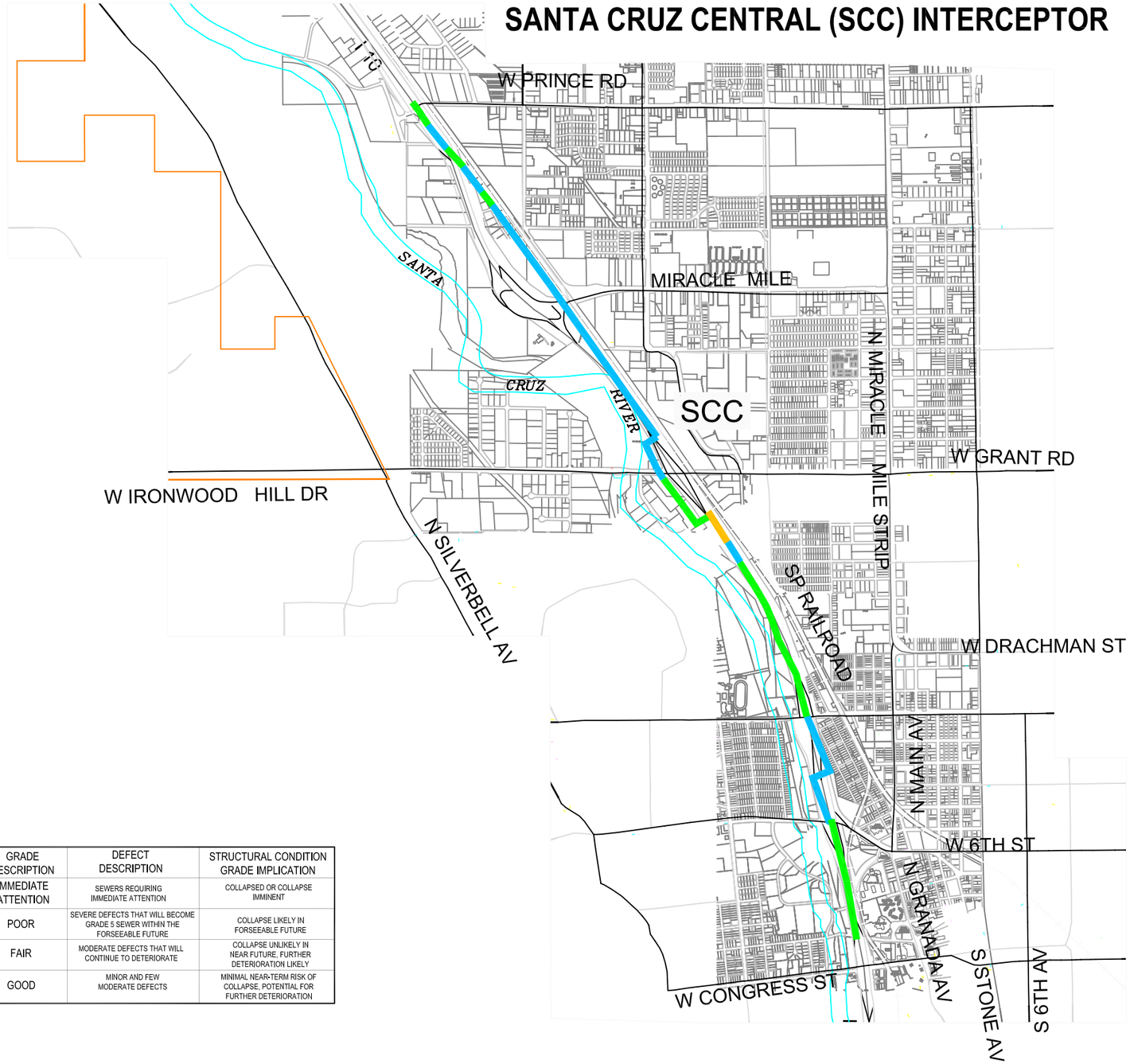
Figure 4.1.9
PANTANO INTERCEPTOR (PTI) SYSTEM

SANTA CRUZ CENTRAL (SCC) INTERCEPTOR



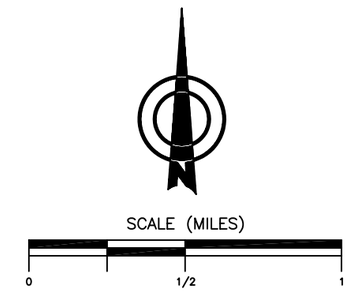


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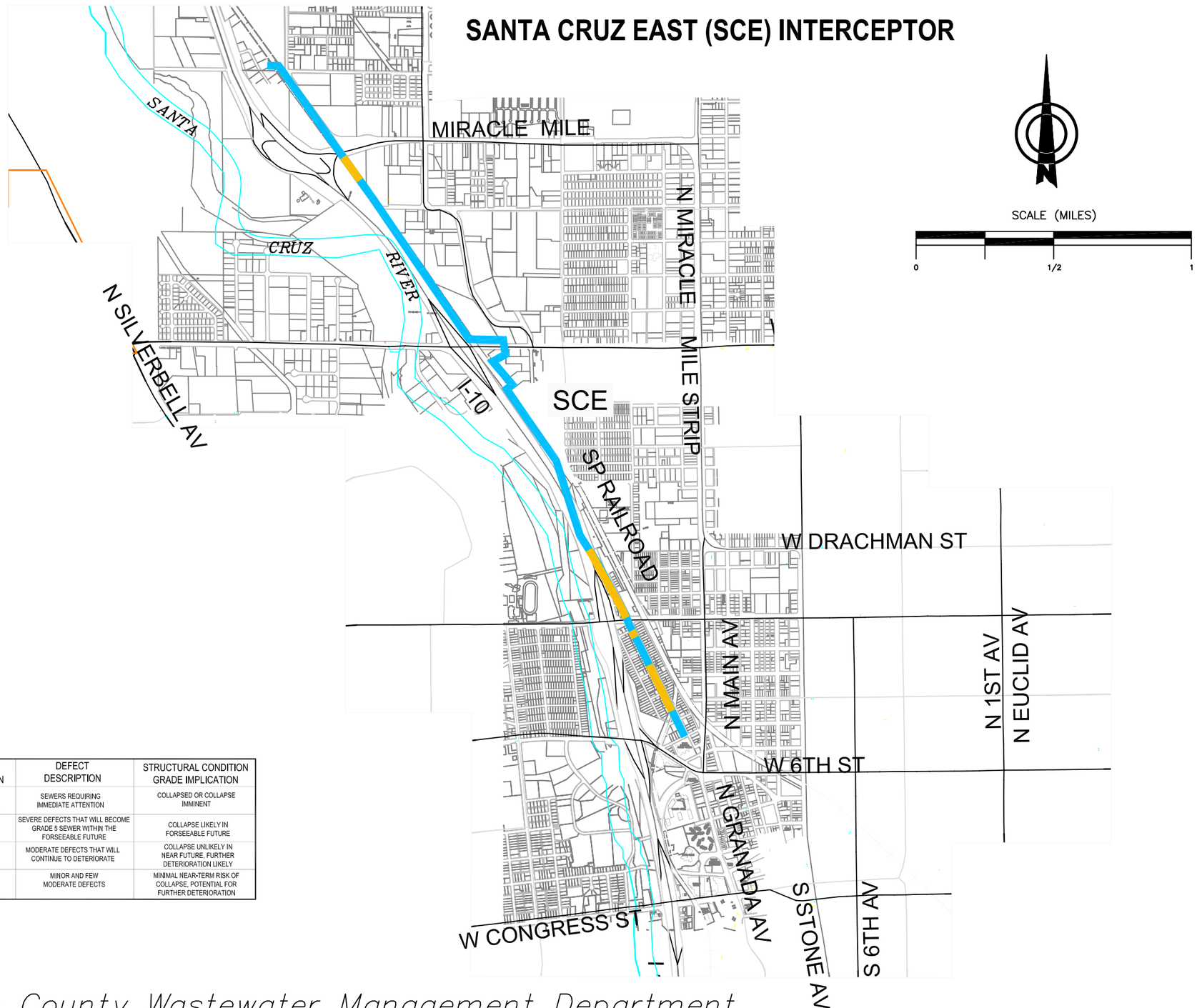
Figure 4.1.10
SANTA CRUZ CENTRAL (SCC) INTERCEPTOR

SANTA CRUZ EAST (SCE) INTERCEPTOR



CONDITION GRADE	GRADE DESCRIPTION	DEFECT DESCRIPTION	STRUCTURAL CONDITION GRADE IMPLICATION
5	IMMEDIATE ATTENTION	SEWERS REQUIRING IMMEDIATE ATTENTION	COLLAPSED OR COLLAPSE IMMINENT
4	POOR	SEVERE DEFECTS THAT WILL BECOME GRADE 5 SEWER WITHIN THE FORSEEABLE FUTURE	COLLAPSE LIKELY IN FORSEEABLE FUTURE
3	FAIR	MODERATE DEFECTS THAT WILL CONTINUE TO DETERIORATE	COLLAPSE UNLIKELY IN NEAR FUTURE, FURTHER DETERIORATION LIKELY
2	GOOD	MINOR AND FEW MODERATE DEFECTS	MINIMAL NEAR-TERM RISK OF COLLAPSE, POTENTIAL FOR FURTHER DETERIORATION

Pima County Wastewater Management Department
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Figure 4.1.11
SANTA CRUZ EAST (SCE) INTERCEPTOR

SANTA CRUZ INTERCEPTOR (SCI)

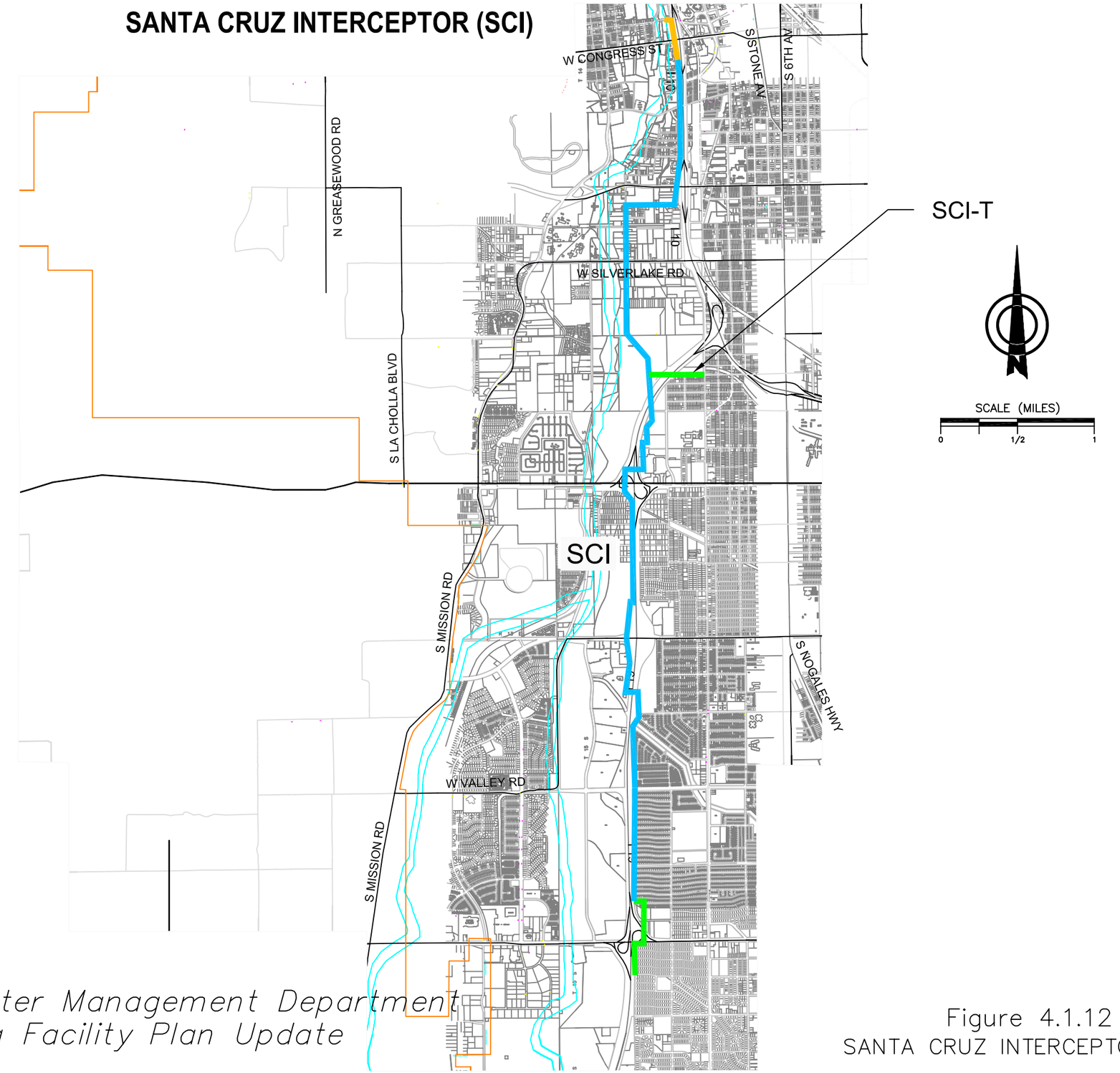

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Figure 4.1.12
SANTA CRUZ INTERCEPTOR (SCI)

SOUTHEAST INTERCEPTOR (SEI)

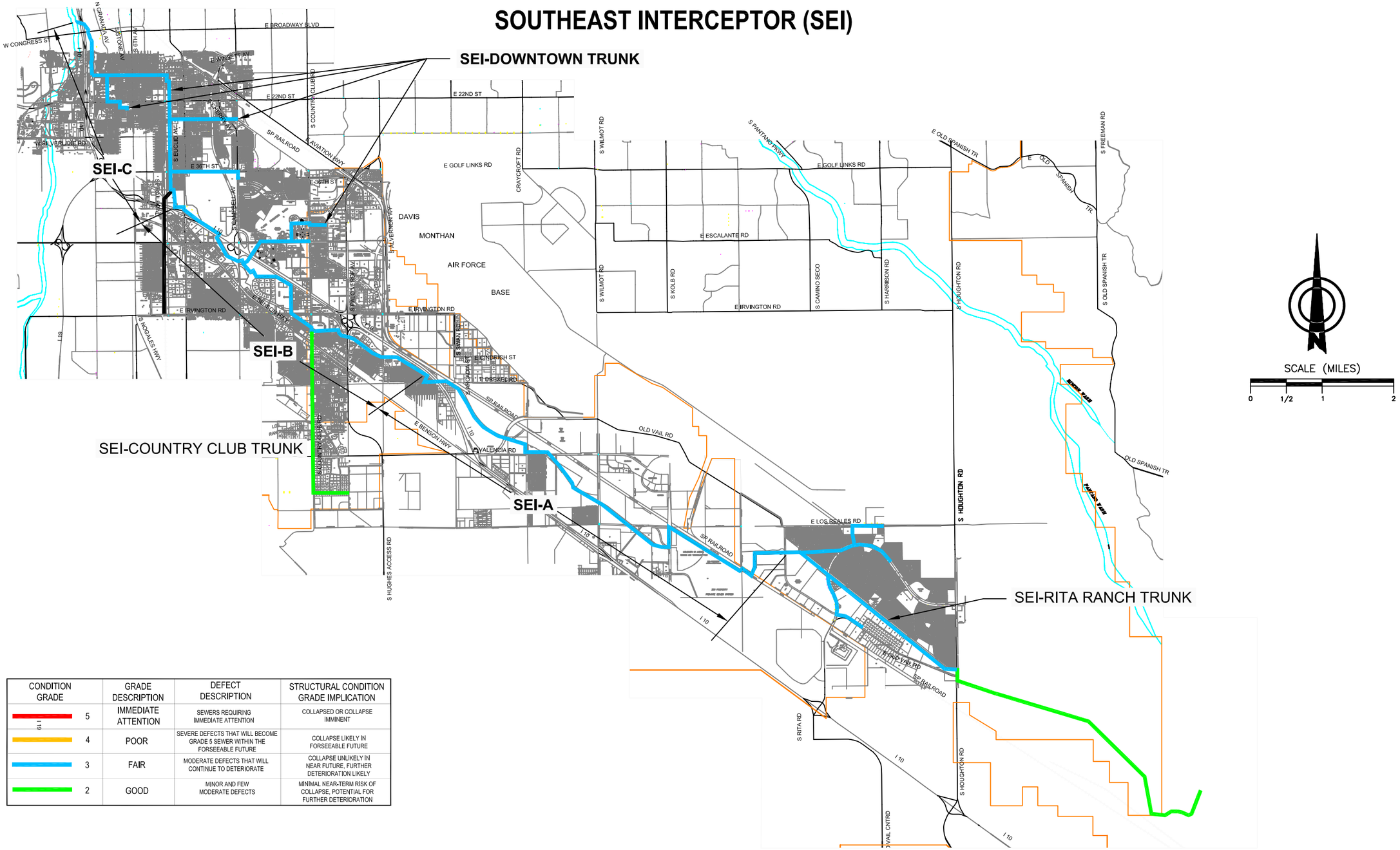

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Figure 4.1.13

SOUTHEAST INTERCEPTOR (SEI) SYSTEM

SOUTH RILLITO ROGER ROAD (SRRR) INTERCEPTOR

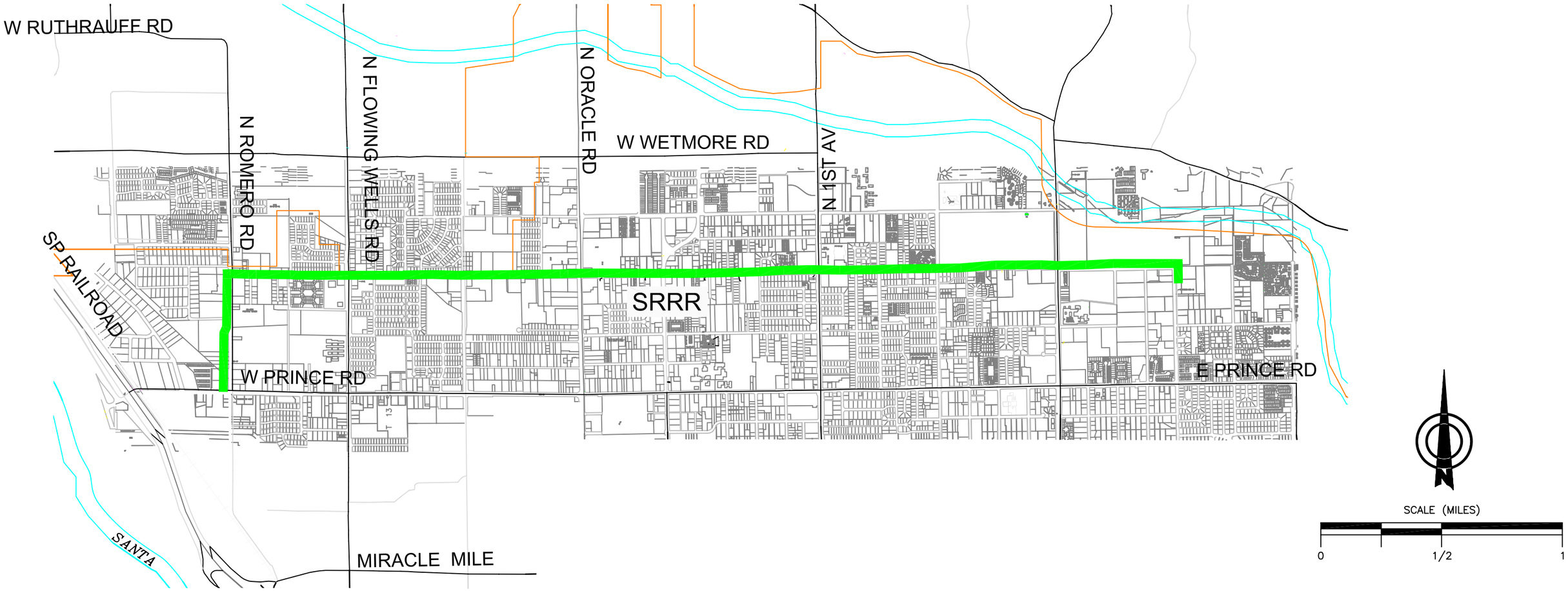

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Figure 4.1.14

SOUTH RILLITO ROGER ROAD (SRRR) INTERCEPTOR

SOUTH RILLITO WEST-CENTRAL (SRWC) INTERCEPTOR

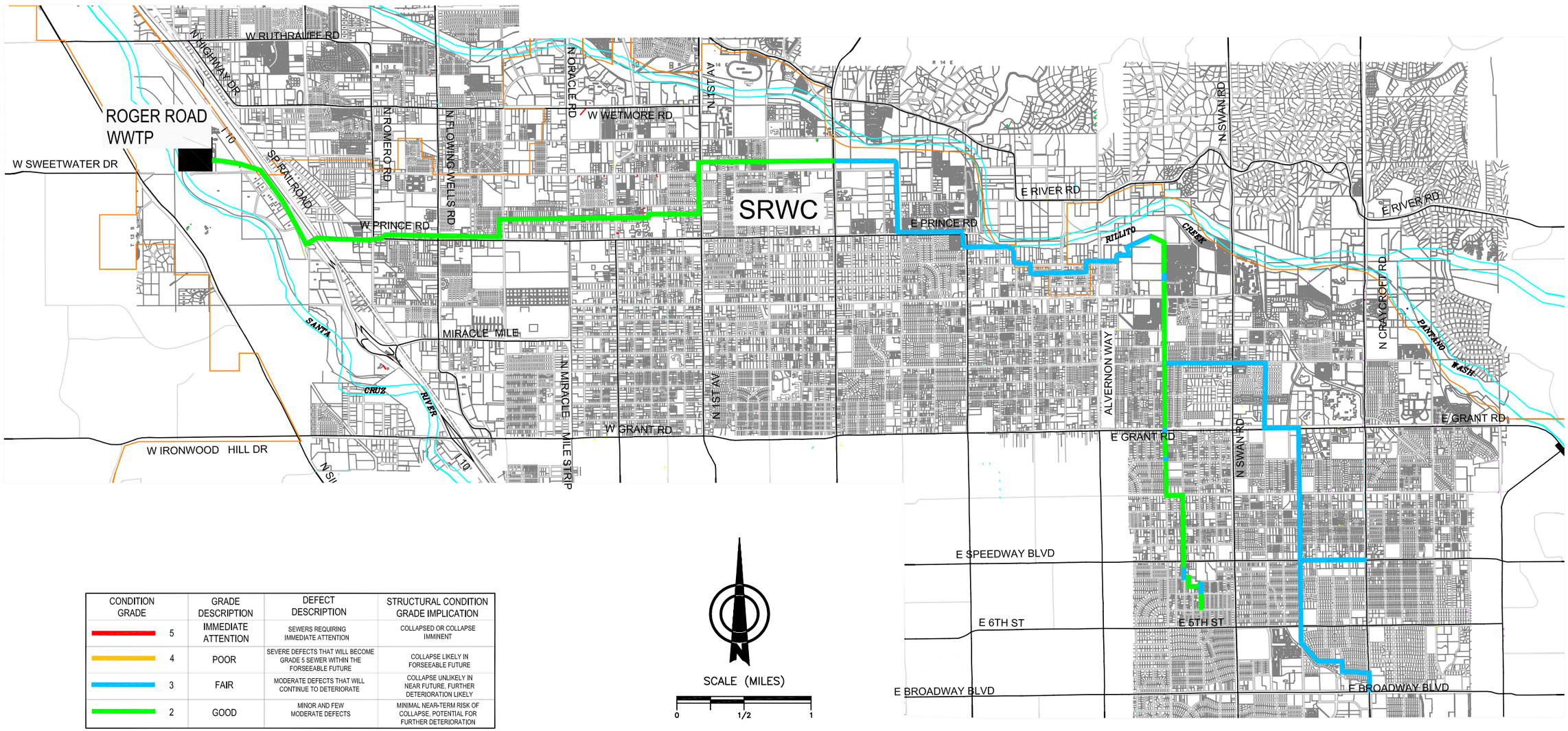

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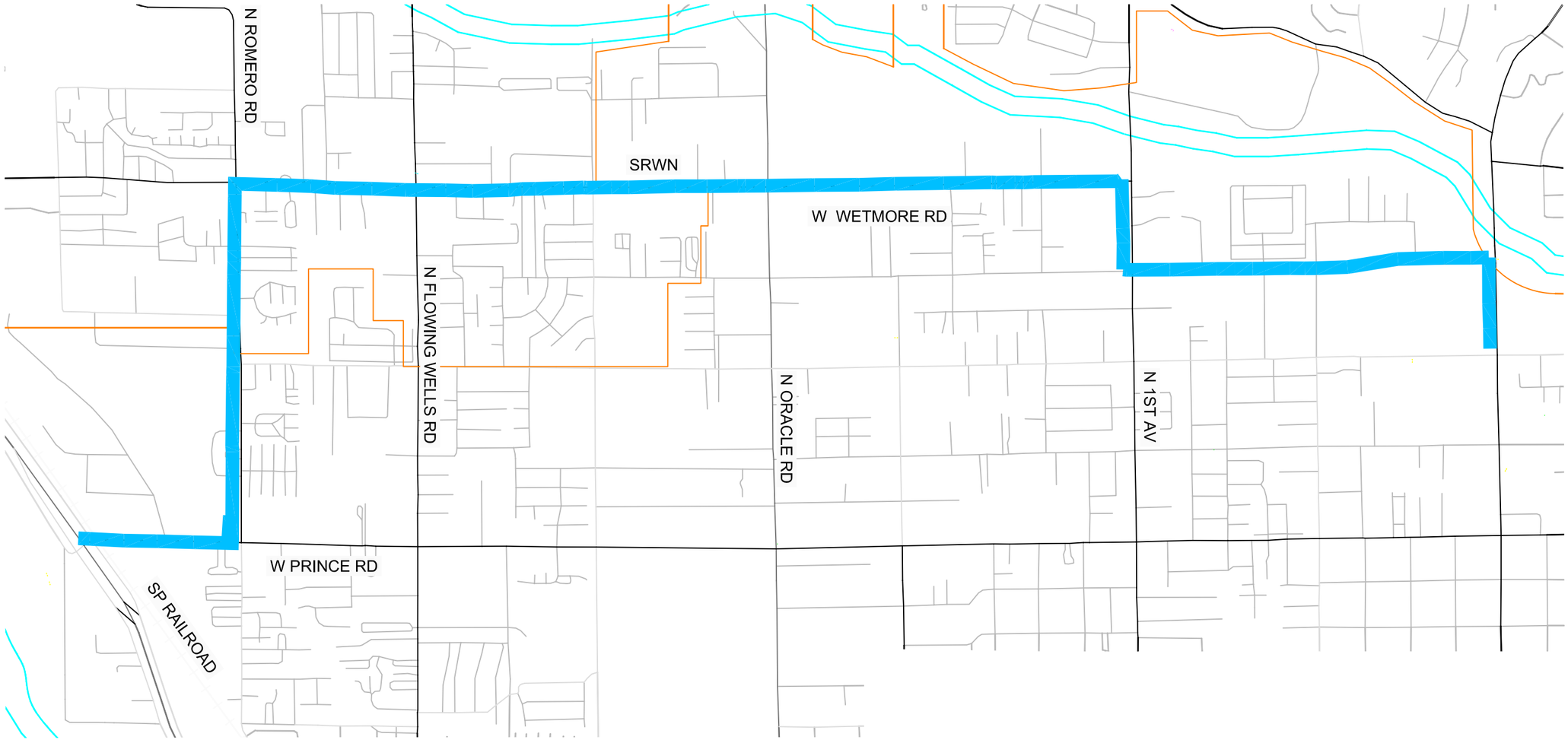
Figure 4.1.15
SOUTH RILLITO WEST-CENTRAL
(SRWC) INTERCEPTOR

SOUTH RILLITO WEST - NORTH (SRWN) INTERCEPTOR



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SCALE (MILES)

0 1/4 1/2

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Figure 4.1.16

SOUTH RILLITO WEST NORTH (SRWN) INTERCEPTOR

SOUTH RILLITO WEST - SOUTH (SRWS) INTERCEPTOR

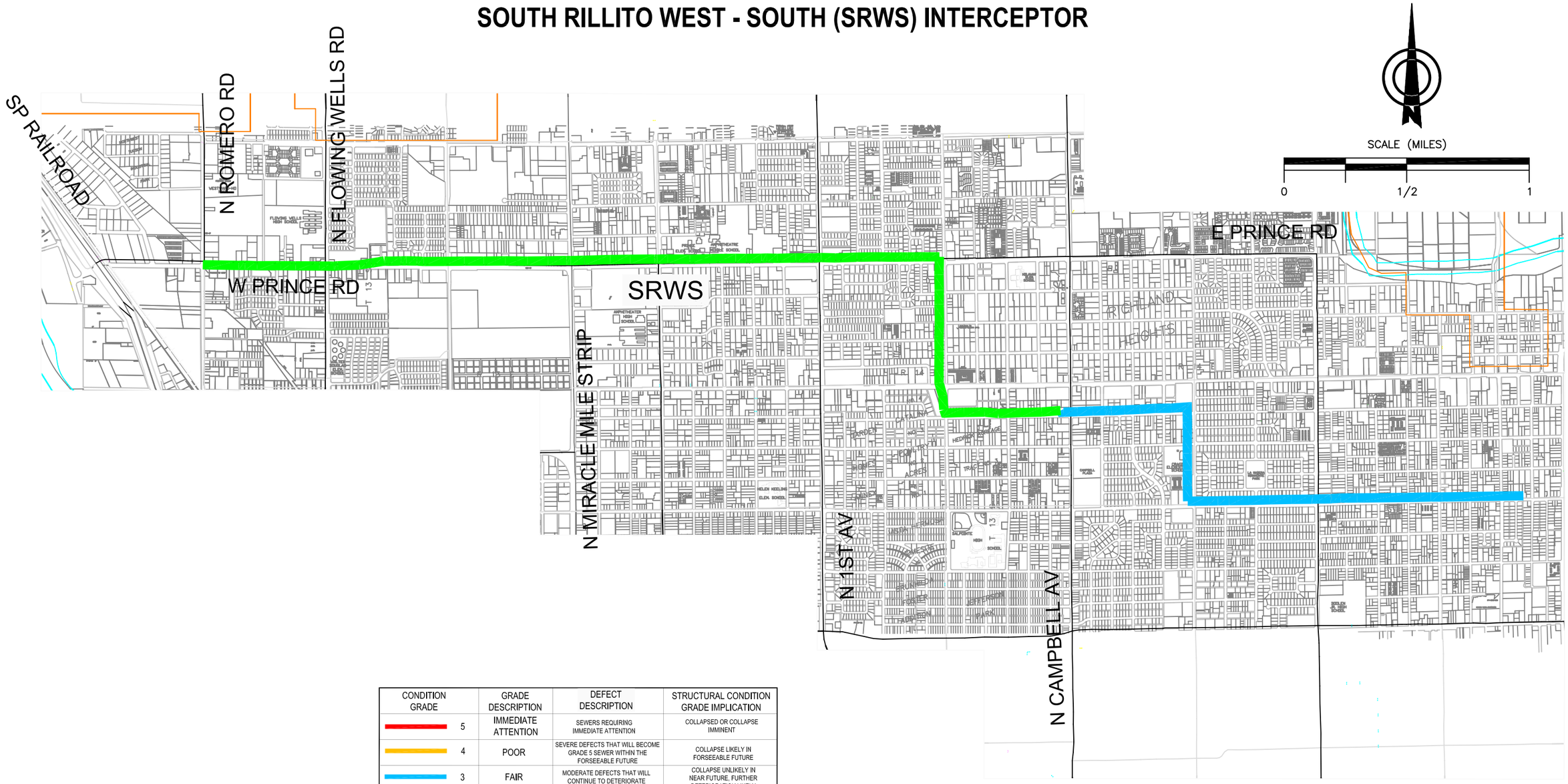

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Figure 4.1.17

SOUTH RILLITO WEST – SOUTH (SRWS) INTERCEPTOR

SOUTHWEST INTERCEPTOR (SWI)

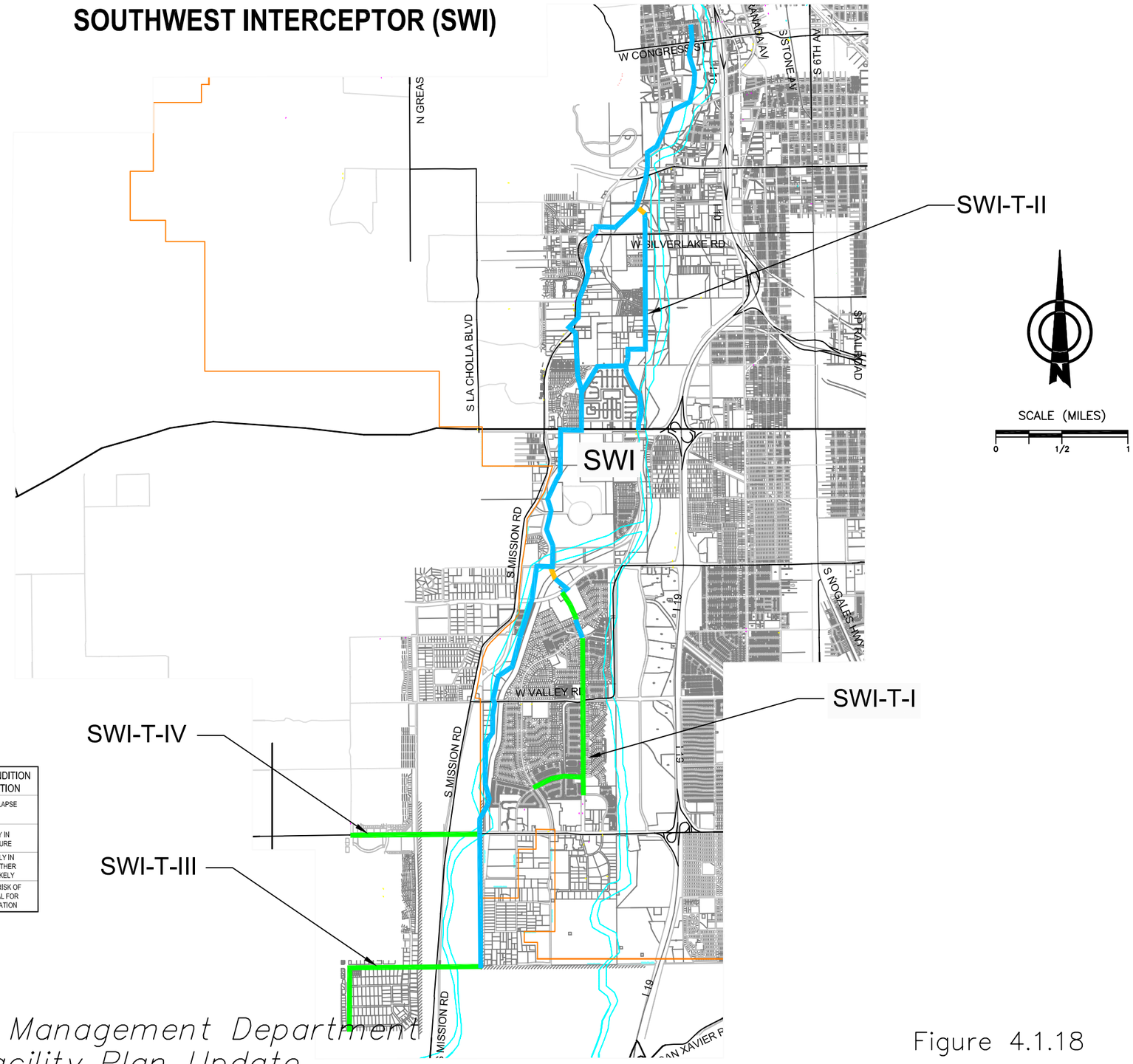

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Figure 4.1.18

SOUTHWEST INTERCEPTOR (SWI)

TANQUE VERDE INTERCEPTOR (TVI)

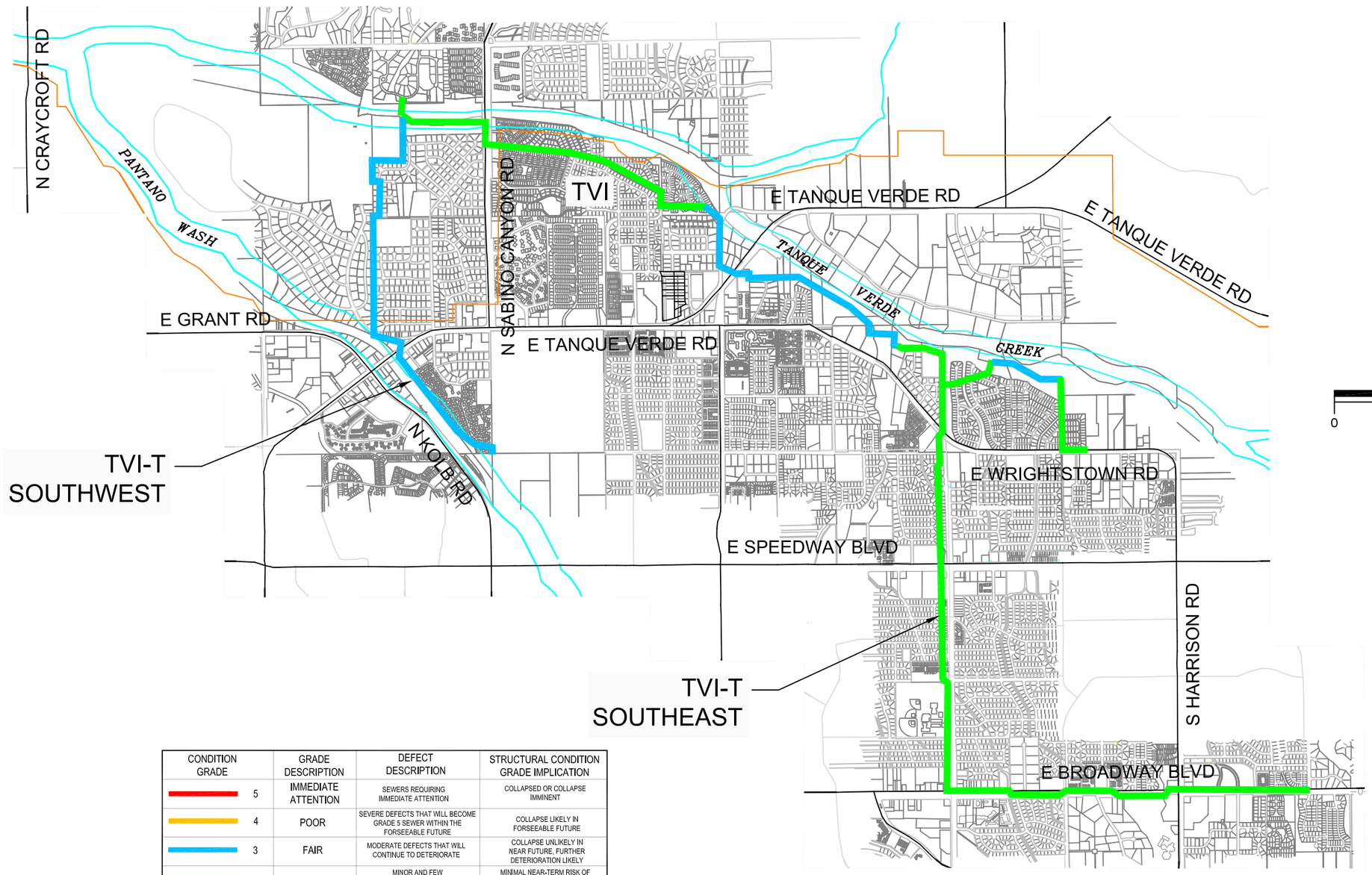

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Figure 4.1.19

TANQUE VERDE INTERCEPTOR (TVI)

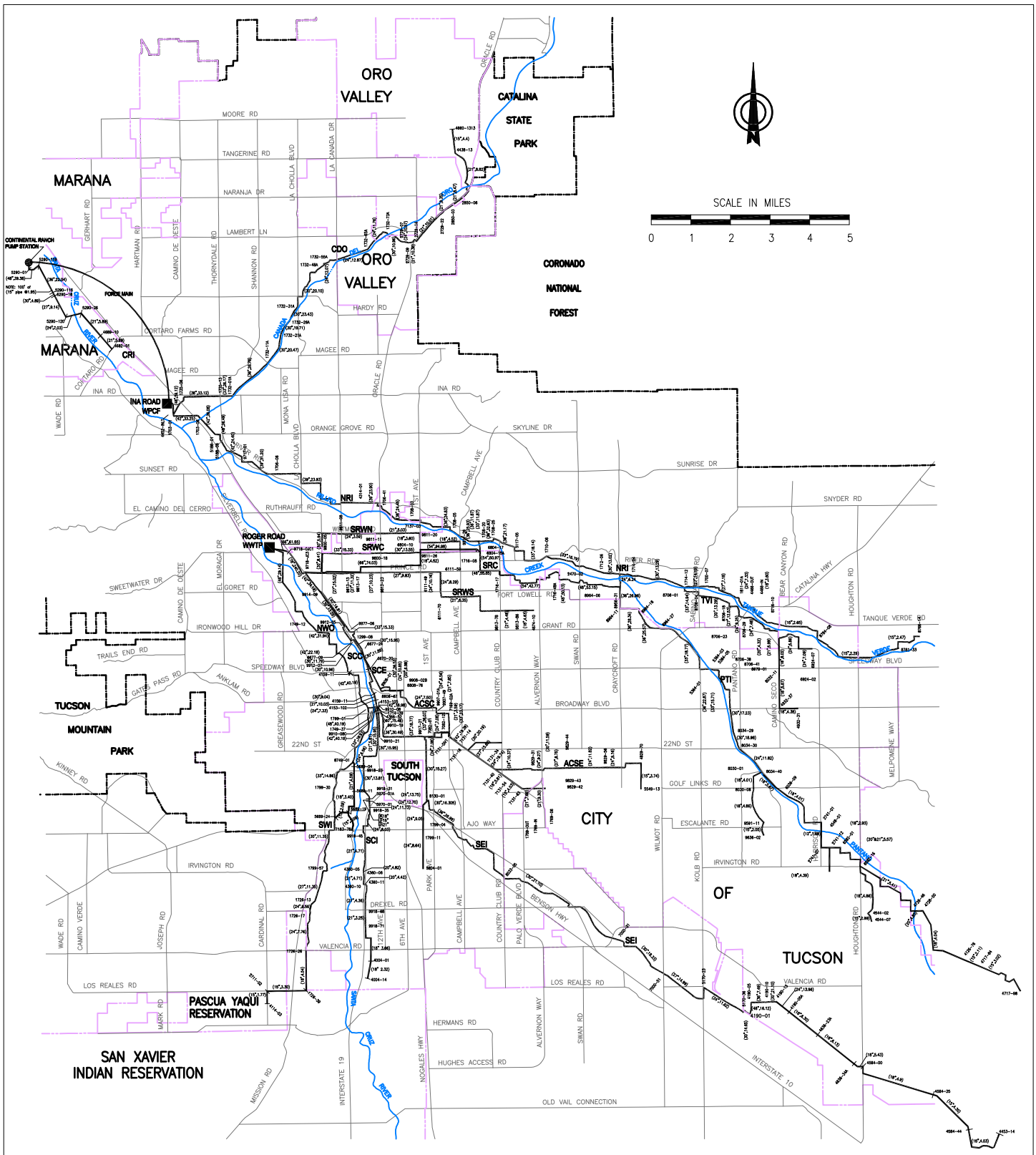

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Figure 4.2.1
Interceptor System with Approximate Full Pipe Capacities

SUB-CHAPTER 4.2 FUTURE CONVEYANCE

Sub-chapter 4.2 discusses the wastewater modeling effort to determine future capacity of the system.

Capacity Determination

The determination of the future capacity requirements of the existing conveyance system has been accomplished by the use of the Facility Plan Model. The Facility Plan Model's development, methods of calculation and operation are discussed in detail in Chapter 3.4. The assumptions and application of population distribution projections presented in that chapter generate the capacity demands on the conveyance system for the next 20 years that are presented in this chapter.

The configuration and capacity of the major interceptors of the PCWMD are presented in Figure 4.2.1. The map presents the routing of the Interceptors and the capacity of individual sections of the Interceptors from the Interceptor's beginning until their discharge to the Metropolitan Treatment Facilities. The identified capacity is the capacity of the pipe flowing full. The identification numbers of the manholes bracketing each significant change in pipe capacity locates significant changes in pipe capacity. As an example referring to Figure 4.2.1, the capacity and size of the North Rillito Interceptor from manhole 4314-01 to manhole 1706-08 is given in parenthesis as (39-inch, 23.93), that is 39-inch pipe diameter and 23.93 MGD full pipe capacity. The information for the remainder of the interceptors is similarly presented.

The Facility Plan Model uses PAG's Transportation Analysis Zone (TAZ) population projections to determine the population within PCWMD sewer basins. The TAZ population and the resulting sewer basin populations can be easily updated as PAG issues revised population forecasts. Likewise, sewer basin populations can be revised to reflect alternate population scenarios that are deemed by the Department to significantly affect the conveyance and treatment system capacities.

The basin populations, as explained in Section 3.4, determine the ADWF in the pipes of the conveyance system. The PDWF is obtained by multiplying the ADWF by a Peaking Factor determined from the total population upstream of the section of pipe under consideration. The Peak Wet Weather Flow (PWWF) is not calculated but accounted for by limiting the carrying capacity of the pipes to 85 percent of full pipe capacity (75 percent d/D). Wet weather flow can, from past experience, be adequately transported in the remaining 15 percent pipe area capacity.

The conveyance system capacities are shown on Figure 4.2.1. These capacities are jointly taken from information presented in the 1990 Facility Plan Update, modified by system upgrades and extensions between 1990 and the present. The values shown in Figure 4.2.1 are full pipe capacities. The Facility Plan Model compares the flows calculated to the capacity of the pipe in that basin. The program issues an alarm when the flow in the basin reaches 85 percent of the full pipe capacity of the pipe sections in the basin. The alarms are divided into two classes, RED for flows in excess of 85 percent of the full pipe capacity at the basin exit and ORANGE when flow exceeds 85 percent of the inlet capacity of the basin.

The ADWF flows for the years 2005 through 2030 are presented in Chapter 5.2 Future Treatment. These flows, although the basis for the PDWF flows presented in this chapter, are not the measure used in judging conveyance system adequacy. This section of the Facility Plan will concern itself with the future PDWF flows identified by the model for the years 2005, 2010, 2015, 2020, 2025 and 2030.

The PDWF flowchart is arranged in a hierarchical manner beginning with the interceptor basins farthest from the Metropolitan Treatment Facilities. Flows generated in the basins along the

interceptors and closer to the treatment plant are added to the flows from the upstream basins. The increasing flows are modified by the peaking factor at the entrance and exit of each succeeding basin and checked with the pipe capacity. The interceptors join their parent interceptors with flows from all upstream basins considered in the parent interceptor until the major parent interceptors' discharge to the Metropolitan Treatment Facilities. (See Figure 4.2.1)

The Facility Plan model summarizes flow on a basin-by-basin platform, assigning the entire flow generated within a basin to the interceptor at the basin's exit manhole. This variation from the real world flows enables the Facility Plan model to compare the flow at the exit from the basin to the pipe capacity at not only the basin's exit but also the basin's entrance. Interceptors within basins where the exit flow exceeds the interceptor's capacity at the basin's entrance and exit are identified on the flowcharts. The pipe capacity of the interceptor in the identified basin requires an Engineering evaluation before being certified as being deficient.

There are many opportunities for the diversion of flows within the conveyance systems tributary to the Roger Road WWTP and Ina Road WPCF. The diversions used in the model were set based upon the metered flows, in both the Conveyance System and at the plant's entrance, in the months of November and December 2004. The Facility Plan Model is flexible and can be set for a wide range of diversion possibilities. However, the 2005 diversion settings, as well as special flows from areas of unusual discharge, were consistently applied to the years 2005 through 2030 (except as noted) for ease of comparison of year-to-year results. These diversions and unusual discharges and their settings are:

1. Diversion from Roger Road WWTP to Ina Road WPCF by means of the Tucson Boulevard Flow Management Structure [from the South Rillito to the North Rillito Interceptors: (see #12)]

2005	5.35 MGD
2010	5.35 MGD
2015	0 MGD (Roger Road to Ina Road Plant Interconnect) Installed
2020	0 MGD (Roger Road to Ina Road Plant Interconnect) Installed
2025	0 MGD (Roger Road to Ina Road Plant Interconnect) Installed
2030	0 MGD (Roger Road to Ina Road Plant Interconnect) Installed

2. Slim Fast Discharge to Basin 43A: 0.00 MGD
3. Discharge from the State and Federal Prison Complex on South Wilmot Road. 0.38 MGD
4. Discharge above and beyond resident population in the University of Arizona Basin: 0.25 MGD
5. Discharge from daily work force in the Downtown Area: 0.40 MGD
6. Discharge from the Airport and Casino & Industrial daily population inflow: 0.80 MGD
7. Discharge from the Davis-Monthan AFB daily population inflow: 0.33 MGD

8. Flow removed from the system at Randolph Park WRF:

2005	0 MGD
2010	3.00 MGD
2015	3.00 MGD
2020	3.00 MGD
2025	3.00 MGD
2030	3.00 MGD

9. Flow diverted from Basin 9 discharge (Southeast Interceptor) to Basin 24 (Santa Cruz Central Interceptor) at the Alameda Siphon. (The remainder of the flow goes to the Northwest Outfall Interceptor). The Santa Cruz Prince to Franklin installed between 2005 and 2010 becomes Basin 24. The diversions from Basis 9 to Basin 24 area as follows:

2005	17 percent
2010	100 percent
2015	100 percent
2020	100 percent
2025	100 percent
2030	100 percent

10. Percentage of flow diverted from Basin 22 (Aviation Corridor Sewer- East) to Basin 4 (The Santa Cruz East interceptor): 25 percent
11. Additional discharge from Tucson Mall: 0.40 MGD
12. Roger Road WWTP to Ina Road WPCF Plant Interconnect installed between 2010 & 2015. Upon completion of the Plant Interconnect flow to the North Rillito Interceptor utilizing the Tucson Boulevard Flow Management Structure will be used only in emergencies or planned maintenance activities.

2005	0 MGD
2010	0 MGD
2015	18.66 MGD
2020	17.85 MGD
2025	17.07 MGD
2030	27.67 MGD*

* Note! Ina Road WPCF scheduled for expansion to 50 MGD in 2026.

The above principles will be covered more fully in the following discussion of the Model's findings in the years 2005, 2010, 2015, 2020, 2025 and 2030.

See the following Figure 4.2.1.

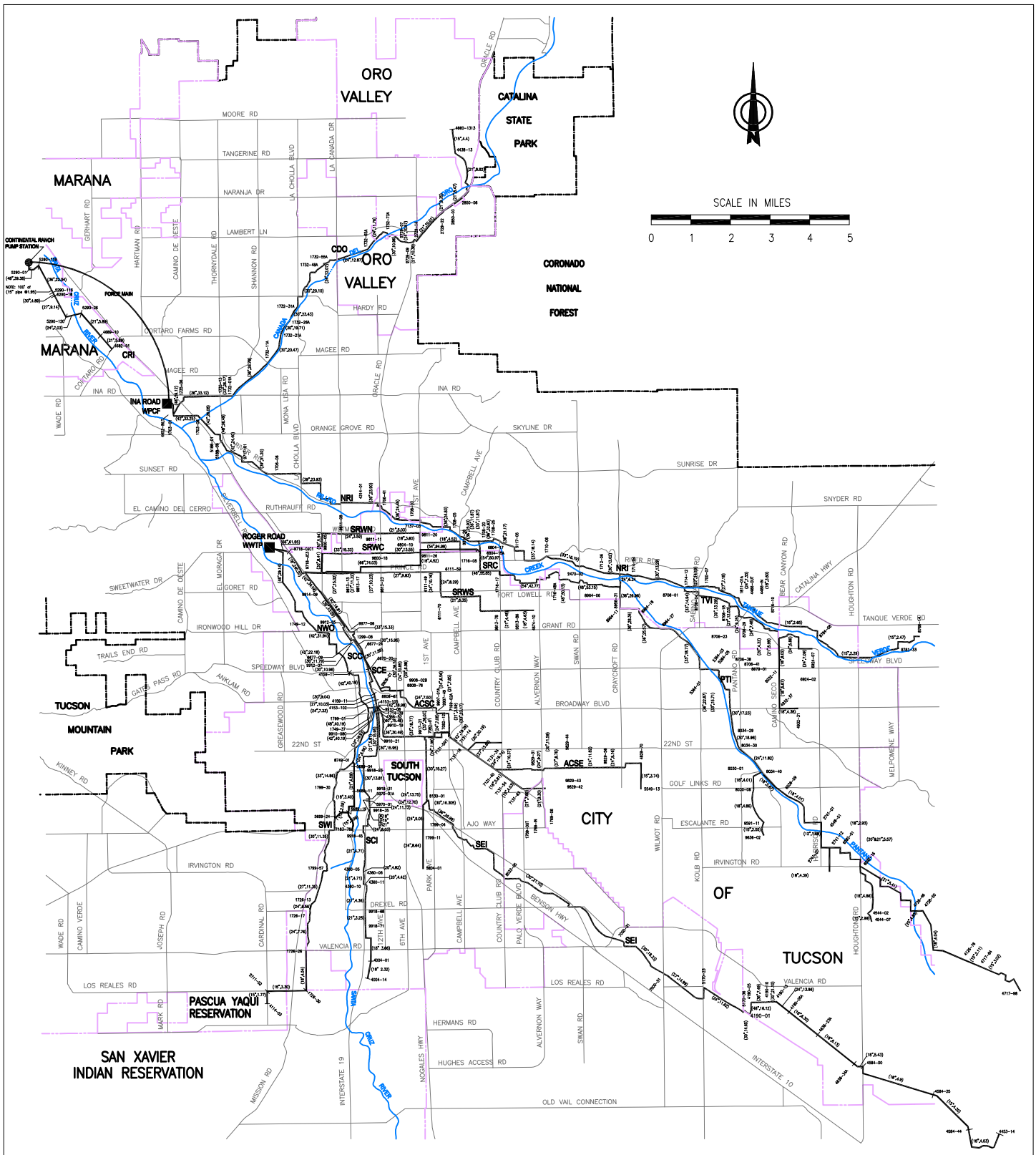

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Figure 4.2.1
Interceptor System with Approximate Full Pipe Capacities

2005 Model Results

The results of the Facility Plan Model's evaluation of the PCWMD's interceptor system for PDWF in the year 2005 are presented in Figures 4.2.2a. and 4.2.2b for Roger Road WWTP and Ina Road WPCF tributary systems, respectively. The sections of the system identified by the Facility Plan Model as being deficient (Red) or requiring further evaluation (Orange) for both the Roger Road WWTP and Ina Road WPCF systems are shown on Figure 4.2.2, Interceptor Capacity Analysis 2005.

Figures 4.2.2a and 4.2.2b are arranged in hierarchal order culminating at the Roger Road WWTP and Ina Road WPCF, respectively. The flows presented are PDWF. The colored circles represent the location of flow meters in the Conveyance System with the adjacent Red numbers the recorded flows. The correlation between recorded peak flows and the calculated peak flows varies widely. Several reasons are offered for these variances:

- Meter recorded peaks are more susceptible to rain events and other flow upsets while the calculated flows are based upon stable population figures. Supporting this premise is the closer agreement of the two readings as the flows increase approaching the plants.
- The calculated flows cannot mirror the effects of real world circumstances.
- The meter recordings are not all from the same types of meters. Some measure flow, some measure depth and others were temporarily set for a week or two and capable of recording unusual peaks with not sufficient data for averaging. The meters in the charts are color coded as follows:

Yellow	SCADA meters recording flow (Million gallons per day (MGD)).
Dotted Yellow	SCADA meters recording depth only (inches).
Blue	Non SCADA meters with flow from Nov-Dec 2004 (MGD).
Green	Non SCADA meters with flow from dates other than Nov-Dec 2004.

The meter's location in relation to the basins is shown on the flow chart. The meter readings are only shown on the 2005-year flow charts, as the readings recorded in 2004 have no validity for years beyond 2005.

Deficiencies Identified

The portions of the interceptors the model identifies as having deficiencies (Red), or requiring further evaluation (Orange) are shown in the color coded tables on Figures 4.2.2a for the Roger Road WWTP Tributary system and on Figure 4.2.2b for the Ina Road WPCF Tributary system. The results are graphically shown on a map of PCWMD's entire interceptor system in Figure 4.2.2. and are summarized as follows:

NOTE. Basins where both entrance and exit problems are indicated are color coded red on Figures 4.2.2 through 4.2.7.

RED (Flow greater than 85 percent of Pipe Capacity)

Roger Road WWTP System

1. Northwest Outfall (NWO) from Speedway Boulevard to the Roger Road WWTP. (Basin 57B). (The 2004 Bond Project will relieve Flow Problems on the NWO: Santa Cruz Interceptor (SCI) Prince to Franklin.)

Ina Road WPCF System

1. (None.)

ORANGE (Flow greater than basin entrance capacity. Requires further evaluation)

Roger Road WWTP System

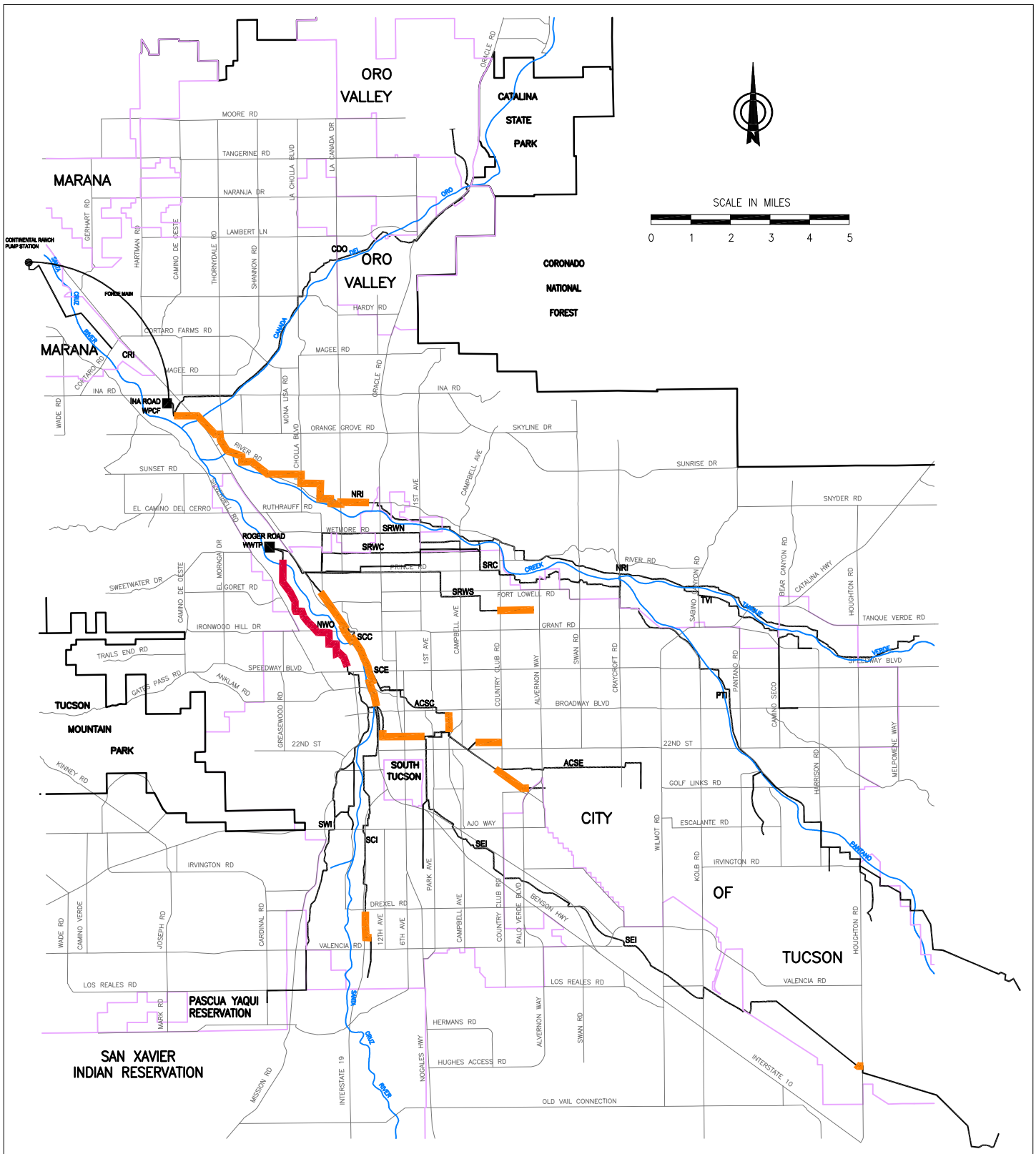
1. Aviation Corridor Sewer Central (ACSC) Aviation/Kino diversion structure to 12th Street and Vine (Basin 4). (This condition is due to the diversion from the ACSE as basin flow at the exit is only 33 percent higher than entrance capacity.)
2. Southeast Interceptor (SEI) from Euclid and 18th Street to 17th Street and Osborne (Basin 9). (This condition is in a downstream basin whose own basin flow is not large; however, the interceptor in this basin carries all of the flow from upstream SEI.)
3. ACSE along 21st Street from Tucson Boulevard to Plumer (Basin 46).

   (This is due to the pipe slope of a section being less than 0.2%.)
4. Santa Cruz Central (SCC) from the Alameda Siphon north to Grant Road and I-10 (Basin 24). (The entrance capacity of Basin 24 is small compared to the Basin 24 exit flow. The exit flow includes the additional flow from large tributary basins joining the interceptor downstream of the Basin 24's entrance point.)
5. Southeast Interceptor (SEI) from near Houghton and Old Vail Roads west to Desert Valley Way (Basin 43A). (This is a section of 36-inch pipe at the basin's entrance that has less capacity than the basin's exit flow. This section of pipe may require augmentation.)
6. Aviation Corridor Sewer East (ACSE) from the Golf Links/Veterans Memorial siphon to Silverlake and Aviation Parkway (Basin 22). (The entrance capacity of this basin is determined by a minor trunk sewer feeding the main interceptor. The pipe in this basin requires evaluation.)
7. Santa Cruz Interceptor (SCI) from Lincoln to Drexel Road (Basin 75). (The peaking factor for this basin caused by its small population magnifies a relatively low ADWF to a significant PDWF.)
8. South Rillito Interceptor (SRI) from Glenn and Alvernon to Glenn west of Country Club (Basin 78). (PCWMD has designed a relief sewer for this problem and awaits funding for construction.)

Ina Road WPCF System

1. North Rillito Interceptor (NRI) from Oracle and River Road to Ina Road WPCF (Basin 19). (This is due to diversion of flow from the South to the North Rillito Interceptor and the limited capacity of several sections of pipe. It should be evaluated. Upon completion of the Plant Interconnect in the 2004 Bonds, this diversion will be used only for emergencies.)

See the following Figures 4.2.2 to 4.2.2b.



LEGEND

DEFICIENT (Calculated Basin Exit Flow is Greater Than 85% of Full Pipe Capacity at the Basin Exit)

FURTHER (Calculated Basin Inlet Flow is Greater Than 85% of Full Pipe Capacity Somewhere Within the Basin)

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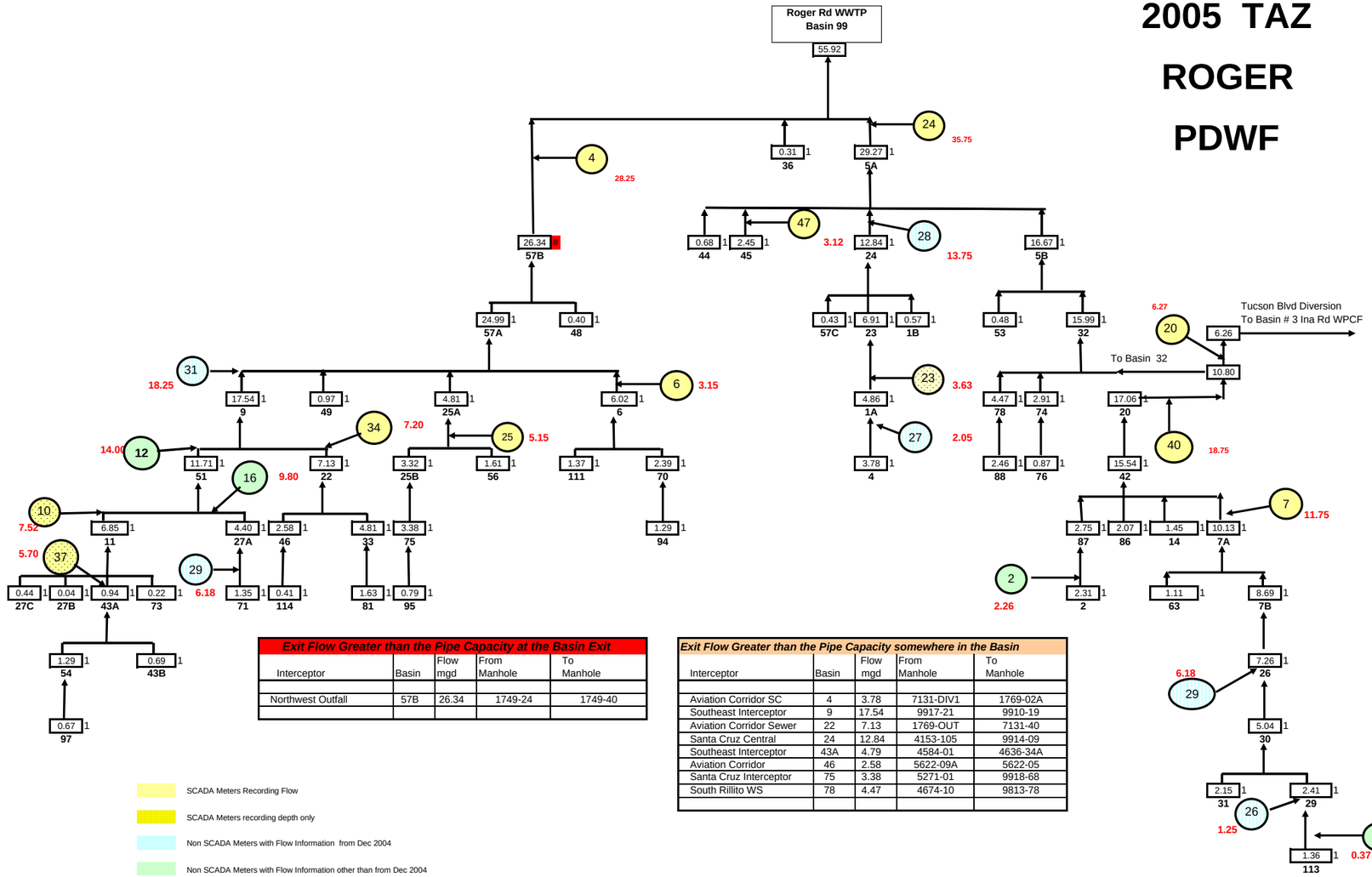
Figure 4.2.2
Capacity Analysis 2005

2005 TAZ
ROGER
PDWF

Basin No.		Basin Population 2005	Interceptor Flow ADWF	Basin Flow ADWF	Peak Factor	PDWF mgd	CAPACITY 85% Full Pipe Capacity ENTER	CAPACITY EXIT	METERS PDWF	METERS Mtr No	Over Exit Capacity Indicator	Over Enter Capacity Indicator	
1A		5,066	2.75	0.43	1.77	**4.86**	5.93	10.11	**3.63**	**23**	5.24	1.07	##
1B		3,258	0.28	0.28	2.07	**0.57**	1.70	9.40			8.83	1.13	##
2		15,232	1.29	1.29	1.78	**2.31**	2.98	3.66	**2.26**	**2**	1.35	0.67	##
4		11,442	2.07	0.97	1.83	**3.78**	2.37	6.67	**2.05**	**27**	2.89	(1.41)	##
5A		561	20.84	0.05	1.40	**29.27**	50.80	129.12	**35.75**	**24**	99.85	21.54	##
5B		3,003	11.22	0.26	1.49	**16.67**	62.93	50.80			34.13	46.25	##
6		18,755	3.67	1.59	1.64	**6.02**	9.65	16.94	**3.15**	**6**	10.92	3.62	##
7A		4,618	6.41	0.39	1.58	**10.13**	15.95	22.92	**11.75**	**7**	12.79	5.83	##
7B		11,219	5.44	0.95	1.60	**8.69**	13.35	15.95			7.27	4.67	##
9		9,645	11.50	0.82	1.52	**17.54**	15.95	64.16	**18.25**	**31**	46.62	(1.58)	##
11		12,628	4.18	1.07	1.64	**6.85**	17.94	22.94	**7.52**	**10.00**	16.10	11.09	##
14		9,153	0.78	0.78	1.86	**1.45**	0.00	6.53			5.08	(1.45)	##
20		12,559	11.20	1.07	1.52	**17.06**	36.35	43.32	**18.75**	**40**	26.26	19.29	##
22		755	4.38	0.06	1.63	**7.13**	6.51	12.02	**7.20**	**34**	4.88	(0.62)	##
23		16,152	4.12	1.37	1.68	**6.91**	10.11	14.29	5.13	23	7.38	3.20	##
24		11,148	7.90	0.95	1.63	**12.84**	6.57	29.68	**13.75**	**28**	16.84	(6.27)	##
25A		916	2.91	0.08	1.65	**4.81**	9.97	34.16			29.35	5.16	##
25B		6,319	1.97	0.54	1.69	**3.32**	4.00	6.83	**5.15**	**25**	3.50	0.68	##
26		17,182	4.49	1.46	1.62	**7.26**	16.13	14.65			7.39	8.87	##
27A		4,475	2.53	0.38	1.74	**4.40**	7.68	12.37	**9.80**	**16**	7.97	3.29	##
27B		526	0.04	0.04	2.62	**0.12**	0.00	2.93			2.82	(0.12)	##
27C		5,167	0.44	0.44	1.97	**0.87**	0.00	3.12			2.25	(0.87)	##
29		7,447	1.36	0.63	1.78	**2.41**	3.41	4.82	**1.25**	**26**	2.41	1.00	##
30		5,532	3.03	0.47	1.67	**5.04**	10.05	10.05	**6.18**	**29**	5.01	5.01	##
31		14,072	1.20	1.20	1.80	**2.15**	0.00	3.41			1.26	(2.15)	##
32		6,707	10.74	0.57	1.49	**15.99**	79.93	62.93			46.94	63.94	##
33		10,461	2.85	0.89	1.69	**4.81**	7.79	8.81			4.00	2.97	##
36		1,606	0.14	0.14	2.24	**0.31**	0.00	1.70			1.39	(0.31)	##
42		2,596	10.13	0.22	1.53	**15.54**	45.18	42.61			27.07	29.64	##
43A		11,011	2.41	0.94	1.99	**4.79**	4.59	11.85	**5.70**	**37**	7.06	(0.20)	##
43B		4,747	0.40	0.40	1.72	**0.69**	0.00	4.17			3.47	(0.69)	##
44		3,945	0.34	0.34	2.03	**0.68**	2.31	7.15			6.47	1.63	##
45		10,981	1.33	0.93	1.83	**2.45**	3.06	13.52	**3.12**	**47**	11.07	0.61	##
46		12,436	1.46	1.06	1.76	**2.58**	2.41	3.88			1.30	(0.17)	##
48		2,160	0.18	0.18	2.17	**0.40**	0.00	1.95			1.55	(0.40)	##
49		5,840	0.50	0.50	1.95	**0.97**	0.00	3.04			2.08	(0.97)	##
51		8,148	7.40	0.69	1.58	**11.71**	12.98	12.98	**14.00**	**12**	1.27	1.27	##
53		2,639	0.22	0.22	2.12	**0.48**	0.00	1.12			0.65	(0.48)	##
54		133	0.69	0.01	1.89	**1.29**	16.01	13.70			12.41	14.72	##
56		10,251	0.87	0.87	1.85	**1.61**	0.00	2.52			0.91	(1.61)	##
57A		4,004	16.97	0.34	1.47	**24.99**	17.70	27.15			2.16	(7.29)	##
57B		9,345	17.95	0.79	1.47	**26.34**	27.15	24.77	**28.25**	**4**	(1.58)	0.80	##
57C		2,338	0.20	0.20	2.15	**0.43**	0.00	3.90			3.47	(0.43)	##
63		6,839	0.58	0.58	1.92	**1.11**	0.00	4.29			3.18	(1.11)	##
70		7,768	1.35	0.66	1.78	**2.39**	6.60	9.65			7.25	4.20	##
71		15,848	2.15	1.35	1.78	**3.82**	0.00	7.88	**3.49**	**30**	4.06	(3.82)	##
73		2,559	0.22	0.22	2.13	**0.46**	0.00	10.05			9.58	(0.46)	##
74		14,423	1.67	1.23	1.75	**2.91**	7.05	6.48			3.56	4.13	##
75		13,829	1.97	1.18	1.72	**3.38**	2.71	3.72			0.34	(0.67)	##
76		5,208	0.44	0.44	1.97	**0.87**	0.00	1.52			0.65	(0.87)	##
78		14,940	2.66	1.27	1.68	**4.47**	3.81	5.40			0.93	(0.66)	##
81		19,190	1.63	1.63	1.75	**2.85**	0.00	3.18			0.33	(2.85)	##
86		13,526	1.15	1.15	1.80	**2.07**	0.00	6.60			4.53	(2.07)	##
87		3,224	1.57	0.27	1.75	**2.75**	3.66	8.77			6.02	0.90	##
88		16,313	1.39	1.39	1.77	**2.46**	0.00	3.80			1.34	(2.46)	##
94		8,072	0.69	0.69	1.89	**1.29**	0.00	3.90			2.61	(1.29)	##
95		9,293	0.79	0.79	1.86	**1.47**	0.00	2.71			1.24	(1.47)	##
97		7,941	0.67	0.67	1.89	**1.28**	0.00	7.81			6.53	(1.28)	##
99		0	38.92	0.00	1.40	**54.65**	78.20	78.20			23.55	23.55	##
111		8,576	0.73	0.73	1.88	**1.37**	0.00	5.29			3.92	(1.37)	##
113		8,544	0.73	0.73	1.88	**1.36**	0.00	3.94	**0.37**	**11**	2.57	(1.36)	##
114		4,767	0.41	0.41	1.99	**0.81**	0.00	1.09			0.28	(0.81)	##
20A				5.35	1.17	**6.26**			**6.27**	**20**			##



Exit Flow Greater than the Pipe Capacity at the Basin Exit				
Interceptor	Basin	Flow mgd	From Manhole	To Manhole
Northwest Outfall	57B	26.34	1749-24	1749-40

Exit Flow Greater than the Pipe Capacity somewhere in the Basin				
Interceptor	Basin	Flow mgd	From Manhole	To Manhole
Aviation Corridor SC	4	3.78	7131-DIV1	1769-02A
Southeast Interceptor	9	17.54	9917-21	9910-19
Aviation Corridor Sewer	22	7.13	1769-OUT	7131-40
Santa Cruz Central	24	12.84	4153-105	9914-09
Southeast Interceptor	43A	4.79	4584-01	4636-34A
Aviation Corridor	46	2.58	5622-09A	5622-05
Santa Cruz Interceptor	75	3.38	5271-01	9918-68
South Rillito WS	78	4.47	4674-10	9813-78

SCADA Meters Recording Flow

SCADA Meters recording depth only

Non SCADA Meters with Flow Information from Dec 2004

Non SCADA Meters with Flow Information other than from Dec 2004

Figure 4.2.2a

Peak Dry Weather Flow (PDWF)

Roger Road Tributary System

TAZ 2005

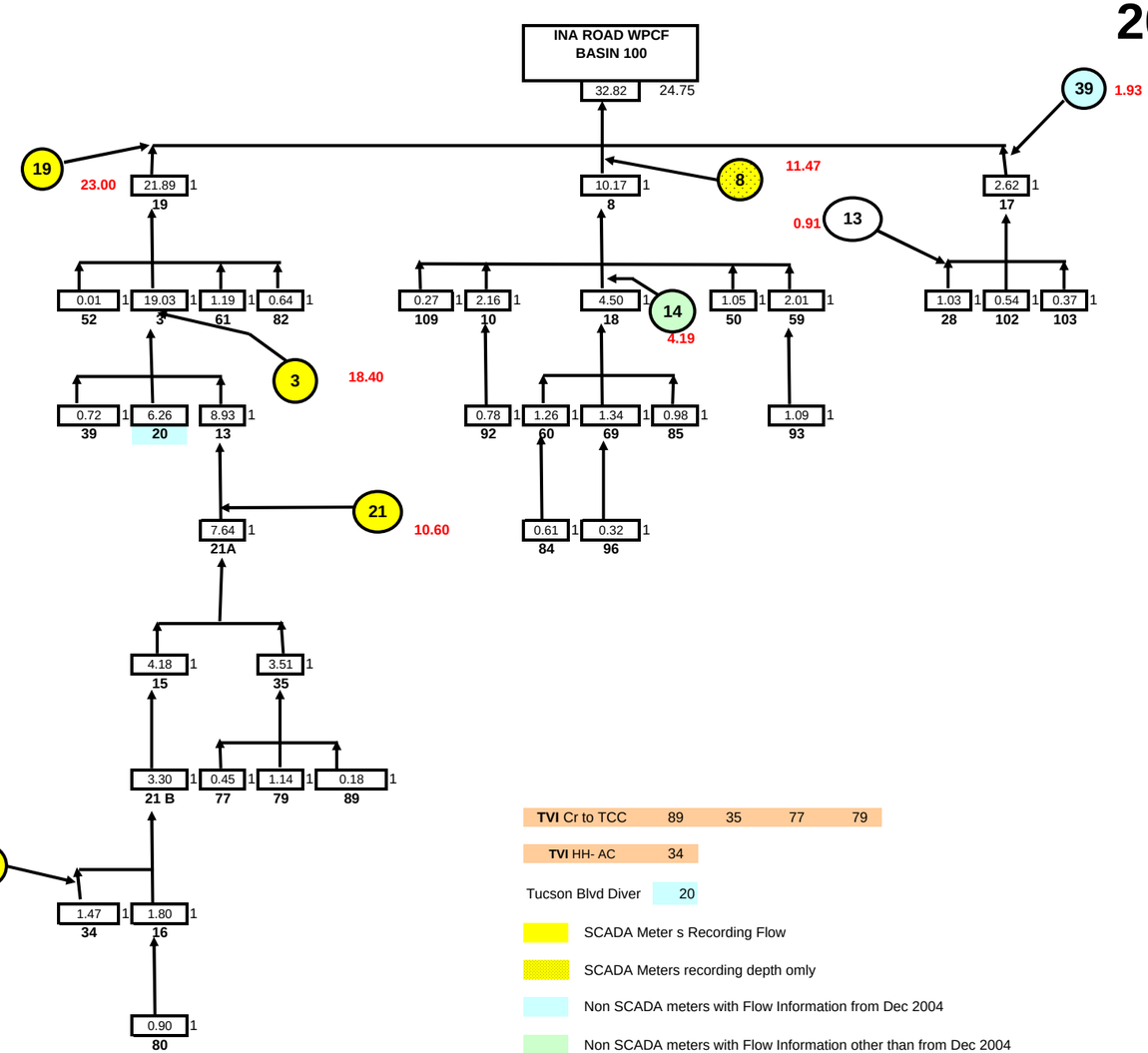
3/15/05 10:30am

2005 TAZ

INA

PDWF

Basin No	Basin Population on Sewer 2005	Interceptor Flow **ADWF**	Basin Flow **ADWF**	**Peak Factor**	**PDWF** mgd	**CAPACITY** 85% Full Pipe Capacity ENTER	EXIT	**METERS** PDWF	Mtr. No	**Over Exit Capacity Indicator**	**Over Entrance Capacity Indicator**	
3	12,367	12.25	0.87	1.55	**19.03**	22.04	20.33			1.30	3.01	##
8	8,720	6.43	0.78	1.58	**10.17**	17.09	33.25	**11.47**	**8**	23.08	6.91	##
10	8,977	1.20	0.81	1.80	**2.16**	3.37	5.79			3.62	1.21	##
13	12,487	5.67	0.87	1.57	**8.93**	0.00	27.74			18.81	(8.93)	##
15	8,125	2.50	0.57	1.67	**4.18**	12.06	11.30			7.12	7.88	##
16	7,660	1.00	0.54	1.81	**1.80**	3.69	4.69			2.89	1.89	##
17	6,206	1.49	0.53	1.76	**2.62**	4.17	32.62	**1.93**	**39**	30.00	1.55	##
18	9,361	2.68	0.80	1.68	**4.50**	7.50	17.09	**4.19**	**14**	12.58	2.99	##
19	16,019	14.33	1.12	1.53	**21.89**	20.34	28.26	**23.00**	**19**	6.38	(1.55)	##
20	0	5.35	5.35	1.17	**6.26**	9.18	17.48			11.22	2.92	##
21A	3,322	4.80	0.22	1.59	**7.64**	11.30	11.30	**6.27**	**20**	3.66	3.66	##
21B	1,910	1.94	0.13	1.70	**3.30**	7.82	7.63	**10.60**	**21**	4.34	4.52	##
28	6,693	0.54	0.54	1.92	**1.03**	0.00	3.17	**0.91**	**13**	2.14	(1.03)	##
34	11,507	0.81	0.81	1.83	**1.47**	0.00	6.57	**2.04**	**1**	5.10	(1.47)	##
35	16,862	2.08	1.18	1.69	**3.51**	5.08	6.36			2.85	1.57	##
39	4,188	0.36	0.36	2.02	**0.72**	0.00	3.55	**18.40**	**3**	2.84	(0.72)	##
50	6,370	0.54	0.54	1.93	**1.05**	0.00	4.32			3.27	(1.05)	##
52	15	0.00	0.00	6.06	**0.01**	0.00	0.43			0.43	(0.01)	##
59	6,044	1.11	0.54	1.81	**2.01**	12.02	4.36			2.35	10.01	##
60	4,380	0.67	0.37	1.89	**1.26**	2.52	3.73			2.47	1.25	##
61	9,115	0.64	0.64	1.86	**1.19**	0.00	3.71			2.52	(1.19)	##
69	6,266	0.71	0.56	1.89	**1.34**	2.77	10.00			8.66	1.43	##
77	3,109	0.22	0.22	2.08	**0.45**	0.00	2.52			2.06	(0.45)	##
79	8,684	0.61	0.61	1.87	**1.14**	0.00	6.48			5.34	(1.14)	##
80	5,416	0.46	0.46	1.96	**0.90**	0.00	2.52			1.61	(0.90)	##
82	4,546	0.32	0.32	2.00	**0.64**	0.00	1.74			1.11	(0.64)	##
84	3,466	0.29	0.29	2.06	**0.61**	0.00	4.20			3.59	(0.61)	##
85	5,942	0.51	0.51	1.94	**0.98**	0.00	6.16			5.18	(0.98)	##
89	1,067	0.07	0.07	2.36	**0.18**	0.00	4.01			3.84	(0.18)	##
92	4,338	0.39	0.39	2.01	**0.78**	0.00	1.47			0.69	(0.78)	##
93	6,655	0.57	0.57	1.92	**1.09**	0.00	8.73			7.64	(1.09)	##
96	1,713	0.15	0.15	2.23	**0.32**	0.00	1.85			1.53	(0.32)	##
102	3,056	0.26	0.26	2.09	**0.54**	0.00	3.01			2.47	(0.54)	##
103	1,986	0.17	0.17	2.19	**0.37**	0.00	2.46			2.09	(0.37)	##
109	1,319	0.12	0.12	2.30	**0.27**	0.00	3.17			2.90	(0.27)	##
100	0	22.25	0.00	1.48	**32.82**							##



TVI Cr to TCC	89	35	77	79
TVI HH- AC	34			
Tucson Blvd Diver	20			

SCADA Meter s Recording Flow

SCADA Meters recording depth omly

Non SCADA meters with Flow Information from Dec 2004

Non SCADA meters with Flow Information other than from Dec 2004

Exit flow greater than the Pipe Capacity at the Basin Exit				
Interceptor	Basin	Flow mgd	From Manhole	To Manhole

Exit flow greater than the Pipe Capacity somewhere in the Basin				
Interceptor	Basin	Flow mgd	From Manhole	To Manhole
North Rillito Interceptor	19	21.89	1706-36	1703-06

Figure 4.2.2b

Peak Dry Weather Flow (PDWF)

Ina Road WPCF Tributary System

TAZ 2005

2010 Model Results

The results of the model's evaluation of the PCWMD's interceptor system for PDWF in the year 2010 are presented in Figures 4.2.3a. and 4.2.3b for Roger Road WWTP and Ina Road WPCF tributary systems, respectively. The sections of the system identified by the Facility Plan Model as being deficient (Red) or requiring further evaluation (Orange) for both the Roger Road WWTP and Ina Road WPCF systems are shown on Figure 4.2.3, Interceptor Capacity Analysis 2010.

In the period from 2005-2010 the Randolph Park WRF is placed in service at 3.0 MGD capacity. Also, the Santa Cruz Interceptor, Prince to Franklin (SCIPF) project is placed in service. The model considers the SCIPF replaces the Santa Cruz Central thereby increasing the capacity of Basin 24 at 75 percent d/D to 64.16 MGD. Basin 25A, the Santa Cruz Interceptor is directed to the SCIPF (Basin 24). Similarly, the Southeast Interceptor Flow (Basin 9) is 100 percent directed to the SCIPF (Basin 24). The redirection of Basin 9 and 25A relieve flow to the Northwest Outfall.

The Randolph Park WRF is now in service. 3.0 MGD is diverted from Basin 22 to the Randolph WRF reducing the exit flow to a value below the entrance capacity of Basin 22.

The portions of the Interceptors in 2010 that the Facility Plan Model identifies as having deficiencies (Red) or requiring further evaluation (Orange) are shown in the color coded tables on Figures 4.2.3a for the Roger Road Tributary system and on Figure 4.2.32b for the Ina Road Tributary system. The results are graphically shown on a map of PCWMD's entire Interceptor system in Figure 4.2.3. The unique results for 2010 are presented in the following narrative; however, the sections of the Interceptors found deficient (Red) and requiring evaluation, (Orange) in 2005 will, barring corrective action, be problems in 2010. The following narrative will, unless noted, limit itself to newly identified reaches of Interceptor or reaches that move from requiring evaluation to deficient. Reaches of interceptor found to have problems (either deficient or requiring evaluation) in prior years are considered to not have been repaired and still pose problems in this and future years. The results are:

Deficiencies noted

Red (Flow greater than 85 percent of Pipe Capacity)

Roger Road WWTP System

1. (From 2005) Northwest Outfall ceases to be a capacity problem as flow is re-directed to the SCIPF (Basin 57B).
2. SEI from Park & I-10 to 18th street and Euclid Avenue (Basin 51). (The condition is due to growth in Vail, Houghton Road, the Wilmot prison complex, Rita Ranch and the Airport Area. Solution is either enlarge sewer from Park & I-10 to 18th and Osborne or build a Water Reclamation Facility in the area.)

Ina Road WPCF System

1. No new problems.

ORANGE (Flow greater than basin entrance capacity. Requires further evaluation)

Roger Road WWTP System

1. (From 2005) Northwest Outfall ceases to be a capacity problem as flow is re-directed to the SCIPF (Basin 57B).
2. (From 2005) Santa Cruz Central ceases to be a capacity problem as flow is re-directed to the SCIPF (Basin 51).

3 (From 2005) Aviation Corridor Sewer East (ACSE) along 21 Street from Tucson Boulevard to Plumer (Basin 46). (This is due to the pipe slope of a section being less than 0.2%.)

4 Pantano Interceptor from Stella Road and the Pantano Wash to Doral Drive and the Pantano Wash (Basin 29). (The 18" pipe capacity at the basin entrance noted on Fig 4.2.1 is less than the flow at the basin exit.)

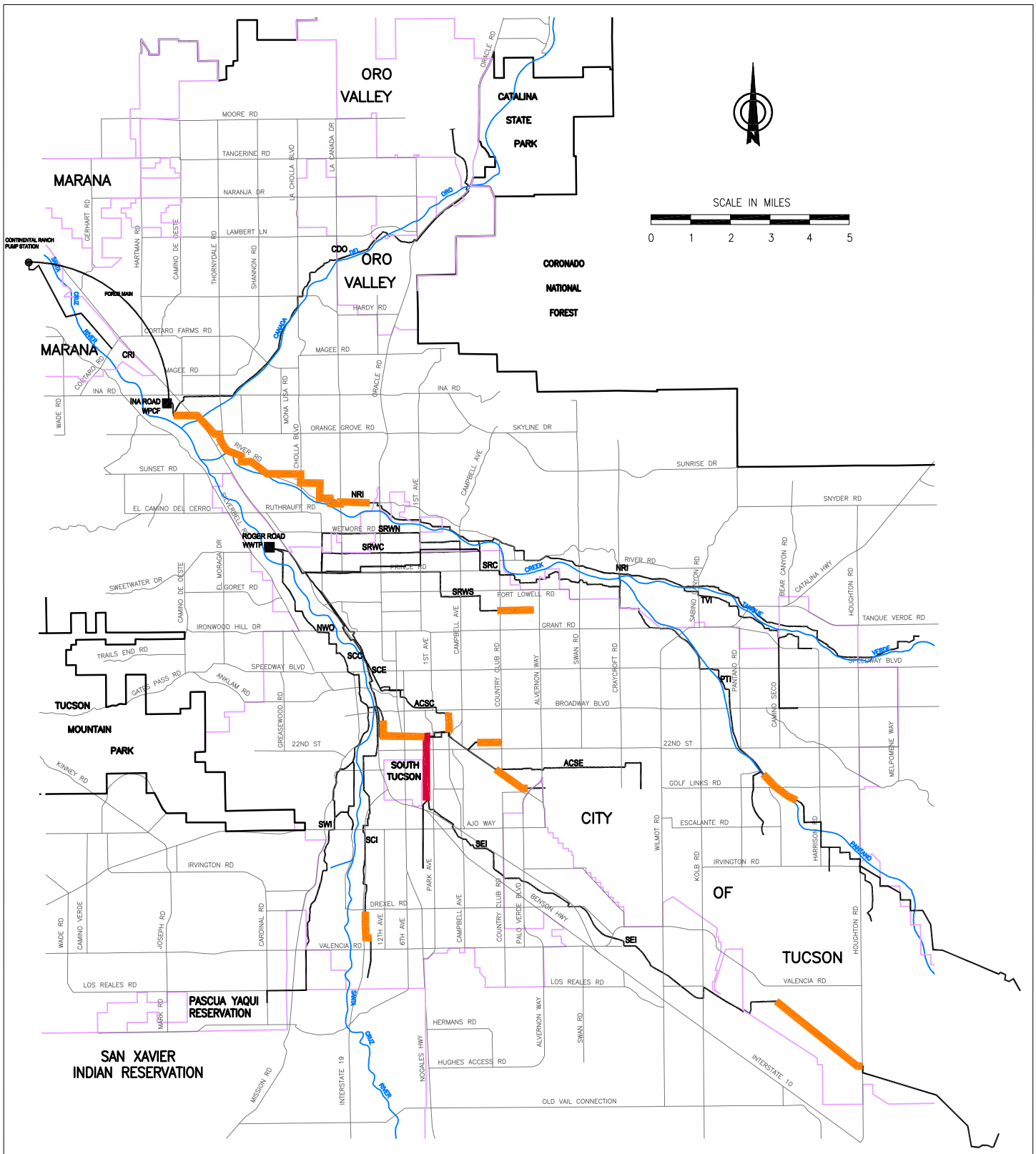
5. SEI at Old Vail Road near I-10 (Basin 43A). (This is a section of 36-inch pipe at the basin's entrance that has less capacity than the basin's exit flow. This section of pipe may require augmentation.)

6. SEI from Park & I-10 to 18th Street and Euclid Avenue. (The appearance of this section of Interceptor in both the RED & ORANGE problem areas indicates the projected flow is greater than the pipe capacity at the entrance and the exit to this basin condition.)

Ina Road WPCF System

1. No new problems.

See the following Figures 4.2.3 TO 4.2.3b.



LEGEND

- DEFICIENT (Calculated Basin Exit Flow is Greater Than 85% of Full Pipe Capacity at the Basin Exit)
- FURTHER (Calculated Basin Inlet Flow is Greater Than 85% of Full Pipe Capacity Somewhere Within the Basin)

NOTE

1.) The Santa Cruz Interceptor, Prince to Franklin has been constructed between 2005 and 2010 relieving The Santa Cruz Central and the Northwest Outfall.

2.) Randolph Park WRF is placed in service between 2005 and 2010.

Pima County Wastewater Management Department
Facility Plan Update

Figure 4.2.3
Capacity Analysis 2010

2010 TAZ

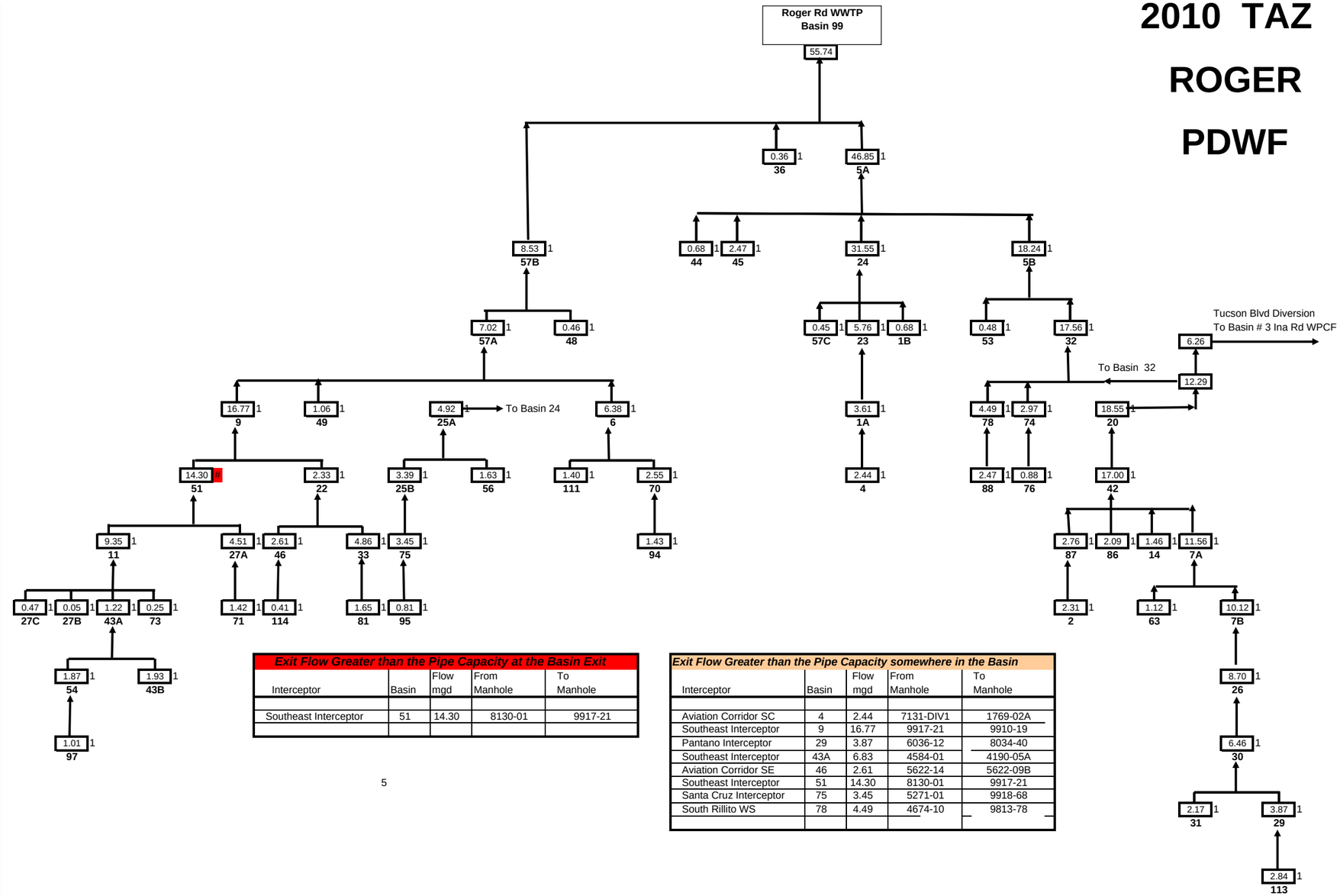
ROGER

PDWF

Basin No.		Basin Population on sewer 2010	Interceptor Flow **ADWF**	Basin Flow **ADWF**	**Peak Factor**	**PDWF** mgd	**CAPACITY** 85% Full Pipe Capacity ENTER	EXIT	**Over Exit Capacity Indicator**	**Over Enterance Capacity Indicator**	
1A		5,448	2.05	0.46	1.77	**3.61**	5.93	10.11	6.49	2.32	##
1B		3,931	0.33	0.33	2.03	**0.68**	1.70	9.40	8.72	1.02	##
2		15,279	1.30	1.30	1.78	**2.31**	2.98	3.66	1.34	0.66	##
4		11,476	1.33	0.98	1.83	**2.44**	2.37	6.67	4.24	(0.06)	##
5A		574	33.51	0.05	1.40	**46.85**	204.20	52.32	5.47	157.35	##
5B		3,038	12.33	0.26	1.48	**18.24**	62.93	50.80	32.56	44.69	##
6		20,122	3.90	1.71	1.63	**6.38**	9.65	16.94	10.56	3.27	##
7A		4,704	7.39	0.40	1.56	**11.56**	15.95	22.92	11.35	4.39	##
7B		11,309	6.41	0.96	1.58	**10.12**	13.35	15.95	5.84	3.23	##
9		10,058	11.12	0.85	1.51	**16.77**	15.95	64.16	47.38	(0.82)	##
11		15,246	5.86	1.30	1.60	**9.35**	17.94	22.94	13.59	8.59	##
14		9,208	0.78	0.78	1.86	**1.46**	0.00	6.53	5.07	(1.46)	##
20		12,844	12.24	1.09	1.51	**18.55**	36.35	43.32	24.78	17.81	##
22		766	1.43	0.07	1.63	**2.33**	6.51	12.02	9.69	4.18	##
23		16,396	3.44	1.39	1.67	**5.76**	10.11	14.29	8.53	4.35	##
24		11,330	19.45	0.96	1.62	**31.55**	64.16	64.16	32.61	32.61	##
25A		1,127	2.99	0.10	1.65	**4.92**	9.97	34.16	29.24	5.05	##
25B		6,496	2.01	0.55	1.69	**3.39**	4.00	6.83	3.44	0.62	##
26		17,519	5.45	1.49	1.60	**8.70**	16.13	14.65	5.95	7.44	##
27A		4,551	2.60	0.39	1.73	**4.51**	7.68	12.37	7.85	3.17	##
27B		538	0.05	0.05	2.61	**0.12**	0.00	2.93	2.82	(0.12)	##
27C		5,548	0.47	0.47	1.96	**0.92**	0.00	3.12	2.20	(0.92)	##
29		7,625	2.27	0.65	1.70	**3.87**	3.41	4.82	0.95	(0.46)	##
30		5,601	3.96	0.48	1.63	**6.46**	10.05	10.05	3.59	3.59	##
31		14,230	1.21	1.21	1.79	**2.17**	0.00	3.41	1.24	(2.17)	##
32		6,797	11.85	0.58	1.48	**17.56**	79.93	62.93	45.37	62.37	##
33		10,605	2.88	0.90	1.69	**4.86**	7.79	8.81	3.95	2.92	##
36		1,948	0.17	0.17	2.19	**0.36**	0.00	1.70	1.34	(0.36)	##
42		2,842	11.15	0.24	1.52	**17.00**	45.18	42.61	25.61	28.18	##
43A		14,358	3.80	1.22	1.80	**6.83**	4.59	11.85	5.02	(2.24)	##
43B		13,730	1.17	1.17	1.65	**1.93**	0.00	4.17	2.24	(1.93)	##
44		3,965	0.34	0.34	2.03	**0.68**	2.31	7.15	6.47	1.63	##
45		11,148	1.35	0.95	1.83	**2.47**	3.06	13.52	11.05	0.59	##
46		12,653	1.48	1.08	1.76	**2.61**	2.41	3.88	1.27	(0.20)	##
48		2,515	0.21	0.21	2.13	**0.46**	0.00	1.95	1.49	(0.46)	##
49		6,474	0.55	0.55	1.93	**1.06**	0.00	3.04	1.98	(1.06)	##
51		8,582	9.19	0.73	1.56	**14.30**	12.98	12.98	-1.32	(1.32)	##
53		2,650	0.23	0.23	2.12	**0.48**	0.00	1.12	0.64	(0.48)	##
54		149	1.03	0.01	1.82	**1.87**	16.01	13.70	11.83	14.14	##
56		10,404	0.88	0.88	1.84	**1.63**	0.00	2.52	0.89	(1.63)	##
57A		4,063	4.80	0.35	1.46	**7.02**	17.70	27.15	20.13	10.68	##
57B		9,850	5.85	0.84	1.46	**8.53**	27.15	24.77	16.24	18.62	##
57C		2,483	0.21	0.21	2.13	**0.45**	0.00	3.90	3.45	(0.45)	##
63		6,880	0.58	0.58	1.92	**1.12**	0.00	4.29	3.17	(1.12)	##
70		7,962	1.44	0.68	1.77	**2.55**	6.60	9.65	7.10	4.05	##
71		16,650	2.22	1.42	1.77	**3.92**	0.00	7.88	3.96	(3.92)	##
73		2,940	0.25	0.25	2.09	**0.52**	0.00	10.05	9.52	(0.52)	##
74		14,779	1.71	1.26	1.74	**2.97**	7.05	6.48	3.51	4.08	##
75		14,106	2.01	1.20	1.72	**3.45**	2.71	3.72	0.27	(0.74)	##
76		5,283	0.45	0.45	1.97	**0.88**	0.00	1.52	0.64	(0.88)	##
78		14,975	2.67	1.27	1.68	**4.49**	3.81	5.40	0.91	(0.68)	##
81		19,422	1.65	1.65	1.75	**2.88**	0.00	3.18	0.30	(2.88)	##
86		13,657	1.16	1.16	1.80	**2.09**	0.00	6.60	4.51	(2.09)	##
87		3,248	1.57	0.28	1.75	**2.76**	3.66	8.77	6.01	0.89	##
88		16,428	1.40	1.40	1.77	**2.47**	0.00	3.80	1.33	(2.47)	##
94		9,025	0.77	0.77	1.87	**1.43**	0.00	3.90	2.47	(1.43)	##
95		9,503	0.81	0.81	1.86	**1.50**	0.00	2.71	1.21	(1.50)	##
97		11,941	1.01	1.01	1.82	**1.85**	0.00	7.81	5.96	(1.85)	##
99		0	39.53	0.00	1.40	**55.25**	78.20	78.20	22.95	22.95	##
111		8,817	0.75	0.75	1.87	**1.40**	0.00	5.29	3.89	(1.40)	##
113		19,096	1.62	1.62	1.75	**2.84**	0.00	3.94	1.10	(2.84)	##
114		4,769	0.41	0.41	1.99	**0.81**	0.00	1.09	0.28	(0.81)	##
20A				5.35	1.17	**6.26**					##

1 The Santa Cruz Interceptor, Prince to Franklin (SCIPF) was constructed between 2005 and 2010. This effects Basin 24. The basin exit capacity at 75% d/D is 64.16 a minimum value for this section of sewer.

2 After installation of the Santa Cruz Interceptor, Prince to Franklin (SCIPF) all of the flow from the Southeast Interceptor (Basin 9) and the Santa Cruz Interceptor (basin 25) will flow through SCIPF (Basin 24) to Basin 5A at Prince Road.



Exit Flow Greater than the Pipe Capacity at the Basin Exit				
Interceptor	Basin	Flow mgd	From Manhole	To Manhole
Southeast Interceptor	51	14.30	8130-01	9917-21

Exit Flow Greater than the Pipe Capacity somewhere in the Basin				
Interceptor	Basin	Flow mgd	From Manhole	To Manhole
Aviation Corridor SC	4	2.44	7131-DIV1	1769-02A
Southeast Interceptor	9	16.77	9917-21	9910-19
Pantano Interceptor	29	3.87	6036-12	8034-40
Southeast Interceptor	43A	6.83	4584-01	4190-05A
Aviation Corridor SE	46	2.61	5622-14	5622-09B
Southeast Interceptor	51	14.30	8130-01	9917-21
Santa Cruz Interceptor	75	3.45	5271-01	9918-68
South Rillito WS	78	4.49	4674-10	9813-78

Figure 4.2.3a

Peak Dry Weather Flow (PDWF)

Roger Road Tributary System

TAZ 2010

1/20/06 11:30 am

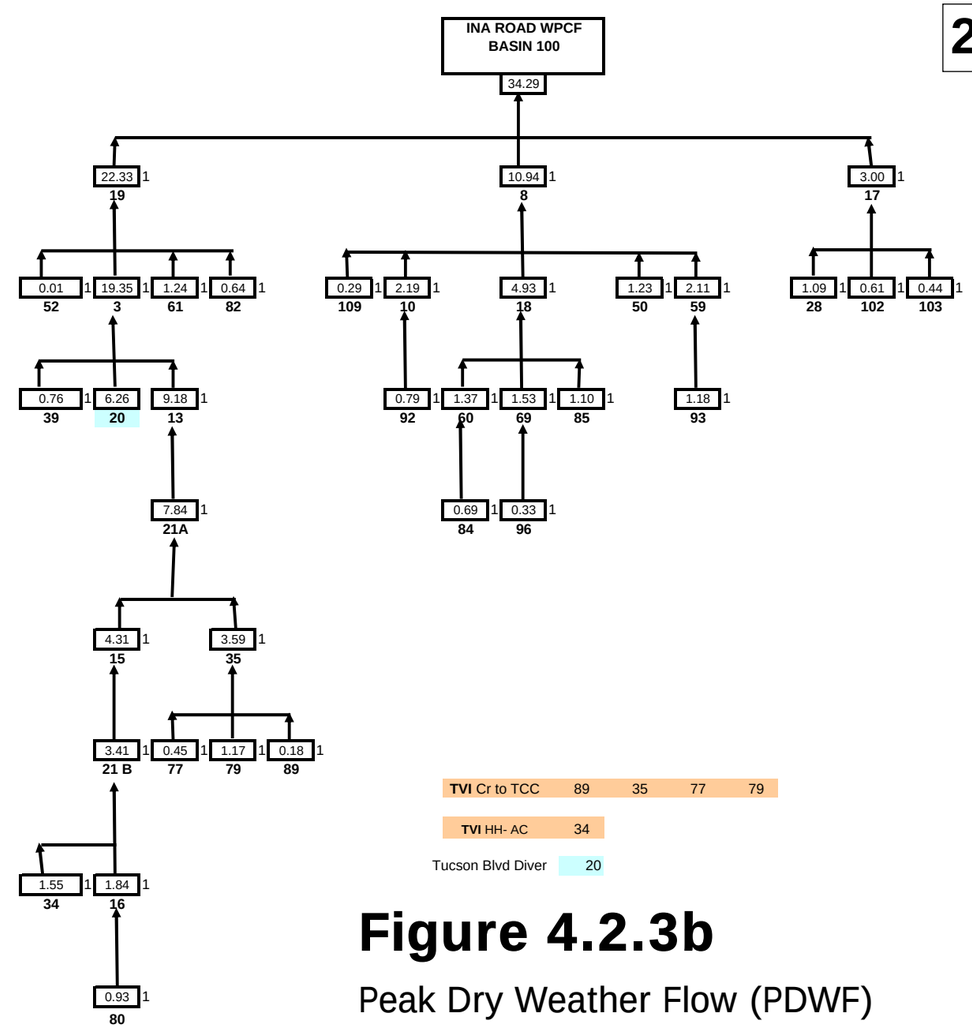
Basin No	Basin Population on sewer 2010	Interceptor Flow **ADWF**	Basin Flow **ADWF**	**Peak Factor**	**PDWF** mgd	**CAPACITY** 85% Full Pipe Capacity ENTER	EXIT	**Over Exit Capacity Indicator**	**Over Entrance Capacity Indicator**	
3	12,935	12.48	0.91	1.55	**19.35**	22.04	20.33	0.98	2.69	##
8	9,334	6.95	0.84	1.57	**10.94**	17.09	33.25	22.31	6.14	##
10	9,087	1.21	0.82	1.80	**2.19**	3.37	5.79	3.60	1.19	##
13	12,985	5.85	0.91	1.57	**9.18**	0.00	27.74	18.56	(9.18)	##
15	8,302	2.59	0.58	1.66	**4.31**	12.06	11.30	6.98	7.75	##
16	7,742	1.02	0.54	1.80	**1.84**	3.69	4.69	2.85	1.85	##
17	7,690	1.73	0.65	1.74	**3.00**	4.17	32.62	29.62	1.17	##
18	9,755	2.96	0.83	1.67	**4.93**	7.50	17.09	12.15	2.56	##
19	16,838	14.65	1.18	1.52	**22.33**	20.34	28.26	5.93	(1.99)	##
20	0	5.35	5.35	1.17	**6.26**	9.18	17.48	11.22	2.92	##
21A	3,403	4.94	0.22	1.59	**7.84**	11.30	11.30	3.45	3.45	##
21B	1,953	2.01	0.14	1.70	**3.41**	7.82	7.63	4.22	4.41	##
28	7,150	0.57	0.57	1.91	**1.09**	0.00	3.17	2.08	(1.09)	##
34	12,208	0.85	0.85	1.82	**1.55**	0.00	6.57	5.02	(1.55)	##
35	17,215	2.13	1.21	1.69	**3.59**	5.08	6.36	2.77	1.50	##
39	4,437	0.38	0.38	2.00	**0.76**	0.00	3.55	2.80	(0.76)	##
50	7,618	0.65	0.65	1.90	**1.23**	0.00	4.32	3.09	(1.23)	##
52	15	0.00	0.00	6.06	**0.01**	0.00	0.43	0.43	(0.01)	##
59	6,102	1.17	0.55	1.80	**2.11**	12.02	4.36	2.25	9.91	##
60	4,566	0.73	0.39	1.87	**1.37**	2.52	3.73	2.36	1.15	##
61	9,549	0.67	0.67	1.86	**1.24**	0.00	3.71	2.47	(1.24)	##
69	7,437	0.82	0.67	1.86	**1.53**	2.77	10.00	8.47	1.24	##
77	3,117	0.22	0.22	2.08	**0.45**	0.00	2.52	2.06	(0.45)	##
79	8,982	0.63	0.63	1.87	**1.17**	0.00	6.48	5.30	(1.17)	##
80	5,610	0.48	0.48	1.96	**0.93**	0.00	2.52	1.58	(0.93)	##
82	4,613	0.32	0.32	2.00	**0.64**	0.00	1.74	1.10	(0.64)	##
84	4,030	0.34	0.34	2.02	**0.69**	0.00	4.20	3.51	(0.69)	##
85	6,768	0.58	0.58	1.92	**1.10**	0.00	6.16	5.06	(1.10)	##
89	1,070	0.07	0.07	2.36	**0.18**	0.00	4.01	3.84	(0.18)	##
92	4,388	0.39	0.39	2.01	**0.79**	0.00	1.47	0.68	(0.79)	##
93	7,315	0.62	0.62	1.90	**1.18**	0.00	8.73	7.55	(1.18)	##
96	1,773	0.15	0.15	2.22	**0.33**	0.00	1.85	1.52	(0.33)	##
102	3,489	0.30	0.30	2.06	**0.61**	0.00	3.01	2.40	(0.61)	##
103	2,408	0.20	0.20	2.14	**0.44**	0.00	2.46	2.02	(0.44)	##
109	1,407	0.13	0.13	2.28	**0.29**	0.00	3.17	2.88	(0.29)	##
100	0	23.33		1.47	**34.29**					##

Exit flow greater than the Pipe Capacity at the Basin Exit

Interceptor	Basin	Flow mgd	From Manhole	To Manhole

Exit flow greater than the Pipe Capacity at the Basin Exit

Interceptor	Basin	Flow mgd	From Manhole	To Manhole
North Rillito Interceptor	19	22.33	1706-36	1703-06



TVI Cr to TCC	89	35	77	79
TVI HH- AC	34			
Tucson Blvd Diver	20			

2010 TAZ

INA

PDWF

Figure 4.2.3b

Peak Dry Weather Flow (PDWF)

Ina Road WPCF Tributary System

TAZ 2010

2015 Model Results

The results of the model's evaluation of the PCWMD's interceptor system for PDWF in the year 2015 are presented in Figures 4.2.3a.and 4.2.3b for Roger Road WPCF and Ina Road WPCF tributary systems respectively. The sections of the system identified by the Facility Plan Model as being deficient (Red) or requiring further evaluation (Orange) for both the Roger Road WWTP and Ina Road WPCF systems are shown on Figure 4.2.3, Interceptor Capacity Analysis 2015.

In the period 2010 to 2015 the Roger Road WWTP to Ina Road WPCF Plant Interconnect is placed in service. The Tucson Boulevard Flow Management Structure ceases to continuously direct flow to the North Rillito Interceptor.

The portions of the Interceptors in 2015 that the Facility Plan Model identifies as having deficiencies (RED) or requiring further evaluation (ORANGE) are shown in the color coded tables on Figures 4.2.4a for the Roger Road WWTP Tributary system and on Figure 4.2.4b for the Ina Road WPCF Tributary system. The results are graphically shown on a map of PCWMD's entire Interceptor system in Figure 4.2.4. The unique results for 2015 are presented in the following narrative; however, the sections of the Interceptors found deficient (RED) and requiring evaluation (ORANGE) in 2005 and 2010 will, barring corrective action, be problems in 2015. The following narrative will limit itself to newly identified reaches of Interceptor or reaches that move from requiring evaluation to deficient. Reaches of interceptor found to have problems (either deficient or requiring evaluation) in prior years are considered to not have been repaired and still pose problems in this and future years. The results are:

Deficiencies noted

Red (Flow greater than 85 percent of Pipe Capacity)

Roger Road WWTP System

1. Roger Road WWTP entrance pipe from Business Center drive to the plant (Basin 5A). (This 66-inch pipe connects the 78-inch pipe to the plant. This may not be a problem depending upon where the plant Interconnect begins from Roger Road WWTP to the Ina Road WPCF.)
2. Pantano Interceptor from Stella Road and the Pantano Wash to Quail Hollow Drive and the Pantano Wash (Basin 29). (This section of pipe carries flow from the Houghton Area Master Plan (HAMP), Rocking K Ranch, Civano and area south of Golf Links and east of Pantano Wash which are all rapidly growing areas.)
3. Pantano Interceptor from Rocking K to Stella Road and Pantano Wash (Basin 113). (This section of pipe carries flow from the HAMP, Rocking K Ranch and Civano all rapidly growing areas.)
4 Basin 51 continues as an increasing capacity problem.

Ina Road WPCF System

1. No problems.

Orange (Flow greater than basin entrance capacity. Requires further evaluation)

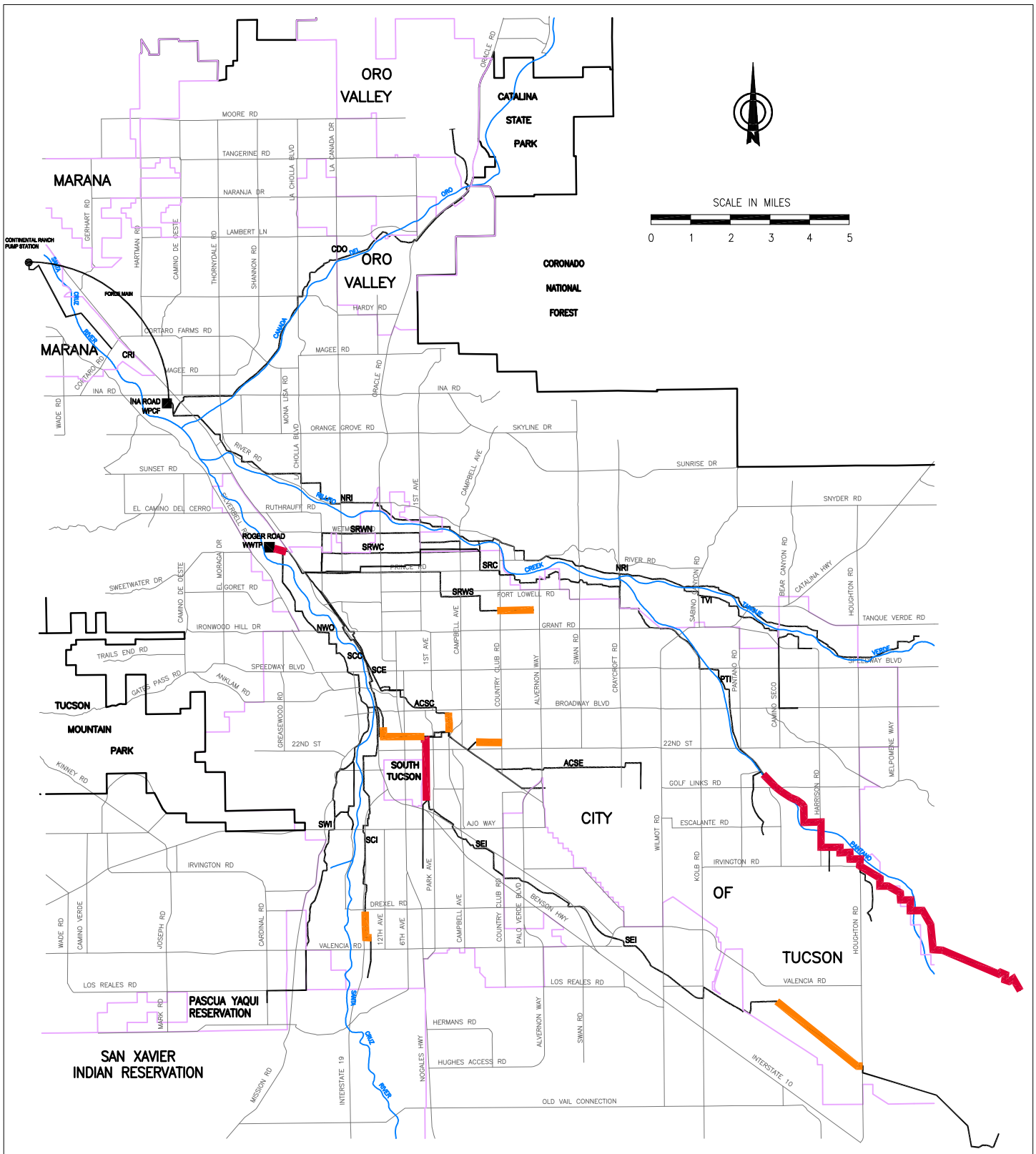
Roger Road WWTP System

1. No new problems. All basins that were problems in 2010 continue in 2015.

Ina Road WPCF System

1. (From 2005 & 2010) the North Rillito Interceptor ceases to be a capacity problem as the Tucson Boulevard Flow Management Structure ceases to direct any flow to the North Rillito Interceptor.

See the following Figures 4.2.4 to 4.2.4b.



LEGEND

- DEFICIENT (Calculated Basin Exit Flow is Greater Than 85% of Full Pipe Capacity at the Basin Exit)
- FURTHER (Calculated Basin Inlet Flow is Greater Than 85% of Full Pipe Capacity Somewhere Within the Basin)

NOTE

1.) The Roger Road WWTF to Ina Road WPCF Plant Interconnect is placed in service between 2010 and 2015.
The Tucson Blvd. Flow Management Structure is removed from service thereby reducing flow in the North Rillito Interceptor.

Pima County Wastewater Management Department
Facility Plan Update

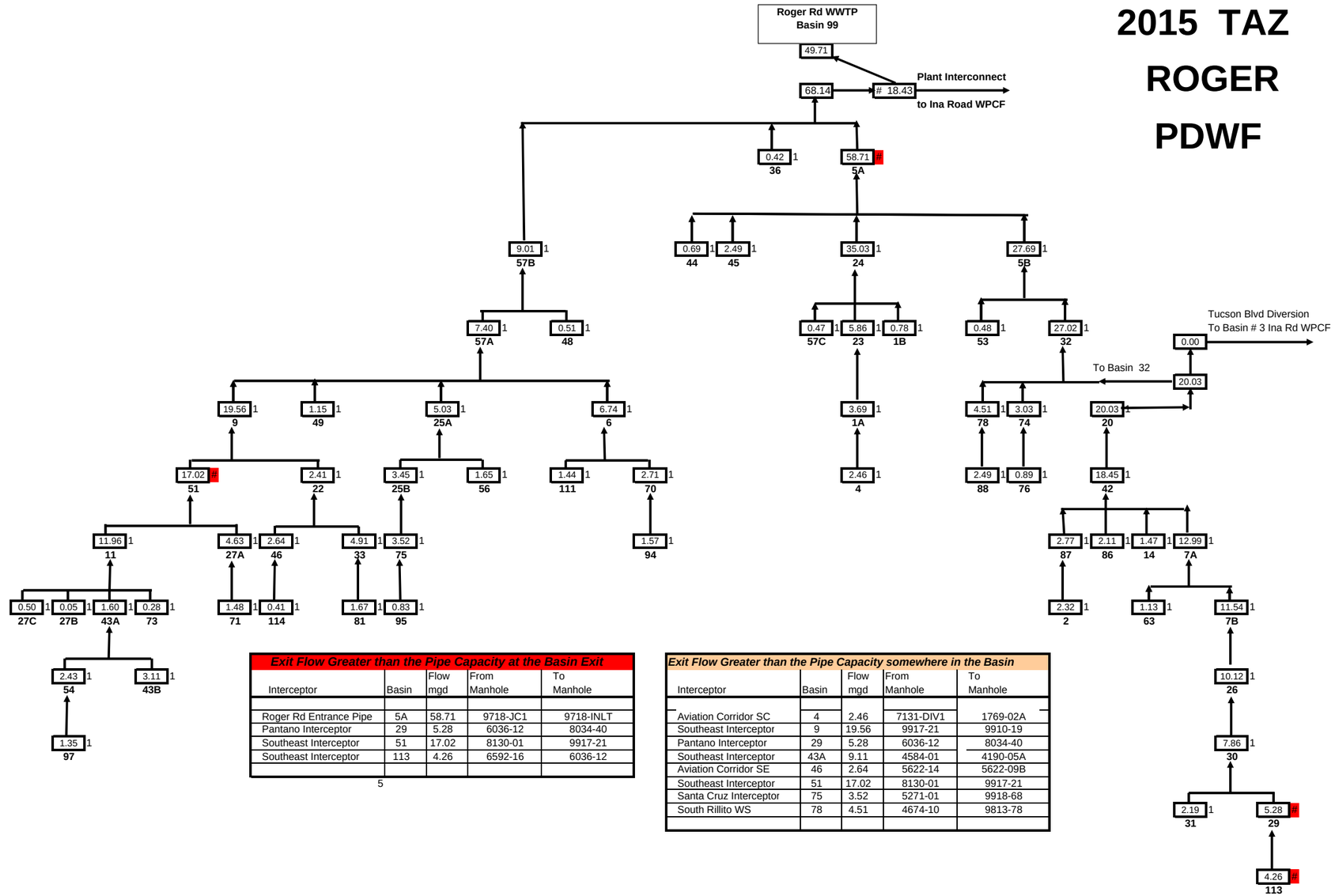
Figure 4.2.4
Capacity Analysis 2015

2015 TAZ
ROGER
PDWF

Basin No.		Basin Population on sewer 2015	Interceptor Flow **ADWF**	Basin Flow **ADWF**	**Peak Factor**	**PDWF** mgd	**CAPACITY** 85% Full Pipe Capacity ENTER	EXIT	**Over Exit Capacity Indicator**	**Over Enterance Capacity Indicator**	
1A		5,833	2.09	0.50	1.76	**3.69**	5.93	10.11	6.41	2.24	##
1B		4,606	0.39	0.39	2.00	**0.78**	1.70	9.40	8.62	0.92	##
2		15,328	1.30	1.30	1.78	**2.32**	2.98	3.66	1.33	0.65	##
4		11,514	1.35	0.98	1.83	**2.46**	2.37	6.67	4.21	(0.09)	##
5A		588	42.18	0.05	1.39	**58.71**	204.20	52.32	-6.40	145.49	##
5B		3,073	18.79	0.26	1.47	**27.69**	62.93	50.80	23.11	35.23	##
6		21,493	4.14	1.83	1.63	**6.74**	9.65	16.94	10.20	2.91	##
7A		4,790	8.37	0.41	1.55	**12.99**	15.95	22.92	9.92	2.96	##
7B		11,400	7.38	0.97	1.56	**11.54**	13.35	15.95	4.41	1.81	##
9		10,477	13.08	0.89	1.50	**19.56**	15.95	64.16	44.60	(3.60)	##
11		17,871	7.64	1.52	1.57	**11.96**	17.94	22.94	10.98	5.98	##
14		9,265	0.79	0.79	1.86	**1.47**	0.00	6.53	5.06	(1.47)	##
20		13,135	13.29	1.12	1.51	**20.03**	36.35	43.32	23.30	16.33	##
22		776	1.48	0.07	1.63	**2.41**	6.51	12.02	9.61	4.10	##
23		16,643	3.51	1.41	1.67	**5.86**	10.11	14.29	8.42	4.24	##
24		11,513	21.64	0.98	1.62	**35.03**	64.16	64.16	29.13	29.13	##
25A		1,340	3.06	0.11	1.64	**5.03**	9.97	34.16	29.13	4.94	##
25B		6,676	2.05	0.57	1.68	**3.45**	4.00	6.83	3.38	0.55	##
26		17,860	6.41	1.52	1.58	**10.12**	16.13	14.65	4.53	6.01	##
27A		4,629	2.68	0.39	1.73	**4.63**	7.68	12.37	7.74	3.06	##
27B		549	0.05	0.05	2.60	**0.12**	0.00	2.93	2.81	(0.12)	##
27C		5,929	0.50	0.50	1.94	**0.98**	0.00	3.12	2.14	(0.98)	##
29		7,805	3.18	0.66	1.66	**5.28**	3.41	4.82	-0.46	(1.87)	##
30		5,670	4.89	0.48	1.61	**7.86**	10.05	10.05	2.18	2.18	##
31		14,392	1.22	1.22	1.79	**2.19**	0.00	3.41	1.22	(2.19)	##
32		6,889	18.30	0.59	1.48	**27.02**	79.93	62.93	35.91	52.91	##
33		10,750	2.91	0.91	1.69	**4.91**	7.79	8.81	3.90	2.87	##
36		2,292	0.19	0.19	2.15	**0.42**	0.00	1.70	1.28	(0.42)	##
42		3,089	12.18	0.26	1.52	**18.45**	45.18	42.61	24.16	26.73	##
43A		18,862	5.28	1.60	1.72	**9.11**	4.59	11.85	2.74	(4.52)	##
43B		22,716	1.93	1.93	1.61	**3.11**	0.00	4.17	1.06	(3.11)	##
44		3,985	0.34	0.34	2.03	**0.69**	2.31	7.15	6.46	1.63	##
45		11,321	1.36	0.96	1.83	**2.49**	3.06	13.52	11.02	0.57	##
46		12,872	1.50	1.09	1.76	**2.64**	2.41	3.88	1.24	(0.23)	##
48		2,872	0.24	0.24	2.10	**0.51**	0.00	1.95	1.43	(0.51)	##
49		7,110	0.60	0.60	1.91	**1.15**	0.00	3.04	1.89	(1.15)	##
51		9,017	11.08	0.77	1.54	**17.02**	12.98	12.98	-4.04	(4.04)	##
53		2,662	0.23	0.23	2.12	**0.48**	0.00	1.12	0.64	(0.48)	##
54		166	1.37	0.01	1.77	**2.43**	16.01	13.70	11.27	13.58	##
56		10,560	0.90	0.90	1.84	**1.65**	0.00	2.52	0.86	(1.65)	##
57A		4,122	5.09	0.35	1.45	**7.40**	17.70	27.15	19.75	10.30	##
57B		10,357	6.22	0.88	1.45	**9.01**	27.15	24.77	15.76	18.14	##
57C		2,630	0.22	0.22	2.12	**0.47**	0.00	3.90	3.43	(0.47)	##
63		6,921	0.59	0.59	1.91	**1.13**	0.00	4.29	3.17	(1.13)	##
70		8,157	1.54	0.69	1.76	**2.71**	6.60	9.65	6.94	3.89	##
71		17,452	2.28	1.48	1.76	**4.02**	0.00	7.88	3.86	(4.02)	##
73		3,321	0.28	0.28	2.07	**0.58**	0.00	10.05	9.46	(0.58)	##
74		15,138	1.74	1.29	1.74	**3.03**	7.05	6.48	3.45	4.02	##
75		14,385	2.05	1.22	1.72	**3.52**	2.71	3.72	0.21	(0.81)	##
76		5,358	0.46	0.46	1.96	**0.89**	0.00	1.52	0.63	(0.89)	##
78		15,013	2.68	1.28	1.68	**4.51**	3.81	5.40	0.89	(0.70)	##
81		19,659	1.67	1.67	1.75	**2.92**	0.00	3.18	0.26	(2.92)	##
86		13,792	1.17	1.17	1.80	**2.11**	0.00	6.60	4.49	(2.11)	##
87		3,274	1.58	0.28	1.75	**2.77**	3.66	8.77	6.00	0.88	##
88		16,550	1.41	1.41	1.77	**2.49**	0.00	3.80	1.31	(2.49)	##
94		9,982	0.85	0.85	1.85	**1.57**	0.00	3.90	2.33	(1.57)	##
95		9,717	0.83	0.83	1.85	**1.53**	0.00	2.71	1.18	(1.53)	##
97		15,941	1.35	1.35	1.78	**2.41**	0.00	7.81	5.40	(2.41)	##
99		0	30.17	0.00	1.39	**41.98**	78.20	78.20	36.22	36.22	##
111		9,061	0.77	0.77	1.87	**1.44**	0.00	5.29	3.85	(1.44)	##
113		29,653	2.52	2.52	1.69	**4.26**	0.00	3.94	-0.32	(4.26)	##
114		4,771	0.41	0.41	1.99	**0.81**	0.00	1.09	0.28	(0.81)	##
20A				0.00	1.17	**0.00**					##

8

1 **Randolph Park WRF at 3.0 mgd.**
2 **SCIPF in Operation**
3 **The Roger to Ina Plant Interconnect is in service and no flow is diverted to Ina at Tucson Blvd.**
4 **Wastewater is Conveyed from Roger to Ina by Plant Interconnector. 18.43 MGD**



Exit Flow Greater than the Pipe Capacity at the Basin Exit				
Interceptor	Basin	Flow mgd	From Manhole	To Manhole
Roger Rd Entrance Pipe	5A	58.71	9718-JC1	9718-INLT
Pantano Interceptor	29	5.28	6036-12	8034-40
Southeast Interceptor	51	17.02	8130-01	9917-21
Southeast Interceptor	113	4.26	6592-16	6036-12

5

Exit Flow Greater than the Pipe Capacity somewhere in the Basin				
Interceptor	Basin	Flow mgd	From Manhole	To Manhole
Aviation Corridor SC	4	2.46	7131-DIV1	1769-02A
Southeast Interceptor	9	19.56	9917-21	9910-19
Pantano Interceptor	29	5.28	6036-12	8034-40
Southeast Interceptor	43A	9.11	4584-01	4190-05A
Aviation Corridor SE	46	2.64	5622-14	5622-09B
Southeast Interceptor	51	17.02	8130-01	9917-21
Santa Cruz Interceptor	75	3.52	5271-01	9918-68
South Rillito WS	78	4.51	4674-10	9813-78

Figure 4.2.4a
Peak Dry Weather Flow (PDWF)
Roger Road Tributary System
TAZ 2015

1/20/06

2015 TAZ

INA

PDWF

Basin No		Basin Population on Sewer 2015	Interceptor Flow **ADWF**	Basin Flow **ADWF**	**Peak Factor**	**PDWF** mgd	**CAPACITY** 85% Full Pipe Capacity ENTER	EXIT	**Over Exit Capacity Indicator**	**Over Entrance Capacity Indicator**	
3		13,508	7.37	0.95	1.55	**11.41**	22.04	20.33	8.92	10.63	##
8		9,952	7.48	0.90	1.57	**11.71**	17.09	33.25	21.54	5.37	##
10		9,200	1.23	0.83	1.80	**2.21**	3.37	5.79	3.58	1.17	##
13		13,486	6.02	0.94	1.57	**9.44**	0.00	27.74	18.30	(9.44)	##
15		8,481	2.68	0.59	1.66	**4.45**	12.06	11.30	6.85	7.61	##
16		7,824	1.04	0.55	1.80	**1.87**	3.69	4.69	2.82	1.81	##
17		9,177	1.96	0.78	1.72	**3.38**	4.17	32.62	29.25	0.80	##
18		10,151	3.23	0.86	1.66	**5.36**	7.50	17.09	11.72	2.13	##
19		17,661	9.63	1.24	1.52	**14.65**	20.34	28.26	13.62	5.69	##
20		0	0.00	0.00	1.17	**0.00**	9.18	17.48	17.48	9.18	##
21A		3,486	5.08	0.23	1.58	**8.05**	11.30	11.30	3.25	3.25	##
21B		1,996	2.08	0.14	1.69	**3.53**	7.82	7.63	4.10	4.29	##
28		7,608	0.61	0.61	1.90	**1.15**	0.00	3.17	2.02	(1.15)	##
34		12,914	0.90	0.90	1.81	**1.63**	0.00	6.57	4.94	(1.63)	##
35		17,570	2.17	1.23	1.68	**3.66**	5.08	6.36	2.70	1.43	##
39		4,689	0.40	0.40	1.99	**0.79**	0.00	3.55	2.76	(0.79)	##
50		8,869	0.75	0.75	1.87	**1.41**	0.00	4.32	2.91	(1.41)	##
52		15	0.00	0.00	6.06	**0.01**	0.00	0.43	0.43	(0.01)	##
59		6,162	1.23	0.55	1.79	**2.21**	12.02	4.36	2.15	9.81	##
60		4,753	0.79	0.40	1.86	**1.48**	2.52	3.73	2.25	1.04	##
61		9,986	0.70	0.70	1.85	**1.29**	0.00	3.71	2.41	(1.29)	##
69		8,609	0.93	0.77	1.84	**1.72**	2.77	10.00	8.28	1.06	##
77		3,126	0.22	0.22	2.08	**0.46**	0.00	2.52	2.06	(0.46)	##
79		9,285	0.65	0.65	1.86	**1.21**	0.00	6.48	5.27	(1.21)	##
80		5,805	0.49	0.49	1.95	**0.96**	0.00	2.52	1.55	(0.96)	##
82		4,682	0.33	0.33	1.99	**0.65**	0.00	1.74	1.09	(0.65)	##
84		4,593	0.39	0.39	2.00	**0.78**	0.00	4.20	3.42	(0.78)	##
85		7,597	0.65	0.65	1.90	**1.23**	0.00	6.16	4.94	(1.23)	##
89		1,073	0.08	0.08	2.36	**0.18**	0.00	4.01	3.83	(0.18)	##
92		4,439	0.40	0.40	2.00	**0.80**	0.00	1.47	0.67	(0.80)	##
93		7,979	0.68	0.68	1.89	**1.28**	0.00	8.73	7.45	(1.28)	##
96		1,832	0.16	0.16	2.21	**0.34**	0.00	1.85	1.51	(0.34)	##
102		3,925	0.33	0.33	2.03	**0.68**	0.00	3.01	2.33	(0.68)	##
103		2,830	0.24	0.24	2.10	**0.51**	0.00	2.46	1.95	(0.51)	##
109		1,496	0.13	0.13	2.26	**0.30**	0.00	3.17	2.87	(0.30)	##
100		0	19.07		1.46	**27.93**					##

Exit flow greater than the Pipe Capacity at the Basin Exit

Interceptor	Basin	Flow mgd	From Manhole	To Manhole

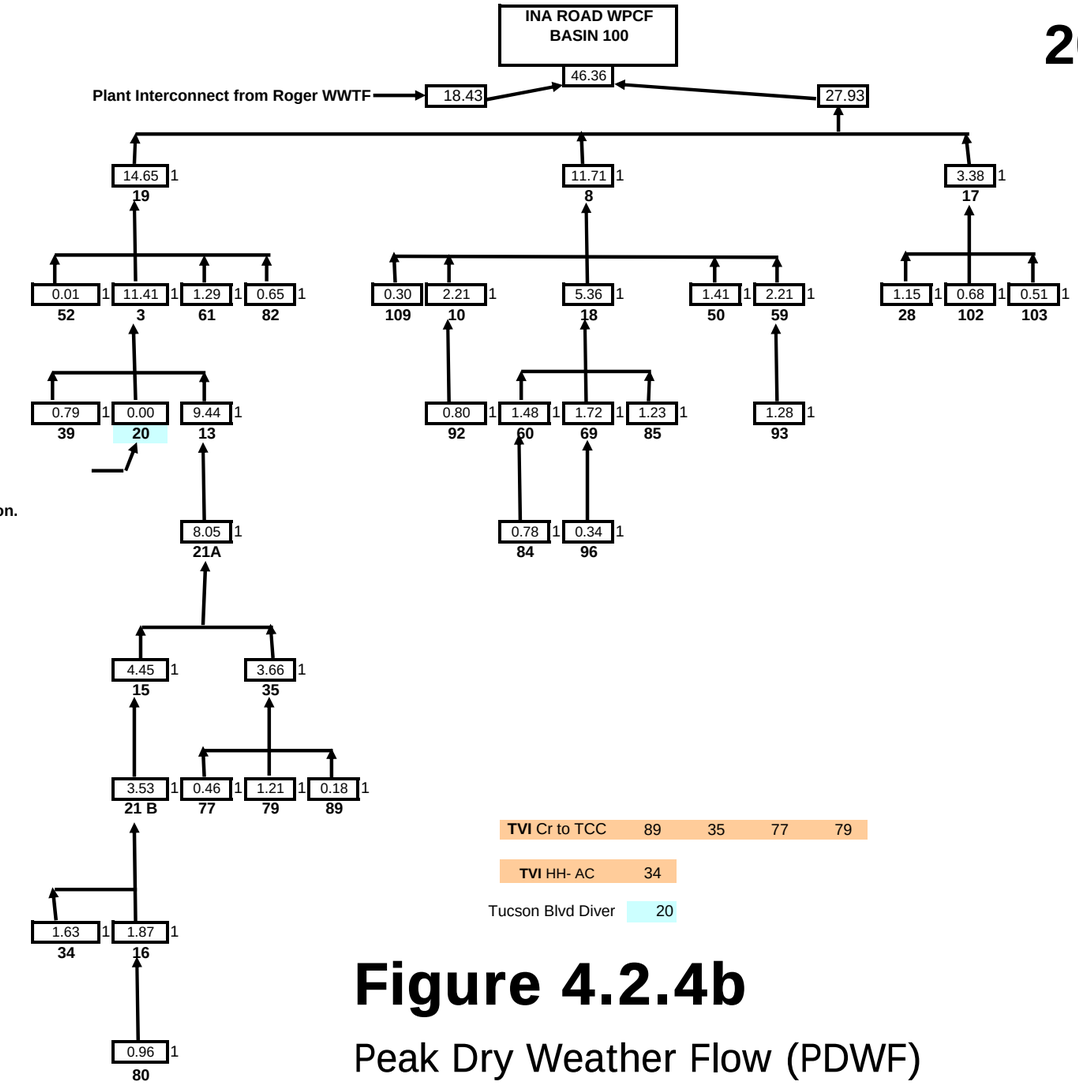
Exit flow greater than the Pipe Capacity at the Basin Exit

Interceptor	Basin	Flow mgd	From Manhole	To Manhole

1 The Roger to Ina Plant Interconnect is placed in Service between 2010 & 2015. Tucson Blvd Diversion is Zero.

2 Wastewater is Conveyed from Roger to Ina by the Plant Interconnect = 18.43 MGD

The Roger to Ina Plant Interconnect is in service and no flow is diverted to Ina through Tucson Blvd Diversion.



TVI Cr to TCC	89	35	77	79
TVI HH- AC	34			
Tucson Blvd Diver	20			

Figure 4.2.4b

Peak Dry Weather Flow (PDWF)

Ina Road WPCF Tributary System

TAZ 2015

2020 Model Results

The results of the model's evaluation of the PCWMD's interceptor system for PDWF in the year 2020 are presented in Figures 4.2.5a. and 4.2.5b for Roger Road WWTP and Ina Road WPCF tributary systems, respectively. The sections of the system identified by the Facility Plan Model as being deficient (Red) or requiring further evaluation (Orange) for both the Roger Road WWTP and Ina Road WPCF systems are shown on Figure 4.2.5, Interceptor Capacity Analysis 2020.

The Facility Plan Model does not consider any major projects impacting capacity during 2015-2020 period.

The portions of the Interceptors in 2020 that the Facility Plan Model identifies as having deficiencies (Red) or requiring further evaluation (Orange) are shown in the color coded tables on Figures 4.2.5a for the Roger Road tributary system and on Figure 4.2.5b for the Ina Road tributary system. The results are graphically shown on a map of PCWMD's entire Interceptor system in Figure 4.2.5. The unique results for 2020 are presented in the following narrative; however, the sections of the Interceptors found deficient (Red) and requiring evaluation (Orange) in 2005, 2010 & 2015 will, barring corrective action, be problems in 2020. The following narrative will limit itself to newly identified reaches of Interceptor or reaches that move from requiring evaluation to deficient. Reaches of interceptor found to have problems (either deficient or requiring evaluation) in prior years are considered to not have been repaired and still pose problems in this and future years. The results are:

Deficiencies noted

RED (Flow greater than 85 percent of Pipe Capacity)

Roger Road WWTP System

1. Southeast Interceptor from Houghton and Old Vail Road to Vail (Basin 43A). (This section serves two rapidly growing areas Vail and the Houghton Road Master Plan (HAMP).
2. All other deficient Basins were identified in 2015 or before.

Ina Road WPCF System

1. No problems.

ORANGE (Flow greater than basin entrance capacity. Requires further evaluation)

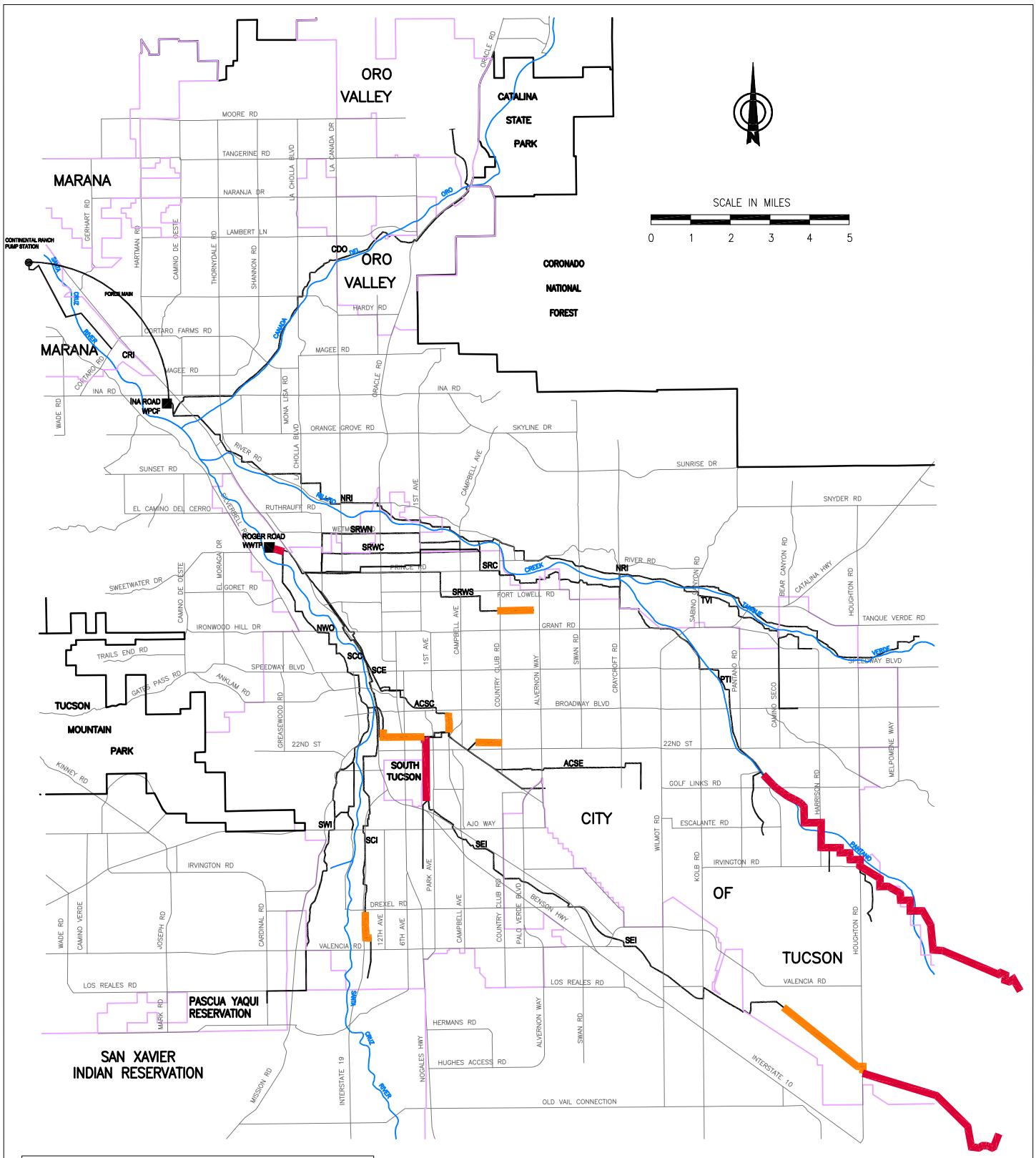
Roger Road WWTP System

1. All deficient basins were identified in 2015 or before. (No new problems.)

Ina Road WPCF System

1. No problems.

See the following Figures 4.2.5 to 4.2.5b.



LEGEND

DEFICIENT (Calculated Basin Exit Flow is Greater Than 85% of Full Pipe Capacity at the Basin Exit)

FURTHER (Calculated Basin Inlet Flow is Greater Than 85% of Full Pipe Capacity Somewhere Within the Basin)

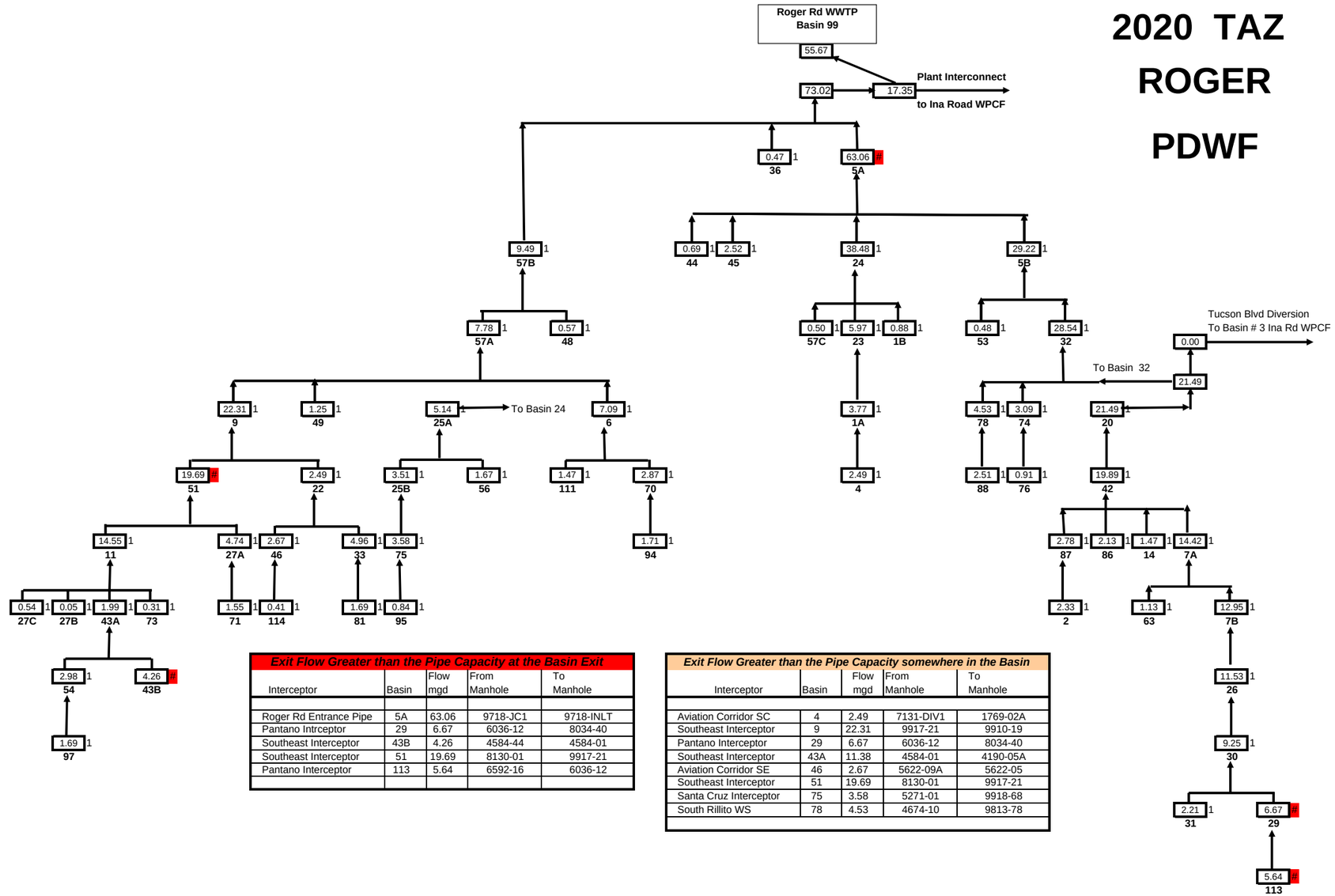
Pima County Wastewater Management Department
Facility Plan Update

Figure 4.2.5
Capacity Analysis 2020

2020 TAZ
ROGER
PDWF

Basin No.		Basin Population on sewer 2020	Interceptor Flow **ADWF**	Basin Flow **ADWF**	**Peak Factor**	**PDWF** mgd	**CAPACITY** 85% Full Pipe Capacity ENTER	EXIT	**Over Exit Capacity Indicator**	**Over Enterance Capacity Indicator**	
1A		6,216	2.14	0.53	1.76	**3.77**	5.93	10.11	6.34	2.16	##
1B		5,276	0.45	0.45	1.97	**0.88**	1.70	9.40	8.52	0.82	##
2		15,373	1.31	1.31	1.78	**2.33**	2.98	3.66	1.33	0.65	##
4		11,544	1.36	0.98	1.83	**2.49**	2.37	6.67	4.18	(0.12)	##
5A		601	45.49	0.05	1.39	**63.06**	204.20	52.32	-10.75	141.14	##
5B		3,108	19.89	0.26	1.47	**29.22**	62.93	50.80	21.59	33.71	##
6		22,856	4.37	1.94	1.62	**7.09**	9.65	16.94	9.85	2.56	##
7A		4,875	9.35	0.41	1.54	**14.42**	15.95	22.92	8.50	1.54	##
7B		11,489	8.34	0.98	1.55	**12.95**	13.35	15.95	3.00	0.40	##
9		10,890	15.04	0.93	1.48	**22.31**	15.95	64.16	41.85	(6.36)	##
11		20,488	9.41	1.74	1.55	**14.55**	17.94	22.94	8.40	3.39	##
14		9,320	0.79	0.79	1.86	**1.47**	0.00	6.53	5.05	(1.47)	##
20		13,419	14.34	1.14	1.50	**21.49**	36.35	43.32	21.83	14.86	##
22		787	1.53	0.07	1.63	**2.49**	6.51	12.02	9.53	4.02	##
23		16,887	3.58	1.44	1.67	**5.97**	10.11	14.29	8.32	4.14	##
24		11,695	23.83	0.99	1.61	**38.48**	64.16	64.16	25.68	25.68	##
25A		1,551	3.13	0.13	1.64	**5.14**	9.97	34.16	29.02	4.83	##
25B		6,853	2.09	0.58	1.68	**3.51**	4.00	6.83	3.31	0.49	##
26		18,197	7.37	1.55	1.56	**11.53**	16.13	14.65	3.12	4.61	##
27A		4,705	2.75	0.40	1.72	**4.74**	7.68	12.37	7.63	2.94	##
27B		560	0.05	0.05	2.59	**0.12**	0.00	2.93	2.81	(0.12)	##
27C		6,309	0.54	0.54	1.93	**1.04**	0.00	3.12	2.08	(1.04)	##
29		7,983	4.10	0.68	1.63	**6.67**	3.41	4.82	-1.85	(3.26)	##
30		5,736	5.82	0.49	1.59	**9.25**	10.05	10.05	0.80	0.80	##
31		14,546	1.24	1.24	1.79	**2.21**	0.00	3.41	1.20	(2.21)	##
32		6,978	19.40	0.59	1.47	**28.54**	79.93	62.93	34.39	51.39	##
33		10,893	2.95	0.93	1.68	**4.96**	7.79	8.81	3.85	2.82	##
36		2,633	0.22	0.22	2.12	**0.47**	0.00	1.70	1.23	(0.47)	##
42		3,335	13.19	0.28	1.51	**19.89**	45.18	42.61	22.72	25.29	##
43A		23,366	6.77	1.99	1.68	**11.38**	4.59	11.85	0.47	(6.79)	##
43B		31,701	2.69	2.69	1.58	**4.26**	0.00	4.17	-0.09	(4.26)	##
44		4,003	0.34	0.34	2.03	**0.69**	2.31	7.15	6.46	1.62	##
45		11,488	1.38	0.98	1.83	**2.52**	3.06	13.52	11.00	0.54	##
46		13,086	1.52	1.11	1.76	**2.67**	2.41	3.88	1.21	(0.26)	##
48		3,226	0.27	0.27	2.07	**0.57**	0.00	1.95	1.38	(0.57)	##
49		7,743	0.66	0.66	1.89	**1.25**	0.00	3.04	1.80	(1.25)	##
51		9,451	12.97	0.80	1.52	**19.69**	12.98	12.98	-6.71	(6.71)	##
53		2,673	0.23	0.23	2.12	**0.48**	0.00	1.12	0.64	(0.48)	##
54		183	1.71	0.02	1.74	**2.98**	16.01	13.70	10.72	13.03	##
56		10,714	0.91	0.91	1.84	**1.67**	0.00	2.52	0.84	(1.67)	##
57A		4,179	5.39	0.36	1.44	**7.78**	17.70	27.15	19.37	9.92	##
57B		10,860	6.58	0.92	1.44	**9.49**	27.15	24.77	15.28	17.66	##
57C		2,775	0.24	0.24	2.11	**0.50**	0.00	3.90	3.40	(0.50)	##
63		6,961	0.59	0.59	1.91	**1.13**	0.00	4.29	3.16	(1.13)	##
70		8,350	1.64	0.71	1.75	**2.87**	6.60	9.65	6.78	3.73	##
71		18,251	2.35	1.55	1.76	**4.13**	0.00	7.88	3.75	(4.13)	##
73		3,700	0.31	0.31	2.04	**0.64**	0.00	10.05	9.40	(0.64)	##
74		15,493	1.78	1.32	1.74	**3.09**	7.05	6.48	3.39	3.96	##
75		14,661	2.09	1.25	1.71	**3.58**	2.71	3.72	0.14	(0.87)	##
76		5,432	0.46	0.46	1.96	**0.91**	0.00	1.52	0.62	(0.91)	##
78		15,046	2.70	1.28	1.68	**4.53**	3.81	5.40	0.87	(0.72)	##
81		19,890	1.69	1.69	1.74	**2.95**	0.00	3.18	0.23	(2.95)	##
86		13,920	1.18	1.18	1.80	**2.13**	0.00	6.60	4.47	(2.13)	##
87		3,297	1.59	0.28	1.75	**2.78**	3.66	8.77	5.99	0.87	##
88		16,665	1.42	1.42	1.77	**2.51**	0.00	3.80	1.29	(2.51)	##
94		10,935	0.93	0.93	1.84	**1.71**	0.00	3.90	2.20	(1.71)	##
95		9,928	0.84	0.84	1.85	**1.56**	0.00	2.71	1.15	(1.56)	##
97		19,939	1.69	1.69	1.74	**2.95**	0.00	7.81	4.85	(2.95)	##
99		0	34.95	0.00	1.39	**48.44**	78.20	78.20	29.76	29.76	##
111		9,302	0.79	0.79	1.86	**1.47**	0.00	5.29	3.82	(1.47)	##
113		40,203	3.42	3.42	1.65	**5.64**	0.00	3.94	-1.70	(5.64)	##
114		4,773	0.41	0.41	1.99	**0.81**	0.00	1.09	0.28	(0.81)	##
20A				0.00	1.17	**0.00**					##

8



Exit Flow Greater than the Pipe Capacity at the Basin Exit

Interceptor	Basin	Flow mgd	From Manhole	To Manhole
Roger Rd Entrance Pipe	5A	63.06	9718-JC1	9718-INLT
Pantano Intrceptor	29	6.67	6036-12	8034-40
Southeast Interceptor	43B	4.26	4584-44	4584-01
Southeast Interceptor	51	19.69	8130-01	9917-21
Pantano Interceptor	113	5.64	6592-16	6036-12

Exit Flow Greater than the Pipe Capacity somewhere in the Basin

Interceptor	Basin	Flow mgd	From Manhole	To Manhole
Aviation Corridor SC	4	2.49	7131-DIV1	1769-02A
Southeast Interceptor	9	22.31	9917-21	9910-19
Pantano Interceptor	29	6.67	6036-12	8034-40
Southeast Interceptor	43A	11.38	4584-01	4190-05A
Aviation Corridor SE	46	2.67	5622-09A	5622-05
Southeast Interceptor	51	19.69	8130-01	9917-21
Santa Cruz Interceptor	75	3.58	5271-01	9918-68
South Rillito WS	78	4.53	4674-10	9813-78

1 Randolph Park WRF at 3.0 mgd.
2 SCIPF in Operation
3 The Roger to Ina Plant Interconnect is in service and no flow is diverted to Ina at Tucson Blvd.
4 Wastewater is Conveyed from Roger to Ina by Plant Interconnector. 17.35 MGD

Figure 4.2.5a
Peak Dry Weather Flow (PDWF)
Roger Road Tributary System
TAZ 2020

2020 TAZ

INA

PDWF

Basin No		Basin Popualtion on Sewer 2020	Interceptor Flow **ADWF**	Basin Flow **ADWF**	**Peak Factor**	**PDWF** mgd	**CAPACITY** 85% Full Pipe Capacity ENTER	EXIT	**Over Exit Capacity Indicator**	**Over Entrance Capacity Indicator**	
3		14,074	7.60	0.99	1.55	**11.75**	22.04	20.33	8.59	10.30	##
8		10,563	8.00	0.95	1.56	**12.47**	17.09	33.25	20.78	4.61	##
10		9,309	1.24	0.84	1.80	**2.23**	3.37	5.79	3.55	1.14	##
13		13,982	6.20	0.98	1.56	**9.69**	0.00	27.74	18.05	(9.69)	##
15		8,656	2.76	0.61	1.66	**4.58**	12.06	11.30	6.72	7.48	##
16		7,906	1.06	0.55	1.80	**1.91**	3.69	4.69	2.78	1.78	##
17		10,660	2.20	0.91	1.70	**3.75**	4.17	32.62	28.88	0.43	##
18		10,544	3.51	0.90	1.65	**5.79**	7.50	17.09	11.30	1.71	##
19		18,474	9.96	1.29	1.52	**15.11**	20.34	28.26	13.16	5.23	##
20		0	0.00	0.00	1.17	**0.00**	9.18	17.48	17.48	9.18	##
21A		3,568	5.22	0.23	1.58	**8.25**	11.30	11.30	3.04	3.04	##
21B		2,038	2.16	0.14	1.69	**3.65**	7.82	7.63	3.99	4.17	##
28		8,064	0.65	0.65	1.89	**1.22**	0.00	3.17	1.95	(1.22)	##
34		13,612	0.95	0.95	1.80	**1.72**	0.00	6.57	4.86	(1.72)	##
35		17,920	2.22	1.25	1.68	**3.73**	5.08	6.36	2.63	1.35	##
39		4,937	0.42	0.42	1.98	**0.83**	0.00	3.55	2.72	(0.83)	##
50		10,115	0.86	0.86	1.85	**1.59**	0.00	4.32	2.73	(1.59)	##
52		15	0.00	0.00	6.06	**0.01**	0.00	0.43	0.43	(0.01)	##
59		6,221	1.29	0.56	1.79	**2.31**	12.02	4.36	2.05	9.71	##
60		4,938	0.86	0.42	1.85	**1.59**	2.52	3.73	2.15	0.93	##
61		10,421	0.73	0.73	1.84	**1.34**	0.00	3.71	2.36	(1.34)	##
69		9,779	1.04	0.88	1.82	**1.90**	2.77	10.00	8.10	0.87	##
77		3,134	0.22	0.22	2.08	**0.46**	0.00	2.52	2.06	(0.46)	##
79		9,581	0.67	0.67	1.86	**1.24**	0.00	6.48	5.23	(1.24)	##
80		5,998	0.51	0.51	1.94	**0.99**	0.00	2.52	1.53	(0.99)	##
82		4,749	0.33	0.33	1.99	**0.66**	0.00	1.74	1.08	(0.66)	##
84		5,155	0.44	0.44	1.97	**0.86**	0.00	4.20	3.33	(0.86)	##
85		8,422	0.72	0.72	1.88	**1.34**	0.00	6.16	4.82	(1.34)	##
89		1,075	0.08	0.08	2.36	**0.18**	0.00	4.01	3.83	(0.18)	##
92		4,488	0.40	0.40	2.00	**0.81**	0.00	1.47	0.66	(0.81)	##
93		8,638	0.73	0.73	1.87	**1.38**	0.00	8.73	7.35	(1.38)	##
96		1,892	0.16	0.16	2.20	**0.35**	0.00	1.85	1.50	(0.35)	##
102		4,358	0.37	0.37	2.01	**0.74**	0.00	3.01	2.27	(0.74)	##
103		3,252	0.28	0.28	2.07	**0.57**	0.00	2.46	1.88	(0.57)	##
109		1,583	0.14	0.14	2.25	**0.32**	0.00	3.17	2.85	(0.32)	##
100		0	20.15		1.46	**29.42**					##

Exit flow greater than the Pipe Capacity at the Basin Exit

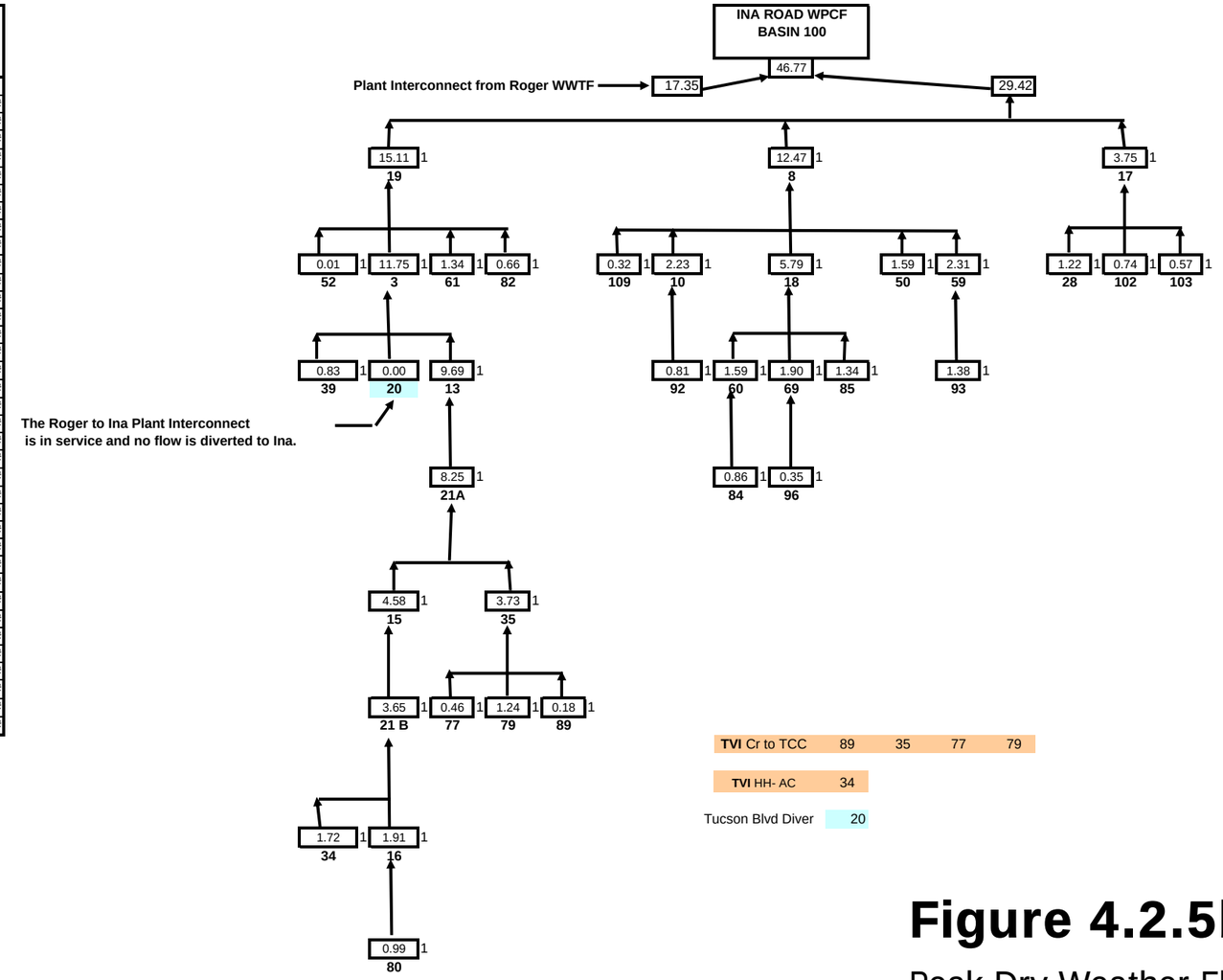
Interceptor	Basin	Flow mgd	From Manhole	To Manhole

Exit flow greater than the Pipe Capacity at the Basin Exit

Interceptor	Basin	Flow mgd	From Manhole	To Manhole

1 The Roger to Ina Plant Interconnect is placed in Service between 2010 & 2015. Tucson Blvd Diversion is Zero.

2 Wastewater is Conveyed from Roger to Ina by the Plant Interconnect = 17.35 MGD



TVI Cr to TCC	89	35	77	79

TVI HH- AC	34

Tucson Blvd Diver	20

Figure 4.2.5b

Peak Dry Weather Flow (PDWF)

Ina Road WPCF Tributary System

TAZ 2020

2025 Model Results

The results of the model's evaluation of the PCWMD's interceptor system for PDWF in the year 2025 are presented in Figures 4.2.6a. and 4.2.6b for Roger Road WWTP and Ina Road WPCF tributary systems respectively. The sections of the system identified by the Facility Plan Model as being deficient (Red) or requiring further evaluation (Orange) for both the Roger Road WWTP and Ina Road WPCF systems are shown on Figure 4.2.6, Interceptor Capacity Analysis 2025.

The portions of the Interceptors in 2025 that the Facility Plan Model identifies as having deficiencies (Red) or requiring further evaluation (Orange) are shown in the color coded tables on Figures 4.2.6a for the Roger Road WWTP Tributary system and on Figure 4.2.6b for the Ina Road WPCF Tributary system. The results are graphically shown on a map of PCWMD's entire Interceptor system in Figure 4.2.6. The unique results for 2025 are presented in the following narrative; however, the sections of the Interceptors found deficient (Red) and requiring evaluation (Orange) in 2005, 2010, 2015 and 2020 will, barring corrective action, be problems in 2025. The following narrative will limit itself to newly identified reaches of Interceptor or reaches that move from requiring evaluation to deficient. Reaches of interceptor found to have problems (either deficient or requiring evaluation) in prior years are considered to not have been repaired and still pose problems in this and future years. The results are:

Deficiencies noted

RED (Flow greater than 85 percent of Pipe Capacity)

Roger Road WWTP System

1. PTI from Pantano Wash and Quail Hollow Drive to Pantano Wash and 22nd Street (Basin 30). (This section of pipe carries flow from the HAMP, Rocking K Ranch, Civano and area south and east of 22nd Street and Pantano Wash all rapidly growing areas.)
2. All other deficient basins were identified in 2020 or before.

Ina Road WPCF System

1. No problems.

ORANGE (Flow greater than basin entrance capacity. Requires further evaluation) 7B 30

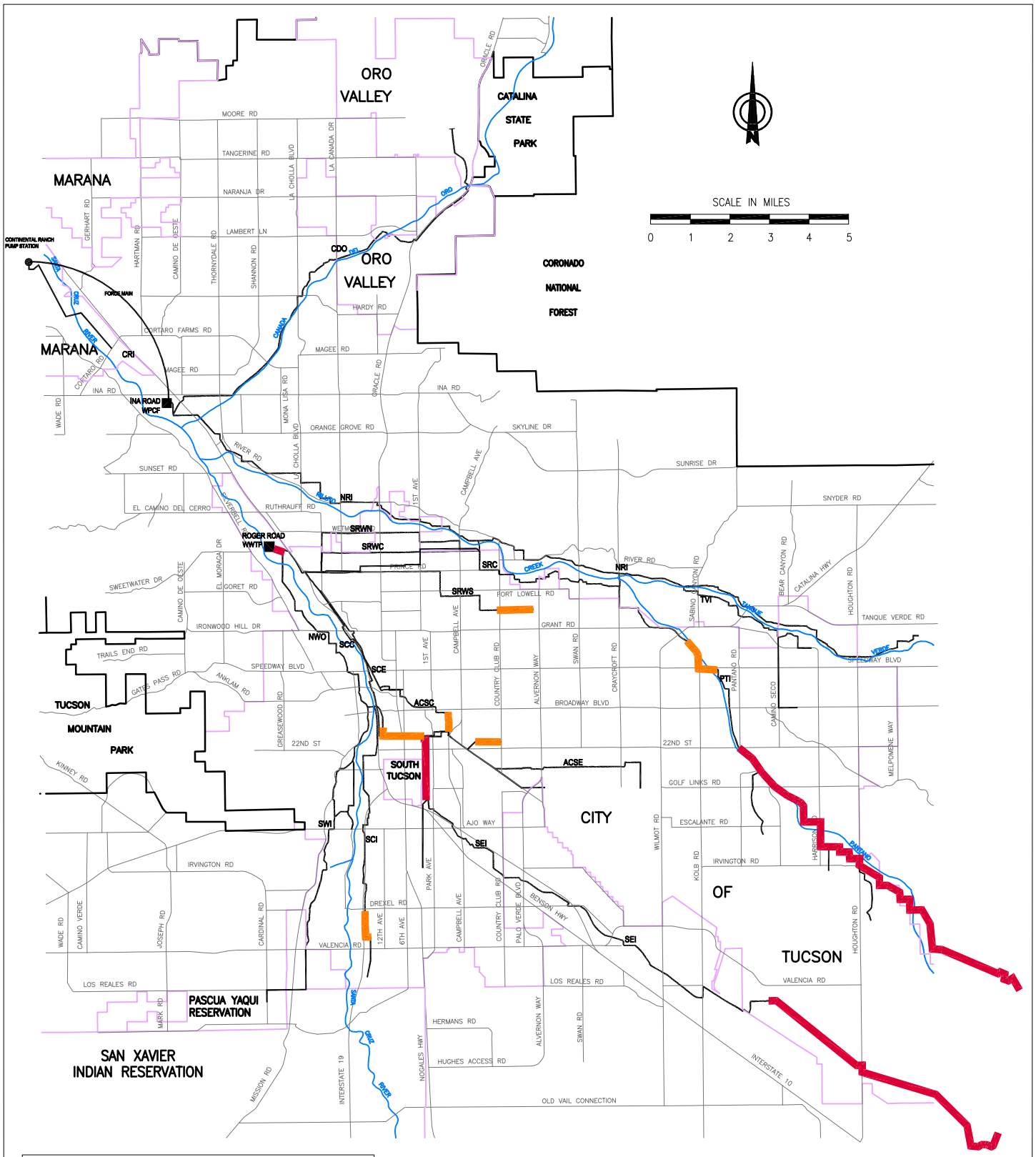
Roger Road WWTP System

1. PTI from Pantano Wash and Quail Hollow Drive to Pantano Wash and 22nd Street (Basin 30). (This section of pipe carries flow from the HAMP, Rocking K Ranch, Civano and area south and east of 22nd Street and Pantano Wash all rapidly growing areas.)
2. PTI from Speedway and Pantano Wash to Kolb Road and Via Dorado (Basin 7B). (This section of the Interceptor is downstream from Basin 30 and carries all the flow from Basin 30 plus the area east of ½ mile west of Kolb road and Speedway.)
3. All other deficient Basins were identified in 2020 or before.

Ina Road WPCF System

1. No problems.

See the following Figures 4.2.6 to 4.2.6b.



LEGEND

DEFICIENT (Calculated Basin Exit Flow is Greater Than 85% of Full Pipe Capacity at the Basin Exit)

FURTHER (Calculated Basin Inlet Flow is Greater Than 85% of Full Pipe Capacity Somewhere Within the Basin)

Pima County Wastewater Management Department
Facility Plan Update

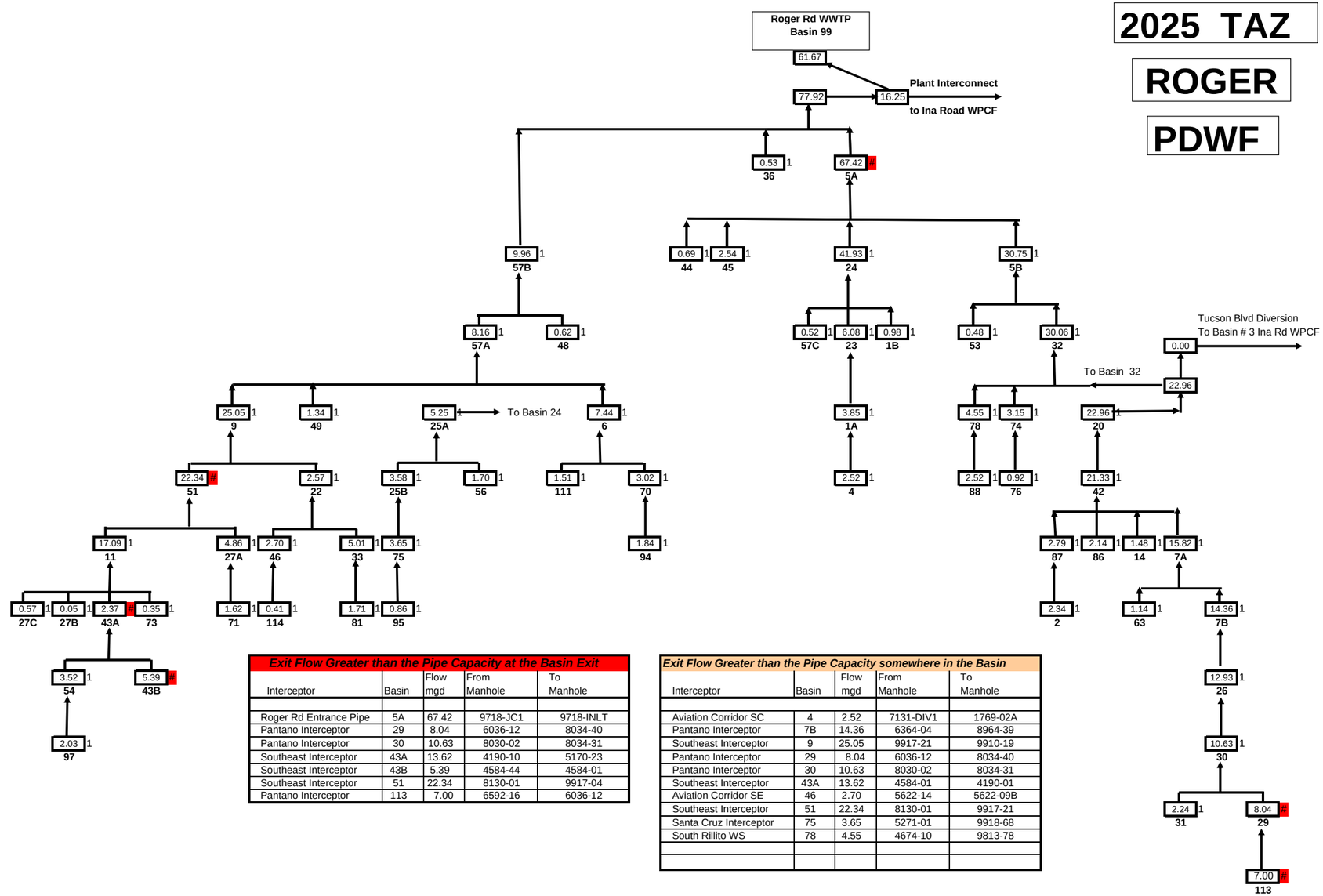
Figure 4.2.6
Capacity Analysis 2025

2025 TAZ

ROGER

PDWF

Basin No.		Basin Population on sewer 2025	Interceptor Flow **ADWF**	Basin Flow **ADWF**	**Peak Factor**	**PDWF** mgd	**CAPACITY** 85% Full Pipe Capacity ENTER	EXIT	**Over Exit Capacity Indicator**	**Over Enterance Capacity Indicator**	
1A		6,601	2.19	0.56	1.76	**3.85**	5.93	10.11	6.26	2.08	##
1B		5,952	0.51	0.51	1.94	**0.98**	1.70	9.40	8.42	0.72	##
2		15,425	1.31	1.31	1.78	**2.34**	2.98	3.66	1.32	0.64	##
4		11,582	1.38	0.98	1.83	**2.52**	2.37	6.67	4.15	(0.15)	##
5A		615	48.81	0.05	1.38	**67.42**	204.20	52.32	-15.10	136.78	##
5B		3,143	21.01	0.27	1.46	**30.75**	62.93	50.80	20.06	32.18	##
6		24,228	4.61	2.06	1.62	**7.44**	9.65	16.94	9.50	2.20	##
7A		4,963	10.33	0.42	1.53	**15.82**	15.95	22.92	7.09	0.13	##
7B		11,580	9.31	0.98	1.54	**14.36**	13.35	15.95	1.59	(1.01)	##
9		11,309	17.00	0.96	1.47	**25.05**	15.95	64.16	39.11	(9.10)	##
11		23,114	11.19	1.96	1.53	**17.09**	17.94	22.94	5.86	0.85	##
14		9,377	0.80	0.80	1.86	**1.48**	0.00	6.53	5.05	(1.48)	##
20		13,710	15.38	1.17	1.49	**22.96**	36.35	43.32	20.36	13.39	##
22		798	1.58	0.07	1.62	**2.57**	6.51	12.02	9.45	3.94	##
23		17,135	3.65	1.46	1.67	**6.08**	10.11	14.29	8.21	4.03	##
24		11,880	26.02	1.01	1.61	**41.93**	64.16	64.16	22.23	22.23	##
25A		1,764	3.21	0.15	1.64	**5.25**	9.97	34.16	28.91	4.72	##
25B		7,034	2.13	0.60	1.68	**3.58**	4.00	6.83	3.25	0.42	##
26		18,540	8.33	1.58	1.55	**12.93**	16.13	14.65	1.72	3.20	##
27A		4,783	2.83	0.41	1.72	**4.86**	7.68	12.37	7.51	2.83	##
27B		571	0.05	0.05	2.58	**0.13**	0.00	2.93	2.81	(0.13)	##
27C		6,690	0.57	0.57	1.92	**1.09**	0.00	3.12	2.03	(1.09)	##
29		8,163	5.01	0.69	1.61	**8.04**	3.41	4.82	-3.22	(4.64)	##
30		5,805	6.75	0.49	1.57	**10.63**	10.05	10.05	-0.58	(0.58)	##
31		14,709	1.25	1.25	1.79	**2.24**	0.00	3.41	1.17	(2.24)	##
32		7,071	20.51	0.60	1.47	**30.06**	79.93	62.93	32.86	49.86	##
33		11,040	2.98	0.94	1.68	**5.01**	7.79	8.81	3.80	2.77	##
36		2,977	0.25	0.25	2.09	**0.53**	0.00	1.70	1.17	(0.53)	##
42		3,583	14.22	0.30	1.50	**21.33**	45.18	42.61	21.28	23.85	##
43A		27,870	8.26	2.37	1.65	**13.62**	4.59	11.85	-1.77	(9.03)	##
43B		40,689	3.46	3.46	1.56	**5.39**	0.00	4.17	-1.22	(5.39)	##
44		4,023	0.34	0.34	2.02	**0.69**	2.31	7.15	6.46	1.62	##
45		11,661	1.39	0.99	1.82	**2.54**	3.06	13.52	10.98	0.52	##
46		13,306	1.54	1.13	1.76	**2.70**	2.41	3.88	1.18	(0.29)	##
48		3,583	0.30	0.30	2.05	**0.62**	0.00	1.95	1.32	(0.62)	##
49		8,379	0.71	0.71	1.88	**1.34**	0.00	3.04	1.70	(1.34)	##
51		9,889	14.85	0.84	1.50	**22.34**	12.98	12.98	-9.36	(9.36)	##
53		2,686	0.23	0.23	2.12	**0.48**	0.00	1.12	0.64	(0.48)	##
54		199	2.05	0.02	1.72	**3.52**	16.01	13.70	10.18	12.49	##
56		10,870	0.92	0.92	1.84	**1.70**	0.00	2.52	0.82	(1.70)	##
57A		4,239	5.68	0.36	1.44	**8.16**	17.70	27.15	18.98	9.53	##
57B		11,367	6.95	0.97	1.43	**9.96**	27.15	24.77	14.80	17.18	##
57C		2,922	0.25	0.25	2.10	**0.52**	0.00	3.90	3.38	(0.52)	##
63		7,003	0.60	0.60	1.91	**1.14**	0.00	4.29	3.15	(1.14)	##
70		8,546	1.74	0.73	1.74	**3.02**	6.60	9.65	6.63	3.57	##
71		19,056	2.42	1.62	1.75	**4.23**	0.00	7.88	3.65	(4.23)	##
73		4,081	0.35	0.35	2.02	**0.70**	0.00	10.05	9.35	(0.70)	##
74		15,853	1.82	1.35	1.73	**3.15**	7.05	6.48	3.33	3.90	##
75		14,942	2.13	1.27	1.71	**3.65**	2.71	3.72	0.07	(0.94)	##
76		5,508	0.47	0.47	1.96	**0.92**	0.00	1.52	0.60	(0.92)	##
78		15,085	2.71	1.28	1.68	**4.55**	3.81	5.40	0.85	(0.74)	##
81		20,127	1.71	1.71	1.74	**2.98**	0.00	3.18	0.20	(2.98)	##
86		14,056	1.19	1.19	1.80	**2.14**	0.00	6.60	4.45	(2.14)	##
87		3,323	1.59	0.28	1.75	**2.79**	3.66	8.77	5.98	0.86	##
88		16,787	1.43	1.43	1.77	**2.52**	0.00	3.80	1.28	(2.52)	##
94		11,893	1.01	1.01	1.82	**1.84**	0.00	3.90	2.06	(1.84)	##
95		10,144	0.86	0.86	1.85	**1.59**	0.00	2.71	1.12	(1.59)	##
97		23,939	2.03	2.03	1.72	**3.49**	0.00	7.81	4.31	(3.49)	##
99		0	39.77	0.00	1.38	**54.91**	78.20	78.20	23.29	23.29	##
111		9,546	0.81	0.81	1.86	**1.51**	0.00	5.29	3.78	(1.51)	##
113		50,765	4.31	4.31	1.62	**7.00**	0.00	3.94	-3.07	(7.00)	##
114		4,776	0.41	0.41	1.99	**0.81**	0.00	1.09	0.28	(0.81)	##
20A				0.00	1.17	**0.00**					##



Exit Flow Greater than the Pipe Capacity at the Basin Exit

Interceptor	Basin	Flow mgd	From Manhole	To Manhole
Roger Rd Entrance Pipe	5A	67.42	9718-JC1	9718-INLT
Pantano Interceptor	29	8.04	6036-12	8034-40
Pantano Interceptor	30	10.63	8030-02	8034-31
Southeast Interceptor	43A	13.62	4190-10	5170-23
Southeast Interceptor	43B	5.39	4584-44	4584-01
Southeast Interceptor	51	22.34	8130-01	9917-04
Pantano Interceptor	113	7.00	6592-16	6036-12

Exit Flow Greater than the Pipe Capacity somewhere in the Basin

Interceptor	Basin	Flow mgd	From Manhole	To Manhole
Aviation Corridor SC	4	2.52	7131-DIV1	1769-02A
Pantano Interceptor	7B	14.36	6364-04	8964-39
Southeast Interceptor	9	25.05	9917-21	9910-19
Pantano Interceptor	29	8.04	6036-12	8034-40
Pantano Interceptor	30	10.63	8030-02	8034-31
Southeast Interceptor	43A	13.62	4584-01	4190-01
Aviation Corridor SE	46	2.70	5622-14	5622-09B
Southeast Interceptor	51	22.34	8130-01	9917-21
Santa Cruz Interceptor	75	3.65	5271-01	9918-68
South Rillito WS	78	4.55	4674-10	9813-78

1 **Randolph Park WRF at 3.0 mgd.**
2 **SCIPF in Operation**
3 **The Roger to Ina Plant Interconnect is in service and no flow is diverted to Ina at Tucson Blvd.**
4 **Wastewater is Conveyed from Roger to Ina by Plant Interconnector. 16.25 MGD**

Figure 4.2.6a

Peak Dry Weather Flow (PDWF)

Roger Road Tributary System

TAZ 2025

1/20/06

2025 TAZ

INA

PDWF

Basin No	Basin Population 0n Sewer 2025	Interceptor Flow **ADWF**	Basin Flow **ADWF**	**Peak Factor**	**PDWF** mgd	**CAPACITY** 85% Full Pipe Capacity ENTER	EXIT	**Over Exit Capacity Indicator**	**Over Entrance Capacity Indicator**	
3	14,648	7.84	1.03	1.54	**12.09**	22.04	20.33	8.24	9.95	##
8	11,183	8.53	1.01	1.55	**13.24**	17.09	33.25	20.01	3.85	##
10	9,422	1.26	0.85	1.80	**2.26**	3.37	5.79	3.53	1.12	##
13	14,484	6.37	1.01	1.56	**9.95**	0.00	27.74	17.79	(9.95)	##
15	8,834	2.85	0.62	1.65	**4.71**	12.06	11.30	6.58	7.35	##
16	7,991	1.09	0.56	1.79	**1.95**	3.69	4.69	2.74	1.74	##
17	12,147	2.43	1.03	1.69	**4.12**	4.17	32.62	28.51	0.06	##
18	10,941	3.79	0.93	1.64	**6.21**	7.50	17.09	10.87	1.28	##
19	19,298	10.29	1.35	1.51	**15.58**	20.34	28.26	12.69	4.76	##
20	0	0.00	0.00	1.17	**0.00**	9.18	17.48	17.48	9.18	##
21A	3,651	5.36	0.24	1.58	**8.46**	11.30	11.30	2.84	2.84	##
21B	2,082	2.23	0.15	1.68	**3.76**	7.82	7.63	3.87	4.06	##
28	8,523	0.68	0.68	1.88	**1.28**	0.00	3.17	1.89	(1.28)	##
34	14,323	1.00	1.00	1.79	**1.80**	0.00	6.57	4.77	(1.80)	##
35	18,277	2.27	1.28	1.68	**3.80**	5.08	6.36	2.56	1.28	##
39	5,189	0.44	0.44	1.97	**0.87**	0.00	3.55	2.68	(0.87)	##
50	11,366	0.97	0.97	1.83	**1.77**	0.00	4.32	2.55	(1.77)	##
52	15	0.00	0.00	6.06	**0.01**	0.00	0.43	0.43	(0.01)	##
59	6,282	1.36	0.57	1.78	**2.41**	12.02	4.36	1.95	9.61	##
60	5,126	0.92	0.44	1.84	**1.69**	2.52	3.73	2.04	0.82	##
61	10,858	0.76	0.76	1.84	**1.40**	0.00	3.71	2.31	(1.40)	##
69	10,952	1.15	0.99	1.81	**2.08**	2.77	10.00	7.91	0.69	##
77	3,145	0.22	0.22	2.08	**0.46**	0.00	2.52	2.06	(0.46)	##
79	9,886	0.69	0.69	1.85	**1.28**	0.00	6.48	5.20	(1.28)	##
80	6,195	0.53	0.53	1.94	**1.02**	0.00	2.52	1.50	(1.02)	##
82	4,818	0.34	0.34	1.99	**0.67**	0.00	1.74	1.07	(0.67)	##
84	5,719	0.49	0.49	1.95	**0.95**	0.00	4.20	3.25	(0.95)	##
85	9,251	0.79	0.79	1.86	**1.46**	0.00	6.16	4.70	(1.46)	##
89	1,078	0.08	0.08	2.36	**0.18**	0.00	4.01	3.83	(0.18)	##
92	4,539	0.41	0.41	2.00	**0.82**	0.00	1.47	0.65	(0.82)	##
93	9,302	0.79	0.79	1.86	**1.47**	0.00	8.73	7.26	(1.47)	##
96	1,951	0.17	0.17	2.19	**0.36**	0.00	1.85	1.49	(0.36)	##
102	4,794	0.41	0.41	1.99	**0.81**	0.00	3.01	2.20	(0.81)	##
103	3,676	0.31	0.31	2.04	**0.64**	0.00	2.46	1.82	(0.64)	##
109	1,672	0.15	0.15	2.23	**0.34**	0.00	3.17	2.83	(0.34)	##
100	0	21.25		1.46	**30.92**					##

Exit flow greater than the Pipe Capacity at the Basin Exit

Interceptor	Basin	Flow mgd	From Manhole	To Manhole

Exit flow greater than the Pipe Capacity at the Basin Exit

Interceptor	Basin	Flow mgd	From Manhole	To Manhole

The Roger to Ina Plant Interconnect is in service and no flow is diverted to Ina.

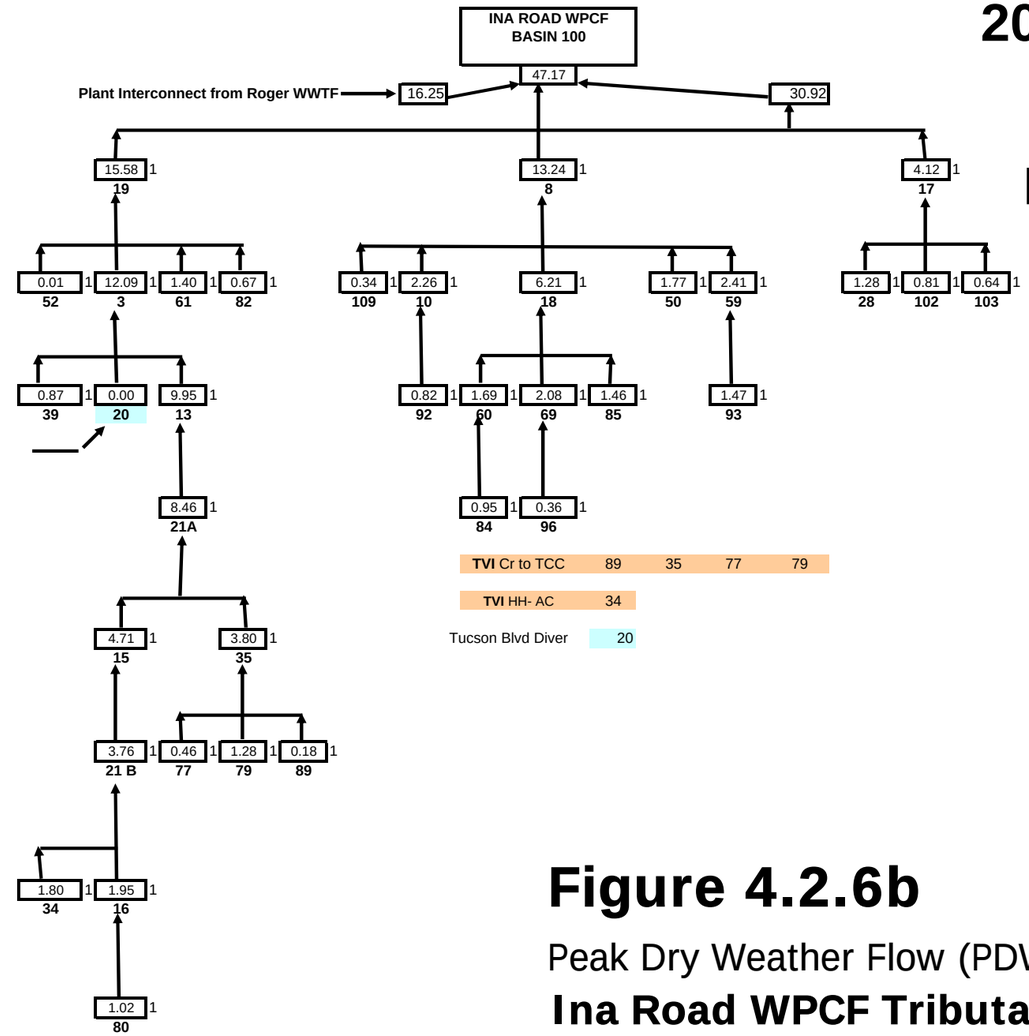


Figure 4.2.6b

Peak Dry Weather Flow (PDWF)

Ina Road WPCF Tributary System

TAZ 2025

2030 Model Results

The results of the model's evaluation of the PCWMD's interceptor system for PDWF in the year 2030 are presented in Figures 4.2.7a. and 4.2.7b for Roger Road WWTP and Ina Road WPCF tributary systems respectively. The sections of the system identified by the Facility Plan Model as being deficient (Red) or requiring further evaluation (Orange) for both the Roger Road WWTP and Ina Road WPCF systems are shown on Figure 4.2.7, Interceptor Capacity Analysis 2025.

The portions of the Interceptors in 2030 that the Facility Plan Model identifies as having deficiencies (Red) or requiring further evaluation (Orange) are shown in the color coded tables on Figures 4.2.7a for the Roger Road WWTP tributary system and on Figure 4.2.7b for the Ina Road WPCF tributary system. The results are graphically shown on a map of PCWMD's entire Interceptor system in Figure 4.2.7. The unique results for 2030 are presented in the following narrative; however, the sections of the Interceptors found deficient (Red) and requiring evaluation (Orange) in 2005, 2010, 2015, 2020 & 2025 will, barring corrective action, be problems in 2030. The following narrative will limit itself to newly identified reaches of Interceptor or reaches that move from requiring evaluation to deficient. Reaches of interceptor found to have problems (either deficient or requiring evaluation) in prior years are considered to not have been repaired and still pose problems in this and future years. The results are:

Deficiencies noted

RED (Flow greater than 85 percent of Pipe Capacity)

Roger Road WWTP System

1. All other deficient basins were identified in 2020 or before.

Ina Road WPCF System

(No Problems.)

ORANGE (Flow greater than basin entrance capacity. Requires further evaluation) 7B 30

Roger Road WWTP System

1. PTI from Wimot and Grant Road to Craycroft and Sutter Lane (Basin 7A). (This section of pipe is downstream from the HAMP, Rocking K Ranch, Civano and the Southeast side, all rapidly growing areas.)
2. SEI from Craycroft and Valencia to Park and I-10 (Basin 11). (The section of pipe is downstream from Vail, HAMP, Rita Ranch and the prisons all areas expected to grow rapidly in the future.)
3. All other deficient basins were identified in 2025 or before.

Ina Road WPCF System

1. Continental Ranch Pump Station Gravity Line from the Santa Cruz River and Yarborough Drive to the Santa Cruz River and Odyssey Way (Basin 17). (This is a shallow slope portion of the interceptor is in a section serving a growing area in the northwest.)

Facility Plan Model Summary

The Pima Association of Governments' June 2005 TAZ population forecast was used as the basis for population distribution among the sewer basins of the PCWMD. PAG updates these forecasts, as they consider necessary, to reflect either significant variations from the assumptions of total population increases or population distribution for the forecast period. PAG's issuance of a new population forecast would be the signal for PCWMD to investigate the impact of the revised forecast upon its conveyance and treatment system.

PCWMD utilizes the TAZ forecasts to determine flows in the conveyance system and to the Treatment Facilities. PCWMD employs the Facility Plan Model to convert TAZ population into sewer basin population. Sewer basin wastewater production is predicted by the application of an average 85 gallons of wastewater produced per capita (person) per day (gpcd) in the basin in the year 2030. The 85 gpcd figure was determined initially as the figure that most closely matched the metered flow in the conveyance system in 2005. Each basin contributes its flow to one of the interceptors where the flow increases until it is discharged into one of the downstream treatment plants. The present flow predictions are generated in five-year increments, matching PAG's population predictions, between 2005 and 2030.

The flow predictions for the Conveyance System tributary to the Roger Road WWTP and Ina Road WPCF plants are presented in both graphic and spreadsheet format. The PDWF flows for the year 2005 were compared to the peak flows of conveyance meters and the plant inflow meters. There is a rough agreement between the calculated and metered readings. The variances are probably due more to the calculated peak flows being more of an "average peak dry weather flow" while the meters record actual real world peak wet weather flows. The metered results presented on the spreadsheets are the maximum flow values (those greater than 99 percent of the recordings) recorded during periods in November and December 2004.

The Facility Plan Model has identified relatively few capacity problems in the PCWMD conveyance system in the next twenty five years. Given the overall system length of 3,300 plus miles and the population growth expected in the service area, the identification of less than a dozen capacity issues is gratifying. Of these few issues several have been anticipated and have been accounted for in the 2004 Bond Authorization (i.e. the NWO relief by the Santa Cruz Interceptor, Prince – Franklin) and the NRI by the Plant Interconnect.

Also, contributing to the scarcity of capacity problems is that the oversizing of gravity sewers involves minimal additional cost during initial installation. The oversized gravity conveyance system functions with minimal additional problems than a capacity sized sewer. Further, gravity sewers involve no mechanical equipment resulting in no high initial equipment costs, no equipment operating costs and no equipment maintenance costs, all of which are normally detriments to oversizing other facilities.

The Facility Plan Model also considers flow diversions whereby flow is diverted from an Interceptor's next downstream basin to either another Interceptor system in the same treatment plant tributary system or into the tributary system for another treatment system. The major such diversion is the diversion of flow from basin 20 on the South Rillito Interceptor (SRI) tributary to Roger Road WWTP to Basin 3 on the North Rillito Interceptor (NRI) tributary to the Ina Road WPCF. This diversion removes 5.35 MGD from the SRI to the NRI in each period from 2005 through 2010. This effectively reduces the treatment load at Roger Road WWTP and increases the load at Ina Road WPCF. The Tucson Boulevard Flow Management Structure flow re-direction falls to zero upon installation of the Plant Interconnect.

The Facility Plan Model, in considering the Ina Road WPCF tributary conveyance system, identified only Basin 19 and on the NRI and Basin 19 on the Continental Ranch Pump Station Gravity Line as having flow exceeding capacity. In the case of Basin 19 and Basin 17 an ORANGE condition occurs in periods from 2005 and 2010 and in year 2030, respectively. It is interesting to note that should 5.35 MGD not be diverted from the SRI to the NRI, Basin 19 would not have issues from 2005 through 2010. The installation of the Roger Road WWTP to Ina Road WPCF plant Interconnect 2004 Bond project prior to 2015 alleviates the identified capacity problem in the NRI. Basin 19 deficiency occurring in year 2030 allows ample time to plan for alleviating this issue.

The Roger Road tributary Conveyance System by contrast exhibits a number of basins identified as issues. The absence of diversion from Basin 20 to Basin 3, discussed above, would not impact the carrying capacity of the SRI conveyance system. The major issues are identified in the text and are summarized here:

The 66-inch diameter Roger Road WWTP entrance pipe between Business Center Drive and the plant develops a capacity problem when the SCIPF and re-directed Tucson Boulevard Flow Management Structure flow use this stretch of pipe. Should the plant interconnect Roger Road start point be at Business Center Drive, this ceases to be a problem.

The Northwest Outfall in Basin 57B from Speedway to the Santa Cruz River crossing is the only RED condition in 2005. The 2004 Bond project, The Santa Cruz Interceptor, Prince to Franklin, when installed, will allow the redirection of flows from the east side of the Santa Cruz River away from the Alameda siphon and the NWO thereby preventing overloading the NWO.

The Southeast Interceptor (SEI) in Basin 51, from Park & I-10 to 18th and Euclid, serves the growing southeast area as well as the Tucson International area Industrial and Commercial area and becomes a RED problem in 2010. Presently there are no Bond or CIP projects addressing this problem.

The Southeast Interceptor in Basin 9 is an ORANGE capacity problem from 2005 through 2030. This section of the SEI is downstream of Basin 51 and has capacity problems along 18th Street from Euclid to Osborne. Presently there are no Bond or CIP projects addressing this problem.

The Southeast Interceptor in Basin 43A from Kolb Road and I-10 to the Rita Ranch area reaches an Orange condition in 2010 through 2020 and graduates to a Red condition in 2025 and 2030. The area east of Houghton Road, (Basin 43B) in response to area growth, becomes a Red condition in 2025 and 2030. The growth of flow in the upstream reaches of the Southeast Interceptor eventually involve Basin 11 in the year 2030. Presently there are no Bond or CIP projects addressing this problem.

The Pantano Interceptor graduates from an Orange condition to a Red condition in individual basin stages from 2010 in Basin 29 to a RED condition from 22nd Street and Pantano Wash to Rocking K Ranch and an Orange condition on the PTI from Craycroft and the Rillito to 22nd street in 2030. As discussed, a Water Reclamation Facility in the vicinity of Harrison Road and Pantano River is being evaluated to help relieve flow and provide reclaimed water for the eastside.

There are other indications for further investigation throughout the system that are considered minor problems caused by the methods of the Facility Plan Model that, upon further engineering investigation, may prove of no consequence. These occur on the Aviation Corridor sewer Central, the Santa Cruz Central, Aviation Corridor sewer South East and the Santa Cruz Interceptors. Details on these situations are outlined in the text.

Conclusions and Recommendations

As summarized in Chapter 4.2 Conveyance Future Conditions, the following new CIP capacity related conveyance projects have been determined to be advisable.

1. Because there are three interceptor locations that were found to be in an 'Orange' condition between 2005 and 2010, the following CIP project is recommended:

   Interceptor Condition Evaluation: Perform an evaluation on the following 3 interceptor locations to determine current Peak Dry Weather Flow conditions and need for expansion;

   a. ACSC - Aviation/Kino diversion structure to 12th and Vine.

   b. ACSE - From Golf Links/Veteran's Memorial siphon to Silverlake and Aviation Parkway.

   c. SRI - From Glenn and Alvernon to Glenn west of Country Club.

2. Since the SEI is 'Orange' from 2005 at Euclid and 18th to Osborne and 18th and

   'Red' after 2010 at Park and I-10 to 18th and Euclid, the following CIP project is recommended:

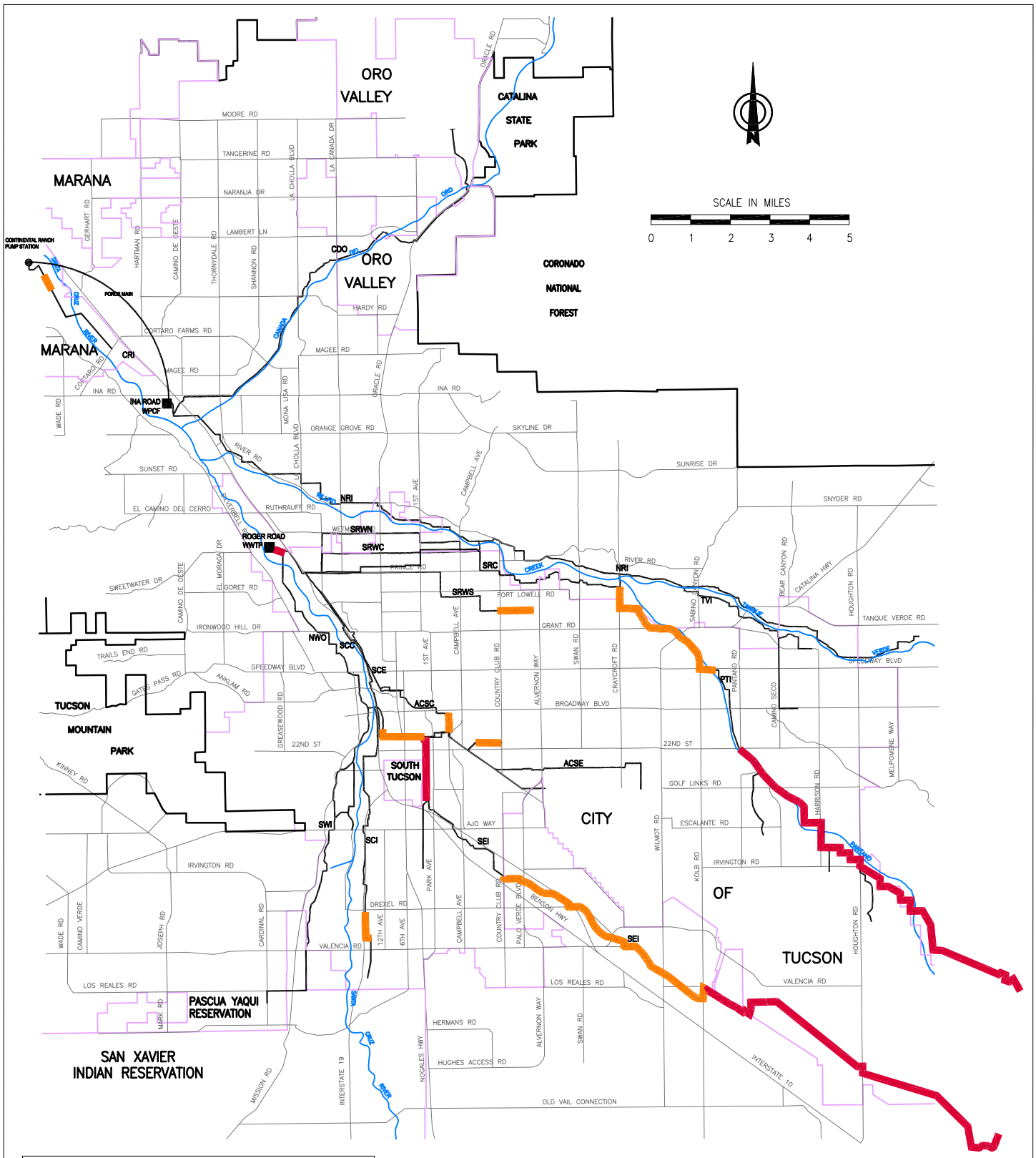
   SEI: 18th and Osborne to Park and I-10 – the scope will include a preliminary engineering report to determine the need for expansion over the entire length so only the reaches in need of expansion will be constructed.

3. The Facility Plan Model has only considered the interceptor system for pipe sizes greater than 15 inch and greater in diameter. Capacity in the intermediate or trunk system in 10, 12 and 15-inch size pipe requires study to identify possible capacity problems.

4. Conduct a study of the PTI and SEI in the area east of Kolb Road to determine if Treatment Plants such as the Pantano and Harrison and the Kolb and I-10 proposed facilities would relieve conveyance problems on these two interceptors.

In other cases, PCWMD has to wait to see how areas in the southeast develop before investigating potential capacity problems. And, as previously mentioned, construction of the SCI: Prince to Franklin will relieve the Alameda Siphon and Northwest Outfall flows that currently appear as capacity problems. It will also allow the closure of the SCC upon rehabilitation and some flow diversions of portions of the SCE along I-10.

Additionally, as already noted, the construction of the Plant Interconnect will relieve the NRI from the capacity problems indicated.



LEGEND

DEFICIENT (Calculated Basin Exit Flow is Greater Than 85% of Full Pipe Capacity at the Basin Exit)

FURTHER (Calculated Basin Inlet Flow is Greater Than 85% of Full Pipe Capacity Somewhere Within the Basin)

Pima County Wastewater Management Department
Facility Plan Update

Figure 4.2.7
Capacity Analysis 2030

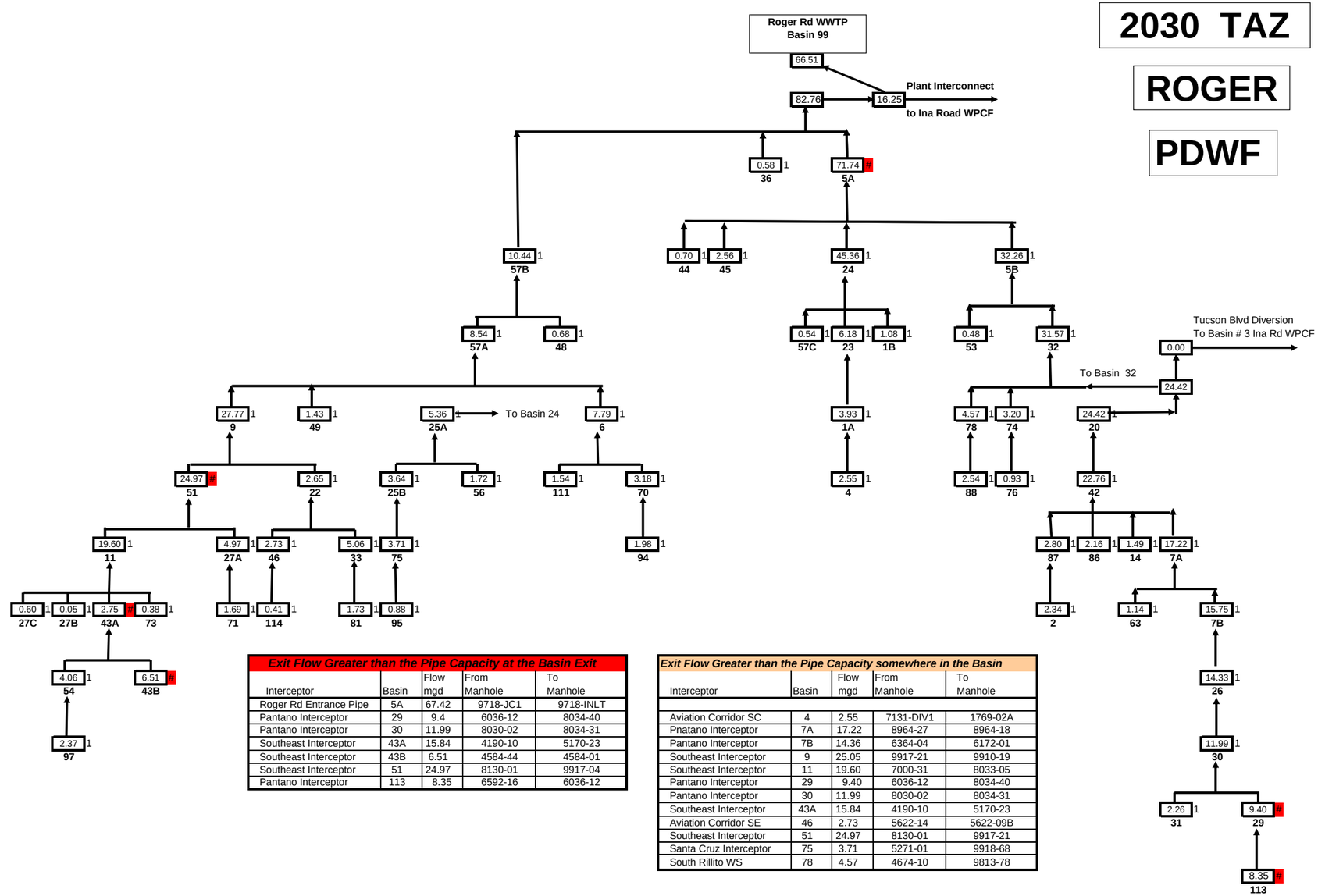
2030 TAZ

ROGER

PDWF

Basin No.		Basin Population on sewer 2030	Interceptor Flow **ADWF**	Basin Flow **ADWF**	**Peak Factor**	**PDWF** mgd	**CAPACITY** 85% Full Pipe Capacity ENTER	EXIT	**Over Exit Capacity Indicator**	**Over Enterance Capacity Indicator**	
1A		6,982	2.24	0.59	1.75	**3.93**	5.93	10.11	6.18	2.01	##
1B		6,621	0.56	0.56	1.92	**1.08**	1.70	9.40	8.32	0.62	##
2		15,467	1.31	1.31	1.78	**2.34**	2.98	3.66	1.31	0.63	##
4		11,613	1.40	0.99	1.83	**2.55**	2.37	6.67	4.12	(0.18)	##
5A		628	52.12	0.05	1.38	**71.74**	204.20	52.32	-19.42	132.47	##
5B		3,177	22.11	0.27	1.46	**32.26**	62.93	50.80	18.55	30.67	##
6		25,590	4.84	2.18	1.61	**7.79**	9.65	16.94	9.15	1.85	##
7A		5,047	11.31	0.43	1.52	**17.22**	15.95	22.92	5.70	(1.26)	##
7B		11,668	10.28	0.99	1.53	**15.75**	13.35	15.95	0.20	(2.40)	##
9		11,720	18.96	1.00	1.46	**27.77**	15.95	64.16	36.39	(11.81)	##
11		25,730	12.96	2.19	1.51	**19.60**	17.94	22.94	3.34	(1.66)	##
14		9,431	0.80	0.80	1.86	**1.49**	0.00	6.53	5.04	(1.49)	##
20		13,992	16.43	1.19	1.49	**24.42**	36.35	43.32	18.91	11.94	##
22		808	1.63	0.07	1.62	**2.65**	6.51	12.02	9.37	3.86	##
23		17,378	3.72	1.48	1.66	**6.18**	10.11	14.29	8.10	3.92	##
24		12,059	28.21	1.03	1.61	**45.36**	64.16	64.16	18.80	18.80	##
25A		1,975	3.28	0.17	1.63	**5.36**	9.97	34.16	28.80	4.61	##
25B		7,211	2.17	0.61	1.68	**3.64**	4.00	6.83	3.18	0.36	##
26		18,874	9.29	1.60	1.54	**14.33**	16.13	14.65	0.32	1.81	##
27A		4,859	2.90	0.41	1.71	**4.97**	7.68	12.37	7.40	2.72	##
27B		582	0.05	0.05	2.58	**0.13**	0.00	2.93	2.81	(0.13)	##
27C		7,067	0.60	0.60	1.91	**1.15**	0.00	3.12	1.97	(1.15)	##
29		8,340	5.92	0.71	1.59	**9.40**	3.41	4.82	-4.58	(5.99)	##
30		5,871	7.68	0.50	1.56	**11.99**	10.05	10.05	-1.94	(1.94)	##
31		14,863	1.26	1.26	1.79	**2.26**	0.00	3.41	1.15	(2.26)	##
32		7,161	21.61	0.61	1.46	**31.57**	79.93	62.93	31.35	48.35	##
33		11,184	3.01	0.95	1.68	**5.06**	7.79	8.81	3.75	2.73	##
36		3,317	0.28	0.28	2.07	**0.58**	0.00	1.70	1.12	(0.58)	##
42		3,828	15.24	0.33	1.49	**22.76**	45.18	42.61	19.85	22.42	##
43A		32,372	9.75	2.75	1.63	**15.84**	4.59	11.85	-3.99	(11.25)	##
43B		49,672	4.22	4.22	1.54	**6.51**	0.00	4.17	-2.34	(6.51)	##
44		4,041	0.34	0.34	2.02	**0.70**	2.31	7.15	6.45	1.62	##
45		11,827	1.41	1.01	1.82	**2.56**	3.06	13.52	10.95	0.50	##
46		13,519	1.56	1.15	1.76	**2.73**	2.41	3.88	1.15	(0.32)	##
48		3,937	0.33	0.33	2.03	**0.68**	0.00	1.95	1.27	(0.68)	##
49		9,012	0.77	0.77	1.87	**1.43**	0.00	3.04	1.61	(1.43)	##
51		10,323	16.74	0.88	1.49	**24.97**	12.98	12.98	-11.99	(11.99)	##
53		2,697	0.23	0.23	2.11	**0.48**	0.00	1.12	0.64	(0.48)	##
54		216	2.39	0.02	1.70	**4.06**	16.01	13.70	9.64	11.96	##
56		11,022	0.94	0.94	1.83	**1.72**	0.00	2.52	0.80	(1.72)	##
57A		4,296	5.97	0.37	1.43	**8.54**	17.70	27.15	18.61	9.15	##
57B		11,869	7.32	1.01	1.43	**10.44**	27.15	24.77	14.33	16.71	##
57C		3,066	0.26	0.26	2.08	**0.54**	0.00	3.90	3.36	(0.54)	##
63		7,043	0.60	0.60	1.91	**1.14**	0.00	4.29	3.15	(1.14)	##
70		8,738	1.83	0.74	1.73	**3.18**	6.60	9.65	6.47	3.42	##
71		19,852	2.49	1.69	1.74	**4.34**	0.00	7.88	3.54	(4.34)	##
73		4,460	0.38	0.38	2.00	**0.76**	0.00	10.05	9.29	(0.76)	##
74		16,205	1.85	1.38	1.73	**3.20**	7.05	6.48	3.27	3.84	##
75		15,215	2.17	1.29	1.71	**3.71**	2.71	3.72	0.01	(1.00)	##
76		5,582	0.47	0.47	1.96	**0.93**	0.00	1.52	0.59	(0.93)	##
78		15,117	2.72	1.28	1.68	**4.57**	3.81	5.40	0.83	(0.76)	##
81		20,357	1.73	1.73	1.74	**3.01**	0.00	3.18	0.17	(3.01)	##
86		14,184	1.21	1.21	1.79	**2.16**	0.00	6.60	4.43	(2.16)	##
87		3,346	1.60	0.28	1.75	**2.80**	3.66	8.77	5.97	0.85	##
88		16,901	1.44	1.44	1.77	**2.54**	0.00	3.80	1.26	(2.54)	##
94		12,844	1.09	1.09	1.81	**1.98**	0.00	3.90	1.93	(1.98)	##
95		10,353	0.88	0.88	1.84	**1.62**	0.00	2.71	1.09	(1.62)	##
97		27,937	2.37	2.37	1.70	**4.03**	0.00	7.81	3.78	(4.03)	##
99		0	43.47	0.00	1.38	**59.81**	78.20	78.20	18.39	18.39	##
111		9,786	0.83	0.83	1.85	**1.54**	0.00	5.29	3.75	(1.54)	##
113		61,311	5.21	5.21	1.60	**8.35**	0.00	3.94	-4.41	(8.35)	##
114		4,777	0.41	0.41	1.99	**0.81**	0.00	1.09	0.28	(0.81)	##
20A				0.00	1.17	**0.00**					##

12



Exit Flow Greater than the Pipe Capacity at the Basin Exit

Interceptor	Basin	Flow mgd	From Manhole	To Manhole
Roger Rd Entrance Pipe	5A	67.42	9718-JC1	9718-INLT
Pantano Interceptor	29	9.4	6036-12	8034-40
Pantano Interceptor	30	11.99	8030-02	8034-31
Southeast Interceptor	43A	15.84	4190-10	5170-23
Southeast Interceptor	43B	6.51	4584-44	4584-01
Southeast Interceptor	51	24.97	8130-01	9917-04
Pantano Interceptor	113	8.35	6592-16	6036-12

Exit Flow Greater than the Pipe Capacity somewhere in the Basin

Interceptor	Basin	Flow mgd	From Manhole	To Manhole
Aviation Corridor SC	4	2.55	7131-DIV1	1769-02A
Pnatano Interceptor	7A	17.22	8964-27	8964-18
Pantano Interceptor	7B	14.36	6364-04	6172-01
Southeast Interceptor	9	25.05	9917-21	9910-19
Southeast Interceptor	11	19.60	7000-31	8033-05
Pantano Interceptor	29	9.40	6036-12	8034-40
Pantano Interceptor	30	11.99	8030-02	8034-31
Southeast Interceptor	43A	15.84	4190-10	5170-23
Aviation Corridor SE	46	2.73	5622-14	5622-09B
Southeast Interceptor	51	24.97	8130-01	9917-21
Santa Cruz Interceptor	75	3.71	5271-01	9918-68
South Rillito WS	78	4.57	4674-10	9813-78

1 **Randolph Park WRF at 3.0 mgd.**
2 **SCIPF in Operation**
3 **The Roger to Ina Plant Interconnect is in service and no flow is diverted to Ina at Tucson Blvd.**
4 **Wastewater is Conveyed from Roger to Ina by Plant Interconnector. 16.25 MGD**

Figure 4.2.7a

Peak Dry Weather Flow (PDWF)

Roger Road Tributary System

TAZ 2030

1/20/06

Basin No	Basin Population 0n Sewer 2030	Interceptor Flow **ADWF**	Basin Flow **ADWF**	**Peak Factor**	**PDWF** mgd	**CAPACITY** 85% Full Pipe Capacity ENTER	EXIT	**Over Exit Capacity Indicator**	**Over Entrance Capacity Indicator**	
3	15,214	8.07	1.06	1.54	**12.42**	22.04	20.33	7.91	9.62	##
8	11,794	9.05	1.06	1.55	**14.01**	17.09	33.25	19.25	3.08	##
10	9,530	1.27	0.86	1.79	**2.28**	3.37	5.79	3.51	1.09	##
13	14,975	6.54	1.05	1.56	**10.20**	0.00	27.74	17.54	(10.20)	##
15	9,008	2.94	0.63	1.65	**4.85**	12.06	11.30	6.45	7.22	##
16	8,073	1.11	0.57	1.79	**1.98**	3.69	4.69	2.71	1.70	##
17	13,629	2.67	1.16	1.68	**4.48**	4.17	32.62	28.14	(0.31)	##
18	11,332	4.07	0.96	1.63	**6.63**	7.50	17.09	10.45	0.86	##
19	20,111	10.61	1.41	1.51	**16.03**	20.34	28.26	12.23	4.31	##
20	0	0.00	0.00	1.17	**0.00**	9.18	17.48	17.48	9.18	##
21A	3,732	5.49	0.24	1.58	**8.66**	11.30	11.30	2.64	2.64	##
21B	2,125	2.31	0.15	1.68	**3.88**	7.82	7.63	3.75	3.94	##
28	8,977	0.72	0.72	1.87	**1.34**	0.00	3.17	1.83	(1.34)	##
34	15,021	1.05	1.05	1.79	**1.88**	0.00	6.57	4.69	(1.88)	##
35	18,625	2.31	1.30	1.67	**3.87**	5.08	6.36	2.48	1.21	##
39	5,437	0.46	0.46	1.96	**0.91**	0.00	3.55	2.65	(0.91)	##
50	12,611	1.07	1.07	1.81	**1.94**	0.00	4.32	2.37	(1.94)	##
52	15	0.00	0.00	6.06	**0.01**	0.00	0.43	0.43	(0.01)	##
59	6,339	1.42	0.57	1.77	**2.51**	12.02	4.36	1.85	9.51	##
60	5,310	0.99	0.45	1.83	**1.80**	2.52	3.73	1.93	0.72	##
61	11,292	0.79	0.79	1.83	**1.45**	0.00	3.71	2.26	(1.45)	##
69	12,122	1.26	1.09	1.79	**2.26**	2.77	10.00	7.73	0.51	##
77	3,153	0.22	0.22	2.08	**0.46**	0.00	2.52	2.06	(0.46)	##
79	10,180	0.71	0.71	1.85	**1.32**	0.00	6.48	5.16	(1.32)	##
80	6,386	0.54	0.54	1.93	**1.05**	0.00	2.52	1.47	(1.05)	##
82	4,885	0.34	0.34	1.98	**0.68**	0.00	1.74	1.07	(0.68)	##
84	6,281	0.53	0.53	1.93	**1.03**	0.00	4.20	3.17	(1.03)	##
85	10,077	0.86	0.86	1.85	**1.58**	0.00	6.16	4.58	(1.58)	##
89	1,081	0.08	0.08	2.35	**0.18**	0.00	4.01	3.83	(0.18)	##
92	4,588	0.41	0.41	2.00	**0.82**	0.00	1.47	0.65	(0.82)	##
93	9,961	0.85	0.85	1.85	**1.57**	0.00	8.73	7.16	(1.57)	##
96	2,011	0.17	0.17	2.19	**0.37**	0.00	1.85	1.48	(0.37)	##
102	5,227	0.44	0.44	1.97	**0.88**	0.00	3.01	2.13	(0.88)	##
103	4,098	0.35	0.35	2.02	**0.70**	0.00	2.46	1.75	(0.70)	##
109	1,760	0.16	0.16	2.22	**0.35**	0.00	3.17	2.82	(0.35)	##
100	0	22.33		1.45	**32.39**					##

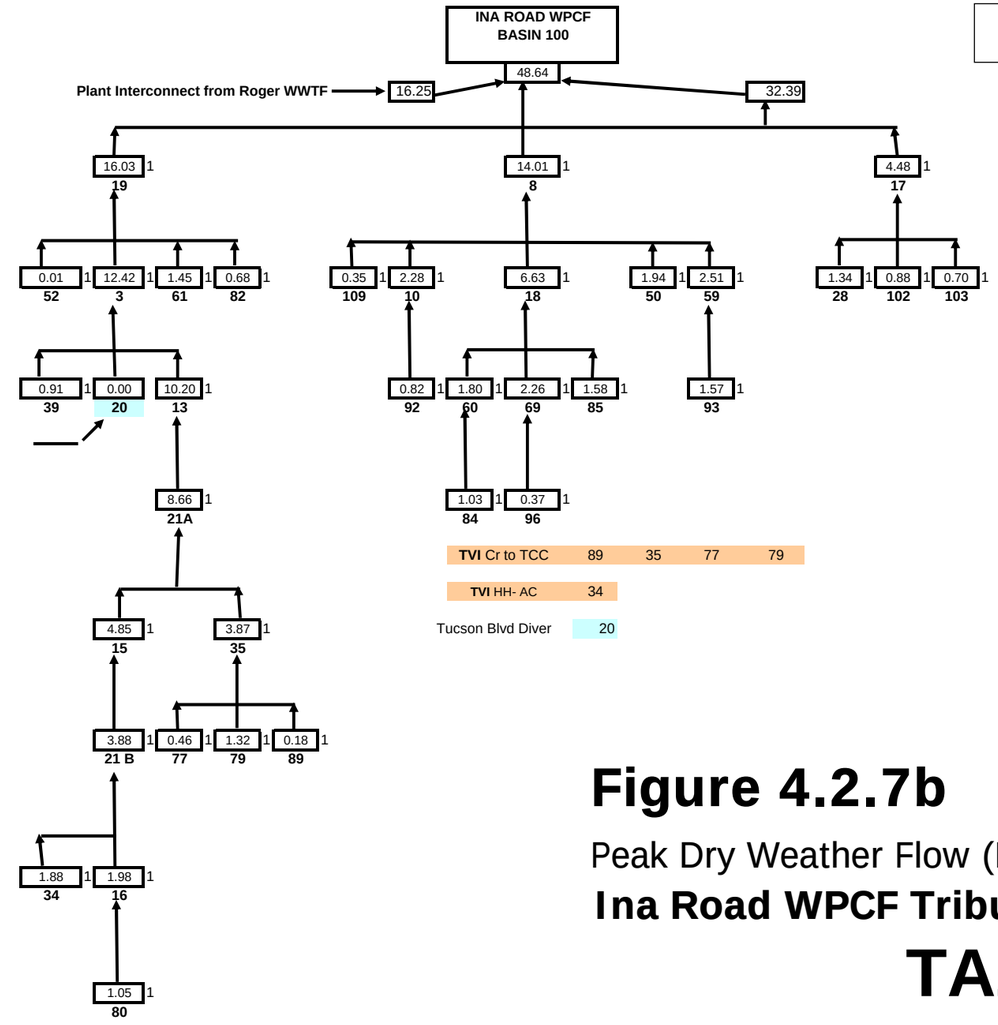
Exit flow greater than the Pipe Capacity at the Basin Exit

Interceptor	Basin	Flow mgd	From Manhole	To Manhole

Exit flow greater than the Pipe Capacity at the Basin Exit

Interceptor	Basin	Flow mgd	From Manhole	To Manhole
Countinental Ranch Pump Station Gravity Line	17	4.48	5290-18	5290-116

The Roger to Ina Plant Interconnect is in service and no flow is diverted to Ina.



2030 TAZ

INA

PDWF

Figure 4.2.7b

Peak Dry Weather Flow (PDWF)

Ina Road WPCF Tributary System

TAZ 2030

Chapter 5 Treatment System

CHAPTER OVERVIEW

The Metropolitan Tucson Planning Area is defined for the Facility Plan as the sewer system that is tributary to the Metropolitan Treatment Facilities. The Metropolitan Area Wastewater Treatment Facilities are the Ina Road Wastewater Pollution Control Facility (WPCF), Roger Road Wastewater Treatment Plant (WWTP) and the Randolph Park Water Reclamation Facility (WRF). However, since Pima County Wastewater Management Department (PCWMD) treats wastewater flows for the Tucson Metropolitan Area and outlying communities within Pima County at eleven facilities, the Facility Plan includes a brief description and discussion of the outlying treatment facilities for context with the metropolitan area. This chapter is divided into current and future conditions for the Metropolitan Area Treatment Facilities, current and future conditions for the Outlying Treatment Facilities and Treatment Modeling.

Metropolitan Treatment Facilities – Current Conditions

The Roger Road WWTP is a trickling filter and activated sludge facility with a capacity of 41 million gallons per day (MGD). Ina Road WPCF consists of a 25 MGD high purity oxygen activated sludge facility and a new 12.5 MGD biological nutrient removal activated sludge train capable of nitrification/denitrification. The Randolph Park WRF is a 3 MGD Membrane Bioreactor facility capable of producing Class A reuse water for discharge directly into the Tucson Water reclaimed water system.

Condition assessments were performed at the Roger Road WWTP and Ina Road WPCF to identify deficiencies. The Roger Road WWTP, because it is the older facility, had the most deficiencies identified for improvement. Deficiencies at the existing Ina Road WPCF were less significant.

Metropolitan Treatment Facilities – Future Conditions

Capacity expansion of any of the metropolitan treatment facilities is not anticipated until the latter part of the planning period. Population growth is projected to be the greatest in the Roger Road WWTP Tributary Area; therefore, addressing the treatment concerns in this area is a high priority. To achieve this, the Plant Interconnect project, funded in the 2004 Bonds, will allow the significant increase in flows to the Roger Road WWTP to be transported and treated at the Ina Road WPCF. This is demonstrated by the "Managed Flows" in Table 5.2.2 which depicts wastewater flow balancing between the metropolitan area wastewater treatment facilities.

Nitrification/denitrification of the original 25 MGD Ina Road WPCF is a significant project in this planning period and will need to be followed by nitrification/denitrification at the Roger Road WWTP during the same period.

A new water reclamation facility in southeastern Tucson is also being evaluated for installation sometime between 2015 and 2020. Until adequate wastewater flow is available in the area, initial flows will be transported through the Pantano and/or Southeast Interceptors to the Metropolitan Treatment Facilities.

As discussed in Chapter 7, it is anticipated PCWMD will prepare an assessment of the most effective biosolids treatment options for the Ina Road WPCF in conjunction with relocation of the solids treatment from the Roger Road WWTP.

Finally, based on evaluation of flows to the metropolitan treatment facilities, PCWMD does not anticipate beginning treatment expansions at the Ina Road WPCF until 2020.

Outlying Treatment Facilities – Current Conditions

The Outlying Facilities are small capacity plants located throughout eastern Pima County in higher population density areas. A condition assessment was performed at these facilities to determine the short and long-term deficiencies at these facilities, including Avra Valley, Corona de Tucson, Fairgrounds, Green Valley, Marana, Rillito Vista, Arivaca Junction and Mt. Lemmon WWTFs.

Outlying Treatment Facilities – Future Conditions

Population is the critical driver for improvements at the eight Outlying Treatment Facilities. Numerous large home developments are being proposed throughout the PCWMD service area tributary to these facilities. This population growth is of greater concern at the smaller capacity treatment facilities that range from less than 0.01 MGD to 4.1 MGD which are more rapidly impacted by increasing populations. Expansions and upgrades are recommended to improve capacity and operational performance, especially at the Avra Valley, Corona de Tucson and Marana WWTFs.

Going forward, PCWMD will review the Pima Association of Governments population forecasts as they are issued. This information will be analyzed using the Facility Plan Model to assess impacts on the conveyance system and treatment capacity. PCWMD will work closely with the jurisdictions and area developers to anticipate growth for the outlying areas and update the Facility Plan, as necessary, to facilitate the schedule and funding for these capacity expansions.

Treatment Modeling

To evaluate the wastewater treatment processes and potential capacity at the Roger Road WWTP and Ina Road WPCF, PCWMD commissioned a process modeling effort utilizing GPS-X performed by Hydromantis Inc. by GPS-X. This process model was developed and calibrated to simulate process functioning and facility capacity. It also simulates the treatment capacity under a range of regulatory effluent quality requirements. Seven different capacity scenarios were developed focusing on process modifications at the metropolitan facilities. Each of the scenarios was evaluated on performance indicators and cost-effectiveness of the treatment process modifications. Results of the analysis will be used to guide operational strategies and investigations at the facilities.

CHAPTER 5.1 METROPOLITAN AREA TREATMENT FACILITIES CONDITION ASSESSMENT

Pima County Wastewater Management (PCWMD) provides wastewater treatment for the Pima County Metropolitan Area at three treatment facilities, the Roger Road Wastewater Treatment Plant (WWTP), The Randolph Park Water Reclamation Facility (WRF) and the Ina Road Water Pollution Control Facility (WPCF).

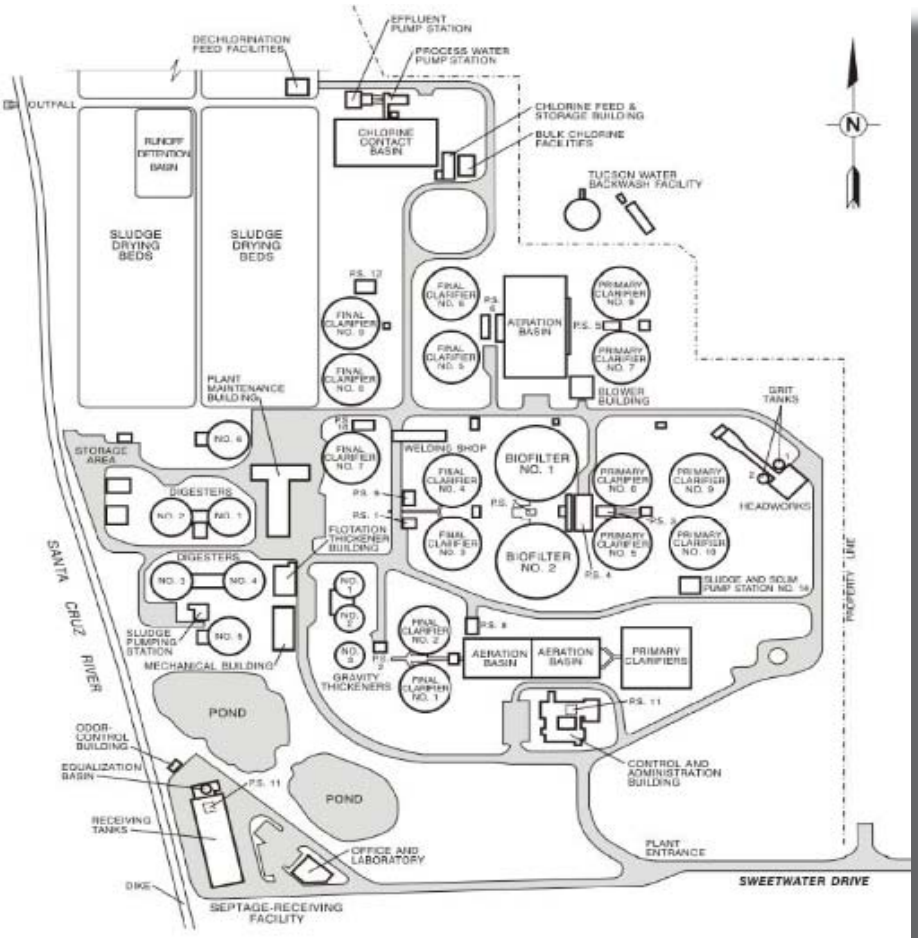
Condition Assessments

Condition assessments of the Roger Road WWTP and Ina Road WPCF were completed as part of this Facility Plan. The results were reviewed by the staff at each treatment plant. The determination of current conditions at these major facilities is the initial step in Asset Management. The results of these assessments are contained in the following discussion.

Roger Road Wastewater Treatment Plant (WWTP)

The Roger Road WWTP is currently rated as a 41 MGD average dry weather flow (ADWF) facility and uses biofilters with post-aeration for secondary treatment. The WWTP is located just north of Prince Road between Interstate 10 and the Santa Cruz River. The WWTP site is bordered on the north, east, and south by lands owned by the City of Tucson; and on the west by the Santa Cruz River. Available County owned land for any significant future plant expansion is limited to the northwest portion of the site, which is currently occupied by inactive sludge drying beds or by purchasing vacant property adjacent to the site. The WWTP present configuration is shown in Figure 5.1.1.

Figure 5.1.1 Roger Road WWTP Site Plan



The WWTP was operated in 1951 as a 12 MGD activated sludge treatment 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 1981 and 1982, the trickling filters were replaced with two large biofilters and the three individual plants at the facility were combined into a single facility re-rated at 30 MGD. A major retrofit was completed in 1997 after the addition of primary and secondary digesters, two primary and three secondary clarifiers and other components to the previously retired

activated sludge process resulting in a capacity increase of 11 MGD thereby increasing the plant capacity to 41 MGD.

Effluent Disposal

The majority of the effluent is discharged to the Santa Cruz River under Arizona Pollutant Discharge Elimination System (AZPDES) Permit Number AZ0020923. The remainder of the effluent is pumped to the Tucson Water Reclamation Plant or pumped directly to the Silverbell Golf Course for irrigation. A summary of the principal discharge limits for the plant is shown in Table 5.1.1.

The present process flow diagram for the Roger Road WWTP is presented in Figure 5.1.2.

Table 5.1.1 Roger Road WWTP AZPDES Permit Discharge Limitation

Parameter	Avg. Monthly	Avg. Weekly	Daily Max
Effluent Flow, MGD	41	---	---
BOD (5 day), mg/l (kg/d)	30 (4,654)	45 (6,984)	(14,299)
Total Susp. Solids, mg/l (kg/d)	30 (4,654)	45 (6,984)	(14,299)
Fecal Coliform Bateria	200/100 ml	---	800/100 ml
e-coli Bacteria	126 CFUs/100 ml	---	576 CFUs/100 ml
Settleable solids, ml/L	[1]	---	[2]
PH	Not less than 6.5 nor greater than 9.0		
Total Residual Chlorine			0.011 mg/l

Notes:

1. Effective November 2, 1999 through November 2, 2004.
2. This is not a comprehensive list as the actual permit includes limitations and/or monitoring and reporting requirements for 22 additional effluent characteristics (microbiological, inorganic and organic trace substances).

Process Description

The existing facilities at the Roger Road WWTP have been divided into three parts: Wet Stream Facilities, Sludge Stream Facilities and Other (non-Process) Facilities.

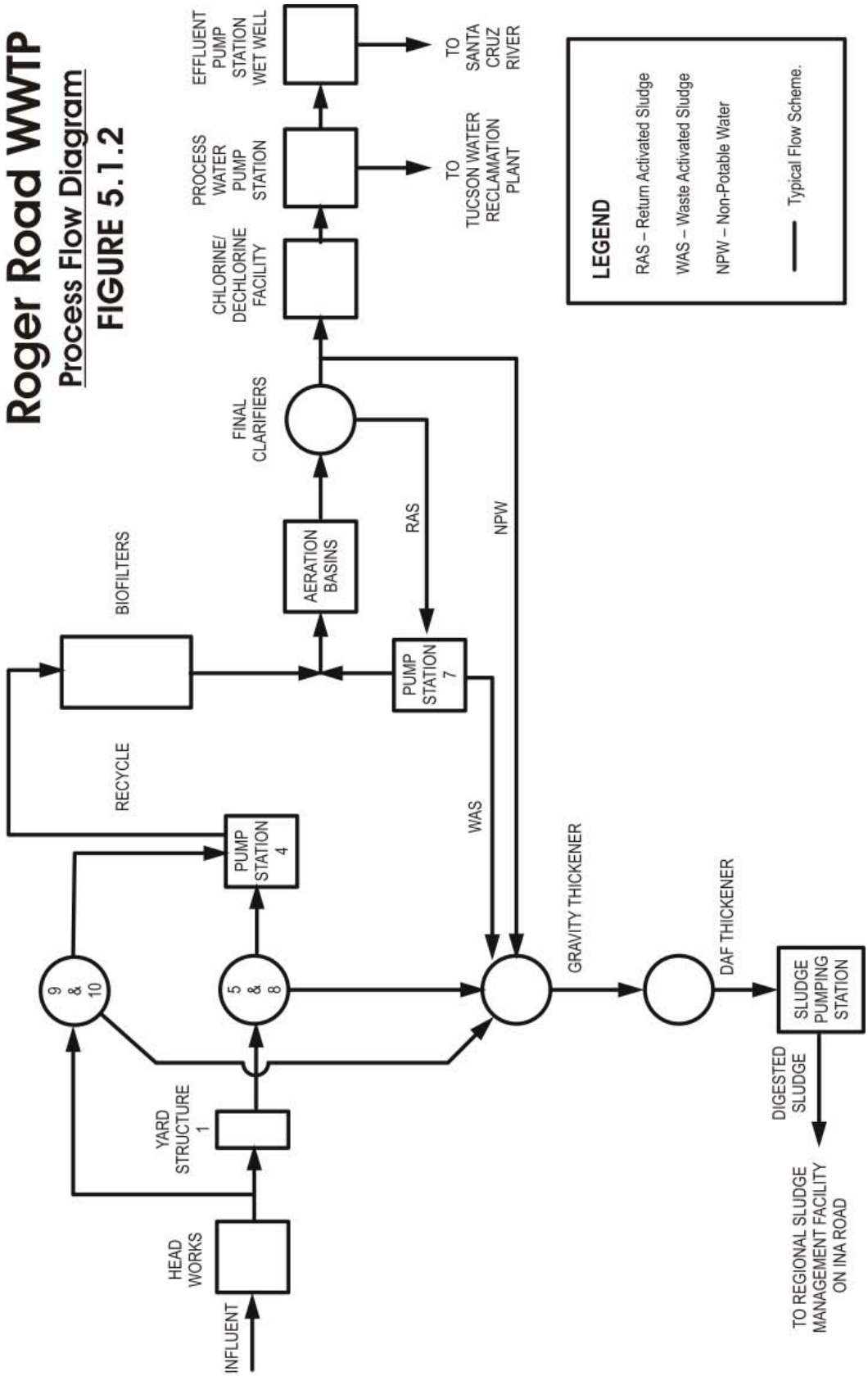
Wet Stream

- Headworks.
- Screening.
- Grit Removal.
- Primary Sedimentation (Primary Clarifiers).
- Biofilters.
- Activated Sludge.
- Final Sedimentation (Secondary Clarifiers).
- Effluent Disinfection with Liquid Sodium Hypo-Chlorite.
- Chlorine Removal with Sodium Bi-Sulfite.
- Process Water Pump Station.
- River Outfall or the City of Tucson Water Reclamation Plant.
- Septage Receiving Station.

Roger Road WWTP

Process Flow Diagram

FIGURE 5.1.2



Sludge Stream

- Gravity Thickening.
- Flotation Thickening.
- Anaerobic Digestion.
- Sludge Drying Beds (emergency only).
- Digested Sludge Pumping to the Ina Centrifuge Facilities.
- Energy Recovery/Power Production Facilities.

Other

- Administration Building.
- Warehouse/Maintenance Shop and Yards.

Wet Stream

Septage Receiving Station

Prior to the expansion to 41 MGD, septage was discharged in a number of selected manholes in the sewer system. Recognizing that unmonitored discharges could potentially have a significant effect on the WWTP's performance, a Septage Receiving Station was constructed at the Roger Road WWTP.

This facility allows for the collection, monitoring and pretreatment of septage prior to being pumped to the headworks of the WWTP.

The condition of the Septage Receiving Station was found acceptable however the Treatment Staff experiences time consuming cleaning and maintenance problems after each use. Due to these problems Treatment Staff are examining alternate ways of collecting Septage.

Headworks

Wastewater is conveyed by 66- and 48-inch interceptor sewers to an influent junction structure. The combined influent enters the headworks through an 7 foot square influent channel where chlorine can be added to oxidize odor-causing substances. The headworks have been renovated in several steps since the year 2000 including enclosing the screens and installing odor collection and scrubbing equipment as well as rehabilitating the influent channel. The headworks, downstream of the influent channel to the grit chambers, is experiencing accelerated corrosion. Rehabilitation is recommended.

Screening

Flow is split among the three bar screens which are located in separate channels. The three Parkson screens remove debris, rags, and other material, harmful to downstream process units (such as pumps and mixers). Operations personnel report that these screens are working well; however, large objects in the waste stream can cause problems. Treatment staff consider that manual coarse screens need to be installed ahead of the Parkson screens to minimize operational and maintenance issues with the fine screens. Screenings are discharged to a belt conveyor that deposits the screenings into a dump truck for hauling to a landfill. Additional odor control at the belt conveyor and dump truck loading areas is required. Screenings can be diverted from the belt conveyor to screenings compactors. Permanent operating platforms are required for access and maintenance. The current compaction system, which reduces water content from screenings prior to the dump truck, is considered inadequate and improvements/alternatives are being evaluated.

Grit Removal

After passage through the bar screens, the wastewater is routed through a vortex grit removal system. Grit removal is required to protect moving mechanical equipment from abrasion and normal wear, to reduce pipe clogging, to prevent the accumulation of grit in tankage and to reduce loading of treatment works with inert matter that might interfere with operation of the units.

Deposited grit is pumped to vortex grit separators and in turn directed to classifying screw conveyors. The classifying screw conveyors discharge onto the screenings conveyor for dump truck disposal along with screenings. Odor control equipment was recently installed at the headworks and additional improvements to the system, by covering the screenings and grit removal system, were provided to abate odor.

An emergency bypass to relieve possible blockage at the screens is required. The construction of a plant interconnect to the Ina Road WPCF is a project contained in the 2004 Bond Authorization, combined with the emergency bypass will provide this protection.

A future assessment of the pipes between the headworks and the primary clarifiers is recommended as the pipes could not be decommissioned for inspection during the condition assessment.

Liquid effluent from the grit tanks flows to three Parshall flumes (two active) for influent flow measurement. Flow continues on to Yard Structure Number 1 where all recycle flows are combined with the de-gritted wastewater. Primary Clarifiers Number 1 through Number 4 are no longer used as clarifiers but now function as equalization basins.

Primary Sedimentation (Primary Clarifiers)

This process removes settleable solids, floating material and some organic material contributing to BOD. Typically, primary sludge is pumped to the gravity thickeners, but it can also be sent directly to the anaerobic digesters. Scum is pumped directly to the anaerobic digesters. Primary effluent flows by gravity to the Biofilter Pump Station.

The primary clarifiers generally are in acceptable condition with no noticeable mechanical or structural problems, however it is suggested that one clarifier among the primary as well as secondary clarifiers be scheduled for maintenance and/or refurbishment every year. An allowance for purchase of major clarifier equipment component replacement is included in the plant recommended improvements.

Biofilter Pump Station

The Biofilter Pump Station receives flow from the primary clarifiers and is capable of receiving return sludge from the secondary clarifiers. This pump station sends all its flow to the two 165-foot diameter biofilter towers. There are three gas-engine driven pumps and one electric motor driven pumps. At the plant ADWF of 41 MGD, two of the three gas driven pumps are in-service with third gas driven pump and the electric motor driven pump on stand-by. Methane gas from the anaerobic digesters and natural gas are used to power the engines. Waste heat from the engines is recovered as part of the Roger Road WWTP energy recovery program.

The Biofilter Pump Station wet well and channels are severely corroded. The recirculation control valve stem was recently replaced, however the valve is constantly hunting for its set point. The valve has been closed (not used) as recent plant modifications have rendered it unnecessary.

The engine driven pumps have been difficult to reliably operate on digester gas. A second electric motor driven pump replaced one of the gas-engine driven pumps to improve reliability. Both the proposed new electric motor driven pump and the existing electric motor driven pump should be

equipped with Variable Frequency Drives (VFD) to allow pump performance to be matched to diurnal flow. In order to perform rehabilitation work, the proposed Plant Interconnect must be in place to reduce flows; however, additional internal bypasses will still be required.

Biofilters

The biofilters remove organic material from the primary effluent and form a flocculent that settles in the final clarifiers. The two biofilters are 165 feet in diameter and have a plastic media depth of 26 feet. Each biofilter has a maximum hydraulic capacity of 50 MGD. Influent flow is distributed equally between the two biofilters and discharged through six rotating arms on the top of each biofilter. As flow passes through the media, colloidal and soluble organics are consumed by the biomass growing on the plastic media. Biomass routinely sloughs off the media as it grows.

At the bottom of each biofilter is a grating system that allows wastewater to pass from the biofilter and air to move upward through the biofilter. Air provides oxygen for the microorganisms on the media and will normally move upward because of natural convection currents caused by the flow of water down the media and the temperature difference between the water and air. It becomes necessary to provide supplemental air when the natural air ventilation is low or when the organic loading on the biofilters increases. Four 18,250-cfm blowers at the base of each biofilter provide this supplemental air, as needed. The elevated walkway from the central stairway to the top of the biofilter shows signs of deterioration and require repair and/or replacement.

The biofilter towers and the media structural support system do not show any significant signs of deterioration. The media does not show obvious signs of deterioration, however it is of an age when media normally requires replacement. The media should be closely monitored and the Capital Improvement Program should plan for its replacement upon signs of deterioration. In order to change out the media; however, the proposed Plant Interconnect must be in service.

Aeration Basins

Effluent from the biofilter towers flows to the aeration basins where any remaining soluble BOD concentrations are reduced and form a better-settling biomass so that suspended solids and BOD concentrations in the final clarifier effluent are minimized. Air is supplied to the aeration basins from the Blower Building.

The south aeration basin's concrete is deteriorating and needs to be repaired. Operations states that the undersides of the concrete beams spanning both north and south aeration basins are deteriorating and in need of repair. Operations have reported some aeration basins have sidewall settling.

The aeration basins are being operated in the activated sludge mode to increase solids removal.

Natural gas fired engines power the blowers. The equipment appears in good condition. However, building modifications or system improvements to facilitate blower and engine operations and maintenance are necessary.

Secondary Sedimentation (Secondary Clarifiers)

The secondary clarifiers remove the suspended solids from the biofilters and/or aeration basin effluent. A portion of the secondary clarifier sludge and biofilter effluent mixture is returned under the biotower into aeration basins to increase the available microorganisms for removal of organic material. The sludge is pumped to the gravity thickeners where it is settled with the primary clarifier sludge.

The secondary clarifiers are generally in good condition. A scheduled maintenance program to examine and repair defective units is ongoing. Additional secondary clarifiers may be required to meet new permit requirements at maximum flow (41 MGD).

Disinfection

The plant, after a decision to move away from gaseous chlorine, uses liquid sodium hypochlorite for disinfection and liquid sodium bisulfite for chlorine neutralization to meet discharge limits for chlorine residual. The present system is classified as a “temporary system”, appears in good shape with no structural problems; however, the remainder of permanent facilities installations should be completed as liquid sodium-hypochlorite disinfection is a permanent part of plant operations.

The plant effluent flow is metered and sampled prior to final discharge to ensure its compliance with discharge permits. Additionally, there is an effluent pump station whose primary purpose is to provide flood protection. During major floods, effluent must be pumped to the Santa Cruz River in lieu of gravity flow to the outfall due to water levels in the Santa Cruz. There are three effluent pumps.

Sludge Stream Facilities

Gravity Thickening

The three gravity thickeners are used to concentrate the excess solids removed from the primary and secondary clarifiers. This reduces the sludge volume, thereby reducing the required size and operating costs of downstream solids treatment units. The gravity thickeners are 50-foot diameter covered concrete tanks and are ventilated to a sodium hypochlorite scrubber. Thickened sludge is pumped to the primary digesters, and supernatant is drained to the primary clarifier influent.

Dissolved Air Flotation Thickening

There are two, each 250-foot DAF, 300-GPM thickeners located in a building west of the gravity thickeners. These units are used for thickening waste secondary sludge only during biofilter sloughing events. These units are outdated, undersized and functionally in need of replacement.

Anaerobic Digestion

The existing anaerobic digester facility was designed as a two-stage high-rate anaerobic digestion system. The objectives of sludge digestion are the reduction of pathogens, the elimination of offensive odors, the inhibition of potential for putrefaction, and the reduction of solids to be disposed. There are four 80-foot diameter primary digesters heated by circulating digested sludge through heat exchangers maintain the digester temperature. These tanks have fixed covers and are equipped with mechanical draft tube mixers. Following the primary digesters are two similarly sized secondary digesters used for thickening and storage of digested sludge and gas collection. Each secondary digester has a floating gas-holder type cover that can provide 30,000 cubic feet of gas storage. Methane gas, a by-product of anaerobic digestion, is used as a part of the total fuel source for power generation equipment and pumps within the plant.

Operators report that scum, not effectively treated within the prior processes, accumulates in the digesters, reducing digester volume, thereby affecting the digester performance. Additionally, grit and rag accumulation within the digesters creates a problem requiring the routine isolation of the digesters for draining and cleaning.

The structural condition of the digesters is questionable as there is evidence of leaks through the walls of several of the units. The lack of digester gas storage is an on-going problem. The storage capacity of the floating covers on the secondary digesters is judged inadequate. The roof of Digester Number 3 reportedly leaks gas and repair attempts have been unsuccessful.

Sludge Pumping

Sludge from Digester Number 4 or Number 5 is pumped by two centrifugal pumps to the regional sludge management facilities at Ina Road through an 8 – inch diameter, 5.3 mile long ductile iron force main. The plant staff reports that although the pump impellers have been trimmed, it is still necessary to throttle a discharge valve to avoid pumping sludge at excessive velocities.

Sludge Drying Beds

PCWMD plans to demolish a majority of the beds retaining and upgrading only the concrete-bottom drying beds (Nos. 3 through 26).

Other (Non–process) Facilities

Energy Recovery/Power Generation System

The Roger Road WWTP produces power and heat using methane gas produced by the anaerobic digester as its primary fuel source. Methane gas is collected and piped to the three engine-generators and three engine-driven biofilter feed pumps. Commercial natural gas supplements the methane gas supply. Heat is recovered from the gas-operated engines and is used to heat the anaerobic digesters as well as to provide plant hot water and heat.

Additional electric power is purchased from Tucson Electric Power Company (TEP). TEP can supply all electrical needs should the on-site electrical generators fail. The digester gas supplies a portion of the fuel for on-site power generation

There have been some problems with the corrosive nature of the digester gas, and PCWMD is studying methods to clean the gas.

The structural adequacy of the basement walls of the building has been questioned as rebar is exposed in places and there are apparently voids that have been identified by sound.

The condition assessment contains several suggestions to upgrade the generators to increase capacity and match generation to plant load.

Electrical Distribution System

The Roger Road WWTP electrical distribution system was designed and installed in several stages over the past fifty years. There are many instances where the equipment and installation do not meet current codes. The Department has commissioned an engineering study to determine electrical system requirements and the 2004 Bond Authorization provides funding for the installation of electrical system upgrades. The electrical system upgrade is also required to proceed with additional process improvements.

Instrumentation and Control System

The plant instrumentation has been upgraded/modified during various plant expansions. The system is in operating condition. The Consultant Condition Assessment contains suggestions for improvements for the Departments consideration.

Administration, Warehouse and Laboratory Buildings

These structures date to the plant's origin in the 1950s and are inadequate for today's operations. The Administration Building contains limited space for staff and modern office equipment. The Laboratory and Warehouse have not been expanded to keep pace with the overall growth in the plant.

It is recommended that new Administrative and Maintenance facilities be constructed in the southeast corner of the plant site, outside the process area, adjacent to Sweetwater Road. The

old maintenance facilities could then be converted to warehouse facilities. The Department might consider a design/build approach utilizing the services of those companies who routinely install pre-engineered buildings at an economical price.

Odor Control

The Condition Assessment found a number of odor control problems and suggested a variety of improvements to the odor control system. Concurrently with this Condition Assessment, the Department commissioned a comprehensive study of odor problems at the Roger Road WWTP. These documents are to be combined into the basis for an engineering design to correct the problems. The study and corrective action are included in the 2004 Bond Authorization.

General

Current standards and recommendations for hazardous area classification will necessitate upgrades to older portions of the plant.

New regulations for treatment and discharge are expected to require nitrification/denitrification of plant effluent

Conclusion and Recommendations

Based on the discussion in this Chapter the following projects should be included in the Roger Road WWTP, elements of the long-range CIP using either System Development Funds (SDF) or Bond Authorizations as available. It should be noted that the $7.1 million Roger Road Biosolids Improvements project will involve relocating biosolids processing to the Ina Road WPCF.

Table 5.1.2 Recommended Improvements and Conceptual Costs Roger Road WWTP

Improvements	Conceptual Cost
Influent Conduits-between Headworks and Primary Clarifiers Condition Assessment	$150,000
Headworks Corrosion Rehabilitation	$1,000,000
Headworks (Grit Removal Area) Emergency Bypass	$500,000
Screening Odor Control Improvements	$1,500,000
Screenings Compactor Operating Platforms	$50,000
Primary and Secondary Clarifier Rehabilitation/Addition	$5,700,000
Biofilter Pumping Station Rehabilitation	$1,500,000
Biofilter Pump/VFD	$1,600,000
Biofilter Media Replacement	$6,000,000
Biofilter Elevated Walkway Repair or Replacement	$150,000
South Aeration Basins-Concrete Repairs (Allowance)	$100,000
Modify Aeration Blower Building to Facilitate Equipment Removal	$200,000
Gravity Thickener Rehabilitation/Ventilation and Odor Control Improvements	$800,000
Dissolved Air Flotation Thickener Replacement	$1,500,000
Biosolids Improvements	$7,100,000
Electrical Testing and Upgrades	$3,000,000
Hazardous Area Classification Improvements	$500,000
SCADA and Control System Improvements	$1,000,000
Nitrification/Denitrification	$50,000,000
Total	**$82,350,000**

Randolph Park Water Reclamation Facility (WRF)

The Randolph Park WRF was originally constructed by the City of Tucson and put into operation in 1975. In 1979 an Inter Governmental Agreement (IGA) between the City of Tucson and Pima County transferred all wastewater treatment responsibilities from the City of Tucson to Pima County. Pima County then operated the plant from 1979 until it was shut down in 1995 during construction of a flood control project on the adjacent golf course. The plant was originally rated at 1.5 MGD, but had an average flow rate of about 634,000 GPD.

In February 2000, the City of Tucson and Pima County entered into a Supplemental IGA. This agreement included restarting the Randolph Park WRF. A portion of the flow of the refurbished facility was designated for irrigation of the adjacent City-owned Golf Course. The remaining plant flows are to be wheeled by Tucson Water to Pima County facilities.

To maximize the reuse benefits from the Randolph Park WRF, it was decided to double the plant capacity on the small site, and thereby change the flow from 1.5 MGD to 3.0 MGD. Even though the plant site is very small, it is in an ideal location to take advantage of the City of Tucson's reuse system. This allows the effluent to be pumped directly into the Tucson Water reuse system without a long force main.

The plant consists of three major components, a lift station, a force main, and the main plant. The lift station is located approximately 2.3 miles to the west of the main plant. This location was needed in order to obtain enough wastewater for the 3.0 MGD facility. Wastewater is scalped from an existing 42-inch Aviation Corridor Interceptor. The remaining flow in that collection sewer continues downstream to the Roger Road WWTP for treatment.

To maximize the main plant site, screenings and grit facilities are also located at the lift station. This has the added benefit of minimizing solids depositions in the force main, as the main solids are removed before pumping. The force main conveys flows to the main plant, where the existing tankage has been re-engineered to allow for the installation of membranes for a membrane bioreactor (MBR) process. The MBR was also selected to maximize use of the existing acreage, as well as provide for a minimum of Class A quality reuse water. The facility is permitted for Class A, but is capable of producing Class A+ reclaimed water.

There are no solids handling facilities located on the site. All solids are conveyed back to the 42-inch Aviation Corridor Interceptor for treatment at the Roger Road WWTP.

Ina Road Water Pollution Control Facility (WPCF)

The Ina Road WPCF will soon be a 37.5 MGD wastewater treatment facility. After passing through newly constructed common Headworks, it was designed for an ultimate 50 MGD flow, consisting of an influent pump station, bar-screens and grit chambers, the wastewater is treated in two different treatment trains, the original 25 MGD High Purity Oxygen (HPO) activated sludge process treatment

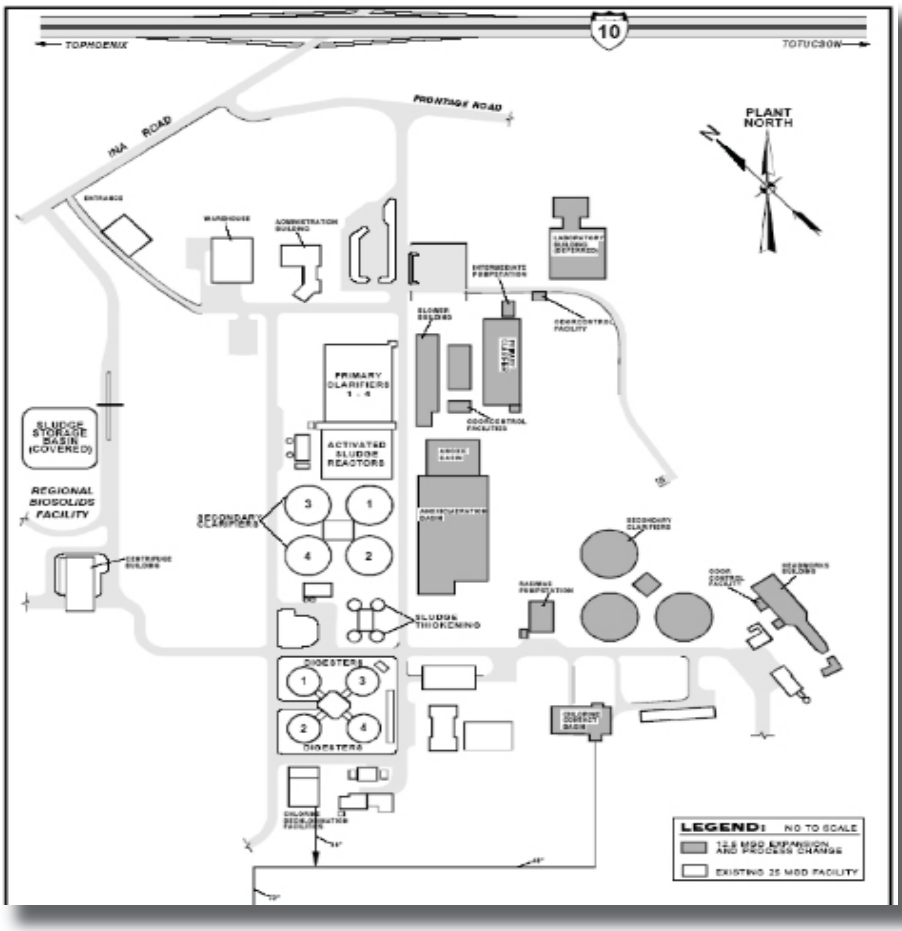
train and a recently completed 12.5 MGD Biological Nutrient Removal Activated Sludge (BNRAS) process. The Headworks, during emergencies, bypasses both trains by routing the wastewater to three emergency influent overflow storage basins.

The HPO-Activated Sludge (HPOAS) Process is a variation of the conventional activated sludge process that uses high purity (85 to 95 percent) oxygen. Typical oxygen concentrations in the reactor are 4 to 8 mg/l with common values as high as 16 mg/l. The original Ina Road WPCF was an EPA innovative technology grant project that influenced Pima County toward utilization of the HPO process.

The original (first) 25 MGD treatment train was designed in 1973 and constructed during the period 1975 to 1977. The treatment train consists of primary clarification, HPO aeration basin activated sludge process and secondary clarification and disinfection. The original plant also incorporates anaerobic digestion and centrifuge solids handling system to meet agricultural land application disposal criteria, and it provides an energy recovery system for on-site generation of electrical power. The original plant layout resulted from a concern for a planned and orderly future growth of the treatment works. The WPCF was designed as the first stage of a regional treatment facility.

In 1987, process modifications to the original design were initiated for operational flexibility and maintainability. Specifically, the modifications provided for normal plant operation when units were out of service for normal maintenance or emergency work. The modifications did not affect the methods of operation, the treatment capacity volume (except for biosolids treatment), or the characteristics of the discharge. The modifications were completed in 1990.

Figure 5.1.3 Ina Road WPCF Site Plan



The second treatment train is a two-stage Biological Nutrient Removal (BNR) or BNRAS process operating in parallel with the existing train. This second train, a 12.5 MGD expansion, was designed in the late 1990s and will be placed in service in 2005. This train consists of primary clarification, biological nutrient removal via nitrification-denitrification using anoxic and aerobic basins, secondary clarification and disinfection. The site plan for the Ina Road WPCF is shown in Figure 5.1.3 and the process diagram for the facility in Figure 5.1.4.

Effluent Discharges

The Ina Road WPCF was constructed to treat sewerage in the Tucson Metropolitan Area north of the Rillito River. The discharge from the WPCF complies with the permit requirements of the Clean Water Act-Arizona Pollutant Discharge Elimination System (AZPDES) and the State of Arizona Aquifer Protection program permit.

Effluent Disposal

The majority of the effluent is discharged to the Santa Cruz River under AZPDES Permit Number AZ0020001. The remainder of the effluent is pumped to the Arthur Pack Golf Course for irrigation. A summary of the principal discharge limits for the plant is shown in Table 5.1.3.

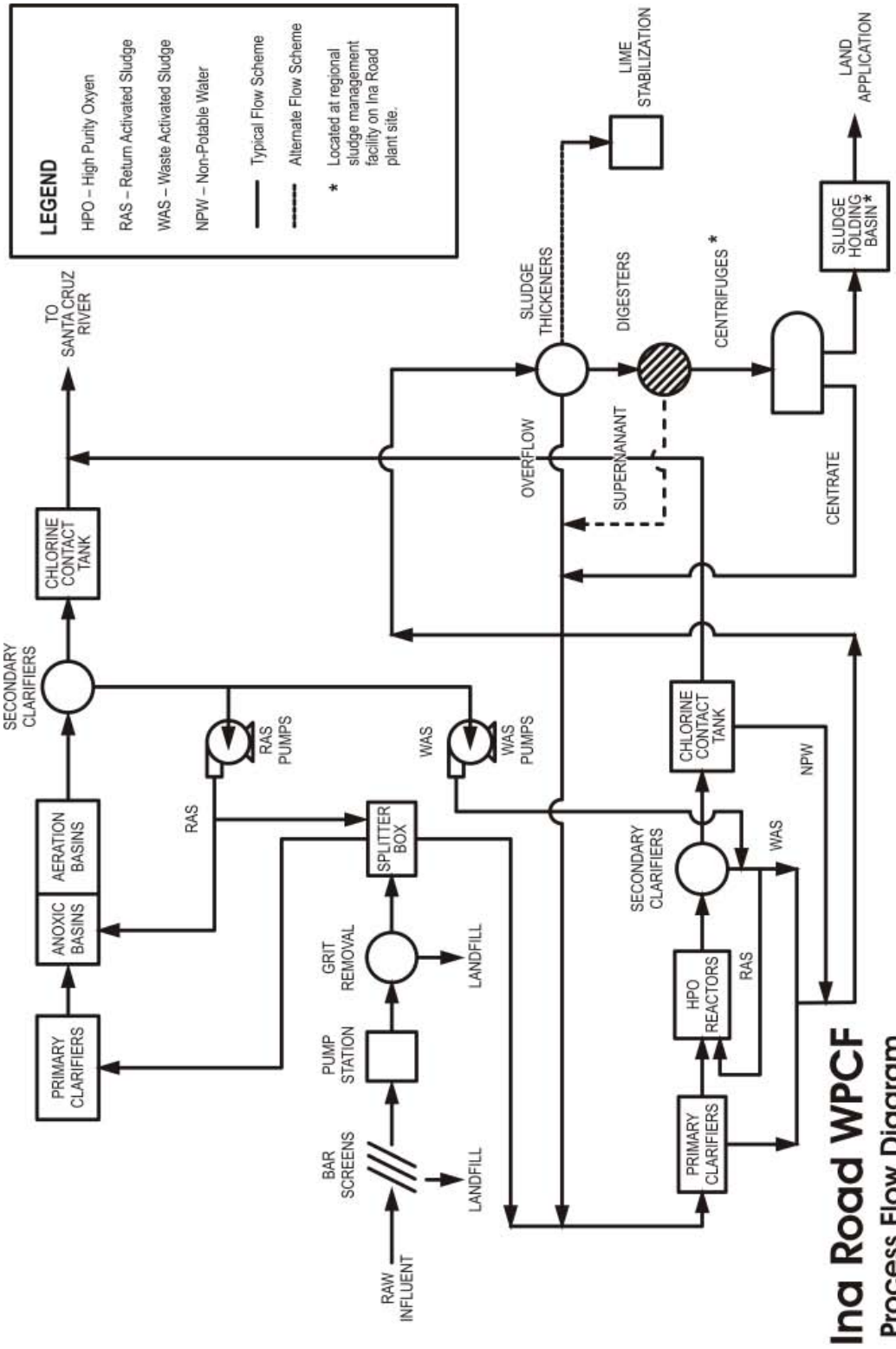
Table 5.1.3 Ina Road WPCF AZPDES Permit Discharge Limitation

Parameter	Avg. Monthly	Avg. Weekly	Daily Max
Effluent Flow, MGD	25	---	---
BOD (5 day), mg/l (kg/d)	30 (2,839)	45 (4,258)	(8,516)
Total Susp. Solids, mg/l (kg/d)	30 (2,839)	45 (4,258)	(8,516)
Fecal Coliform Bacteria	200/100 ml	---	800/100 ml
e-coli Bacteria	126 CFUs/100 ml	---	576 CFUs/100 ml
PH	Not less than 6.5 nor greater than 9.0		
Total Residual Chlorine			0.011 mg/l
Copper (as CU)			38 mg/l

Notes for Table 5.1.3:

1. Effective November 2, 1999 through November 2, 2004.
2. This is not a comprehensive list as the actual permit includes limitations and/or monitoring and reporting requirements for 22 additional effluent characteristics (microbiological, inorganic and organic trace substances).

The present process flow diagram for the Ina Road WPCF is presented in Figure 5.1.4.



Ina Road WPCF
Process Flow Diagram
FIGURE 5.1.4

Current Conditions

The existing facilities at Ina Road WPCF are divided into four parts for this presentation: General, Wet Stream Facilities, Sludge Stream Facilities and Other (Non-Process) Facilities.

The process description of the Ina Road WPCF is divided first into treatment trains and then into subsections for each treatment process. The subsections are Preliminary Treatment, Primary Treatment, Secondary Treatment, Disinfection and Dechlorination, and Sludge Stream and Solids Handling. Last is the discussion of Other (Non-process) Facilities including the power generation, electrical distribution and the Administration, Warehouse and Laboratory facilities.

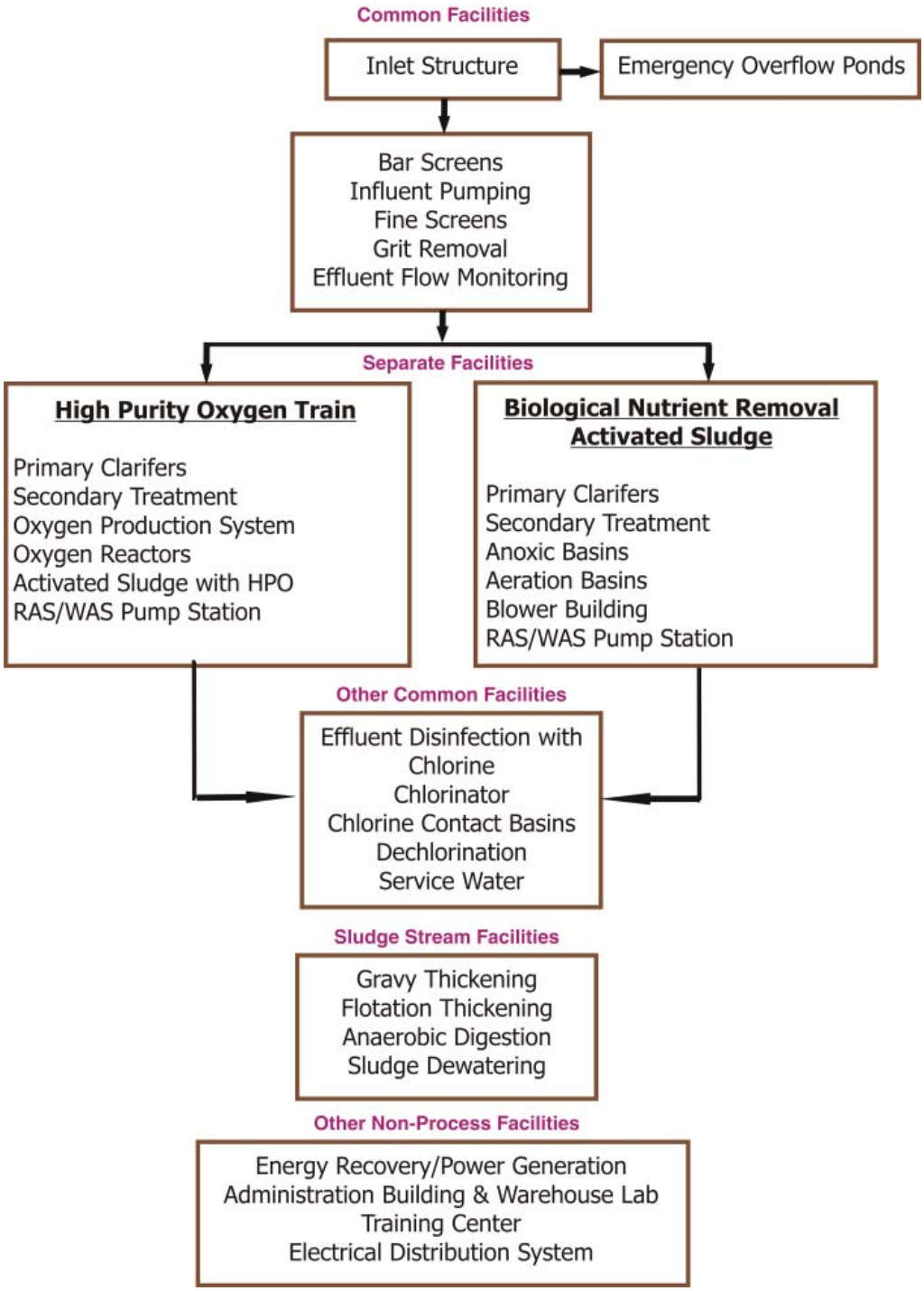
General

- Plant staff practice preventative maintenance on all major equipment. Pumps and small equipment tends to be reactive maintenance. A Computerized Maintenance Management System (CMMS), developed within the Synergen Asset Management system, is recommended.
- Enhanced physical barrier and a remote access control systems are desired to minimize public access to the site and reduce possible terrorism threats.
- New regulations for treatment and discharge are expected to require nitrification/denitrification of the 25 MGD HPO plant effluent. Funding from the 2004 Bond Authorization will provide a portion of the funding for this project.
- The regional Biosolids Facilities will be expanded to treat the combined sludge generated at the Roger Road WWTP. The combined sludge treatment facility will be upgraded to produce Class A biosolids.

Wet Stream

Preliminary Treatment

The preliminary treatment process consists of: Inlet Structure and Emergency Storage Basin; Bar Screens; Influent Pumps; Fine Screens (Headworks); Grit Removal; and Influent Flow Metering; Channel Aerators and a Splitter Structure. Each component is discussed on the following pages.



Headworks

A new headworks facility capable of handling 50 MGD average annual flow was constructed as part of the plant expansion. The new headworks includes larger grit chambers and bar screens, a larger and deeper influent pump station, improved odor control and improved and enlarged Emergency Overflow Basins. The new headworks are divided into three parallel trains of coarse bar screens, pumps, fine screens and grit chambers. This configuration allows one train to be taken out of service for maintenance. A Parshall flume is located in the single channel downstream of the grit chambers to measure total plant influent flow.

The headworks odor control system requires adjustment and balancing to better conduct odors in the area of the fine screens.

Inlet Structure and Emergency Overflow Basins

Wastewater is received via inlet sewers that discharge into a common inlet structure. The inlet structure, part of the original plant, was modified to feed the new headworks through a drop structure. Diversion to the Emergency Overflow Basins is through this structure. A new 72-inch pipe carries the coarse bar screens flow to the influent pumping station. The new headworks are 5 feet lower than the original plant inlet, which has improved the flow in the incoming sewers.

The Emergency Overflow Ponds are gravity fed with a total storage capacity of 18 million gallons (MG) at 2-feet of freeboard. There are three basins, the first of which is concrete lined. The remaining two are plastic lined with polypropylene sheets. If the basins are used, portable pumps deliver the contents of the basin back to the headworks.

Emergency Overflow Basin Number 2, presently plastic lined, should be re-lined with a hard surface to facilitate cleaning.

Bar Screens

Two mechanically cleaned bar screens remove large debris, such as rags, sticks, and various other items from the influent flow to prevent damage to downstream equipment. The bar screens consist of a series of parallel bar spaced 2-inch apart. Debris is trapped on the bars as wastewater passes through them. The bars are cleaned by a mechanical raking device, which carries the debris to a screening conveyor. The screenings are disposed of in the Tangerine Road Landfill owned by Pima County.

Influent Pumping Station

The influent pumps consist of three Archimedes constant-speed, inclined screw pumps. Each screw pump has a bottom bearing that is submerged and must be continuously lubricated during operation. The influent pumps are preceded by a raw wastewater forebay, which makes it possible to divert flow to a standby pump unit. Sluice gates installed in the forebay direct the influent flow to the active pumps. Each pump discharges to a fine bar screen for further removal of trash.

Fine Screening

The influent pumps discharge to three fine screens to complete the debris removal prior to entering the grit chambers. Sluice gates installed in the forebay divert flow to the active screens. The bars are cleaned by a mechanical raking device, which carries the debris to a screening conveyor. The screenings are washed to control odor and with fecal matter being wasted back into the flow stream before disposal at the Tangerine Road Landfill.

Grit Removal and Disposal

Grit removal is accomplished in three chambers. Sluice gates are installed to divert the flow to active grit tanks. Inlet velocity control gates provide a means to vary the flow speed from 0.7-1.3 feet per second (fps). The flow is aerated to keep organics in suspension and aid in sedimentation. While at this slower flow rate, the heavier inorganic solids (grit) will settle to the bottom where they are mechanically pushed to a sump. The grit is pumped to centrifugal grit separators with the grit deposited to a hopper and the water returning to the flow stream. The grit is then hauled to the Tangerine Road Landfill for disposal.

Influent Flow Monitoring

An ultrasonic flowmeter is installed in the conduit connecting the headworks and primary clarifiers. The flow information is transmitted to the WPCF monitoring and control center where the data are utilized for plant control.

Influent Conduit Blower (Channel Aerators)

This blower provides the air required to keep the solids in suspension in the influent channel, thereby preventing deposition, decomposition and odor.

Splitter Structure

The Splitter Structure allows for flow control and proper flow distribution between the new 12.5 MGD train and the existing 25 MGD train.

Headworks Odor Control Facilities

The Preliminary Treatment Section is new and has minimal problems. The presence of escaping odors throughout the facility requires correction by having the systems balanced and fine-tuned.

The following subsections detail the treatment process and components and are divided according to treatment train and further by processes within the trains.

Train A. High Purity Oxygen Activated Sludge (HPOAS) Process (25 MGD)

Primary Treatment

Primary Clarifiers

There are four rectangular, covered primary clarifiers. Primary Clarifiers are designed to retain the wastewater for several hours at minimum flows allowing solids to settle to the bottom for collection as primary sludge. Primary sludge is routed to the thickeners for further treatment. The primary clarifiers are covered to prevent odors and the gases generated are collected, treated and released to the atmosphere.

The clarifiers are designed to remove all the grit, a portion of the suspended solids, the settleable solids and the BOD_5 from the primary influent.

The Primary Clarifiers contain the following equipment aiding in the solids separation and handling:

- The influent baffle is a fiberglass unit that slows the flow and directs the flow downward, promoting settling.

- Collector mechanisms: each clarifier is equipped with drag chains to move the sludge to the sludge pit. A skimmer conveys the scum from the water surface into the scum trough.
- Effluent weirs are V-notched plates which control the wastewater level.
- Sludge pumps are used to pump to either the digesters or the sludge thickeners. There are six centrifugal sludge pumps for the four clarifiers of each train with four operating and two spares.
- Scum pumps are used to pump scum to either the digesters for further treatment or directly to trucks for removal to the landfill. There are two primary centrifugal scum pumps for each train.
- The dewatering pump is a single horizontal centrifugal pump, which drains the tanks. The pump suction can be valved into any of the four primary clarifiers while it discharges to the influent channel.

High levels of hydrogen sulfide, coupled with turbulence induced by the aeration, have caused corrosion in the primary clarifier influent channels. The concrete in this area is unprotected and showing signs of deterioration. Steel cover plates and frames are severely corroded and the inlet sluice gates are leaking.

The present odor control system design for the primary clarifiers requires improvement to efficiently control noxious fumes.

The building housing the scum collection equipment shows signs of corrosion accompanied by odor concerns. The doors and doorframes for the building are corroded to the point the doors are nearly inoperable. The areas around the primary thickeners require improvement to reduce the possibility of stormwater into the WPCF's tunnels during severe summer storms.

Secondary Treatment

Secondary treatment is accomplished by introducing pure oxygen into the primary clarifier effluent. A pressure swing adsorption (PSA) oxygen generation system supplies high purity oxygen. Four rectangular, three-stage, mechanically agitated oxygen reactor tanks provide aerobic conditions to ensure complete biological stabilization of the organic materials in the effluent.

Oxygen Production System

The oxygen production system has various components that are necessary to effectively produce and supply oxygen to the Secondary Reactors. These components are:

- Chilled water pumps.
- Instrument air compressors.
- Oxygen compressors.
- PSA skid.
- Liquid oxygen storage and vaporizer system.
- Storage Tanks for truck delivered oxygen for use during maintenance or emergencies.

The system is considered outdated and should be considered for upgrade.

Oxygen Reactors

There are four oxygen reactor tanks each consisting of three equally sized stages. The entire reactor deck is covered to maintain high purity oxygen in the vapor space for dissolution of oxygen into the mixed liquor, a combination of the primary effluent and return-activated sludge. Each reactor

stage has a surface mechanical aerator (mixer) to provide complete mixing and suspension of the contents and to dissolve the vapor space oxygen into solution. Each mixer includes a hydraulic vapor seal to prevent the loss of reactor oxygen to the atmosphere.

- Each reactor also has a Return Activated Sludge (RAS) line to convey return sludge from the secondary clarifier by way of the RAS/WAS pump station to each reactor first stage.
- The mixed liquor effluent leaving the reactor is designed so that a gas seal is created, preventing reactor vapor gas from escaping. The mixed liquor effluent flows to the secondary clarifiers.
- The individual reactor trains can be dewatered with the reactor dewatering system. The piping configuration at the dewatering pump provides the flexibility to dewater one reactor train and direct the flow to one or all of the other reactor trains.

The reactor concrete roof decks have numerous hairline cracks causing oxygen leakage from the tanks and the mixers need significant replacement/upgrades.

Secondary Clarifiers

There are four secondary clarifiers for the HPOAS process train. The clarifiers are circular tanks with a drive unit providing continuous rotation of the collection tubes and scum scraper arm. As the mixed liquor from the reactors enters the clarifier the solids settle to the floor of the tank. The collection draft tubes direct the settled sludge to the center collection pipe. This sludge is conveyed to the return and waste activated sludge pumps for return to the oxygen reactor inlet or directed to the sludge-thickener complex.

Clarifier scum (floating debris) is collected by a rotating arm that pushes surface scum to a collection trough for gravity flow to the RAS/WAS pumping station sump. It is pumped back to the primary influent channel.

The capacity of the scum and sludge equipment is limited. Operations have enlarged the sludge withdrawal pipes in one of the secondary clarifiers and plans to enlarge the same equipment in the other clarifiers. An engineering study of the capacities of the withdrawal systems should be undertaken.

Train B. Biological Nutrient Removal (BNR) Process (12.5 MGD)

The discussion of this train is limited, as this train is in the final construction stage and should have no repair issues.

Primary Treatment

The two primary clarifiers for train A and B operate similarly to those of the High Purity Oxygen Activated Sludge train.

Secondary Treatment

Secondary treatment in this train employs an anoxic/aerobic process to achieve nitrogen removal. The Modified Ludzack-Ettinger (MLE) is a two-stage nitrogen removal process that uses an anoxic reactor upstream of the BOD oxidation/nitrification reactor (aeration tanks). The MLE process recycles nitrates from the aerobic stage back to the anoxic stage.

Anoxic Basins

There are four equally sized, covered anoxic basins to remove naturally occurring nitrogen from the wastewater. Wastewater overflow from the primary thickeners is combined with Mixed Liquor Recycle (MLR) and RAS in an oxygen depleted environment.

Aeration Basins

The anoxic basin discharges flows to the aeration basins. Forced air is introduced into the five covered aeration basins to accomplish biological treatment of solids and wastewater in an activated sludge process.

Blower Building

The Blower Building is sized to handle the train expansion to 25 MGD. The blowers distribute forced air to the aeration tanks.

Mixed Liquor Suspended Solids (MLSS) Recycle

These horizontal centrifugal pumps collect transport flow from the aeration basin discharge, mix it with RAS flow from the RAS/WAS pump station, and pump it back to the anoxic basins.

Secondary Clarifiers

There are three new secondary clarifiers to service the BNR train, whose operation is the same as the secondary clarifiers for the HPOAS train.

Return and Waste-Activated Sludge Pumping Station

The RAS/WAS pump station is common to both Train A and Train B.

There are five RAS pumps to return clarifier sludge to the oxygen reactors and the anoxic basins. The basic purpose of returning clarifier sludge to the oxygen reactor and the anoxic tanks is to maintain an adequate quantity of microorganisms (biomass) to accomplish the incoming BOD removal.

RAS pumps, powered by a variable frequency drive (VFD) unit, allow the pump motor to vary its speed permitting the pump to maintain an optimum flow of return sludge.

The WAS pumps move activated sludge from the secondary treatment process to the sludge thickeners. The basic purposes of wasting sludge are to fine-tune the balance of a microorganism to the incoming BOD and to maintain a desired solids inventory concentration.

The remainder of the plant is either similar for Trains A and B or combines the flows from both trains, therefore will only be described once.

The existing WAS pumps are noisy and appear to vibrate excessively which could limit pump life. Operations staff had the pumps checked by the manufacturer who found no problems. Vibration mounting may help to limit noise and vibration. The condition assessment noted the crowded nature of this pump station.

Disinfection

The Ina Road WPCF, after a decision to move away from gaseous chlorine, uses liquid sodium hypochlorite for disinfection and liquid sodium bisulfite for chlorine neutralization to meet discharge limits for chlorine residual. The present system is classified as a “temporary system,” which appears in good shape with no structural problems; however, permanent facilities should be planned.

The plant effluent flow is metered and sampled prior to final discharge to ensure its compliance with discharge permits.

Chlorine Contact Basins

There are two chlorine contact basins; each with baffles that direct flow in a serpentine pattern to prevent short-circuiting. Each tank holds approximately 283,550 gallons of water. The tanks receive the mixture of chlorine solution and final effluent and provide a 30-minute contact period.

Dechlorination

There is a single dechlorination facility that receives the effluent of both chlorine contact basins. Dechlorination is achieved by feeding a sufficient amount of sodium bisulfate solution to the effluent prior to discharge to meet permit requirements for chlorine residual. Factors affecting dechlorination are: other oxidants in the effluent, rate of discharge, and the concentration of chlorine in the effluent.

Service Water Building

This Service Water Building houses effluent heat exchangers and an open-mixing chamber where sodium hypochlorite is added. There is some minor corrosion of the steel cladding; however, the structural steel appears to be in good condition. The shell and tube heat exchangers are a maintenance problem and should be repaired.

Sludge Stream Facilities

Existing Conditions

The Solids Handling Process area consists of the following major components:

Dissolved Air Flotation Thickeners

There are three units which use dissolved air to thicken the organic solids causing them to float to the water surface of the thickeners. The sludge collector and float skimmer mechanism collects both the settleable solids and the floatable solids and conveys accumulated solids through discharge piping to the sump pit.

There is one gravity thickener that receives primary sludge only. Large irregular particle sizes of the primary sludge makes gravity thickening the most effective way to dewater these solids. Solids are pumped from the bottom of the thickener to the centrifuges.

The overflow weir collects the supernatant from the unit and conveys the flow to the primary clarifiers.

The thickened sludge pumps move the thickened sludge from the sludge wet wells to the anaerobic sludge digester.

There is some minor concrete corrosion in these units. The concern is unprotected concrete may experience further corrosion, especially if the thickeners are covered to reduce possible odor emissions.

Anaerobic Sludge Digesters

The four digesters stabilize the sludge for easier dewatering and disposal. The organic matter in the thickened sludge is biologically broken down in the absence of oxygen. The process converts approximately 50 percent of the organic solids to liquid and gas. This greatly reduces the volume of the stabilized sludge for disposal. There are mechanical mixers that mix the sludge to maintain sludge consistency. The four hot water heat exchangers control the temperature of the internal contents of the digesters. Four centrifugal pumps supply the hot water from the power production facility to the sludge heat exchangers. Four centrifugal pumps circulate digested sludge through the heat exchanger.

Four centrifugal compressors transport the methane gas, created during sludge digestion, to the power production facility. Pumps transport sludge to the Centrifuge Building for dewatering. The concentration of hydrogen sulfide in the seal water, draining from the compressors, is considered high. It is recommended that compressor seal water be chemically treated by the addition of equipment to reduce the hydrogen sulfide.

The mechanical mixers, while providing adequate mixing, have experienced high failure rates creating inordinate maintenance expenses. Operations staff is replacing the gas piping from the digesters to the Recovery Building that have developed pinhole corrosion leaks; however, an overall gas piping system renovation is required. There is a concern the piping is undersized. Operations staff report delivery pressure to the compressors of 25 psig. The compressed digester gas delivery piping between the Digester Control Building and the Energy Recovery Building requires a capacity increase. It is recommended ladder access to the digester roofs be replaced with stairways.

Centrifuge Facility

The digested sludge from the Ina Road WPCF is joined by the Roger Road WWTP digested sludge at the Centrifuge Building, where three centrifuges thicken the digested sludge. The thickened sludge is pumped to a bladder equipped storage basin. Thickened sludge is then delivered to a disposal firm that uses the sludge for crop fertilization.

Due to piping constraints at the centrifuge facility, only one of the three centrifuges can be used at any one time. This severely limits the quantity of solids that can be thickened. In addition, if the solids are not thickened enough, PCWMD is required to pay a premium to the disposal firm. During periods of high solids production, the centrifuge facility has, at times, been unable to thicken the solids to avoid this premium. Having two centrifuges available for use will greatly enhance solids handling capabilities, and help to minimize operational costs of the facility.

Besides the solids handling issues, the centrifuge facility is also in need of additional odor control facilities, as well as building maintenance (roof). In addition, gas collection under the sludge storage bladder needs to be investigated.

Other (Non-Process) Facilities

Energy Recovery Building

The WPCF generates a portion of its own electrical power from the waste gas produced in the digesters. The methane gas is captured and used as fuel for engine generators, which in turn produce the electricity needed to operate the plant equipment. Natural gas is used to supplement the methane gas as a fuel source. Waste heat from the engines is used to heat the digesters and run an absorption chiller for plant building and process cooling requirements.

The chiller is unable to be used to full capacity as the return water temperature is too high in the summer months. The lack of a suitable overhead crane causes maintenance problems with servicing the generators.

The engine generator facility presently uses 74 percent natural gas and 26 percent digester methane to produce 50 million Kilowatt-hours of power yearly. There is a present project in the 2004 Bond Authorization to expand the Central Plant facilities.

Administration and Maintenance Building (Warehouse)

The functioning of the HVAC system in the combined Administration/Laboratory Building and in the Maintenance Building (Warehouse) has been questioned. It is possible under certain conditions for fumes from the Laboratory to enter the Administration Building ventilation system. The fumes from testing for toxic substances are exhausted with the possibility of re-entry into the office section of

the building providing the opportunity for contamination. The present HVAC system is unable to adequately cool the Laboratory during the summer months.

The plasma and welding areas in the Maintenance Building do not have exhaust hoods positioned to carry the fumes outside. The paint booth exhaust is too close to the building's fresh air intake.

There is a need for additional office, locker room and lunchroom facilities at WPCF. There are proposals to renovate the old Training Center, Filter Building and portions of the warehouse and Administration Building to provide these facilities following relocation of the present scattered laboratory functions to the 2004 Bond Authorization Laboratory Building.

Laboratory

The present WPCF Laboratory space was designed to meet regulatory testing requirements in the 1970s. Testing requirements have greatly expanded since that time. The present laboratory testing requirements have been accommodated in the Administration Building leading to crowded, inadequate facilities. In recognition of this, a new Laboratory Building was included in the 2004 Bond Authorization. A problem with the present completed engineering design was realized. The design for the Laboratory was completed prior to 2000 and the Uniform Building Code. Pima County has adopted the International Building Code since then. The present design will have to be redone to meet the new code requirements.

In the event the Laboratory Building must be redesigned, the possibility of relocating the building to the area between the Sports Park and the new Outlying Facilities Building should be reviewed. New Training facilities are to be incorporated in this design. A design/build pre-engineered building may prove the most economically feasible solution.

Training Center

New Training Facilities will be included in the new Laboratory facility. The existing Training Facility could possibly be converted to lunch and locker room facilities.

Electrical Power Distribution

The 2004 Bond Authorization contains a project to upgrade the electrical distribution system within the WPCF site. In addition, a program to assess and replace deficient outdoor substations and motor control centers is recommended. A study to replace manual transfer switches between regular and emergency power sources is recommended. In general, an upgrading of the electrical and control system, not covered by the 2004 Bond Authorization, is recommended.

Continental Ranch Pump Station

The Continental Ranch Wastewater Pump Station (CRWWPS) is located approximately one half mile east of Silverbell Road, halfway between Twin Peaks and Avra Valley Road. This facility presently serves the area downstream of the Ina Road WPCF, that area being roughly from Ina Road North along both sides of Silverbell Road to one-half mile south of Avra Valley Road, the area west of Camino de Oeste and east of an extension of Blue Bonnet Road. The main population in the area is concentrated in the Continental Ranch area east of Silverbell Road with the major future expansion expected to be between Camino de Oeste and Interstate 10 (I-10). This area expansion involves large parcels of State land whose release for development is dependent upon the State Land Department.

The Dove Mountain development, located west of Camino de Oeste, flow can reach the CRWWPS by gravity and currently is pumped to the Camino de Oeste trunk sewer at Tangerine Road. The Camino de Oeste trunk sewer is presently flowing below 50 percent capacity while conveying flow, including Dove Mountain, directly to the Ina Road WPCF by gravity.

The Continental Ranch pump station delivers wastewater to the Ina Road WPCF by means of a 26-inch diameter (18-inch Internal Diameter) HDPE pipeline routed generally along the west bank of the Santa Cruz River to Cortaro Farms Road, then runs along Silverbell Road to Ina Road and then along Ina Road to the WPCF. The majority of the route is under the riverside park close to residential areas. The pump station presently has three motor driven pumps with provisions for a fourth pump. The principal area of concern, due to the limitations of on-site storage, is the handling of diurnal flow. Presently, during peak periods of gravity flow to the pump station, the limitations of the wet well, pumps and pipeline set pumping capacity to between 4,000 to 4,400 gallons per minute (GPM) or 5.76 to 6.34 MGD respectively, Peak Wet Weather flow.

The Continental Ranch Pump Station has issues principally caused by the pump feed wet well being undersized. The operational size of the wet well from pump start to overflow is approximately 8,000 gallons. This is a relatively small retention time given the present inflow rate of 2,400 GPM. This allows only 3.3 minutes (8,000/2,400) for the operators to react should a pump fail or to switch to emergency power in case of an outage. This does not give a comfortable margin of safety before a Sanitary Sewer Overflow (SSO)would commence. There is a proposed project to rehabilitate and update this facility that should be undertaken as soon as possible.

Conclusion and Recommendations

Based on the discussion in this Chapter, the following projects should be included in the Ina Road WPCF elements of the long-range Capital Improvement Plan (CIP) using either SDF or 2004 Bond Authorizations as available.

Table 5.1.4 Recommended Improvements and Conceptual Costs for Ina Road WPCF

Improvements	Conceptual Cost
Computerized Maintenance Management System Implementation	$1,500,000
Facility Security Improvements	$210,000
Drainage Improvements at Existing Primary Clarifiers	$50,000
Emergency Overflow Basin #2 Lining	$2,000,000
Headworks Ventilation/Odor Control Improvements (Allowance)	$500,000
New Sluice Gates at Existing Primary Clarifiers	$400,000
Replace Cover Plates/Seat Angles at Existing Primary Clarifiers	$50,000
Rehabilitate and Protect Concrete/Retrofit Odor Control at Existing Primary Clarifiers	$1,500,000
Replace Skimmer House Doors/Retrofit Ventilation and Odor Control Improvements	$1,000,000
Nitrification/Denitrification (Existing Plant)	$27,000,000
Rehabilitate Oxygen Reators Concrete Deck	$3,500,000
Secondary Clarifier/RAS Pump/WAS Pump Improvements	$2,500,000
Permanent Chlorination/Dechlorination Facilities	$5,000,000
Waste Heat Exchanger Improvements at Service Water Building	$990,000
Digester Gas Piping System Renovation	$520,000
Digester Gas Piping Capacity Expansion	$500,000
Digester Gas Compressor Seal Water Drains/H2S Treatment	$100,000
Digester Roof Access Improvements/Minor Insulation Repairs	$200,000
Biosolids Improvements	$42,000,000
Centrifuge Building Odor Control Improvements	$730,000
Roger Road Sludge Fine Screening	$500,000
Energy Recovery Building Crane/Monorail Improvements (Allowance)	$300,000
Administration/Maintenance Building HVAC Improvements	$1,000,000
Office/Locker Room/Lunchroom Renovation	2,800,000
Electrical Improvements (Allowance)	3,000,000
Total	**$97,850,000**

SUB-CHAPTER 5.2 METROPOLITAN AREA TREATMENT SYSTEM FUTURE CONDITIONS

Treatment capacity is divided between the large Metropolitan Area treatment plants, Roger Road WWTP and Ina Road WPCF and the smaller facilities serving the outlying areas of Pima County. The Randolph Park WRF is within the Roger Road Tributary System. These treatment plants and their current conditions have been discussed in detail in Chapter 5.1.

The Drivers defined in Chapter 3.0 affect the future of the Metropolitan Treatment Facilities.

Regulatory Issues affecting the Roger Road WWTP and Ina Road WPCF facilities are increasing regulatory insistence upon de-nitrifying effluent. These increasingly stringent regulations are reflected in the AZPDES and Aquifer Protection Permits (APP). The effect of these permit requirements is the inclusion of projects to nitrify and de-nitrify the Roger Road WWTP and Ina Road WPCF facilities in the CIP. The new Randolph Park WRF is designed to de-nitrify discharge and further filters its discharge to provide Class A reclaimed water that discharges directly into the Tucson Water Reclaimed Water System.

Institutional Issues at the Roger Road WWTP concern the availability of surrounding land owned by the City of Tucson and the Arizona Department of Transportation. The City of Tucson operates a reclaimed water filter plant on its adjacent property while ADOT owns buffer property along I-10. An IGA identifying planned future uses of the involved government agencies and possible land exchanges would be beneficial. There is an IGA identified land exchange at the Ina Road WPCF giving the City of Tucson acreage to construct reclaimed water system facilities. The Randolph Park WRF is the result of the 2000 IGA between the City of Tucson and Pima County.

Asset Management is an outgrowth of the condition assessment of the treatment plant discussed in Chapter 5.1 that will be developed into an ongoing program.

Tributary Area and Sewer Basins

The population effects and resulting individual treatment facility capacity requirements are a major factor in any discussion of the future of the Metropolitan Treatment Facilities. The following narrative discusses the expected demands for capacity on Roger Road WWTP, Ina Road WPCF and Randolph Park WRF.

The tributary areas to Roger Road WWTP and Ina Road WPCF are shown in Figure 5.2.1. The Roger Road WWTP tributary area is shown in rose and the Ina Road WPCF tributary area in green. Although both these treatment plants are designated as urban facilities, the extent of the tributary systems to both plants encompass basins on the fringes of the urban areas expected to experience significant population growth in the next 25 years (see Figure 5.2.2). Basins 1B, 11, 25A, 36, 43A, 43B, 48, 49, 54, 73, 97 and 113 in the Roger Road WWTP tributary area and Basins 17, 50, 69, 84, 85,102 and 103 (see Figure 5.2.3) in the Ina Road WPCF tributary area are forecast to experience between 50 and 500 percent increases in population within the next 20 years (see Figure 3.4.8).

Roger Road WWTP Tributary Area

The basins in the Roger Road WWTP tributary system projected for greatest population increase by present PAG projections are located at the extreme ends of the conveyance system (in the case of Basin 43B approximately 24 miles away). Basin 43A and 43B serve the Rita Ranch, the Houghton Area Master Plan (HAMP) development and the Vail area. Any number of factors could lead to delays in development implementation in this area, such as delays in availability of state land or economic factors such as rising gasoline prices or rising mortgage interest rates.

The HAMP encompasses 10,800 acres or 16.9 square miles at the eastern boundary of incorporated Tucson. The boundaries are Irvington Road on the north, Harrison and Houghton roads on the west, approximately one mile north of I-10 on the south and three miles east of Houghton. The Arizona State Land Department owns a large portion (72 percent) of the area under the state trust.

The 2006 Metropolitan Area Facility Plan Update recommends evaluation of the need for a water reclamation facility to serve the far southeast area of the Metropolitan Area. The facility would be constructed as the Pantano Interceptor sewer approaches flow capacity. Based on current PAG population projections, the need for this facility is projected to occur sometime between 2010 and 2015. Therefore, as the development of the Houghton area continues and more specifically within the HAMP, construction of an eastside fully functioning wastewater treatment facility providing reclaimed water for distribution by Tucson Water's Reclaimed Water System may be appropriate. Initial flows from this area would be directed through the Pantano Interceptor and/or Southeast Interceptor until sufficient flows are developed to begin operation of this sub-regional facility. The facility would be expanded to meet increases in flows as the area grew.

PCWMD and the City of Tucson have agreed that a Community Facility District would be most appropriate to fund this facility, if the evaluation demonstrates need and feasibility. This would establish a funding mechanism to support this specific need and allow the facility to be expanded as the area develops.

The Randolph Park WRF, serving a sub-region of the Roger Road WWTP Tributary Area, reduces flow in the conveyance system to Roger Road WWTP by producing reclaimed water in the center of the City of Tucson while returning the solids portion (less than 5 percent) to the conveyance system for final treatment at Roger Road WWTP.

Ina Road WPCF Tributary Area

The basins in the Ina Road WPCF tributary area are somewhat closer but Basin 60 and 84, which represent Rancho Vistoso and Catalina respectively, are approximately 10 miles away from the Ina Road WPCF. The basins in the Ina Road WPCF tributary system, projected for less aggressive population growth by present PAG projections, and which had been impacted by the restrictions on development due to the Pygmy Owl presence, have become far more development-active in the past year following easing of Federal Pygmy Owl restrictions. Although not presently targeted by PAG for explosive growth, Basins 93 (Dove Mountain), and Basins 28, 59 and 8 (see Figure 5.2.4) are experiencing significant development activity. Should potential homeowners find these areas more desirable than areas in the Roger Road WWTP tributary system, flow growth would change from the Roger Road WWTP to Ina Road WPCF. Further, future population presently forecast as tributary to one of the Outlying Facilities may shift among these facilities or move into the Roger Road WWTP or Ina Road WPCF tributary areas.

Given the uncertainty of the location of development within the Metropolitan Area, PCWMD is pursuing a policy of providing maximum flexibility in directing flow and providing capacity at its treatment facilities.

Home Flows and Managed Flows

The Facility Plan Model Average Dry Weather Flow (ADWF) Excel spreadsheets have been developed for the Roger Road WWTP and Ina Road WPCF tributary areas. The ADWF spreadsheets, in addition to providing predictions for the conveyance system, also provide at their apex, predictions of the average dry weather flow to the Roger Road WWTP and Ina Road WPCF treatment plants.

The ADWF is the average daily flow calculated for a theoretical month with the average flow of the total year. However, treatment capacity is defined in the Arizona Administration Code under the

terms “Design Flow” and “Design Capacity.” Both terms essentially require sustained and reliable performance complying with permit conditions under peaking and contingency conditions. Permit conditions include discharge quality requirements and operational requirements. Design flow is the maximum average daily flow (MADF) (calculated in the month that has the highest total flow for the year) at which a facility can comply with discharge quality requirements.

It should be noted, the ADWF for this Facility Plan is conservative and will be used as equivalent to the MADF when discussing the treatment plant capacity. Preliminary calculations indicate the MADF occurs in the summer months and is approximately 1.1 times the ADWF. The methodology used for calculating ADWF was calibrated using collection system flows and treatment plant influent flows in November and December 2004. The ADWF was based on 85 gallons per capita per day based on ADEQ approved methodology. The actual average per person wastewater generated is closer to 65 gallons per capita per day for the Metropolitan Area. Therefore, the ADWF calculations are conservative by a factor of 1.3 (85/65 = 1.3). Since the MADF peaking factor of 1.1 is less than the conservative factor of 1.3, the ADWF for treatment should be calculated and used for implementation of wastewater treatment projects.

The Facility Plan Model forecasts the ADWF to the Metropolitan Treatment Facilities by totaling the individual flows at Roger Road WWTP and Ina Road WPCF. The total Metropolitan Treatment Facilities, the combined Roger Road WWTP and Ina Road WPCF tributary systems, flow in any month is relatively constant; however, the flow to Roger Road WWTP and Ina Road WPCF varies in accordance with the activities at the flow management structures within the Conveyance System. The Tucson Boulevard Flow Management Structure (TBFMS) is the significant management device currently used to manage flows between the two tributary systems. A meter at the TBFMS constantly monitors flow directed from the Roger Road WWTP tributary system to the Ina Road WPCF tributary system. The TBFMS permits PCWMD limited management of the flows going to the individual treatment plants. This flexibility allows PCWMD to utilize unused treatment capacity within the Metropolitan Area by directing flows away from either plant to permit maintenance and to stay within the design capacities of both plants. The current unused treatment capacity is located at Ina Road WPCF.

The TBFMS is limited in the volume of flow that can be directed away from Roger Road WWTP without adversely affecting the conveyance system as was shown in Chapter 4.2. The solution to this limitation is the Plant Interconnect project proposed in the 2004 Bond Authorization. The magnitude of the required diversion is best presented in terms of ”Home” versus “Managed” flows.

Home flows are defined as those flows arriving at a treatment plant by gravity barring any transfer between tributary systems. Managed flows are the flows arriving at either plant following flow transfer between the tributary systems. This concept is utilized to demonstrate how PCWMD intends to use the current capacity in the Metropolitan Treatment Facilities to treat future flows.

The data for ADWF at the Roger Road WWTP and Ina Road WPCF treatment plants for the years 2005 through 2025 is shown in table 5.2.1 and 5.2.2. Table 5.2.1 presents the “Home” flows. Table 5.2.2 displays the flows to Roger Road WWTP and Ina Road WPCF; however, 5.35 MGD of wastewater has been diverted from the treatment plants in 2005. This flow reduces to zero in 2015 upon installation of the plant interconnect. The 5.35 MGD value was chosen to match the actual average daily flow being transferred from the South to the North Rillito Interceptor in December 1 through 15, 2004 as recorded by PCWMD’s SCADA flowmeter located at the TBFMS.

The Facility Plan Model considers the Roger Road WWTP to Ina Road WPCF Plant Interconnect will be installed by 2015. The ADWF to Ina Road WPCF and Roger Road WWTP reflects the impact of the plant interconnect from 2015 to 2025.

The population tributary to the two treatment plants on sewer (no septic) for the year 2000 was obtained from PAG 2000 Traffic Analysis Zones (TAZ) data reduced by the basin population estimated to be on septic. The 2000 flows for both plants were taken from historical plant effluent records. These figures may not be "Home" flows as flows diverted from Roger Road WWTP to Ina Road WPCF were not recorded. This appears to be the reason for the reduction in flow at Ina Road WPCF from 2000 to 2005.

The flow values for 2005 and beyond displayed in the table are the calculated values from the Facility Plan Model based upon PAG population forecasts. The 2005 ADWF of 38.92 MGD (44.27 - 5.35) calculated for Roger Road WWTP, compares favorably with the 38.95 MGD obtained from plant records for early December 2004. The 22.25 MGD (16.90 + 5.35) calculated for Ina Road WPCF in 2005 compares closely with the 22.63 MGD obtained from plant records for early December 2004. The apparent decrease in flow between the recorded value in 2000 and December 2004 may be due to the decrease in total inflow and infiltration in these drought years.

Table 5.2.1 Home Flows

Wastewater Home Flows to the Roger and Ina Treatment Plants											
	Roger Road WWTP System						Ina Road WPCF System				
	Roger Rd WWTP Tributary System Total Population on Sewer	Randolph WRP	Plant Interconnect	Tucson Blvd Flow Management to Ina	Total Flow Treated at Roger Road WWTP MGD	Total Home Flow in Roger System MGD	Ina Rd WPCF Tributary System Total Population on Sewer	Plant Interconnect	Tucson Blvd Flow Management from Roger	Total Flow Treated at Ina WPCF MGD	Total Roger and Ina (From Plant Daily Records for 2000) MGD
2000	459,598	0.00	0.00	0.00	42.72*	42.72*	198,821	0.00	0.00	18.58*	61.3[1]
2005	503,037	0.00	0.00	0.00	44.71	44.71	225,142	0.00	0.00	17.36	62.1
2010	529,568	3.00	0.00	0.00	43.95	46.95	233,150	0.00	0.00	18.04	65.0
2015	569,202	3.00	0.00	0.00	47.29	50.29	243,099	0.00	0.00	18.84	69.1
2020	604,536	3.00	0.00	0.00	50.27	53.27	253,056	0.00	0.00	19.65	72.9
2025	640,506	3.00	0.00	0.00	53.31	56.31	262,811	0.00	0.00	20.43	76.7
2030	714,919	3.00	0.00	0.00	56.31	62.72	284,957	0.00	0.00	50.00	85.05

1. Flows taken from plant records for the year 2000 and adjusted by 5.35 MGD (added to Roger and subtracted from Ina) to account for flow management.

It should be noted that the percentage of Biological Oxygen Demand (BOD) and suspended solids (SS) in the Metropolitan Area flows has increased over the past five years.

Notes to Table 5.2.1

1. Roger Road WWTP Tributary System Total Population on Sewer is the total population whose wastewater would naturally flow to Roger Road WWTP if the flow were not directed elsewhere by the Tucson Blvd Flow Management Structure.

2. Randolph Park WRF is the wastewater treated at Randolph Park WRF and hence subtracted from the flow to the Roger Road WWTP.
3. Plant Interconnect is the pipeline that will connect the Roger Road WWTP and the Ina Road WPCF.
4. TBFMS makes possible the re-direction of flow originating in the Roger Road WWTP Tributary System to be treated at the Ina Road WPCF.
5. Total flow treated at Roger Road WWTP is the flow entering the WWTP after flow has been either treated at Randolph Park WRF or re-directed by means of the plant interconnect or the TBFMS.
6. Total Flow Home Flows in the Roger System are the sum of flows treated at Roger Road WWTP, flows treated at Randolph Park WRF and those re-directed by either the Plant Interconnect or the TBFMS.
7. Similar titles for Ina Road WPCF Tributary System have the same meanings when applied to the Ina System.
8. Total Roger Road WWTP and Ina Road WPCF is the total flows treated by the Roger Road WWTP and Ina Road WPCF Tributary Systems.

The current Metropolitan Treatment Facilities configuration is shown in Figure 5.2.5. Table 5.2.2 presents the "Managed Flows" to the Roger Road WWTP and Ina Road WPCF. The managed flows table considers that 5.35 MGD is transferred from the Roger Road WWTP to the Ina Road WPCF tributary area in each period considered from 2000 through 2015. In the periods 2015 to 2030 this flow reduces to zero while the Plant Interconnect transfers flow between plants. Randolph

Table 5.2.2 Managed Flows

Wastewater Managed Flows to the Roger and Ina Treatment Plants											
	Roger Road WWTP System						Ina Road WPCF System				
	Roger Rd WWTP Tributary System Total Population on Sewer	Randolph WRP	Plant Interconnect	Tucson Blvd Flow Management to Ina	Total Flow Treated at Roger Road WWTP MGD	Total Home Flow in Roger System MGD	Ina Rd WPCF Tributary System Total Population on Sewer	Plant Interconnect	Tucson Blvd Flow Management from Roger	Total Flow Treated at Ina WPCF MGD	Total Roger and Ina MGD
	(Estimate for 2000)						(Estimate for 2000)				
2000	459,598	0.00	0.00	0.00	42.72[1]	42.72[1]	198,821	0.00	0.00	18.58[1]	61.3[1]
2005	503,037	0.00	0.00	-5.35	39.36	44.71	225,142	0.00	5.35	22.74	62.1
2010	529,568	3.00	0.00	-5.35	38.60	46.95	233,150	0.00	5.35	23.39	65.0
2015	569,202	3.00	-18.66	0.00	28.63	50.29	243,099	18.66	0.00	37.50	69.1
2020	604,536	3.00	-17.85	0.00	32.42	53.27	253,056	17.85	0.00	37.50	72.9
2025	640,506	3.00	-17.07	0.00	36.24	56.31	262,811	17.07	0.00	37.50	76.7
2030	714,919	3.00	-27.67	0.00	32.05	62.72	284,957	27.67	0.00	50.00[2]	85.05

1. Flows taken from plant records for the year 2000.
2. Following the 2026/9 12.5 MGD expansion of Ina Road WPCF to 50 MGD capacity.

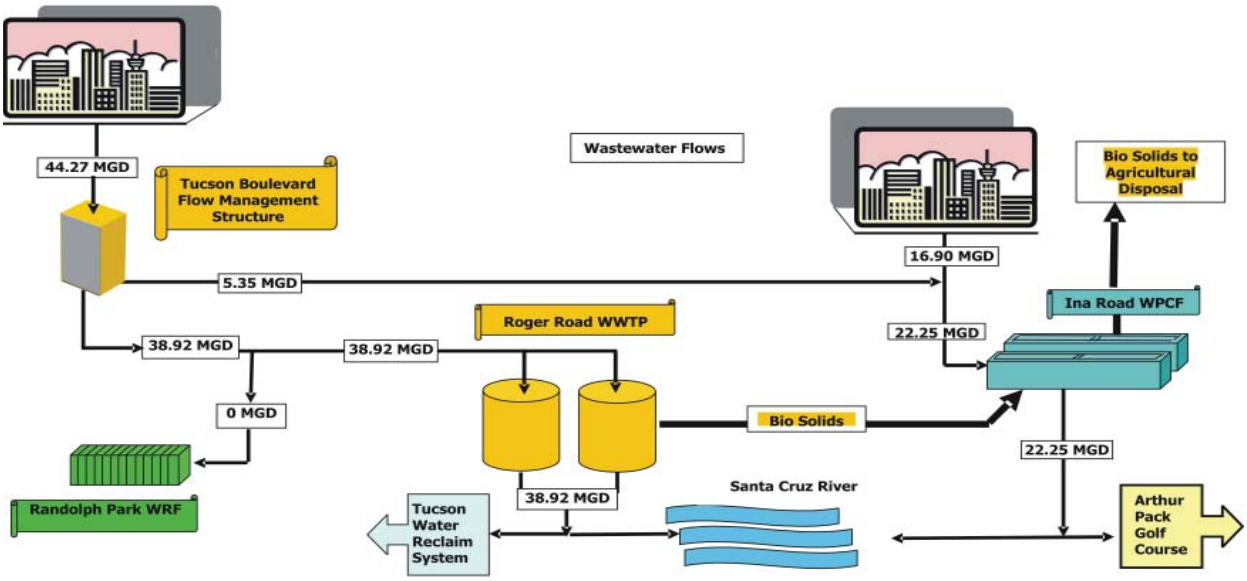
Park WRF, when fully operational, reduces the flow to Roger Road WWTP by 3.0 MGD in periods subsequent to 2005.

The management of flows between the two plants is obviously a key issue. Chapter 4.2 Conveyance Future Conditions displays the limits of continued flow management by using the North Rillito Interceptor (NRI) as forecast flows are presently causing capacity issues. However, by the use of a plant interconnect, PCWMD intends to manage flows to the two plants to utilize the combined in-place design capacity as one treatment entity.

The voters of Pima County approved a 2004 Bond Authorization Project for construction of a pipeline connecting the Ina Road WPCF and Roger Road WWTP. The Plant Interconnect will allow, in 2015, treatment of up to 18.7 MGD of wastewater tributary to Roger Road WWTP at Ina Road WPCF reducing flow through the Roger Road WWTP to approximately 30.2 MGD enabling PCWMD to proceed with the rehabilitation projects described in Chapter 5.1 Current Conditions for the Roger Road WWTP.

Figure 5.2.5

Metropolitan Treatment System
Status as of March 2005



Chapter 5.1 Treatment Current Condition presented current conditions at the Roger Road WWTP and Ina Road WPCF. The capacity of the Ina Road WPCF will reach 37.5 MGD in 2006 with the addition of the new BNR treatment train. The future expansion of the Metropolitan Treatment Capacity by 12.5 MGD for the years beyond 2025 is already planned at Ina Road WPCF by increasing capacity from 37.5 MGD to 50 MGD.

As noted in Chapter 5.1, the recently completed Ina Road WPCF headworks was designed and constructed for expanding the headworks to 50 MGD capacity. Likewise, the engineering design and construction of the new BNR treatment train considered its expansion from 12.5 MGD to 25 MGD. The plant layout provided space in all its parts for inclusion of additional tanks and equipment to accomplish this expansion to 25 MGD.

Roger Road WWTP, by comparison, has no present plan for a physical expansion beyond the 41 MGD. The Randolph Park WRF, when placed in service and the 3.0 MGD of reclaimed water produced is delivered to the Tucson Water Reclaimed Water system, will add an additional 3.0

MGD of capacity to the Metropolitan Treatment Facilities raising capacity to 81.5 MGD when the Ina Road WPCF expansion to 37.5 MGD is completed in 2006.

The foregoing discussions of plant flows and capacities consider the capacity of the plants at current permit discharge limits. The effect upon treatment capacity of more restrictive regulatory requirements is discussed in Chapter 3.1 Regulatory Drivers.

Dynamic Process Modeling

PCWMD is currently actively engaged in dynamic process modeling of the Roger Road WWTP, Randolph WRF and Ina Road WPCF together with several of the Outlying Facilities. This modeling effort will provide guidelines for optimizing the current plant process to realize their maximum treatment potential, and also allow PCWMD to further model treatment additions for plant upgrades to meet future regulatory permit requirements. PCWMD's dynamic modeling program is discussed in Sub-chapter 5.5.

Enhanced Activated Sludge Treatment Process

PCWMD is investigating methods to enhance the activated sludge processes used at the Ina Road WPCF and Roger Road WWTP. The enhancements are considered necessary to meet increasing regulatory discharge standards. Common names for these processes include: attached growth suspended integrated fixed film activated sludge, hybrid activated sludge, moving bed bioreactors, microfiltration and submerged attached growth bioreactors. These processes, if successful, promise to increase the capacity of the existing plants while providing a lower cost means to meet increased effluent regulatory requirements. A fixed film process will be investigated by dynamic modeling and demonstrated in the Marana WWTF in FY2005/06. The process demonstration will include field conducted pilot plant studies as needed to acquire ADEQ BADCT approvals. Should the outcome of the demonstration be successful its application to other PCWMD treatment facilities may be recommended.

PCWMD also plans to investigate the merits of several other processes such as high rate anaerobic reactors and pre-fermentation by dynamic modeling before further discussion.

The success of the demonstration project and BADCT acceptance by ADEQ allow the capacity issues at Roger Road to be readdressed. This may impact the selection of the process to upgrade Roger Road WWTP to a nitrifying-denitrifying facility.

Continental Ranch Pump Station (CRWWPS)

As of December 2004, the ADWF flow to the CRWWPS is approximately 1.6 MGD. The peak dry weather flow (PDWF) for the same period is approximately 1.83 MGD with the maximum pumped discharge reaching 2,400 GPM. These flow figures were obtained from Operations personnel. A basin study was performed for PCWMD in 2002, forecasts an ADWF of 2.34 ADWF and a PWWF pump discharge of 3374 GPM for 2005. The current recorded flows for are approximately 68 percent of those forecast in the basin study.

The basin study forecasts an ADWF of 8.36 MGD and a PWWF of 17.06 MGD at this facility in 2025. The Facility Plan Model forecasts for this facility in 2025 are 2.43 MGD ADWF and 4.12 MGD PDWF. Given the variations in flow forecasts and the variation of forecasts from actual data, PCWMD is carefully investigating the necessity for the addition of a second force main from CRWWPS to Ina Road WPCF.

Given the operational problems with the CRWWPS and the operating cost of power, staffing and maintenance the long-term solution to capacity problems is to extend the gravity sewer serving the pump station downstream to either a new treatment facility near Tangerine Road and I-10 or

to continue the sewer to the Marana Airport and join the 2004 Bond Authorization funded sewer from the airport downstream to an enlarged Marana WWTF.

Conclusion and Recommendations

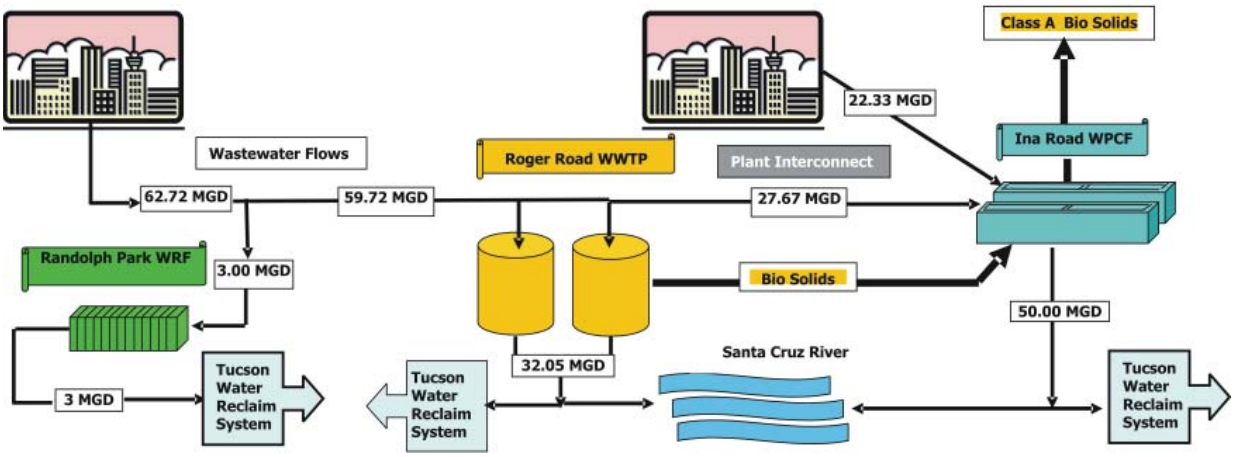
The major concepts in establishing an integrated Metropolitan Treatment Facilities are graphically presented in Figure 5.2.6.

The rehabilitation and upgrade program for the Metropolitan Treatment Facilities over the next twenty-five years involves the following elements:

- Place the new 3 MGD Randolph Park WRF and 12.5 MGD Ina Road WPCF in service in 2005/06.
- Rehabilitate Ina Road WPCF in accordance with the recommendations in Chapter 5.1.
- Construct the Plant Interconnect between Roger Road WWTP and the Ina Road WPCF expeditiously.
- Transport approximately 18.6 MGD of flow tributary to Roger Road WWTP initially for treatment at the expanded Ina WPCF Facility to allow rehabilitation of Roger Road WWTP.
- Convert the main electrical transformer at Roger Road WWTP from a Delta to a Wye system.
- Convert the Roger Road WWTP away from plant-generated gas to electric driven motors.
- Modify the Roger Road WWTP to allow half the WWTP to be taken out of service to facilitate rehabilitation and upgrade.
- Rehabilitate and upgrade the portion of Roger Roger WWTP that is off line following the suggestions contained in Chapter 5.1 Current Conditions for the Roger Road WWTP.

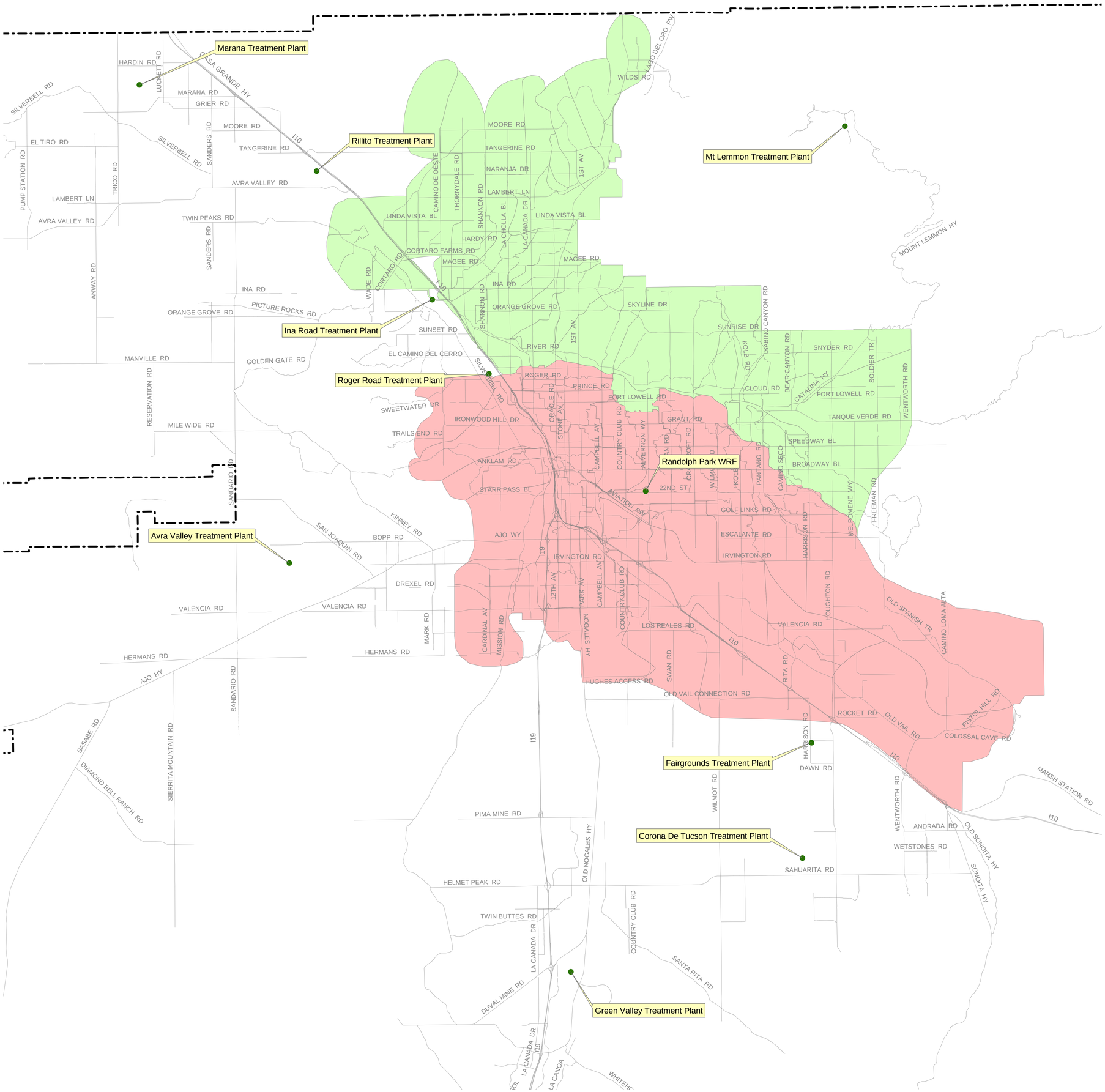
Figure 5.2.6

Metropolitan Treatment System
December 2030



- Determine if the present sludge pumping system is capable of pumping the total sludge produced at the Roger Road WWTP (from a maximum flow of 41 MGD at Roger Road WWTP and 3 MGD from Randolph Park WRF). Add new, if any, pumping and electric distribution equipment. The present pipeline, although it has the capacity to deliver the sludge for the 41 MGD WWTP, provides no back-up line and the pumping system would need to be modified to pump raw sludge.
- Upgrade the Ina Road WPCF powerhouse to gas turbine generators to utilize the total methane gas generated by the expanded Ina Road WPCF Biosolids.
- Following rehabilitation and upgrading of the first one half of the Roger Road WWTP, rehabilitate and upgrade the remainder of the WWTP.
- In 2020, begin engineering to expand Ina Road WPCF to 50 MGD.
- Initiate the 2004 Bond Authorization project, Ina Road WPCF Denitrification, and determine if additional funds will be needed to nitrify/denitrify the 25 MGD HPOAS train.
- Evaluate and implement nitrification/denitrification at the Roger Road WWTP.

Sewer Basins



Treatment Plants

BASINS

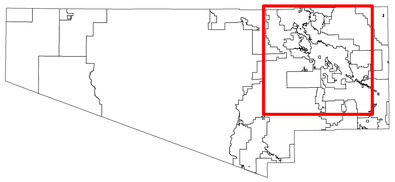
Ina Road

Roger Road

Major Streets

Figure 5.2.1

Pima County Index Map



Index Map Scale 1:1,500,000

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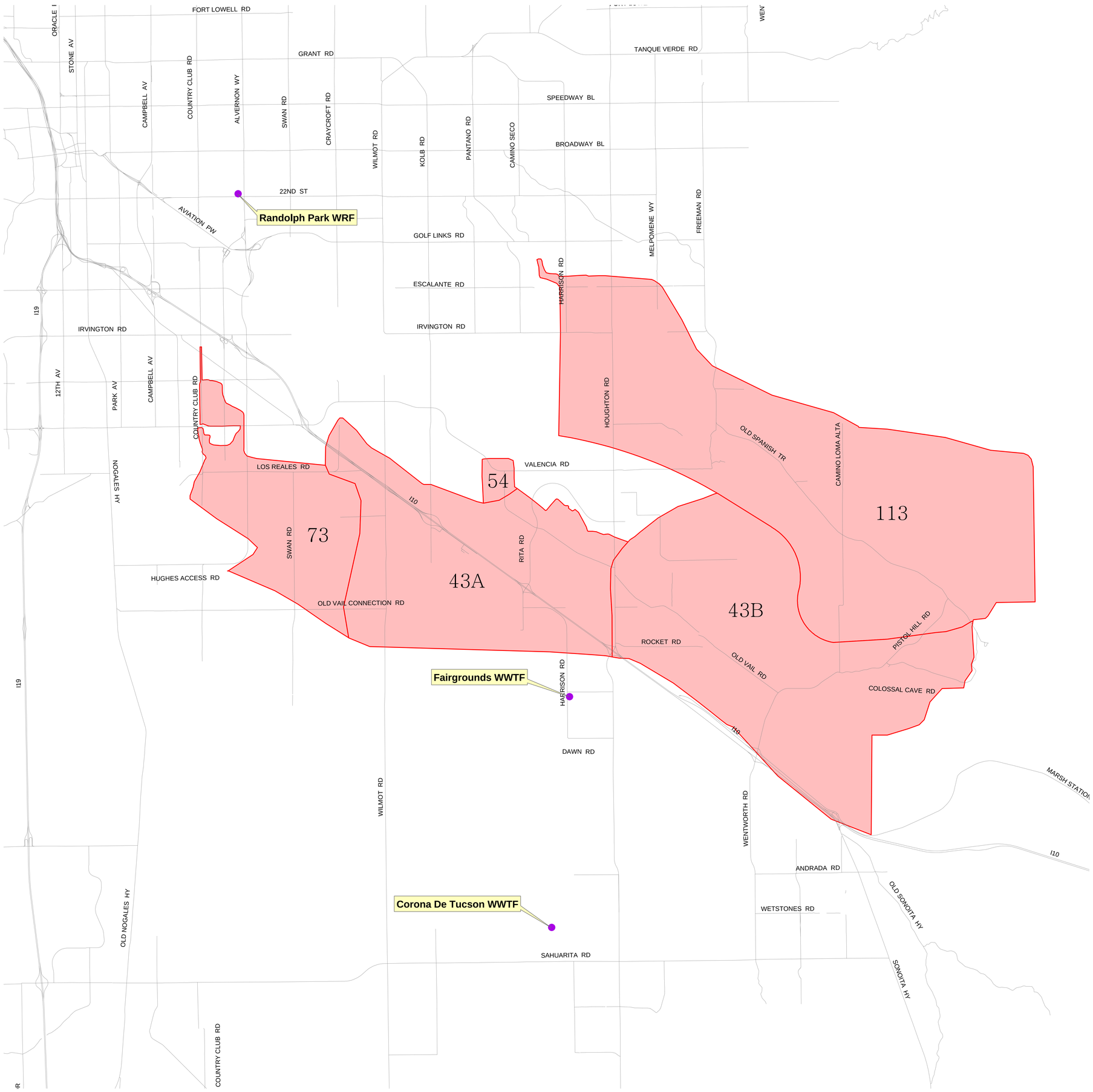
pygmyowl4/projects/wwm7/mxds/roger_ina.mxd mp 2/25/2005

Southeast Basins



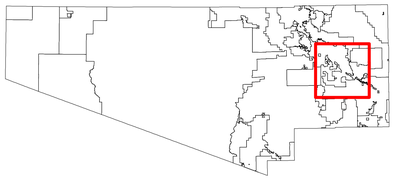
Treatment Plants

Selected Basins

Major Streets

Figure 5.2.2

Pima County Index Map



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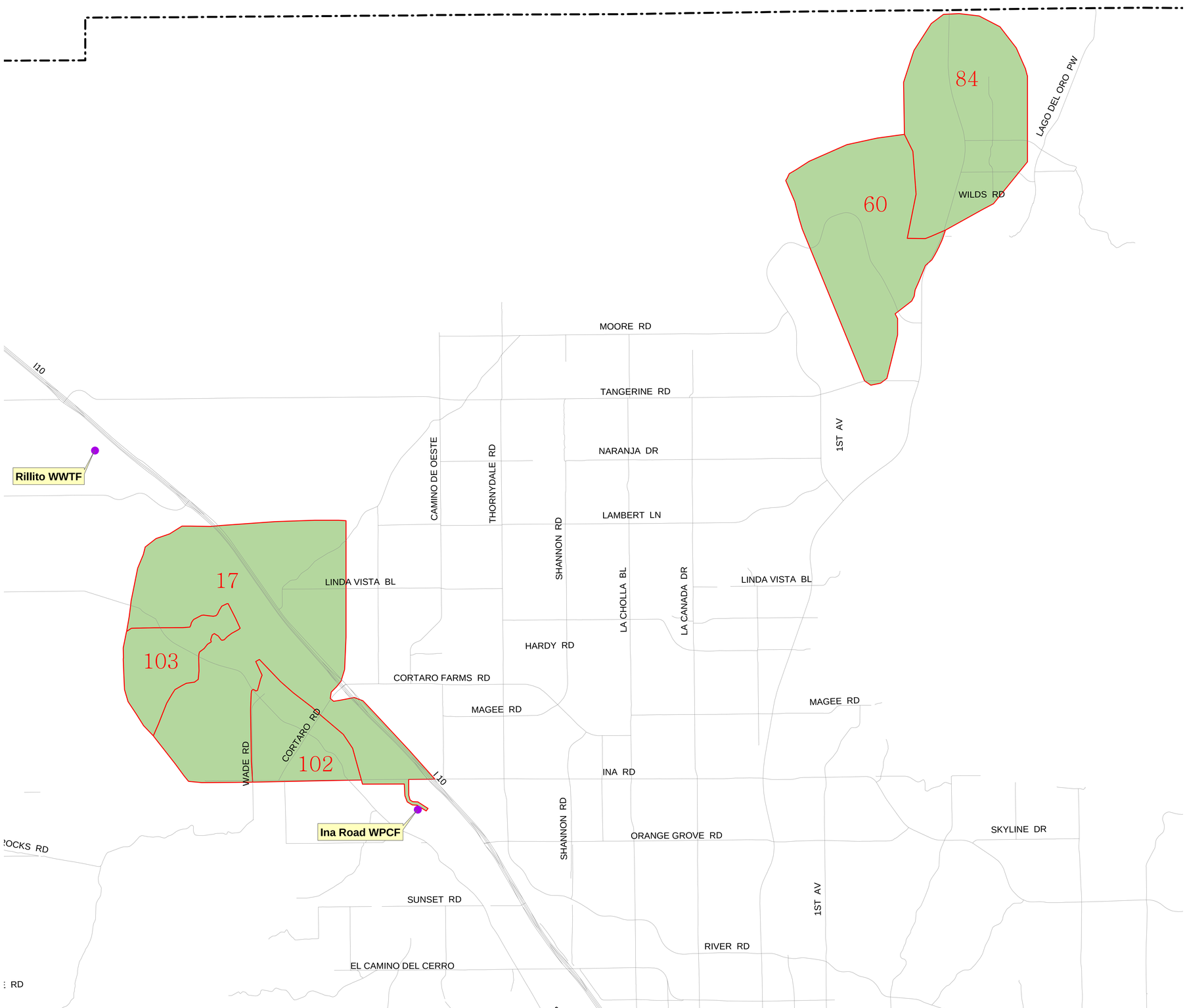
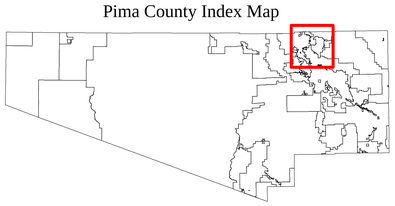
Northwest Basins



- Treatment Plants
- Selected Basins
- Major Streets

Figure 5.2.3

Pima County Index Map



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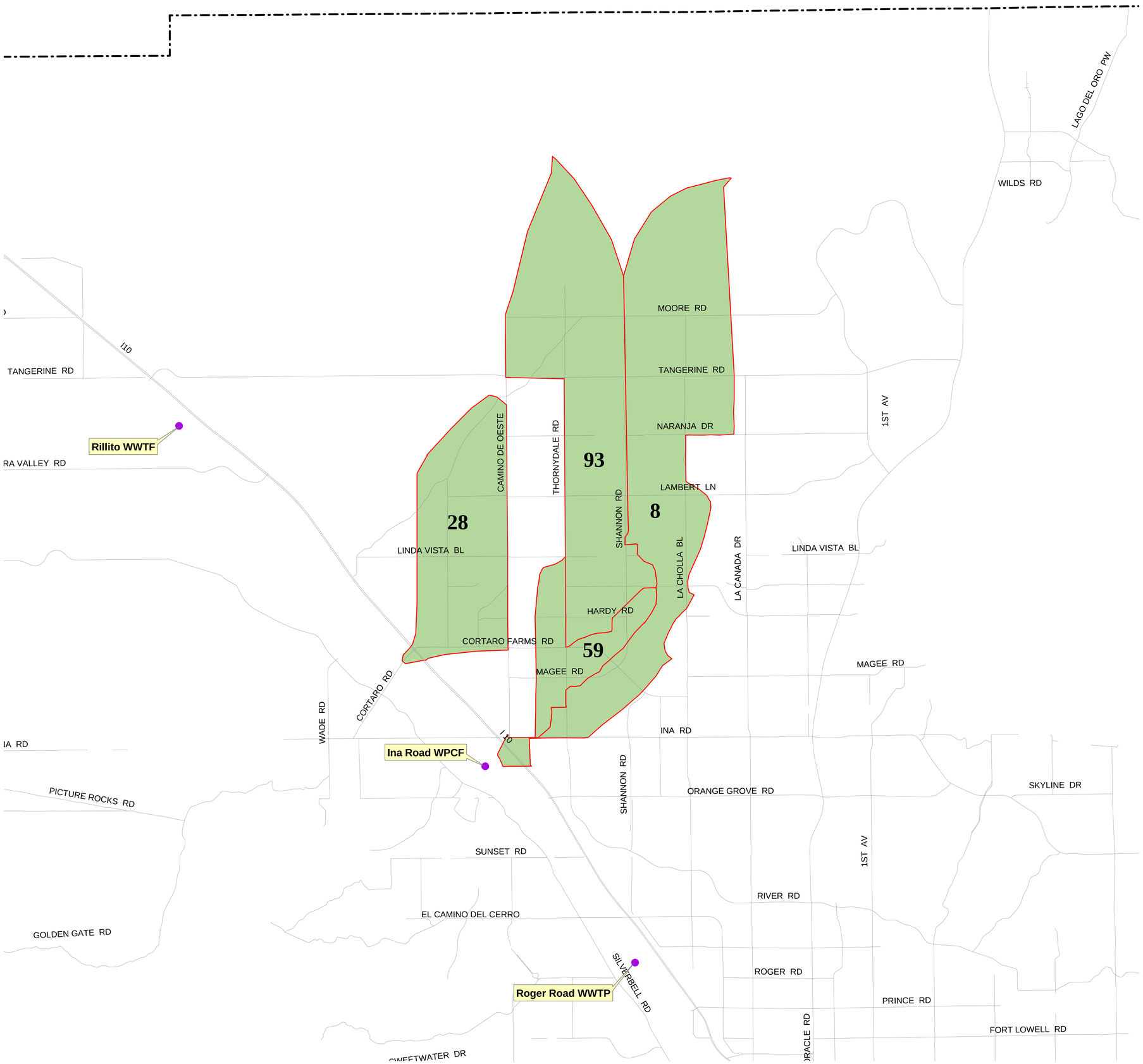
North Basins



Treatment Plants

Selected Basins

Major Streets

Figure 5.2.4

Pima County Index Map

Index Map Scale 1:1,500,000

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pygmyowl4/projects/wwm7/mxds/north_basins_b.mxd mp 12/5/2005

SUB-CHAPTER 5.3 OUTLYING FACILITIES CURRENT CONDITIONS

PCWMD provides service to the areas adjacent to the Metropolitan Treatment Facilities by operating several small capacity plants. These small capacity plants are located throughout eastern Pima County where population densities provide their economic justification. These small capacity plants are collectively known as the Outlying Treatment Facilities. Although not included in the scope of the 2006 Metropolitan Area Facility Plan Update, a brief discussion and overview is included to acknowledge their existence and functions.

The Outlying Treatment Facilities include Arivaca Junction WWTF, Avra Valley WWTF, Corona de Tucson WWTF, Ed Pastor Kino Environmental Restoration Project (KERP), Fairgrounds WWTF, Green Valley WWTF, Marana WWTF, Mt. Lemmon WWTF and the Rillito Vista WWTF.

The Facility Plan also considers the total area immediately south of the Roger Road WWTP Tributary System designated "The Southlands" that, upon development, could flow by gravity to the Roger Road WWTP. The Southlands tributary system does not currently culminate in a treatment facility but rather at a "collection point." The Southlands collection point concept is a planning tool to permit estimating future treatment needs of this area that is predicted to experience major growth in the coming decades and is not discussed in Current Conditions.

Site plans and flow diagrams are not included in this presentation (see Figure 5.3.1).

Arivaca Junction Wastewater Treatment Facility

Arivaca Junction WWTF is located in extreme southern Pima County at the Santa Cruz County line and Interstate 19 (I-19). This WWTF is a 66,000 GPD per day, aerated lagoon whose effluent is used to irrigate nearby pastureland. This facility will be closed upon completion of a combination gravity/pressure sewer line to the Green Valley WWTF.

No current repairs are needed at this facility.

Avra Valley Wastewater Treatment Facility

The Avra Valley WWTF is located roughly 10 miles southwest of Tucson at 10,000 West Snyder Hill Road. The site, which has a total area of 140.39 acres, has been the location of a WWTF since 1967. The population in the area served by the WWTF has expanded rapidly in the period from 2000 to 2005. During this period, a large casino operated by the Pascua Yaqui Tribe contributing flow to the WWTF was constructed. The ADWF and PDWF to the WWTF in December 2004, measured by the SCADA meter at the WWTF's entrance, was 0.90 MGD and 1.49 MGD respectively.

The WWTF's treatment and disposal capacity is rated at 1.2 MGD ADWF and 2.2 MGD PDWF. The main treatment component is an oxidation ditch installed in 1994.

The sewage enters the WWTF through a lift station discharging first to a screening channel then into a flow-equalization pond with a volume of 0.37 million gallons. Treatment by extended aeration, activated sludge, and biological nitrogen removal in an anoxic zone occurs within the oxidation ditch. Additional denitrification and stabilization is achieved using aquaculture. Disposal is completed through evaporation and percolation. The waste activated sludge is pumped into sludge holding tanks. The sludge is allowed to thicken during the fill and draw process. After it is concentrated it is hauled to the Ina Road WPCF for further processing and disposed of with processed biosolids from the Regional Biosolids Facility.

The oxidation ditch is designed for a flow of 1.2 MGD with a loading rate of 14 pounds BOD per 1,000 cubic feet of volume per day. This flow is at the lowest range of capacity for the equipment

to allow maximum operability for the manipulation of a denitrifying anoxic zone. The oxidation ditch is equipped with aerators to supply oxygen as well as submersible mixers.

The aerated mixed liquor from the oxidation ditch flows into two clarifiers via a distribution box. The settled sludge is returned to the oxidation ditch or sent to the sludge storage tanks for liquid-solid separation and hauled to the Metropolitan Treatment Facilities for further processing.

The clarified effluent can be discharged into the effluent reservoir or any one of the four peculation ponds. The percolation ponds are used in rotation with a fill and dry cycle for each pond. The effluent reservoir can also be discharged into the Black Wash spray field system.

Condition Assessment

Treatment capacity was reviewed to determine if additional capacity may be achieved with the same facility. It was determined the WWTF can reach the higher capacity ratings, currently estimated to initially be 1.6 MGD and ultimately 2.2 MGD with additional enhancements and equipment.

The WWTF presently has no outstanding repair issues; however, the integrity of the existing oxidation ditch requires evaluation. The evaluation will require emptying the present oxidation ditch. Therefore, the evaluation cannot be performed until this facility is expanded with an oxidation ditch of the same or larger capacity. There are areas of the current oxidation ditch considered likely to require repairs, particularly the sections of the ditch constructed of “gunite” concrete together with their supporting soils. Additionally, as the WWTF approaches the new design capacity (2.2 MGD), an additional percolation pond may be required.

The WWTF is considered a candidate for expansion in the immediate future to meet the growth in its tributary area, which will be discussed in Chapter 5.4.

Corona de Tucson Wastewater Treatment Facility

The 200-acre Corona de Tucson WWTF is located approximately 22 miles southeast of the City of Tucson at 1100 West Sahuarita Road. The present facility, rated at 0.117 MGD Disposal Capacity, was constructed in 1983. This facility may be incorporated into a larger regional facility in the rapidly growing region in the “Southlands” portion of the Tucson Metropolitan Area.

The WWTF consists of two soil cement lined stabilization ponds of 3.3 and 3.7 acres, operating at average of four feet depth of water. Mechanical aeration was not provided in the original design. The stabilization ponds can be operated either in parallel or series. The WWTF is designed so that the treated water from the stabilization ponds can overflow into an adjacent 10.2-acre lined evaporation pond. There is also a 6.1-acre unlined pond serving as a recharge basin.

Sewage enters the WWTF through a gravity interceptor and then passes through a Parshall flume flow-metering chamber. After passing through the flume, the flow enters a series of “splitter manholes” dividing flow between the stabilization ponds.

The flow enters the stabilization ponds through 18-inch diameter pipes, which extend out into each pond. Stabilization of organic material, a natural occurrence of biological, chemical and physical processes takes place here.

Discharge flows from the storage and stabilization ponds to the evaporation pond where the surcharge capacity and surface area of the ponds provides for storage and evaporation of all inflows. No discharge of effluent to surface or groundwater occurs at this site. The evaporation pond provides enough surface area to completely dispose of 117,000 GPD. Surface evaporation rates can be expected to vary from a maximum of 9 to 10 inches per month during the summer to a minimum of about two inches per month in the winter.

At present there are no repair requirements; however, the WWTF is in a rapidly growing area and is in need of expansion. The initial capacity expansion will be through the installation of mechanical aerators and will utilize Soil Aquifer Treatment for disposal and increase the capacity to 300,000 GPD. This expansion is complete and awaiting the required ADEQ permits to begin operation. The second stage of expansion, a 500,000-GPD-package plant oxidation ditch is currently being engineered for installation and commissioning in the fourth quarter of 2005. The effluent will be recharged and stored in the aquifer for future beneficial use.

Ed Pastor Kino Environmental Restoration Project (KERP)

The newly constructed Ed Pastor KERP provides innovative water conservation for Pima County. This project, built as a joint effort with the U.S. Army Corps of Engineers, utilizes stormwater and reclaimed water, stored in the 120-acre Ajo Detention Basin, to irrigate county owned facilities at the nearby Kino Sports Complex. The project also involves transforming the once concrete basin into a riparian habitat serving as a refuge for migrating and native wildlife. In addition to providing a riparian habitat, the stored water is used to irrigate ball fields and parks. Although the KERP is operated by Pima County's Stadium District, PCWMD provides testing of the waters and assists with the operation and maintenance of the onsite pump station. As this is not really a treatment facility with no plans for expansion, it will not be included in the discussion of the future for Outlying Treatment Facilities.

The recirculation pumps require modification and also the addition of a chlorination/dechlorination system is considered likely.

Fairgrounds Wastewater Treatment Facility

This WWTF, located at the Pima County Fairgrounds, is a 3,000 GPD evaporation pond facility operated for the convenience of the public during events such as the Pima County Fair, concerts, sporting competitions and specialty shows.

The WWTF needs improvements to the influent box and the addition of a SCADA recording flowmeter.

Green Valley Wastewater Treatment Facility

The Green Valley WWTF, the major facility serving southern Pima County, is located on a 52-acre rural site, 3/4 mile north of the Green Valley residential area at 2201 N. Old Nogales Highway, approximately 250 feet east of the Santa Cruz River. The original WWTF was constructed in December 1964, expanded in 1972 and again in 1981. The latest expansion, completed in 2004, added a 2.0 MGD Biological Nutrient Removal Oxidation Ditch (BNROD) increasing the total plant capacity to 4.1 MGD ADWF.

The Green Valley WWTF processes wastewater through two separate parallel treatment trains, the Original Train and the BNROD Train. The plant includes the following major components:

Headworks (screenings/grit removal and direct flow to either the emergency overflow basin or the influent pump station)

- Emergency Overflow Basin.
- Influent Pumping.
- Metering Station.

Lagoon Train (original treatment plant)

- Aerated Lagoons.
- Effluent Polishing Ponds.
- Percolation Beds.

BNROD Train

- Activated Sludge Process Oxidation Ditch with Biological Nutrient Removal (BNR).
- Secondary Sedimentation.
- Recycle Activated Sludge (RAS) / Waste Activated Sludge (WAS).
- Solids Handling.
- Filtration.
- Disinfection.

Influent flow passes through the headworks for screening and grit removal then flows to the influent Pump Station. Screenings and grit are disposed of at a municipal landfill.

The influent pump station is comprised of a wet-well and pump station. The Pump Station discharge divides flow between the original and BNROD trains. Should a power failure occur, the influent wastewater diverts to the emergency overflow pond. When power is restored, wastewater can be valved back to the pump station.

Lagoon Train

Influent directed to the original treatment train passes through primary aerated lagoons, secondary aerated lagoons, an effluent holding pond and percolation beds. The two primary, mechanically aerated lagoons may be operated in parallel. These lagoons are concrete lined, aerobic aerated units providing a high rate of oxygen transfer from air to wastewater and discharge to the secondary lagoons. The secondary, mechanically aerated facultative lagoons provide partial mixing and aeration by means of floating aerators and are capable of being operated in series or parallel.

The Aerated Lagoons discharge to two parallel effluent polishing (maturation) ponds providing natural aeration for biochemical oxidation and solids settling.

Effluent from the polishing ponds is disposed of through rotation to four percolation beds, totaling 11 acres, used alternately. The effluent is directed to one percolation bed at a time then the bed is allowed to dry while the effluent is directed to the next pond. Effluent discharged the percolation beds may be provided to local entities for reuse and/or recharge or may be discharged to the Santa Cruz River.

Once every 5 to 10 years, biosolids, which have settled in the bottom of the secondary aeration lagoons and polishing ponds, are removed and disposed of by land application or to the Tangerine Road Landfill.

BNROD Train

The parallel BNROD treatment train is an activated sludge with biological nutrient removal process carried out in an oxidation ditch wherein the influent flows around a loop and is aerated by a mechanical brush rotor system. Submersible mixers operate continuously to maintain the activated

sludge in suspension. To achieve nitrification, an aerobic zone is when the aerators are operated. Denitrification is achieved in an anoxic zone created when the aerators are off. The oxidation ditch overflows a weir to secondary clarifiers.

The secondary clarifiers settle the activated sludge. Return activated sludge is pumped to the oxidation ditch inlet structure while WAS is pumped to the gravity belt thickeners. Effluent flows to the filters where the multi-media filter of sand and anthracite reduces suspended solids/turbidity to less than 2 NTUs.

The WAS flow is pumped through polymer addition static-mixers and discharged onto two parallel gravity belt thickeners. The thickened WAS (TWAS) is pumped to parallel aerobic digesters. Digested (stabilized) solids are pumped through a static mixer to a belt filter press. The produced filter cake is discharged to a hopper and then moved to a sludge drying bed. Liquids decanted off the biosolids (supernatant) are returned to the head of the treatment process. The biosolids are transferred from the storage facility to the truck loading facility for disposal.

Filtered effluent flows by gravity to a chlorine contact tank where the required dosage of sodium hypochlorite is added to the mixing chamber. Flow passes over a weir to the reclaimed water pump station.

Reclaimed water can be used for off-site open access turf (golf course) irrigation and onsite for industrial water, fire protection, and landscape irrigation. Any effluent not used for reclaimed water is either recharged or discharged to the Santa Cruz River.

Other plant facilities include a control building with storage space for spare parts, a maintenance workshop area, and a motor control center.

The original treatment train requires the following repairs to continue to function at design capacity:

Table 5.3.1 Recommended Improvements and Conceptual Costs for Green Valley WWTF

Modify the headworks screens by replacing the manual screens with mechanical screens	$250,000
Replace secondary lagoon aerators	$180,000
Upgrades to electrical systems	$80,000
Replace the damaged street lights	$20,000
Earthwork to repair erosion damage to the pond and lagoon berms	$40,000
Re-grade, repair and repave site roads	$40,000
Total	**$610,000**

Marana Wastewater Treatment Facility

The 200-acre Marana WWTF is located 1 mile east of Trico Road and 1 1/8 miles north of Trico Marana Road. It presently serves the area of “central” Marana, the area adjacent to Trico-Marana Road and I-10, with a trunk sewer flowing west along Trico–Marana Road to the WWTF site. The original 23,000-GPD design capacity plant, comprised of two facultative/evaporation ponds (FEP) operated in series, opened in 1986. The WWTF proved adequate until year 2000, as growth was concentrated elsewhere in the town. Since 2000, development in the area served by the Marana WWTF has accelerated requiring plant capacity expansion.

A new 150,000 GPD facility composed of three 50,000 GPD packaged plants was placed in operation in the Fourth Quarter of 2001. Package plants are manufactured treatment plants previously been approved by permitting agencies. Presently the WWTF is operated at 70,000 GPD with flow being divided among the three package plants until influent flow exceeds 150,000 GPD. The east pond of the original FEP facility was converted to an emergency influent storage basin.

The resulting effluent quality meets discharge water quality standards for Class B effluent that can be discharged into the Santa Cruz River, used for agricultural irrigation, or recharged to groundwater.

The current WWTF capacity was increased, in 2005 by the addition of a fourth 50,000-GPD package plant. The present influent pump station will require enlargement together with the installation of a recording flow meter. The main equipment slab requires repair and voids under the slab need to be grouted. These repairs and additions are currently estimated to cost $385,000. The current expansion and long range plans for this facility are further discussed in Sub-chapter 5.4.

Mt. Lemmon Wastewater Treatment Facility

Background

The Mt. Lemmon WWTF, a 12,500 GPD package plant Oxidation Ditch Facility treats sewage from the small mountain community of Summerhaven in the Coronado National Forest. Unlike the remainder of PCWMD's system, the Mt. Lemmon experiences freezing wintertime temperatures. Aside from a few restaurants and gift shops, the WWTF serves a residential population. Effluent is disposed of through spray irrigation on 10 acres of U.S. Forest Service land.

The 2001 Bullock Fire heavily damaged the spray field as well as destroyed much of the residential community and commercial center of Summerhaven; however, the WWTF was undamaged. The main concern now is the aftermath of the Bullock Fire creating a hazardous environment due to dry and brittle timber.

The WWTF's current needs are limited to re-coating the package plant oxidation ditch estimated at $100,000.

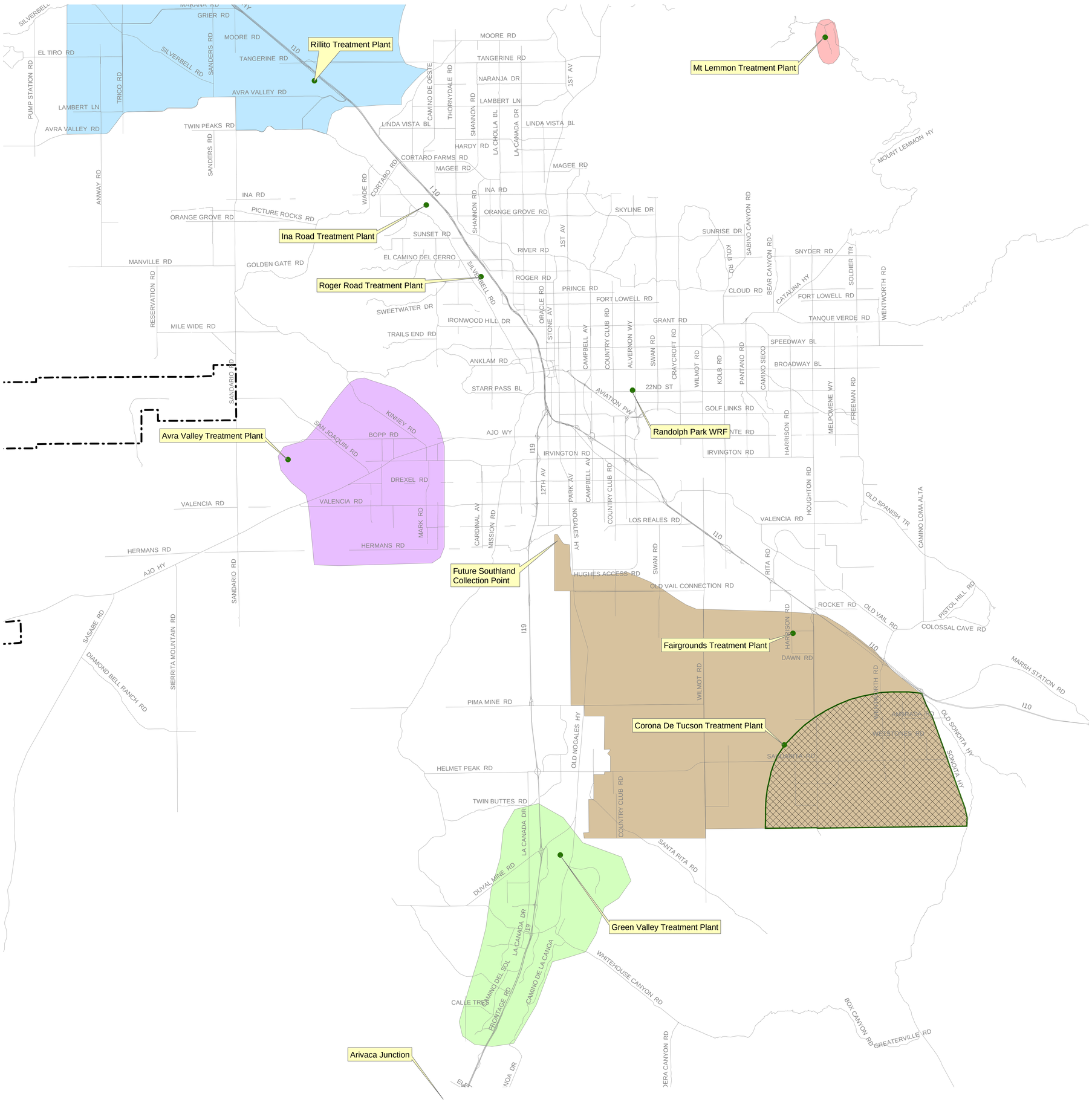
Rillito Vista Wastewater Treatment Facility

There are no current repair issues at this WWTF. An expansion of the WWTF in the long term to relieve the Continental Ranch Pump Station has been discussed and is under review also at this time. Flow-monitoring improvements are also needed.

The Southlands

The Southlands is a future treatment area containing only the Corona de Tucson Basin at this time.

Outlying Basins



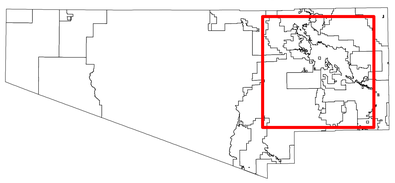
- Treatment Plants

BASINS

- Avra Valley
- Marana
- South Lands
- Green Valley
- Mt lemmon
- Corona de Tucson
- Major Streets

Figure 5.3.1

Pima County Index Map



Index Map Scale 1:1,500,000

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pygmyowl4/projects/wwm7/mxds/outlying_basins_b.mxd mp 4/29/05

SUB-CHAPTER 5.4 OUTLYING TREATMENT FACILITIES FUTURE CONDITIONS

The Outlying Facilities are the Arivaca Junction WWTF, Avra Valley WWTF, Corona de Tucson WWTP, Ed Pastor KERP, Fairgrounds WWTF, the Green Valley WWTF, Marana WWTF, Mt. Lemmon WWTF and Rillito Vista WWTF. The current condition of these treatment facilities was discussed in Sub-chapter 5.3.

Given the uncertainty of the location of development within both the Metropolitan Area tributary systems as well as among the Outlying Treatment Facilities, PCWMD is pursuing a policy of providing maximum flexibility in directing flow and providing capacity at any of its treatment facilities.

Dynamic Process Modeling

PCWMD is currently actively engaged in dynamic process modeling of the Outlying Treatment Facilities Oxidation Ditch plants. This modeling effort is capable of providing guidelines for not only optimizing the current plant process to realize their maximum treatment potential, but also allowing PCWMD to model further treatment additions to upgrade the plants to meet future regulatory permit requirements. PCWMD's dynamic modeling program, its capabilities and modeling results are presented in detail in Sub-chapter 5.5.

New Planning/Design Processes for Outlying Facilities

PCWMD, as previously mentioned, maintains treatment facilities in eight suburban outlying locations with varying degrees of interdependence with the Metropolitan Area Treatment Facilities. Most of these eight facilities are being heavily impacted by projected population growth.

The development community has put forth plans for a number of substantial home developments throughout the PCWMD service area tributary to these facilities. The impact of these types of projects on the Outlying Treatment Facilities is more severe than on the Roger Road WWTP and Ina Road WPCF tributary areas previously discussed. The Outlying Treatment Facilities are smaller in size, ranging from the 10,000 gallon per day (GPD) Rillito Vista WWTF to the 4.1 MGD facility at Green Valley WWTF.

The impact on Outlying Treatment Facilities of a 500 home development with 2.7 persons per household, with each person contributing 85 GPD of wastewater, is an additional 115,000 GPD of flow. Developments of this size are envisioned for the areas tributary to Marana, Green Valley, Corona de Tucson and Avra Valley WWTFs and, in some cases, multiple such developments within the next decade. Given that a development of this size represents 50 percent of the 200,000 GPD capacity of the present Marana WWTF, 97 percent of the 117,000 GPD capacity of the present Corona facility, 10 percent of the 1.2 MGD capacity of the Avra Valley WWTF and 5 percent of the Green Valley WWTF (before its recent expansion), the impact of such a development on existing treatment facilities is extreme.

Planning to incorporate development of this magnitude in the Outlying Treatment Facilities is further complicated by the uncertainty of the schedule for this development. PCWMD's history contains numerous examples of planned developments that were never finalized. The Continental Ranch Pump Station was built in 1988 in response to urgent projections of immediate tributary development activity. The facility was not placed in full service until 1997 as area development was curtailed by economic factors. Designation as endangered species habitat can also significantly impact the magnitude and schedule of population growth in a given area. The curtailment of development on the northwest side of Tucson and its shift to Sahuarita, Vail and the southeast Tucson area from the late 1990s until 2004 is well documented.

A further example of the difficulty of forecasting future populations is demonstrated by the variance between the forecast of future development of the Marana WWTF put forth by PAG and the local jurisdiction/developer planning estimates. (See Table 5.4.1)

Table 5.4.1 Marana WWTF: PAG versus Developer Population Projections

	Forecast Based on Proposed Development				Forecast Based on PAG Projections			
			ADWF				ADWF	
	Population	Change in Population	Total Flow MGD	Flow Increase MGD	Population	Change in Population	Total Flow MGD	Flow Increase MGD
2000	9,819	6,880	0.03	0.13	9,819	5,028	0.03	0.55
2005	16,699	28,862	0.16	2.45	14,847	8,435	0.85	0.72
2010	45,561	13,502	2.61	1.15	23,282	8,439	1.57	0.72
2015	59,063	13,646	3.76	1.16	31,721	8,430	2.29	0.71
2020	72,709	10,753	4.92	0.92	40,151	8,441	3.0	0.72
2025	83,462		5.84		48,592		2.96	

PCWMD's reaction to this relocation of development to the smaller outlying facilities is hampered by the time it takes from the identification of an area of potential major development until the treatment plant capacity expansion is placed in service. The Department can only be sure that a potential development will become reality at the time a developer submits construction plans for the project. However, PCWMD must procure a design contract (a process designated in the 2004 Bond Authorization Implementation Plan as taking 6 months), design the project (12 months including the 35 percent, 70 percent, 95 percent and 100 percent reviews normally imposed on Department projects), secure ADEQ permits (8 to 12 months – design must be submitted as part of application), conduct construction procurement (2 to 6 months) and then build the expansion (18 to 24 months) in order to place new treatment capacity in service. The total process can take four years. In that time, any number of events may change development location, extend the development schedule or cancel the project entirely. In the meantime, PCWMD may have committed significant resources for the design and construction of a treatment facility that could remain unused or under-utilized for some time.

In an effort to respond more quickly to treatment capacity requests, PCWMD envisions following a procedure to pre-design and acquire permits rapidly for standard capacity treatment plants. The treatment process selected for treatment facilities less than 5 MGD will typically be a Biological Nutrient Removal Oxidation Ditch. The idea is to pre-design and permit several different capacity Oxidation Ditch treatment plants, or similar treatment concepts, and have the completed plans available to meet identified capacity needs. The process would be aided by utilizing a Construction-Manager-At-Risk design/build process whereby the successful contractor would also be responsible for the site-specific design, such as site grading, yard piping, electrical power distribution and etc., required to construct the plant. This method is envisioned to reduce the overall project time.

Flows to Outlying Facilities

The Facility Plan Model forecasts population and treatment plant flows in three suburban areas closest to the Metropolitan Treatment Facilities (Roger Road WWTP, Ina Road WPCF and the Randolph Park WRF). These three are the areas tributary to the Avra Valley and Marana WWTFs and the area south of I-10 and east of I-19, identified as the Southlands. The Corona de Tucson and Fairgrounds WWTFs are basins within the overall Southlands Tributary area. The relative

locations of these basins are shown on Figure 5.2.2, while the actual basin designations are shown in Figure 3.4.2.

The Facility Plan Model population forecasts for the Avra, Marana and Southlands sewer basins are graphically presented sewer basin percentage increases in Figure 3.4.8. The Avra, Marana and Southlands tributary areas are identified as among the most rapidly growing tributary areas within the PCWMD system. The Average Dry Weather Future Flows generated in each area are summarized in Table 5.4.2.

Table 5.4.2 Flow Projections for Outlying Areas

ADWF Projections for Avra, Marana, The Southlands and Corona de Tucson				
	Avra	Marana	Southlands	Corona de Tucson[1]
	ADWF	ADWF	ADWF	ADWF
2000	0.86	0.033		0.045
2005	1.10	0.16		0.11
2010	1.41	0.86	1.42	0.23
2015	1.71	1.56	2.70	0.35
2020	2.02	2.26	4.00	0.47
2025	2.32	2.96	5.29	0.59
2030	2.95	4.44	13.70	2.63

1. The Corona de Tucson treatment facility tributary area is Basin SL5 in the Southlands tributary area. Corona de Tucson flows are also included in the total Southlands flows for 2005.

Arivaca Junction WWTF

The Arivaca Junction WWTF will be closed upon completion of a connection to the Green Valley WWTF. Currently a gravity line runs north to Elephant Head Road. The completion of the section between Elephant Head Road and the Green Valley WWTF involves:

1. Constructing a gravity line from Elephant Head Road across I-19 to join a new developer installed gravity sewer leading to the Green Valley WWTF.
2. Locating an approximately 100,000 GPD Water Reclamation Facility at the north end of Canoa Ranch with the effluent being used for irrigating the Pima County owned park at Canoa Ranch. The solids would continue to flow to the Green Valley WWTF.

The Arivaca Junction WWTF will be de-activated upon completion of connection to Green Valley WWTF.

Avra Valley WWTF

Due to seasonal variations, February is the highest flow month at the Avra Valley WWTF. The February 2005 recorded flows matched the end of 2005 projected flows. These flows are approaching the 1.2 MGD rated capacity. A recently completed evaluation concluded that with the addition of some process equipment, the existing facility can be operated at flows up to 2.2 MGD.

The Facility Plan Model flow predictions, presented in Table 5.4.2, indicate that even with the additional treatment capacity, probable population growth in this tributary area may need added capacity. An additional factor in forecasting flow to this plant is the presence of the Yaqui Tribes gaming casinos and the possible addition of a resort complex and golf course at one of the casinos. A resort complex of that size would cause the flow to this WWTF to grow much more quickly than presently forecast. Therefore, the next expansion to this facility is currently forecast to add 4.0 MGD in 2008/09.

The future expansion of this WWTF is planned to be accomplished by the construction of a BNROD facility. Any additional plant expansion will also include provisions for reuse or recharge of the effluent produced as discussed in Chapter 6. The expansion must also include provisions for handling the total biosolids produced as discussed in Chapter 7. In planning for any expansion, the proposed site must be surveyed to position the facility to meet ADEQ setback rules with the possible requirement of an additional land purchase to meet these setbacks.

Corona de Tucson Wastewater Treatment Facility (see Figure 5.4.1)

The current Corona de Tucson WWTF is being expanded in two phases. The first phase to add aerators is complete. The second stage of the installation is the addition of a 500,000 GPD package plant to raise the total treatment plant capacity to 800,000 gallons per day. This second stage expansion will be funded by the developers in the basin tributary to the Corona de Tucson WWTF and was completed in September 2005.

The developers are anticipating utilizing this capacity within the next few years while PAG projects that the 0.8 MGD plant will be adequate for development through 2008-10. The February 2005 flow to the plant was close to 110,000 GPD. In order to utilize all of the 0.8 MGD capacity, new home construction would have to continue at a rate of 50 to 60 houses per month for 5 years. Developers are projecting construction of up to 100 houses per month.

PCWMD, in response to present development plans, has included a 0.5 MGD expansion of Corona de Tucson WWTF in the Capital Improvement Program (CIP) beginning in fiscal year 2006-07 to bring the capacity to 1.3 MGD. Further, following development forecasts, an expansion of the WWTF to 2.0 MGD is included in the CIP for 2011-12.

Given the disparity between development and PAG population forecasts, PCWMD will closely monitor growth in this region and coordinate with area developers to match the actual growth.

Ed Pastor Kino Environmental Restoration Project

There are no plans for expansion of this facility. PCWMD will continue to operate and maintain the pump house and water testing.

Fairgrounds Wastewater Treatment Facility

PCWMD has no current plans to increase the size of this facility. In the event that development of the Southlands follows PAG forecasts, this plant may be considered for inclusion in the overall area plan.

Green Valley Wastewater Treatment Facility

The Green Valley WWTF was recently upgraded by the addition of a 2.0 MGD BNROD facility. The original plant remains capable of treating its original 2.1 MGD capacity; however, the effluent from the original WWTF will not be suitable for use as reclaimed water.

The growth of flow to the Green Valley WWTF was not included in the 2005 Facility Plan Upgrade as it is more remote from the Metropolitan area. The southern Pima County area served by the Green Valley WWTF will be the subject of a near future project to coordinate the PAG census tract forecasts to the Green Valley tributary conveyance system. In the meantime, PCWMD is monitoring population growth in the region. PCWMD has included a CIP project to install a second 2.0 MGD BNROD facility at this location beginning in the 2009-10 fiscal year for completion in 2013.

Marana Wastewater Treatment Facility (see Figure 5.4.2)

Beginning in 2000, the farming area west of I-10 in northwest Marana came under active development planning. This was due in large part to the impact of the Pygmy Owl endangered species designation on developments being planned east of I-10. Wastewater conveyance and treatment infrastructure was in place or programmed to serve development on the east side of I-10. However, this was not the case west of I-10. An accelerated effort had to be put forth to plan and implement creation of the public wastewater system needed to serve the anticipated development west of I-10.

A collection and conveyance system was planned in cooperation with the development community and the Marana WWTF was expanded to a treatment capacity of 200,000 GPD in order to accommodate the first phase of the anticipated new development. Initial design efforts to plan for long-term expansion of the treatment facility that were begun prior to 2000 were accelerated.

After a 3-year delay in initiation of development, housing construction is now proceeding at a rapid pace and expansion of the treatment facility is progressing on an accelerated schedule in order to meet demand. As more developments are platted, the number of houses completed each month will increase. The current forecast based on development proposals presented to PCWMD is that average daily flows will reach 3.6 million gallons per day by 2015. In contrast, utilizing PAG TAZ predictions for population growth yield (as per the Facility Plan Model) a much lower flow number of 2.29 MGD by 2015 (see Table 5.4.1).

Regardless of the forecasting method used, the continued population growth in the Marana WWTF service area necessitates an increase in wastewater treatment capacity. This discussion considers the WWTF's expansion beyond the 200,000-GPD capacity reached in 2005 with the addition of a fourth 50,000 GPD package plant.

For the next phase of the expansion, the $10 million in the 2004 Bond Authorization will be added to the existing 1997 bond funds. The $2.05 million from the 1997 Bond Authorization originally envisioned the relocation and construction of a much smaller facility. The $12 million, combined with System Development Funds, will be used first to add a 0.5 MGD interim BNROD package plant in 2005-06. At the same time, design and construction of a 1.5 MGD BNROD will be initiated for completion in 2007-08. An additional 1.5 MGD expansion to the plant capacity is planned for 2010-11.

The U.S. Army Corp of Engineers funded preparation of plans for a multi-tank oxidation ditch facility. These plans are being updated and finalized for eventual expansion of facility capacity in stages to more than 3 MGD. The expansion planned in 2007/08 is the first phase of this facility.

Evaluation of disposal of effluent and biosolids from this expanded facility are discussed in Chapter 6.1 and 6.2.

Mt. Lemmon Wastewater Treatment Facility

The Mt. Lemmon sewage system upgrading was included in the 2004 Bond Authorization. This system is entirely within the boundaries of the Coronado National Forest. The US Forest Service has significant input into future plans for growth, water use and effluent disposal for this system. The long-range plans for the future of the Mt. Lemmon sewer system will be evaluated and discussed with the Forest Service and the Mt. Lemmon community prior to implementing any changes or improvements.

Rillito Vista Wastewater Treatment Facility

The future of the Rillito Vista WWTF has several alternatives:

1. The facility will continue as a limited service facility serving its present customers.
2. The facility will be abandoned with its flow incorporated in the larger Marana WWTF system as a tributary basin.

Present plans call for the WWTF to continue in its limited service role and ultimately be abandoned.

The Southlands

The Southlands in year 2005 is a conceptual area. The treatment facilities presently in the conceptual Southlands are Corona de Tucson, Fairgrounds and the Sahuarita WWTFs. The Sahuarita WWTF is not a part of the Pima County Wastewater System but rather owned and operated by the Town of Sahuarita. The Fairgrounds WWTF presently serves the Pima County Fairgrounds and basically treats event flow. Gravity flow to this facility from areas outside the Fairgrounds, not served by the Southeast Interceptor, Corona de Tucson or presently on septic is limited. There are no plans for an additional facility at the Fairgrounds.

The future of the Corona de Tucson WWTF is discussed above. Its future as a part of a larger Southlands region may:

- Include use as an upstream Water Reclamation Facility.
- Continue as an independent WWTF for its tributary basin.
- Abandonment in favor of a regional treatment facility.

The future of the Corona de Tucson WWTF will be greatly dependent upon future area development.

The developer of a large tract along Swan Road south of the airport has contacted PCWMD about the possibility of constructing an approximately 2.0 MGD treatment facility just west of Swan Road and south of Old Vail Road. The site is within Southlands Basin SL-2 and presumably could be located to serve the eastern half of Basins SL-2 and SL-7 as well as the upstream Basins SL-3, SL-4 and SL-6 (SL-5 being the Corona de Tucson WWTF). Assuming the development proceeds as outlined in the development agreement, a total of 2.84 MGD of capacity will be needed in the Southlands within the next 5 years.

Table 5.4.3 presents the population growth of the Southlands by sewer basin in 5-year increments.

Table 5.4.3 Population Growth in The Southlands

		Southland Basins						
Year	Total	SL-1	SL-2	SL-3	SL-4	SL-5 Corona de Tucson	SL-6	SL-7
2005	24,409	611	10,161	2,970	264	7,833	877	1,693
2010	46,709	746	21,612	6,159	1,531	12,581	1,191	2,889
2015	78,665	882	35,578	15,331	3,940	17,343	1,505	4,086
2020	110,612	1,017	49,541	24,503	6,350	22,101	1,818	5,282
2025	142,574	1,152	63,509	33,676	8,760	26,865	2,133	6,479
2030	174,515	1,287	77,471	42,846	11,169	31,622	2,446	7,674
Population 2005-30	150,106	676	67,310	39,876	10,905	23,789	1,569	5,981

Table 5.4.3 presents total population in the basin in the year stated. In calculating flows, the people on septic systems in 2005 are assumed to remain on septic systems for the remainder of the 20-year period. All growth, following 2005, is presumed to be on sewer as the density of building now is generally four residences per acre and higher due to the escalating value and scarcity of land.

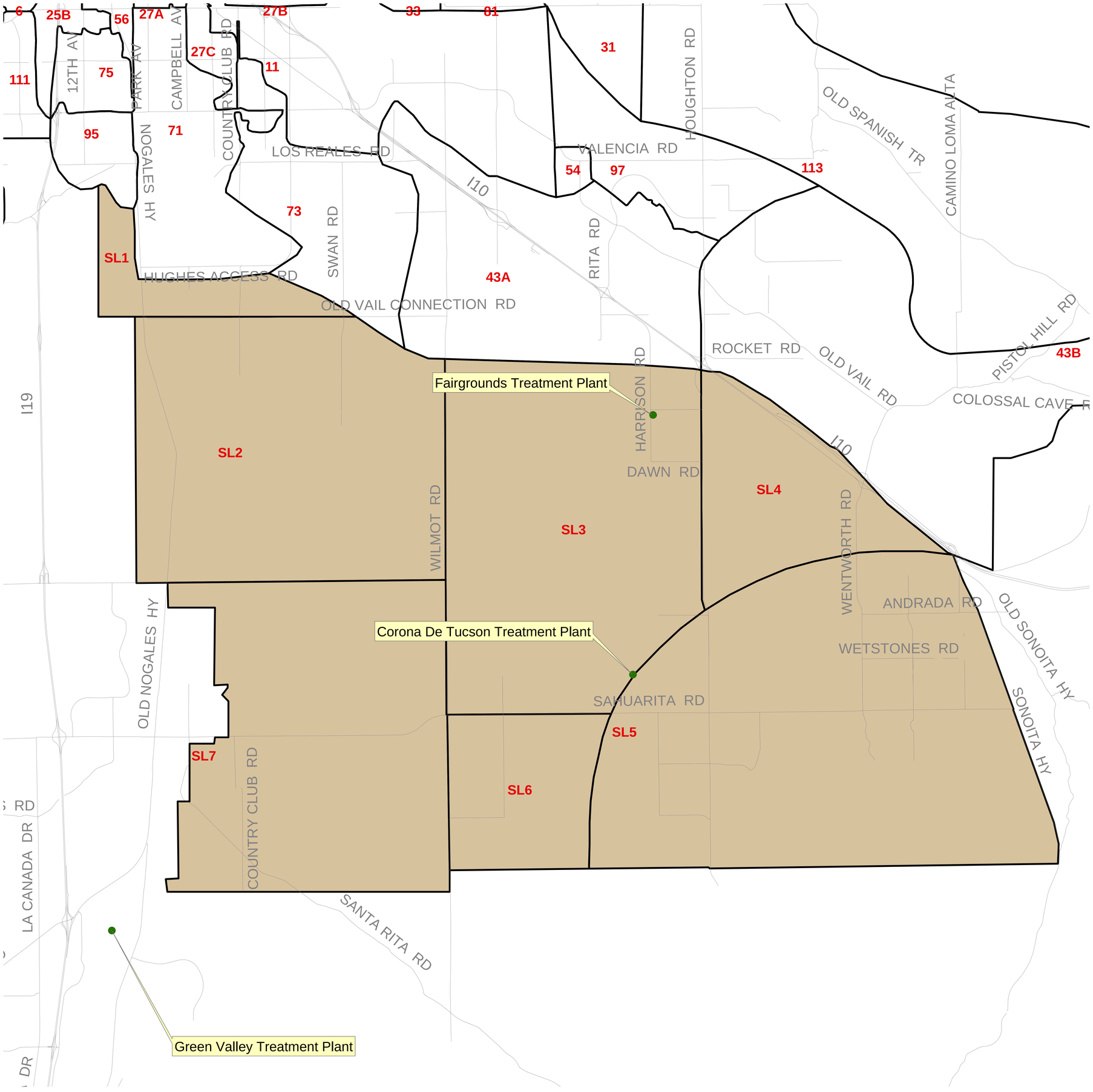
An examination of Table 5.4.3 shows the majority of population growth in the Southlands occurs in Basins SL-2, SL-3 and SL-5. Basin SL-2 and SL-3 are those basins in the center of the Southlands area with an estimated 60 percent of Basin SL-2 and 30 percent of Basin SL-3 being unable to reach the developer constructed treatment plant by gravity (Corona de Tucson being up gradient from these two basins). Basin SL-5 is the Corona de Tucson tributary area and could be expanded to suit population growth. Referring to Table 5.4.2, the total projected wastewater flow for the Southlands in 2015 is 5.55 MGD. Assuming the treatment plant constructions at Corona de Tucson and near Swan and Old Vail Road take place by 2015, the installed capacity will be 4.0 MGD. Again referring to Table 5.4.2, an additional 1.55 MGD (5.55 – 4.0) of treatment capacity will need to be planned and shortly constructed, or a total 1.55 MGD of wastewater flow will need to be connected to the Park Avenue sewer near the Old Nogales highway and Hughes Access Road. The sewer system will then convey the wastewater up Park Avenue to Euclid then north to 18th street and west to Osborne Avenue. The wastewater can then flow through the 2004 Bond Authorization funded Santa Cruz Interceptor, Prince to Franklin and to the Roger Road WWTP. The conveyance system may require augmentation between Hughes Access Road and Osborne Avenue.

Summary

The future development of the PCWMD Outlying Facilities will be greatly influenced by both population growth and distribution within its service area over the next 20 years. The population forecasts (based upon Pima Association of Governments (PAG) data presented in Chapter 3.4) are the foundation upon which the future system conveyance and treatment capacity planning is based. Going forward, as each new, revised PAG population forecast is issued; the new population information should be analyzed by the Facility Plan Model to assess its impact upon PCWMD's conveyance system, treatment capacity and distribution. The Department will use this data in the Facility Plan Model on a continuing basis and update the Facility Plan every two years. The

Department will work closely with the jurisdictions and area developers to anticipate and plan for growth in the outlying areas, especially with capital-intense treatment projects, and work with PAG to update special population data for high-growth areas on a more frequent basis.

Southlands Basins



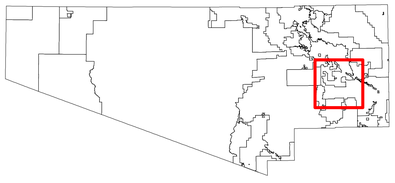
- Treatment Plants

BASINS

- Avra Valley
- Ina Road
- Marana
- Roger Road
- South Lands
- Major Streets

Figure 5.4.1

Pima County Index Map



Index Map Scale 1:1,500,000

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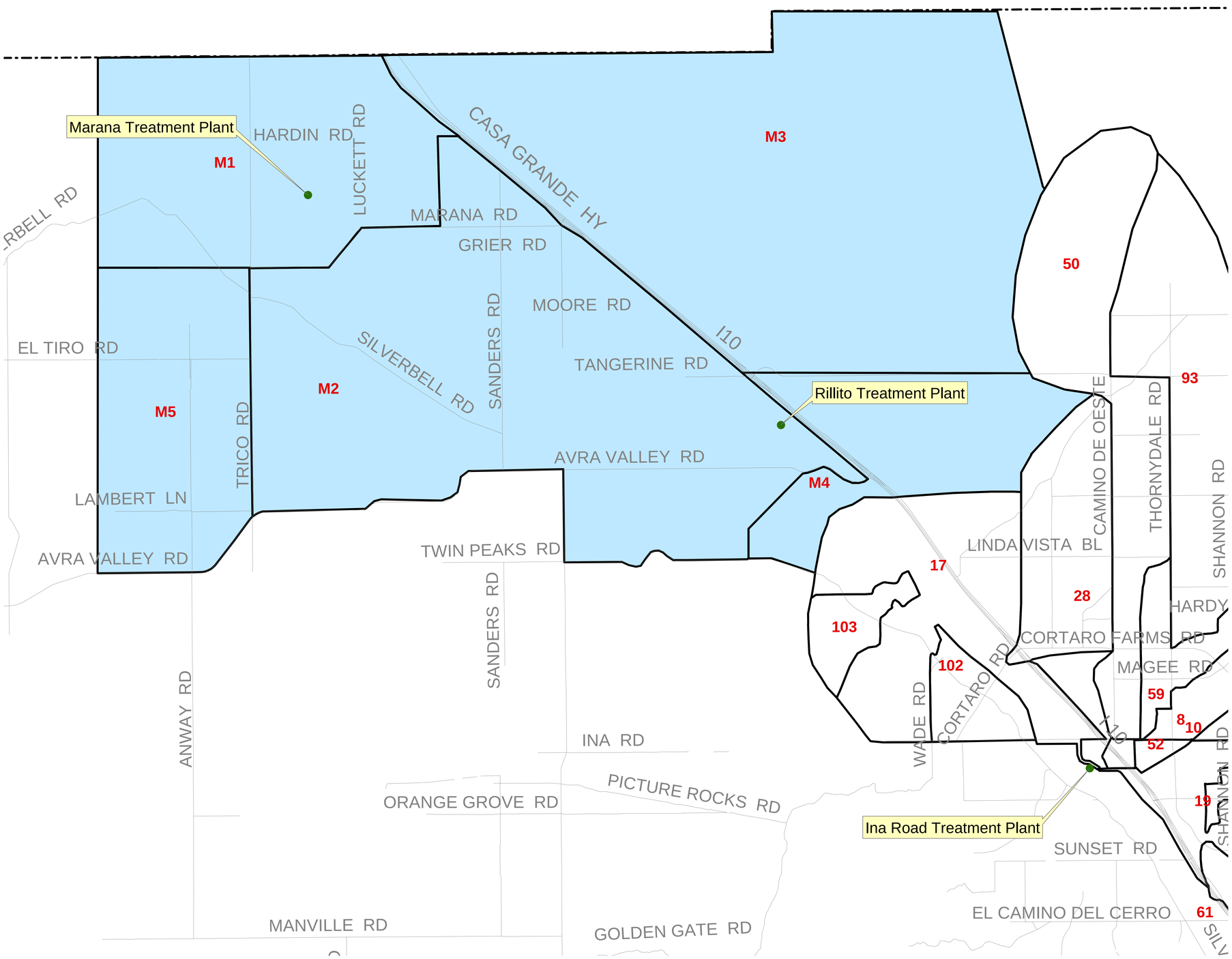
pygmyowl4/projects/wwm7/mxds/southlands_b.mxd mp 2/8/2005

Marana Basins



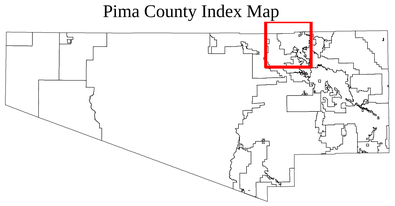
Treatment Plants

BASINS

- Avra Valley
- Ina Road
- Marana
- Roger Road
- South Lands
- Major Streets

Figure 5.4.2

Pima County Index Map



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SUB-CHAPTER 5.5 TREATMENT MODELING AND PROCESS EVALUATION

The Technical Memorandums prepared by Hydromantis, Inc., Appendices E and F, present the evaluation of treatment capacity scenarios for the Roger Road WWTP as well as the Ina Road WPCF, including the HPO and BNRAS treatment trains. These treatment capacity evaluation were conducted by running scenario simulations using dynamic treatment process models in the Hydromantis GPS-X wastewater process modeling environment. The models were developed and calibrated under contract with Hydromantis to develop facility simulation tools for addressing departmental concerns regarding the capacity of existing and proposed facility expansions under a range of regulatory effluent quality requirements.

The scenarios evaluated include the capacity of the existing facilities and the capacity of the facilities with process upgrades and expansions requiring minimal additional infrastructure. The scenarios modeled evaluated the existing capacity of these facilities and were verified using actual plant data; however, the scenarios evaluating future capacity and nutrient removal will require additional simulations with adjusted condition assumptions to ensure the validity of the scenarios.

Treatment modeling shows a number of different options for both increased capacity, as well as nutrient removal for both the Ina Road WPCF and the Roger Road WWTP. The modeling completed to date can help PCWMD map future process modifications to meet regulatory requirements and additional capacity needs. Additional studies are necessary for the overall integrated treatment capabilities for both the Ina Road WPCF and Roger Road WWTP to identify the most cost-effective long term and interim upgrades at the facilities. The ultimate integrated treatment scenarios will be impacted by:

- The Plant Interconnect Pipeline between the Ina Road WPCF and the Roger Road WWTP.
- Solids handling modifications and upgrades at both facilities.
- Centrate treatment options.
- Operation of the two separate treatment trains at the Ina Road WPCF.
- Regulatory requirements at both treatment facilities.
- Process modifications at both facilities.

Modeling and Simulation for Treatment Process Analysis

To evaluate the wastewater treatment capacity of the treatment trains at the Roger Road WWTP and the Ina Road WPCF, dynamic process models were developed utilizing design and operational data. These treatment plant models were constructed using international standard mathematical models representing the mechanisms of the physical separations and biochemical reactions in each of the unit processes making up each treatment train. The unit processes are parameterized using design data, and, for operational plants, were calibrated using operation data and mass-balances. The influent flow was characterized using the analyses from the department's state certified laboratory.

The treatment plant modeling and simulation environment applied is GPS-X version 4.1, utilizing state-of-the-art process models. See Appendices E and F for the modeling results.

Serving the Tucson metropolitan area, PCWMD's metropolitan treatment facilities is presently capable of treating 66 million gallons per day to secondary treatment standards under Arizona's Aquifer Protection and Pollutant Discharge Elimination System permitting programs. The treatment facilities include the 41 MGD Roger Road WWTP and the 25 MGD Ina Road WPCF. A 12.5 MGD expansion is under construction at the Ina Road WPCF, and is expected to be operation by 2006.

In addition, a 3 MGD treatment facility at the Randolph Park WRF was placed into service in 2005. Both the expansion at the Ina Road WPCF and the Randolph Park WRF will be capable of nitrogen removal providing water meeting Class B+ and Class A+ water standards, respectively. This will bring the overall metropolitan treatment capacity up to 81.5 MGD.

The Roger Road WWTP treats wastewater with a screening and degritting headworks, primary sedimentation, trickling biofilter/activated sludge with secondary clarification and chlorination producing Class B water discharged to reuse and (de-chlorinated) to the Santa Cruz River. The existing Ina Road WPCF also uses a screening and degritting headworks, primary sedimentation, a high purity oxygen (HPO) activated sludge process with secondary clarification, and chlorination producing Class B water discharged (de-chlorinated) to the Santa Cruz River. As noted above, the Ina Road WPCF will start up a biological nutrient removal activated sludge (BNRAS) treatment train designed to treat 12.5 MGD to Class B+ reclaimed water standards. This train will share the headworks and influent pump station with the HPO treatment train and the combined effluent will be chlorinated and de-chlorinated prior to discharge to the Santa Cruz River. The combined biosolids produced from both the Roger Road WWTP and the Ina Road WPCF are dewatered at the Ina Road Regional Solids Handling Facility resulting in approximately 0.4 MGD of centrate. The centrate is now returned to the HPO train at the Ina Road WPCF. This centrate return is causing relatively high ammonia concentrations in the plant effluent.

The fundamental concerns in treatment facility assessment are condition assessment and process assessment. Since condition assessment has been discussed earlier in this plan, discussion here is restricted to the assessment of treatment process and capacity impacts. Operational requirements that pertain to capacity are wastewater containment (e.g. minimum freeboard conditions), hydraulic capacity (the design flow with associated peak wet weather flow at which a facility can both convey and contain all flows) as well as equipment limitations (such as limited aeration, or limited recycle rates). With adequate hydraulic capacity, PCWMD's main concern in the process assessment is the other parameters that limit treatment capacity.

The main process performance parameter that effectively determines treatment capacity for these facilities is the required nitrogen removal (total nitrogen and un-ionized ammonia). While aeration and recirculation flow limits are other major concerns, their implementation is easier in terms of the required infrastructure and costs compared to construction of new structures. Given the presumed ability to implement enhanced aeration and internal recirculation flows, the capacity to remove nitrogen is thus limited by reactor and clarifier volumes. Expansion of these structures does require relatively significant capital improvements. Thus, given these presumptions, the main item discussed in this section is nitrogen removal and its impact on treatment capacity.

Process Evaluation Scenarios

The fundamental questions associated with treatment train capacity assessment are:

(1) What is the capacity of the existing plant for given influent and effluent characteristics?

(2) Presuming that aeration, recycle rate, and other ancillary processes can be augmented, what process changes can be implemented to provide nutrient removal with minimal new infrastructure construction requirements?

(3) What are the capacity impacts to the BNRAS facility at the Ina Road WPCF associated with treating the centrate produced under existing conditions, and under future nutrient removal and biosolids processing scenarios at the Metropolitan Facilities?

In the context of the existing and expected future Aquifer Protection (APP) and Arizona Pollutant Discharge Elimination permit programs (AZPDES) Permitting, wastewater treatment, and reclaimed water production demands, the functional questions for this chapter become:

1. What influent (flow & quality) can the existing treatment trains treat to existing discharge standards at both the Ina Road WPCF HPO and BNRAS trains and the Roger Road WWTP?
2. What influent (flow & quality) can the existing treatment trains nitrify and denitrify with (a) existing equipment, (b) additional aeration, and (c) process changes that do not require significant additional construction at both the Ina Road WPCF HPO and the Roger Road WWTP?
3. How is the capacity of the Ina Road WPCF BNRAS treatment train impacted by centrate addition produced under the following scenarios:
   - ✓ Roger Road WWTP treating 41 MGD to secondary effluent standards, with 0.4 MGD of centrate directed entirely to the Ina Road BNRAS train.
   - ✓ Roger Road WWTP treating 20 MGD to less than 8 mg/liter total nitrogen and ammonia to less than 8 mg/liter, with 0.35 MGD of centrate to the Ina Road WPCF BNRAS train.
   - ✓ Roger Road WWTP treating 41 MGD to less than 8 mg/liter total nitrogen and ammonia to less than 6 mg/liter, with 0.5 MGD of centrate to the Ina Road WPCF BNRAS train.
   - ✓ Roger Road WWTP treating 50 MGD to less than 8 mg/liter total nitrogen and ammonia to less than 6 mg/liter, with 0.6 MGD of centrate to the Ina Road WPCF BNRAS train.

Capacity Scenario Evaluations

In order to address these questions, the two following sections deal with Roger Road WWTP and Ina Road WPCF respectively. In these sections we will describe the existing process, its capacity, evaluation of existing process capacity, description of alternate nutrient removal processes, and evaluation of the alternative nutrient removal process performance.

Simulations were conducted to evaluate capacity limitations of the existing processes and the nutrient removal process alternatives proposed for each facility while maintaining the required treatment performance. Diurnal flow patterns were applied in the influent flows used in each simulation. The calibrated models for the existing facilities are based upon several years of both summer and winter operational performance data.

It is important to define the existing treatment train capacity to establish a base of existing conditions against which to compare alternatives and to schedule required expansion. Since nitrification capacity typically determines nitrogen removal capacity, we focus on the nitrification capacity of existing trains. In the following sections, we will first evaluate the existing treatment capacity and then feasible treatment process modifications requiring minimal additional infrastructure to maintain capacity and comply with nutrient removal requirements at both the Roger Road WWTP and Ina Road WPCF.

Existing Treatment Trains

At the present time, the influent flow projections for the metropolitan area, when considered with the 3 MGD capacity relief for the Roger Road WWTP provided by the Randolph Park WRF and the 12.5 MGD increase for the Ina Road WPCF from the new BNRAS train, do not appear to indicate an immediate need for capacity increase at either the Roger Road WWTP, or the Ina Road WPCF. To provide perhaps both additional time and operational flexibility while under secondary treatment requirements, it may be desirable to re-rate the permitted capacity of these facilities

an additional 3.9 percent as allowed under the 2001 Arizona Aquifer Protection Permit program as minor permit amendments. Capacity increases of 4 percent or more are considered significant amendments and trigger Best Available Demonstrated Conventional Technology requirements that include nitrogen removal. The additional time and flexibility afforded by these amendments may provide the latitude required to remain in compliance while process modifications and-or the plant interconnect are implemented. The modeling performed for both facilities as well as recent operational demonstrations indicate that both facilities are capable of treating to their present discharge quality at least an additional 3.9 percent above their existing capacity limits,. For the Roger Road WWTP, this would allow a capacity increase of about 1.6 MGD (< 4 percent), and, for the Ina HPO, this would allow a capacity increase of about 1.0 MGD (<4 percent). These permit amendments would effectively extend the useful life of the unmodified existing processes by approximately two years, allowing additional time to implement process modifications.

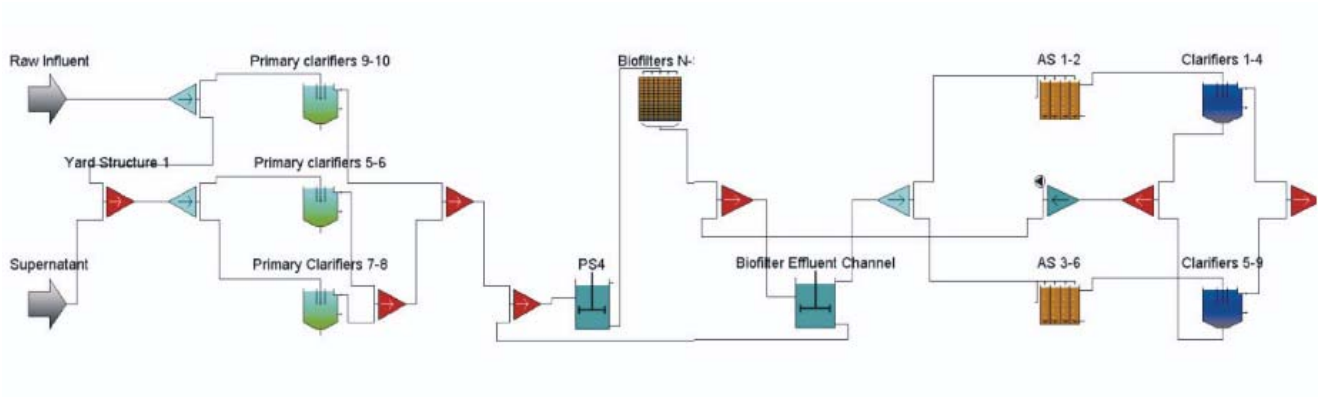
Roger Road WWTP

Existing Process

The Roger Road WWTP has two biofilter/activated sludge trains. It should be noted that the performance of these biofilter and the activated sludge process is not independent, since the two treatment units significantly commingle in the biofilter effluent / return activated sludge trough and in the secondary clarifier influent distribution channel. There are indirect controls over flow and aeration distribution. There is less than a 10 percent difference between the two operating trains at Roger Road WWTP in terms of aeration basin configuration and volume as well as secondary clarifier volumes. These units can be operated either as an activated biofilter (ABF) - when solids are returned and recirculated over the biofilters while the aeration basins may be in operation, or as a biofilter/activated sludge (BF/AS) process - when the aeration basins are in use and are receiving return solids from the secondary clarifiers while the biofilters do not.

For the purpose of the process/capacity simulation/study, the existing capacity for the Roger Road WWTP trains was assessed under operation as a BF/AS. This configuration has been demonstrated to provide more consistent plant performance than just the use of the biofilters alone. The following is a process schematic of the Roger Road WWTP as configured for modeling:

Table 5.5.1 Roger Road WWTP Process Schematic



Existing Process – Capacity Evaluation

As previously noted, the Roger Road WWTP can treat greater than 43 MGD to secondary standards under the current process configuration. This has been confirmed through modeling as well as actual operation of the facility at greater flows when flow needed to be redirected from the Ina

Road WPCF to the Roger Road WWTP to alleviate the HPO. As recommended above, the Roger Road WWTP should be re-rated under a minor APP permit amendment to provide an additional 1.6 MGD of flow, bringing the plant capacity up to 42.5 MGD.

Additionally, the results of simulating the existing process configuration for a nitrification capacity indicate that the facility cannot nitrify at 41 MGD. Additional simulations will need to be run to determine what the maximum nitrification capacity is with and without use of the biofilters and with an improved aeration system. Based upon probable clarifier loading limits and required solids retention time, the capacity of the existing system is between 10 and 20 MGD.

Alternative Nutrient Removal Processes

Under the BF/AS configuration, complete nitrification is probably not economically viable. Modeling shows that nutrient removal with the existing aeration basin and clarifier volumes is impractical because the mixed liquor concentrations required for the minimum solids retention time necessary for nitrification would overload the available clarifier capacity at the existing plant capacity. Nutrient removal could only be accomplished with significant process improvements. Some possible improvements to attain that nutrient removal, while maintaining the existing plant capacity of 41 MGD include:

1. Converting a number of the clarifiers to membrane separators and reducing the load to the remaining clarifiers.
2. Converting the aeration basins to moving-bed (MBBR) or integrated-fixed film-activated-sludge (IFAS) bioreactors.
3. Converting the activated sludge process to a membrane bioreactor.
4. Converting the aeration basins to biologically aerated nitrifying (n_BAF) and anoxic denitrifying (dn_BAF) filters.
5. Adding of post secondary clarification n_BAF and dn_BAF units while maintaining the existing aeration basins.

Each of these process modifications would require for reliable compliance with a total nitrogen effluent quality standard of less than 8 mg/l some minimum methanol feed rate and some type of post-denitrification process. Even for the membrane processes, there would need to be some post-denitrification filtration.

For modeling purposes, the moving bed bioreactor (MBBR) alternative was evaluated as being the least complex to operate, simplest and fastest to implement, allow retirement (or conversion) of the biofilters, the most economical and scalable, as well as compatible with augmentation any of the other process modifications including membrane separation.

The MBBR process configuration does not require RAS return and is effectively a two-sludge system. Internal recycle could be implemented with wall pumps installed in the aeration channel walls, and reactor cells can be established with baffle walls that could be seasonally adjusted for reactor cell volume adjustment, as needed to optimize the heterotrophic to autotrophic biomass ratio and distribution process over a range of influent temperatures and carbon to nitrogen ratios that can arise in methanol feed augmented processes. The MBBR process configuration, as well as any of the other options, would require at least an aeration distribution system replacement and probably at least augmentation of the blower capacity and controls. The preliminary estimated cost (+/- 30 percent) for this process conversion is $15,000,000. Construction of a portion of the modifications required by this process could be completed during the 5-month warm-weather period, during which time the plant could to continue to treat 41 MGD using only the biofilters.

Under secondary treatment requirements, the existing aeration basins are not needed to meet discharge limits between mid-April through mid-September.

The MBBR process configuration, once implemented, would also allow the biofilters to be taken offline for a packing upgrade or for those structures to be converted to tanks for anoxic flow equalization, equalizing prefermentation, or as high-rate anaerobic reactors (e.g. upflow anaerobic sludge blankets). Additional modeling and studies will be necessary to determine the most cost effective options for improving effluent quality and capacity (if needed) at the Roger Road WWTP.

Nutrient Removal Process Results

The two scenario alternatives evaluated actually demonstrate the technical feasibility of the other hybrid nutrient removal processes that are also based upon elevated effective biomass concentrations in the aeration and anoxic basins. The other hybrid nutrient removal process alternatives were enumerated above.

The scenarios evaluated the Moving Bed Bioreactor for reasons describe above as the hybrid nutrient removal process at the Roger Road WWTP. These scenarios include:

1) Convert the facility to an MBBR that can treat 41 MGD to less than 8 mg/l TN, with and without use of the Biofilters.
2) Convert the facility to an MBBR with a post-denitrification filter can treat 50 MGD to less than 8 mg/l TN with and without the Biofilters.

These options would necessitate some plant modifications including, but are not necessarily limited to:

- Methanol Feed Systems for both Pre- and Post- denitrification reactors.
- Post-denitrification filters.

Ina Road WPCF

Description of Existing Processes (HPO)

The existing HPO process receives primary effluent and return activated sludge from the secondary clarifiers in the first of three aeration cells in series that comprise each of four covered parallel trains. The aeration cells in each train share a common covered headspace connected by wall vents through which the which the introduced high-purity (~ 90 percent) oxygen (HPO) and respired carbon dioxide flow from the first cell to atmosphere through pressure regulated vents in the roof covering the third cell. The HPO is produced the pressure swing adsorption system (PSA) system and/or from stored liquefied oxygen that is first passed through a flash (vaporization) volume. Mechanical surface mixers that essentially splash the mixed liquor into the headspace containing the HPO accomplish aeration. Headspace pressure is maintained at between 2 and 4 inches of water column, and dissolved oxygen is measured at between 12 and 20 mg/liter in the effluent from the third aeration cell. The oxygen supply is controlled by the headspace pressure setpoint as well as the dissolved oxygen measurement.

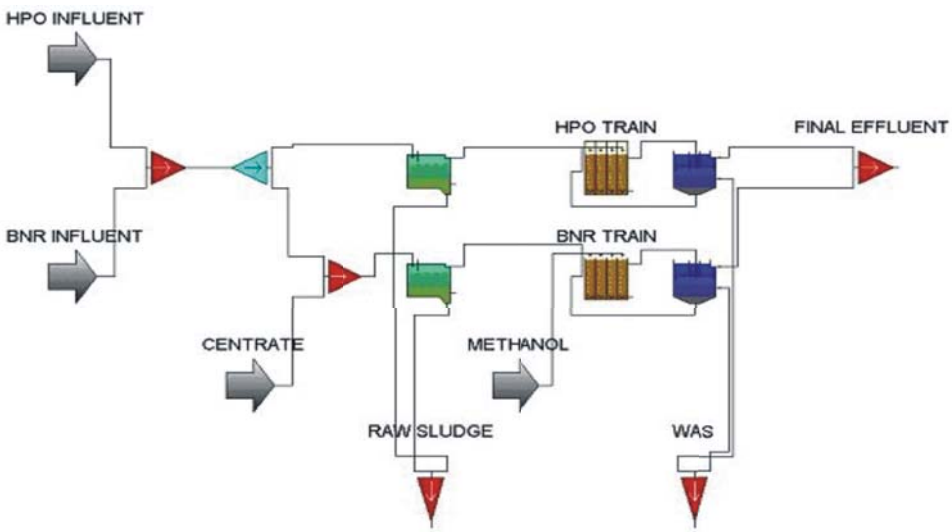
This mechanical aeration system and the associated controls contribute to a very inefficient system relative to currently available alternatives . The system's vendor (Lotopro) claims that an upgrade to this system could result in an 80 percent improvement in aeration efficiency. Additionally, over 50 percent of the HPO produced by the PSA is leaked through cracks in the deck covering the reactors. Further, during low flows in the early morning, the liquid level in the reactors lowers below the reach of the mechanical aerators as they partially emerge from the mixed liquor, which

reduces their aeration efficiency triggering the addition of liquefied nitrogen to maintain the dissolved oxygen concentration and headspace pressure set point.

Capacity Evaluation – Existing HPO

Modeling and actual operation of the existing Ina HPO shows that this facility under the current process configuration can treat greater than 26 MGD to secondary standards. This has been confirmed through modeling as well as actual operation of the facility at greater flows when flow needed to be redirected from the Roger Road WWTP to the Ina Road WPCF. If needed, the Ina Road WPCF HPO could be easily re-rated to provide an additional 1.0 MGD of flow, bringing the plant capacity up to 26 MGD, with only a minor permit modification. Again, at the present time

Figure 5.5.2 Ina Road WPCF Process Schematic



this additional capacity does not appear necessary, unless significant population growth moves to the Ina Road WPCF basin, since the new BNRAS facility is expected to be on line at an additional 12.5 MGD by the end of the year 2005.

Existing HPO Process Nitrification Capacity

Simulations were conducted to evaluate the performance of the existing HPO facilities to determine modifications needed to implement nutrient removal at the existing facility. This modeling did not include the impact of centrate addition to the HPO. treatment needs. Once solids handling treatment options are evaluated, the impact of those options on the existing treatment facilities will need to be evaluated, and additional studies will be necessary to determine additional modifications. The nutrient removal options that were evaluated for, and could be phased into, the existing HPO included:

1) Nitrification with the existing Activated Sludge

The existing system with improvements to mitigate the leaking HPO deck and an upgrade to the aeration system could nitrify up to 20 MGD (existing capacity is 25 MGD) and denitrify with a post-denitrification filter. The high methanol feed rates and costs associated with post-denitrification could be a relatively temporary, easily implemented option, installed until additional process changes could be made, that allow nitrification without the filter. This could be an interim measure to minimize upgrade costs.

2) Nutrient Removal with IFAS

With improvements to mitigate the leaking HPO deck and an upgraded aeration system (per the above item) and then conversion to an IFAS process, the HPO could treat up to 18 MGD (again, the existing HPO is rated at 25 MGD) to less than 8 mg/liter. This could be a secondary step in the improvements to meet nutrient removal, while minimizing costs. The BNRAS facility would need to handle the extra capacity until capacity could be increased at the HPO per the next option.

3) Nutrient Removal with MBBR

With improvements to mitigate leaking the HPO deck and an upgraded aeration system (per the above items) and then conversion to an MBBR process, the HPO could treat 25+ MGD to less than 8 mg/liter. This option would require about 2 million gallons of anoxic tankage, and appropriate internal recycle.

The above items do not need to be implemented in phases, but have been presented in phases to show options for cost reduction in the initial years of nutrient removal. Additional studies will be necessary to determine the best, most cost effective option for this facility. These studies need to take into account the BNRAS facilities, their capacity, and operation, as well as centrate treatment options.

A comprehensive study encompassing modifications at the Roger Road WWTP, as well as the Ina Road WPCF is recommended.

Existing Process (HPO) Capacity Evaluation and Alternate Nutrient Removal Processes

HPO process modifications to the existing process to provide nutrient removal were evaluated for feasibility in terms of diurnal flow treatment performance in simulations run on modified process models based upon a calibrated base model of the existing HPO treatment process. The process modifications evaluated include:

1) Nitrification Capacity of the Existing Process

This maintains the existing process configuration while increasing mixed-liquor concentrations to achieve the solids retention time required for nitrification. Prior single train pilot testing and calibrated modeling runs indicate that this is feasible however requires approximately a 20 percent de-rating of capacity without centrate addition and would also require post-denitrification not necessarily requiring filtration, yet would require substantial methanol feed rates to adequately denitrify to achieve less than 8 mg/liter of total effluent nitrogen.

2) Conversion to an integrated fixed film activated sludge (IFAS) process

This process modification requires conversion of the first aerobic cell to an anoxic cell and control of the headspace vent between the first and second cell. This modification also requires conversion of the aeration system to a simpler and yet extremely efficient jet aeration system that is relatively insensitive to level fluctuations and allows step feed of the HPO as well as the influent, individual cell control of DO and headspace pressure. Control of these together provides indirect control of reactor pH (inhibition control). In addition, screens would be required to maintain the carrier media within the each reactor cell. An internal recycle of flows of up to 3-times the influent flow would require a pump station and a conveyance piping to return flows from the third (aerobic) cell discharge back to the first (anoxic) cell. Returning RAS to the first anoxic cell would augment this internal recycle. Adjustments to the inter-tank flow weirs would also be required.

3) Conversion to a Moving Bed Bioreactor (MBBR) process

This process modification would require the same changes as in the IFAS system except that the first cell would be maintained as an aerobic cell and no activated sludge would be returned. A 2-million gallon pre-anoxic reactor volume would need to be constructed for this process modification. The anoxic tank would be divided with solid walls into several trains. Each train would be comprised of two completely mixed reactors in series. Additionally construction of a pump station and the conveyance piping to provide internal recycle flows of up to 3-times the influent flow from the third (aerobic) cell to the first anoxic cell would be required. Adjustments to the inter-tank flow weirs would also be required.

Description of new BNRAS treatment train

As mentioned above, the 12.5 MGD Ina Road BNRAS treatment train is expected to be operational in the 4th quarter of 2005. This process utilized by this treatment train is the Modified-Ludzack Ettinger (MLE) nutrient removal process. The MLE process implements a pre-denitrification anoxic reactor cell followed by a tapered multi-cell aeration basin and secondary clarification.

Following the flow, effluent from the primary clarifiers enters a pre-anoxic denitrification reactor and is blended (and reacted) with an internal recycle of nitrified mixed-liquor from the final cell of the aeration basin at up to 4 times the influent flow. Return activated sludge (RAS) is returned at up to 1.5 times the influent flow from the secondary clarifiers, in his case, to the first aerobic cell. (The MLE process is also used in the Marana Package Plants with the exception that the RAS is returned to the pre-denitrification anoxic cell.) The final aeration cell may be operated without aeration and still maintain suspended mixed liquor as it uses separate mixers when operated without aeration.

New BNRAS Capacity Evaluation

Simulation runs on the preliminary (un-calibrated) modeling of the BNRAS support the feasibility of re-rating the facility to 20 MGD with up to 0.35 MGD of centrate addition and up to 25 MGD without centrate addition - if the BNRAS is operated as an equalized facility. The equalization would only be required due to hydraulic limitations of the primary scum troughs. Equalization of the flow to the BNRAS would require shaving the diurnal peaks to the HPO train. Note that while the simulation results are based upon an un-calibrated model, the model is based upon the detailed design information and specified and tested equipment that is installed. Hence the predicted performance results of the simulations should be regarded as more rigorous than the design and as valid as the design in all regards except with respect to hydraulic restrictions on the range of internal recycle and return activated sludge flows expressed as a multiplier of the influent flow – for example the internal recycle limit is 3 times the influent if the facility operates at 20 MGD.

BNRAS - Performance Impacts with and without Centrate

Simulations to evaluate the nutrient removal performance of the BNRAS with and without centrate addition, with and without diurnal flows, and with varying centrate nutrient loads and flows have been conducted. The results indicate the following.

1) No Centrate Addition

Of course this scenario presumes a separate centrate nitrification process - which when all is considered and based upon first principles may be the final and best solution for the centrate processing.

Without centrate addition, simulation results indicate that maximum capacity of the facility will be determined by either hydraulic limitations in the primary clarifiers or due to solid loading limitations

in the secondary clarifiers. This conclusion is based upon results that indicate that the aeration basin for this train has abundant nitrification capacity at flows approaching even 30 MGD if the flow is equalized (and hydraulically feasible). The maximum capacity configuration would be achieved with equalized influent flow (diurnal peaks trimmed to the HPO) and with post-denitrification filters to polish the effluent nitrate and secondary suspended solids overflow excursions associated occasional operational fluctuations.

Hydraulic limitations associated with ancillary equipment, such as the scum troughs or control weirs have not been evaluated, and will need further investigation – perhaps best evaluated during model is calibration efforts.

In any event, a feasible and favorable phasing alternative for process upgrade at Ina may involve re-rating the BNRAS train under contingent operations (e.g. under trimmed influent flows with and without centrate and as a function of centrate flow and concentration). The elevated resulting re-rating of the BNRAS based upon operational conditions and centrate character would allow de-rating and upgrading the HPO facility in, perhaps prolonged, phases (e.g. post-denitrification filters, then IFAS, then MBBR) to provide nutrient removal capacity as required for a relatively low cost.

2) Sensitivity Analysis for Centrate Addition

The BNRAS facility was evaluated for treatment of various quantities of centrate, to determine the impact of this centrate on its treatment capabilities. Centrate concentrations similar to those presently encountered at the Ina Road WPCF were used. Changes to the solids handling system will affect both the quantity and concentration of the centrate at the facility, thus affecting treatment options, and additional treatment studies will be necessary. The centrate addition scenarios considered for the BNRAS capacity evaluation simulations included:

a. 0.35 MGD of centrate. This option of centrate addition was found to be feasible, with a post-denitrification filter. The combined dewatering facilities can produce 0.35 MGD of centrate, and solids handling modifications may increase that centrate production. As a result additional centrate addition was also modeled.
b. 0.5 MGD of centrate. It was found that the BNRAS facility was not capable to treating this centrate recycle volume, and a separate centrate nitrification process would likely be required.
c. 0.6 MGD of centrate. Again, it was found that the BNRAS facility was not capable to treating this centrate recycle volume, and a separate centrate nitrification process would likely be required.

The above sensitivity analysis shows that treatment of the centrate by recycle to the BNRAS is not feasible. Again, additional modeling/studies will be required to determine the most cost effective method of centrate treatment to meet the effluent ammonia limits. A centrate nitrification process will likely be necessary. This nitrification process could improve the performance of the other Ina Road nitrification reactors providing a means to receive the centrate nitrification reactor's waste activate sludge to augment the active autotrophic (nitrifying biomass) in these reactors.

The nitrified centrate could also be used as an oxidizing agent (while denitrifying – reducing the nitrate to nitrogen gas) as a chemical treatment to mitigate septic conditions and odor in the local conveyance system and in the facility headworks, thereby reducing chemical requirements.

Conclusions and Recommendations

Determination of the most appropriate conversion to allow the existing HPO facilities to meet nutrient removal requirements must be evaluated along with an overall evaluation of process and solids handling requirements at both the Roger Road WWTP and the Ina Road WPCF. The existing facilities cannot be effectively evaluated in a vacuum without determination of some of the following:

a. Treatment capacity and process at the Roger Road WWTP.

b. Solids handling facilities, at both Roger Road WWTP and the Ina Road WPCF.

c. Centrate treatment at the Ina Road WPCF.

Additional studies will be necessary to determine the most cost-effective nutrient removal options for the Roger Road WWTP.

Chapter 6 Effluent Reuse

CHAPTER OVERVIEW

As the major producer of effluent in Eastern Pima County, Pima County Wastewater Management Department (PCWMD) will play a significant role in how effluent is used in the future. There are some restrictions to this role. While PCWMD is the major producer of effluent, the 1979 Merger IGA dictated there were two major recipients of Metropolitan Area effluent: Tucson Water and Pima County. Since 1979, the Southern Arizona Water Rights Settlement Act (SAWRSA) and the 2000 IGA increased the number to four major recipients: Tucson Water, which shares a portion of its allocation of effluent with several other entities that contribute to the Metropolitan Treatment Facilities; the Bureau of Reclamation which is acting on behalf of SAWRSA; Pima County; and the Conservation Effluent Pool (CEP).

Tucson Water receives 90 percent and Pima County receives 10 percent of the remaining effluent once the volumes dedicated for SAWRSA and the CEP are deducted. Tucson Water's 90 percent share is reduced by its agreements with other local water providers that contribute to the Metropolitan Treatment Facilities. Pima County also receives the effluent from the outlying treatment facilities.

Pima County is presently using its allotment or participating in projects such as:

- Ed Pastor Kino Environmental Restoration Project.
- County Parks (including Arthur Pack Golf Course).
- High Plains Effluent Recharge Project.
- Lower Santa Cruz Managed Recharge Project.

Other environmental restoration projects are envisioned to help make beneficial use of the remainder of Pima County's allotment of effluent including:

- Tres Rios del Norte Project.
- Paseo de Las Iglesias.
- Canoa Ranch.
- Black Wash.

CHAPTER 6.0 EFFLUENT REUSE

As the major producer of effluent in Eastern Pima County, PCWMD will play a significant role in how effluent is used in the future. There are some restrictions to this role; however, because while PCWMD is the major producer of effluent, the 1979 Merger IGA dictated there were two major recipients of metropolitan effluent: Tucson Water and Pima County. Since 1979, the Southern Arizona Water Rights Settlement Act (SAWRSA) and the 2000 IGA increased the number to four major recipients: Tucson Water, which shares a portion of its allocation of effluent with several other entities that contribute to the subject treatment facilities; the U.S. Secretary of the Interior, which is acting on behalf of SAWRSA; Pima County; and CEP.

In accordance with the 2000 IGA, SAWRSA provides 28,200 acre feet (AF) of effluent to be allocated to the Secretary of the Interior. Up to 10,000 AF, based on actual usage, is then allotted to the CEP for use on approved environmental restoration projects.

The remaining effluent is then allocated to Tucson Water and PCWMD. Tucson Water has rights to 90 percent of the remaining effluent, currently equaling about 36,000 AF. Tucson Water currently shares approximately 8 percent of its allotment with Metropolitan Domestic Water Improvement District and 5 percent with Oro Valley Water Utility. PCWMD then has rights to the remaining 10 percent, which is approximately 4,000 AF, at this time.

Recent activities, especially those proposed by the Pima County Regional Flood Control District (PCRFCD), could use effluent as a key resource in a number of environmentally sensitive projects. Many of these projects will be wash and riparian restorations. The Conservation Effluent Pool (CEP) is explained later in this chapter.

Chapter 6 of the 2006 Metropolitan Area Facility Plan Update (Facility Plan) will address PCWMD's general infrastructure, allotments, distribution, CEP, recharge projects, constraints, proposed projects and conclusions. However, these policies are very fluid at this time. While effluent will play a larger role in the Metropolitan Area's water resource planning, it is difficult to predict exactly how effluent will be used in the future. While PCWMD's 4,000 AF of effluent sounds significant; as a comparison, this is only enough effluent to water approximately eight golf courses for a year. However, effluent will increase as the population continues to grow. Some gains in effluent are projected in the Metropolitan Area, the significant increases in effluent are projected for the Non-metropolitan Treatment Facilities. Effluent from Non-metropolitan Treatment Facilities such as Avra Valley, Marana, and Corona de Tucson are expected to increase from approximately 2,789 AF in 2005 to 10,323 AF by 2030.

Descriptions of Metropolitan Treatment Facilities

Although PCWMD currently has eleven wastewater treatment facilities, for the purposes of the 2005 Facility Plan, discussions will be limited to three Metropolitan Treatment Facilities: the Ina Road Water Pollution Control Facility (WPCF), Roger Road Wastewater Treatment Plant (WWTP), and Randolph Park Water Reclamation Facility (WRF); and three Non-metropolitan Treatment Facilities: the Corona de Tucson Wastewater Treatment Facility (WWTF), Avra Valley WWTF, and Marana WWTF. The remaining Non-metropolitan Treatment Facilities that are not included in the 2005 Facility Plan are Green Valley WWTP, Pima County Fairgrounds WWTF, Arivaca Junction WWTF, Mt. Lemmon WWTP, and Rillito Vista WWTF. The three Metropolitan Treatment Facilities provide the majority of currently available effluent, and, because of their locations and influent volumes, the three Non-metropolitan Treatment Facilities are the best candidates for the generation of usable quantities of effluent in the future.

Ina Road Water Pollution Control Facility

The Ina Road WPCF is in the northwestern part of the Tucson basin. The plant was originally designed to treat 25 MGD and the average daily inflow of influent is approximately 25 MGD, depending on the amount of flows diverted from the Roger Road WWTP. During the past few years, a new treatment train has been under construction to increase the WPCF's capacity to 37.5 MGD. When the new treatment train is completed in 2006, it will provide an additional 12.5 MGD of treatment capacity through a Biological Nutrient Removal Activated Sludge (BNRAS) process.

The existing 25 MGD facility uses the high-purity oxygen (HPO) activated sludge process. It incorporates digestion and centrifuging for biosolids handling to meet agriculture land application disposal criteria, and provides an energy-recovery system for on-site generation of electrical power to meet plant operations. This portion of the Ina Road WPCF produces Class B effluent.

Effluent from this facility is utilized through three methods: plant irrigation, Arthur Pack Golf Course irrigation and discharge/recharge into the Santa Cruz River. Plant irrigation currently consists of 24 AF. An average of approximately 526,900 GPD (594.19 AF/Yr) of Class B effluent is delivered through a Pima County owned/operated line to the Arthur Pack Golf Course to be used for irrigation purposes. The Arthur Pack Golf Course will be connected to the Tucson Water Reclaimed Water system in 2006. The remaining effluent (approximately 24.2 MGD) is discharged into the Santa Cruz River where it is recharged into the Lower Santa Cruz River Managed Recharge Project (LSCRMRP). The LSCRMRP is a non-constructed recharge project (water is not diverted, slowed or retained by constructed devices) and, as such, it only receives 50 percent recharge credits from ADWR. The credits are apportioned among the five LSCRMRP recipients: City of Tucson, Pima County, the Town of Oro Valley, Metropolitan Domestic Water Improvement District and the Bureau of Reclamation. There are four other partners on the LSCRMRP that do not receive credits: Town of Marana, Flowing Wells Irrigation District (FWID), Avra Valley Irrigation and Drainage District (AVIDD), and Cortaro-Marana Irrigation District (CMID). This partnership is based on the Intergovernmental Agreement titled Permitting and Operating Managed In-Channel Recharge of Effluent in the Santa Cruz River Channel (Managed Recharge IGA 2003).

Roger Road Wastewater Treatment Plant

The Roger Road WWTP is located on the west side of Tucson. This is currently PCWMD's largest facility, with a capacity of 41 MGD. Currently, the plant is receiving average flows of approximately 35 to 40 MGD. Flows to the Roger Road WWTP will also fluctuate slightly depending on the amount of influent processed through the Randolph Park WRF.

Effluent disposal from Roger Road WWTP consists of three methods: plant reuse, Santa Cruz River discharge/recharge, and diversion to Tucson Water's Sweetwater Recharge Facilities/Reclaimed Water Treatment Plant. Plant irrigation consists of 4.8 AF of effluent per year. Approximately 28 MGD of Class B effluent is discharged into the Santa Cruz River for storage in two managed recharge projects (Upper Santa Cruz River Managed Underground Storage Facility and Lower Santa Cruz River Managed Recharge Project). The remaining Class B effluent, approximately 8.8 MGD, is diverted to Tucson Water's Sweetwater Recharge Facilities/Reclaimed Water Treatment Plant.

Randolph Park Water Reclamation Facility

The Randolph Park WRF is located in midtown Tucson. It was originally built by the City of Tucson in 1975; its ownership was transferred to the County as part of the 1979 IGA. In February 2000, a supplemental agreement to the IGA was signed between the two parties, and, as part of this agreement, PCWMD was tasked with rebuilding the Randolph Park WRF. The plant is currently rated at 3.0 MGD. Randolph Park WRF's primary purpose is to produce effluent, with a secondary

benefit of this plant being a reduction of flows to the Roger Road WWTP, although solids are returned to the collection system for treatment at Roger Road WWTP.

Although the facility is currently permitted to produce Class A effluent, which meets the existing requirements of Tucson Water's Reclaimed Water System; it is capable of producing Class A+ effluent. Effluent disposal consists of direct delivery into Tucson Water's Reclaimed Water System, per the agreement reached in the 2000 Supplemental IGA. A significant feature of the Randolph Park WRF is it is considered a "scalping" plant, and, as such, it is not required to remain in operation at all times. When the Randolph Park WRF production is reduced or shut down, sewage simply bypasses the plant and is conveyed on to the Roger Road WWTP. When Randolph Park WRF is in operation, effluent is reused and the biosolids are conveyed to the Roger Road WWTP.

Governing Agreements: IGAs for Effluent

Basis of Effluent Entitlements

Currently, there are four IGAs between Pima County and the City of Tucson governing their effluent ownership and distribution: the 1979 Intergovernmental Agreement (1979 IGA), the 2000 Supplemental Intergovernmental Agreement, (2000 IGA, which governs the Conservation Effluent Pool), and the 2003 Intergovernmental Wheeling Agreement (2003 Wheeling IGA). As the dates of these IGAs suggest, they were sequentially passed and each succeeding IGA builds upon the previously granted agreement. A fourth IGA, the Intergovernmental Agreement titled Permitting and Operating Managed In-Channel Recharge of Effluent in the Santa Cruz River Channel (2003 Managed Recharge IGA), governs the recharge of effluent allotted to the nine participants of the Lower Santa Cruz River Managed Recharge Project.

1979 Intergovernmental Agreement, Resolution No. 1979 – 78 (1979 IGA)

The 1979 Intergovernmental Agreement, signed on June 26, 1979, was the original agreement between PCWMD and the City of Tucson. This agreement assigned control of wastewater conveyance and treatment activities to PCWMD. In exchange, the City of Tucson would receive 90 percent of all effluent produced at the PCWMD Metropolitan Treatment Facilities, which were limited at that time to the Ina Road WPCF, Roger Road WWTP and Randolph Park WRF.

City of Tucson–Pima County Supplemental Intergovernmental Agreement Relating to Effluent, Resolution No. 2000-28 (2000 IGA)

The 2000 Supplemental Intergovernmental Agreement signed on February 8, 2000, placed restrictions on how PCWMD could use the effluent from the Ina Road WPCF and the Roger Road WWTP. This agreement also exempted outlying facilities from the control of City of Tucson, and identified the need for reopening the Randolph Park WRF, which had been shutdown in 1995. It provided an avenue for PCWMD to deliver effluent to Pima County facilities. This supplemental agreement also established a Conservation Effluent Pool for use with riparian habitat projects and identified how the SAWRSA effluent water rights would be treated in determining effluent allocations.

Conservation Effluent Pool Agreement

The 2000 IGA identifies up to 10,000 AF of effluent that will be set aside for use on environmental restoration projects. These projects will be in accordance with the criteria of the 2000 IGA, or must have the approval of both the City of Tucson and Pima County.

Intergovernmental Agreement between the City of Tucson and Pima County for Treating Effluent and Wheeling Reclaimed Water (Wheeling Agreement), Resolution No. 2003-286 (2003 Wheeling IGA)

The Wheeling Agreement, signed December 16, 2003, governs reclaimed water transactions between PCWMD, the effluent provider; City of Tucson, the distributor and a reclaimed water user/owner; and other Pima County facilities, reclaimed water users. The effluent enters the system at the City of Tucson's Sweetwater Recharge Facilities and the Tucson Reclaimed Water Treatment Plant and through direct delivery from the Roger Road WWTP; from there it is piped to various locations. The Randolph Park WRF discharges its effluent directly into the City of Tucson reclaimed water system. The agreement governs the costs (per acre-foot) that will be charged to Pima County for distribution of Pima County effluent to Pima County sites from either of these two locations.

Intergovernmental Agreement – Permitting and Operating Managed In-Channel Recharge of Effluent in the Santa Cruz River Channel (2003 Managed Recharge IGA)

The 2003 Managed Recharge IGA governs the recharge of effluent and the associated credits granted by Arizona Department of Water Resources (ADWR) for the LSCRMRP between the Ina Road WPCF and Trico Road in Marana. Participants include the Town of Marana, Cortaro-Marana Irrigation District, Avra Valley Irrigation and Drainage District, Metropolitan Domestic Water Improvement District, Flowing Wells Irrigation District, Oro Valley, Pima County, City of Tucson, and the Bureau of Reclamation.

Effluent Allotments to Agencies as Determined by the IGAs and the Southern Arizona Water Rights Settlement Act

In accordance with the 1979 IGA, Tucson Water was awarded 90 percent of all effluent after the SAWRSA distribution and PCWMD was awarded 10 percent. However, under the SAWRSA and separate IGAs between Tucson Water, Metropolitan Domestic Water Improvement District, and Oro Valley Water, a new distribution formula was created and also incorporated into the 2003 Managed Recharge IGA.

In accordance with this new formula, of the total effluent generated from all Metropolitan and Non-metropolitan Treatment Facilities, SAWRSA had rights to the first 28,200 AF, and then the CEP had rights to up to 10,000 AF on an as-needed basis for environmental restoration projects. Since CEP is allotted after the United States receives its SAWRSA share and before either Tucson Water or PCWMD receive their share, any allocation to CEP effectively reduces the remaining share available to Pima County and Tucson Water. As part of a settlement, Oro Valley and Metropolitan Domestic Water Improvement District provide a portion of Tucson Water's CEP share, and therefore they indirectly contribute to CEP. However, at the maximum CEP allocation, PCWMD provides 1,000 AF, while Tucson Water and other providers are required to provide up to 9,000 AF.

Although a final agreement has not been reached between Tucson Water and Pima County as to how the CEP will be administered, it is currently anticipated that City of Tucson and Pima County CEP projects could reach the maximum CEP allotment of 10,000 AF of effluent by 2015. As not every restoration project will qualify or attempt to qualify for CEP, it is difficult to say with certainty the CEP allocation will be consumed as quickly as anticipated. It is possible that qualifying for CEP allocations could be a lengthy process involving the United States Fish and Wildlife Department. If the CEP effluent remains unused as an environmental water source, it could become very difficult for PCWMD to predict its own long-term effluent balance.

Tucson Water and PCWMD Allotments of Effluent

In 2004, Metropolitan Area effluent from the Ina Road WPCF and Roger Road WWTP was approximately 68,000 AF. After allocations of SAWRSA (28,200 AF) and CEP (there were no CEP allocations in 2003), the remaining balance was approximately 40,000 AF. Of this remaining 40,000 AF, Tucson Water had rights to its allotment of 90 percent or 36,000 AF (which is shared with other entities that contribute to metropolitan effluent), and PCWMD had rights to an allotment of 10 percent or 4,000 AF.

Projections indicate that by 2030 effluent generated by the three metropolitan plants is estimated to increase to approximately 95,286 AF, with PCWMD receiving approximately 5,700 AF.

County Effluent Recharge Projects

The High Plains Project

The High Plains project is a research project to investigate constructed recharge methods. While it is a Pima County Project requiring effluent, this effluent is part of surface water rights agreement that contributes 2,100 AF to the Santa Cruz River. As part of this agreement, each party that discharges effluent into the Santa Cruz River provides a percentage of this 2,100 AF. These parties include Tucson Water, which shares a portion of its allocation of effluent with several other entities that contribute to the metropolitan treatment facilities; the Bureau of Reclamation; and Pima County. In accordance with the 2003 Managed Recharge IGA, up to 600 AF are currently delivered into the PCRFCD High Plains Project. PCWMD currently has a three-year agreement with the Cortaro-Marana Irrigation District (CMID) to provide the High Plains Project's 600 AF for ADWR credits that go to CMID. PCWMD is also studying the viability of entering into an IGA with PCFCD that would allow Pima County to use the High Plains Project as a means of obtaining constructed recharge credits for its own effluent.

The Santa Cruz River Managed Underground Storage Facility (SCRMUSF) and Lower Santa Cruz River Managed Recharge Project (LSCRMRP)

Pima County effluent that is not reused on site or wheeled to Pima County facilities at Arthur Pack or through Tucson Water's Reclaimed Water System is discharged into the Santa Cruz River where it is recharged into the LSCRMRP. The SCRMUSF and LSCRMRP are non-constructed recharge projects, and, as such, only receive a maximum of 50 percent ADWR recharge credit. However, because of the current drought in the Southwest and the 2003 Mt. Lemmon fire, a layer of algae and/or ash has formed just under the surface of the Lower Santa Cruz River channel making the soil far more resistant to percolation. As a result, recharge rates have dropped to less than 40 percent of normal. If the SCRMUSF and LSCRMRP were constructed recharge projects, participants of the SCRMUSF and LSCRMRP would receive approximately 100 percent credit for the recharged effluent. A LSCMRP subcommittee is studying the feasibility of conducting in-channel constructed recharge and has met with ADWR to explore several possible options.

Currently, PCWMD receives the vast majority of its effluent from the Ina Road WPCF. If PCWMD were to start receiving effluent from the Roger Road WWTP, PCWMD would need to either work out an agreement with Tucson Water and the Bureau of Reclamation for recharge rights to the SCRMUSF or apply for a permit for that project. PCWMD, Metropolitan Domestic Water Improvement District and Oro Valley Water Utility have already asked Tucson Water and the Bureau of Reclamation to join the SCRMUSF. These requests are under consideration. If approved, this move could provide PCWMD with more recharge options and because the SCRMUSF is approximately five miles upstream from the LSCRMRP, effluent that is discharged by PCWMD would have more opportunity to recharge into one of the two facilities.

Effluent and the Outlying Facilities

Corona de Tucson Wastewater Treatment Facility

The Corona de Tucson WWTF is located 22 miles southeast of Tucson. The facility is comprised of two facultative stabilization lagoons, which are each approximately 4-feet deep and 3.5 acres in size. The south lagoon is lined with soil cement and the north lagoon is lined with cement around the top and soil cement on the bottom. The facility also has one 11-acre high density polyethylene (HDPE) lined evaporative disposal pond.

The current WWTF is designed to treat 150,000 GPD of domestic sewage, but the permitted capacity is limited to the evaporation capability of the evaporation pond of 117,000 GPD in the Aquifer Protection Permit dated December 17, 2004. Currently, average monthly inflows are approximately 84,000 GPD; the WWTF doesn't have a reuse permit.

PCWMD has worked with ADEQ to reclassify the plant to 117,000 GPD and is working on designs to potentially increase the plant to approximately 1 MGD in FY2007/08. It is anticipated that effluent will reach 2,946 AF (2.6 MGD) by 2030.

Avra Valley Wastewater Treatment Facility

The Avra Valley WWTF is located approximately 20 miles southwest of Tucson. The facility is comprised of a flow equalization basin, an oxidation ditch, two secondary clarifiers, four sludge-drying beds and four percolation basins. The WWTF is designed to treat 1.2 MGD and is currently averaging approximately 965,000 GPD. WWTF influent is expected to increase to about 1.1 MGD at the end of 2005.

Effluent disposal consists of percolation, evaporation, plant irrigation reuse, and disposal through a spray field into the Black Wash. Generally, the spray field is only used when emergency flow conditions exceed percolation capabilities.

PCWMD, PCRFCD and other stakeholders have developed a plan to utilize future effluent generated from the expansion for on-site pond recharge and recharge to Black Wash in-channel constructed recharge and rirparian restoration.

Projections indicate effluent will increase to 1,154 AF (1.1 MGD) by 2005 and 6,272 AF (5.6 MGD) by 2030.

Marana Wastewater Treatment Facility

It is currently anticipated the Town of Marana will experience significant growth between 2005 and 2030 per PAG projections. Effluent rates at the Marana WWTF are expected to climb from approximately 952 AF in 2005 to approximately 4,973 AF in 2030.

Although still in the planning stages, the Marana WWTF has several plant expansion options available to it. It can use percolation and evaporation to gain approximately 100 percent constructed recharge credits; it can discharge effluent into the Santa Cruz River for 50 percent recharge credits; or PCWMD can sell effluent to the Town of Marana or CMID for irrigation.

Proposed Projects

The United States Army Corps of Engineers is currently working with the City of Tucson and the Town of Marana to develop a proposal for the Tres Rios del Norte project that is expected to extend approximately from Prince Road in Tucson to Sanders Road in Marana. This is a massive environmental project that is expected to require up to 10,000 AF of effluent. However, to date, there has been no specific determination of this effluents' source.

PCFCD has identified fourteen proposed environmental restoration projects including a two-phase project at Paseo de Las Iglesias. These projects could require approximately 5,600 AF of effluent by 2010.

Tucson Water Long Range Water Plan: 2000 – 2050

Tucson Water submitted its draft *Water Plan: 2000 - 2050* to the City of Tucson Mayor and Council in November 2004. The plan was developed to initiate a dialogue with the community about the water resource challenges that lie ahead. The plan is based on the same population projections provided by the Pima Association of Governments as this Facility Plan and states that Tucson Water's service area population is projected to grow from 638,936 in 2000 to approximately 1.3 million by 2050. Tucson Water's total demand in 2000 was 128,521 AF, and this is anticipated to grow to approximately 253,000 AF by 2050. *Water Plan: 2000 - 2050* will be extremely important to the development of effluent policy in the greater Tucson area. This plan is important because it makes these options openly available to the public to choose the pathways to the City of Tucson's water future. The Plan lists a number of options for expanding effluent use, most of which do not commence until about 2015. Key issues affecting effluent planning are discussed in the following sections.

Assured Water Supply

Tucson Water has a designation of Assured Water Supply (AWS) and as such, it is subject to the AWS rules administered by the Arizona Department of Water Resources (ADWR). The AWS Designation allows Tucson Water to use its Central Arizona Project (CAP) water and effluent, but places significant restrictions on the use of groundwater to meet future demand. Tucson Water must significantly reduce its use of groundwater over time. The Plan indicates the expanded use of effluent may be necessary to meet future demands and remain in compliance with the AWS rules.

Current Sources of Water

Tucson Water will need to reduce its dependency on groundwater to a more sustainable pumping rate (currently estimated to be about 50,000 to 70,000 AF per year) by identifying and incorporating other water resources. These additional resources are limited to deliveries from the CAP, which is currently up to 135,966 AF per year (potential to increase to 144,172 AF per year), and effluent at up to 30,739 AF (Tucson Water 2003 figure). Due to allocation limits, the CAP allotment is not likely to be increased above the 144,172 AF. Tucson Water's draft *Water Plan: 2000-2050* projected its effluent entitlement to be 62,000 AF by 2030 and 66,000 AF by 2050. These two projected figures are larger than the combined flows forecasted from the Ina Road WPCF, Roger Road WWTP and Randolph Park WRF facilities in the initial draft of this Facility Plan. In order to achieve consistency across the two plans, Pima County and Tucson Water staff met frequently in late 2005 to resolve this issue. The effluent volumes projected in this finalized Facility Plan are the result of this cooperative effort and will also be used by Tucson Water in subsequent versions of *Water Plan: 2000-2050.*

Water Quality

Tucson Water has been blending groundwater with recharged and recovered CAP water since 2001 to improve the aesthetic appeal of its water. Through blending, Tucson Water can maintain a Total Dissolved Solids (TDS) level below 450 mg/L through at least 2009. One of the critical community decisions identified in *Water Plan: 2000-2050* is whether Tucson Water should implement an enhanced treatment plant to maintain this TDS level indefinitely or allow the TDS level to gradually increase to a new equilibrium of about 600 mg/L. The outcome of this decision will affect the TDS level of wastewater that is treated at the Metropolitan Treatment Facilities. Additionally, the

report comments on the evaluation of emerging contaminants, which is an issue PCWMD is already watching (e.g., pharmaceutical issues).

Tucson Water's Use of Effluent

Tucson Water owns and operates a Reclaimed Water System to supply tertiary treated effluent for turf irrigation and certain industrial uses. Tucson reuses about one-third of its effluent through this system and also wheels effluent owned by other entities, including Pima County, to their points of use. Reclaimed water use meets about eight percent of Tucson Water's current total water demand and this is projected to continue into the future. Tucson Water is also a contributor to the SCRMUSF and the LCSRMRP. However, *Water Plan: 2000-2050* presents scenarios where Tucson could pull all of its effluent out of the Santa Cruz River within the next 15 years. Additional critical decisions of *Water Plan: 2000-2050* are whether to move forward with plans to put all of Tucson's effluent to use and, if so, what types of expanded uses of effluent will be acceptable to the community.

Future Challenges

As part of its long-range planning, Tucson Water is suggesting the possibility of following in the footsteps of other southwestern communities and treating effluent to very high standards for recharge and indirect potable reuse. In the long-range plan, Tucson Water indicated that such a decision would need to be made by 2014 unless other water supplies are acquired or increased levels of water conservation are achieved. Tucson Water has based *Water Plan: 2000-2050* on fully utilizing all of their available water resources, including effluent, while they seek to obtain new ones.

Summary

While there may be some uncertainties surrounding effluent ownership and delivery over the next decade, the need to more effectively use effluent as a renewable water resource in the region will become increasingly important. PCWMD has a finite amount of effluent under its control, and this effluent is regulated by IGAs and constrained by conveyance costs. Therefore, the most likely customers of PCWMD's allotment will be public/governmental entities such as PCFCD.

PCWMD will continue to work toward the goal of using its effluent in the most efficient manner possible. PCWMD would like to wheel as much of its effluent as possible to Pima County projects and thereby reduce the amount of effluent being discharged into the Santa Cruz River. Remaining PCWMD effluent will continue to be discharged into the Santa Cruz River channel where it will be recharged into the LCSRMRP. Finally, at the Non-metropolitan Treatment Facilities, PCWMD will be working toward obtaining constructed recharge permits.

Conclusions and Recommendations

Based on discussion in this chapter, PCWMD should:

- Work in collaboration with Tucson Water on the long range *Water Plan: 2000 - 2050* in areas of mutual benefit.
- Work in collaboration with the other water providers and local citizens groups on recharge, reuse and water conservation activities.
- Assist in developing regional water policy and effluent utilization practices.
- Continue to work closely with the other Pima County agencies including National Resources, Flood Control and the Kino Stadium District to identify and coordinate existing and potential effluent utilization opportunities for Pima County's effluent.

- Obtain the necessary recharge permits for all of the percolating treatment facilities. This would include Avra Valley WWTF, Arivaca Junction WWTF, Corona de Tucson WWTF, Green Valley WWTP, Marana WWTF and Rillito Vista WWTF. The Pima County Fairgrounds WWTF receives only limited seasonal flows and is probably not worth permitting at this time. Effluent from the Mt. Lemmon WWTP is dispersed via spray-field.

Chapter 7 Biosolids

CHAPTER OVERVIEW

Regarding the biosolids presentation in Chapter 7, the primary driver is the management of the asset in conjunction with the Federal, State and local regulatory guidelines. Therefore, the thrust of this chapter will be to introduce and explain the regulatory guidelines and present alternative methods for treatment and utilization of biosolids.

Under current conditions sludge produced at the Roger Road Wastewater Treatment Plant (WWTP) is thickened and digested at the Roger Road WWTP, then pumped to dewatering facilities at the Ina Road Water Pollution Control Facilities (WPCF). Sludge produced at the Ina Road WPCF is thickened and digested at the Ina Road WPCF, then combined with the thickened/digested sludge from the Roger Road WWTP, prior to dewatering at the Regional Biosolids Facility adjacent to the Ina Road WPCF. Sludge from the Outlying Facilities, with the exception of the Green Valley WWTP, are transported for ultimate treatment at the Regional Biosolids Facility. The Regional Biosolids Facility presently treats biosolids to Class B, with limited reuse options. To enhance reuse options it is recommended the biosolids facilities be upgraded to produce Class A biosolids with its resultant enhanced reuse options. There is also some interest in having all of the biosolids in the Metropolitan Area processed at the Regional Biosolids Facility, in lieu of having digestion facilities at the Roger Road WWTP. A comprehensive study to determine the most cost effective methods for processing of biosolids, as well as the best option for the processing location(s) is recommended. This study should evaluate:

- Types of solids handling (biosolids) facilities which should remain at Roger Road WWTP.
- Biosolids pumping facilities from Roger Road WWTP to the Ina Road WPCF.
- Upgrades at the Ina Road WPCF to enhance biosolids treatment capacity, as well as produce Class A biosolids.
- Available local uses for Class A biosolids in various disposal forms (e.g., dewatered cake, dried pellets, etc.).
- Options for biosolids handling at Outlying Treatment Facilities.

CHAPTER 7.0 BIOSOLIDS

A description of the existing biosolids treatment facilities at both Roger Road WWTP and Ina Road WPCF is provided in Chapters 5.1 and 5.2 respectively. Currently, after thickening, digestion, and dewatering (at the Regional Biosolids Facility located at the Ina Road WPCF), biosolids are loaded into trucks and hauled to land application sites for beneficial use. Biosolids are nutrient-rich organic by-products resulting from wastewater treatment that can be beneficially reused. At wastewater treatment plants, solids are separated from the wastewater and transformed into biosolids through the use of physical, chemical, biological and heat processes. These processes reduce the quantity of solids, through conversion to water and methane gas, and also reduce the levels of odor and bacteria in the final product, which then undergoes testing to ensure effective treatment before it can be used.

Currently, 46 states allow for the beneficial use of biosolids in agriculture, forestry and soil improvement projects. Several states, including Arizona, are researching the use of biosolids to reclaim open pit mines and gravel pits. Besides application on farmland, other uses of biosolids include application at plant nurseries, parks, golf courses, home lawns and gardens, and highway medians. Biosolids contain essential plant nutrients, which are released gradually when land applied. Organic matter allows soil to breathe as well as hold more water, which results in decreased water runoff and soil erosion.

In order for biosolids to be used, they must undergo extensive treatment. The processes used for solids treatment have evolved from years of scientific research. They must also meet State and Federal quality standards for safe application. The amount of treatment depends on the desired classification of biosolids are being land applied. There are two classes of biosolids: Class B and Class A. Class B biosolids receive treatment to reduce pathogens, or disease-causing organisms. In addition to treatment, they are subject to management practices such as application setbacks, buffer zones, and tilling into the soil soon after application. Also, the site where the biosolids are applied must be protected from public access for one year following the application. Class A biosolids undergo such rigorous treatment prior to application that they are exempted from State requirements for management practices.

In February 1978, the Regional Metropolitan Tucson Wastewater Management System Facility Plan recommended the biosolids derived from the treatment of wastewater receive anaerobic digestion and be reused as a soil conditioner for agriculture. The selected sludge management plan involved anaerobic digestion at both the Roger Road WWTP and the Ina Road WPCF and conveyance to a centralized biosolids handling facility (Regional Biosolids Facility), for moisture reduction, storage, handling and disposal. This eliminated the use of sludge drying beds at Roger Road WWTP facility. A sludge pumping station was constructed at Roger Road WWTP facility with a 5.3-mile long 8-inch force main connecting to the receiving tanks at the Regional Biosolids Facility located adjacent to Ina Road WPCF facility. This facility included sludge receiving tanks, centrifuges, a polymer dosing system, centrate holding tanks, centrate transfer pumps, sludge pumps, a covered sludge storage pond, and a facility for loading biosolids into tanker trucks for land application.

The Regional Biosolids Facility began operation on July 7, 1987 at the Ina Road WPCF. Sludge is routinely pumped from the Roger Road WWTP and Ina Road WPCF facilities, centrifuged in the Regional Biosolids Facility, loaded into trucks for land application by a private contractor on agricultural fields in Pima and Pinal counties. Centrate from the facility is pumped back to the headworks of the Ina Road WPCF facility for processing with other wastewater entering the facility.

Currently, the daily combined biosolids production from Roger Road WWTP and Ina Road WPCF facilities is about 24 dry tons with a projected increase of about 2.5 percent each year. This includes the biosolids from Mt. Lemmon Wastewater Treatment Facility (WWTF), Avra Valley WWTF, Marana WWTF, Randolph Park Water Reclamation Facility (WRF) and the septage receiving station at Roger Road WWTP. Biosolids from Mt. Lemmon WWTF, Avra Valley WWTF and Marana WWTF are combined with the influent to the Ina Road WPCF for further treatment and disposal. Waste activated sludge from Randolph Park WRF is mixed with the wastewater in the sewers downstream of the Randolph Park WRF and carried in these sewers to Roger Road WWTP. Biosolids from Avra Valley WWTF is mixed with the sewage tributary to Roger Road WWTP. The septage from the receiving station is mixed with the influent to Roger Road WWTP facility at the headworks.

The Green Valley WWTF produces about 20 dry tons sludge per month, which is expected to double in the next five years. The sludge is dried in the sludge drying beds to make it Class A biosolids, which can be used for a number of different options, including cover material for landfills or for mine tailings reclamation.

Even though land application of biosolids on agricultural fields is one of the best uses of this byproduct of wastewater treatment, it is necessary for PCWMD to develop options and alternatives for the future regarding this critical residuals disposal responsibility. Alternatives could include mine tailing reclamation, composting and landfill cover as described later in this chapter. As more farming areas get developed into residential areas, the biosolids will have to be hauled further away for reuse on other available farmlands to avoid odor problems and application complaints. The increased hauling distance and the shrinking farmland availability will make the land application method more expensive in the future. In addition, public perception of biosolids land application has not always been positive, as the recent biosolids disposal bans in California and other states have shown. However, biosolids are in fact produced and utilized under a very strict regulatory environment, which are designed to protect public safety, as shown in the following section.

Biosolids Regulatory Programs

EPA first developed biosolids management regulations under the 1972 Federal Water Pollution Control Act. In 1977, Congress amended the Act to develop regulations containing guidelines to identify alternatives for biosolids use and disposal, identify concentrations of pollutants that would interfere with each use, and specify what factors must be accounted for in determining the methods and practices applicable for each identified use. In 1987, Congress established a timetable for developing biosolids use and disposal guidelines. EPA promulgated the Standards for the Use and Disposal of Sewage Sludge (Code of Federal Regulations, Title 40, Part 503) in 1993.

Arizona Administrative Code (AAC) R18-9-1001 (et seq.) became effective on December 5, 2001. These rules initiated standards to be used when biosolids are applied to the land as a fertilizer or a beneficial soil amendment. The standards establish biosolids quality and management practices that protect the public health and the environment.

Treatment, use and disposal of biosolids resulting from wastewater treatment processes are regulated under both Federal and State law. ADEQ operates the delegated state program for biosolids (18 AAC Chapter 9, Article 10). Biosolids generators and applicators must be in compliance with both standards. ADEQ has also received delegated authority for the AZPDES biosolids permit program from the EPA.

In the US, approximately 60 percent of all biosolids generated are recycled for beneficial use (Biosolids Generation, Use, and Disposal in the United States; USEPA, 1999; EPA 530-R-99-009). Many western states with abundant agricultural land recycle a much higher percentage as a

soil amendment and fertilizer. Agricultural land is the primary outlet for biosolids recycling, but further processing into compost or dried fertilizer products is also common. Landfill disposal and incineration are diminishing due to cost and regulatory limits, while land application has been increasingly common.

The EPA through 40 CFR Part 503 regulates biosolids land application at the Federal level. The 503 Rule is designed to protect public health and the environment from adverse effects that may result from use/disposal practices of biosolids. The Rule provides standards for pollutant limits, operational standards, management practices, and monitoring, record keeping and reporting requirements. The regulatory requirements for biosolids include treatment requirements to meet Class A and Class B standards, as well as end use and disposal requirements.

The Rule is self-implementing and imposes requirements on the generators and entities further treating, distributing, or using the biosolids. Agencies not complying with the requirements are in violation and can be subject to enforcement action from the EPA.

To land apply biosolids, the Rule requires the biosolids be non-hazardous and satisfy risk-based requirements for pollutant limitations and be treated under operational standards to achieve pathogen and vector attraction reduction. In addition, there are general requirements for management practices, monitoring, and reporting. All requirements are described in the regulation as well as guidance documents such as "The Plain English Guide for the EPA Part 503 Biosolids Rule (EPA/832/R-93/003)".

According to federal regulations (40 CFR 503), biosolids samples should be analyzed for the parameters listed in Table 7.1.1.

The nitrogen, phosphorus and potassium content of the biosolids are important when applying biosolids at agronomic rates. Nitrogen content can vary significantly in the biosolids depending on its source, age, and treatment history. The concentration levels of these nutrients should be determined from samples taken immediately before biosolids are applied because stored biosolids can lose nitrogen rapidly. Therefore, it is important that the real nitrogen content of the biosolids is known to avoid under- or over-application. The assumptions used to determine the available nitrogen in the biosolids were:

- 30 percent of the organic nitrogen will be available.
- 50 percent of the ammonia nitrogen will be available.
- 100 percent of the nitrate-nitrite nitrogen will be available.

Table 7.1.1 Sampling Requirements for the EPA 503 Sludge Regulations

Parameter	Units
Arsenic	mg/kg dry weight
Beryllium	mg/kg dry weight
Cadmium	mg/kg dry weight
Chromium	mg/kg dry weight
Copper	mg/kg dry weight
Lead	mg/kg dry weight
Mercury	mg/kg dry weight
Molybdenum	mg/kg dry weight
Nickel	mg/kg dry weight
Selenium	mg/kg dry weight
Zinc	mg/kg dry weight
Total nitrogen	percent dry weight
Nitrate nitrogen	percent dry weight
Ammonia nitrogen	percent dry weight
Phosphorus	percent dry weight
Potassium	percent dry weight
pH	standard units
Total solids	percent
Volatile solids	percent
PCBs	g/kg

Under the Part 503 rule, ceiling concentrations, cumulative pollutant loading rates, exceptional quality or "clean biosolids," and annual pollutant loading rate have been established for heavy metals. Table 7.1.2 lists the acceptable levels for land application based on Federal regulations. These regulations are somewhat different from the State on the soil cation exchange capacity (CEC). These rates are used to determine site life, which is the number of years that biosolids with a uniform metal content could be applied to a specific site.

Table 7.1.2 New Federal Regulations (Part 503) for Heavy Metals[1]

Parameter	Ceiling (mg/kg)	Cumulative loading (kg/ha)	Monthly average concentration (mg/kg)	Annual pollutant loading rate (kg/ha/yr)
Arsenic	75	41	41	20.
Cadmium	85	39	39	1.9
Copper	4,300	1,500	1,500	75
Lead	840	300	300	15
Mercury	57	17	17	.085
Molybdenum	75	---[2]	---[2]	---[2]
Nickel	420	420	420	21
Selenium	100	100	100	5.0
Zinc	7,500	2,800	2,800	140

1. From 40 CFR 503 (include date of source requirement).
2. When 40 CFR 503 was amended in 1994 it deleted pollutant limits for molybdenum in biosolids applied to land but retained the molybdenum ceiling limits.

The Rule sets limits for nine metals, including ceiling limits and more stringent pollution concentration (PC) limits. Biosolids meeting PC limits can be applied to land without tracking cumulative loads to the site. If metals exceed PC limits, but are below ceiling limits, biosolids can be applied until the total load to the site approaches cumulative limits for the most limiting metal. If any metal exceeds the ceiling concentration, land application is prohibited. High metals concentrations have become a rare occurrence in the last 20 years as source control programs have been implemented. Few biosolids programs would be expected to exceed PC limits let alone ceiling concentrations in today's operations.

Biosolids must also meet pathogen and vector attraction reduction standards prior to land application. Pathogen reduction assures protection of public health and the environment under specific use conditions. There are two categories of pathogen reduction standards for biosolids; Class A and Class B. Class A biosolids must undergo treatment that reduces pathogens below detectable levels. Processes that generate Class A biosolids include composting, thermal drying, high temperature processes (combined with prescribed batch holding times), and some alkaline treatment systems. Class A biosolids can be land applied without restrictions with respect to crop type or public access.

Class B biosolids have received sufficient treatment to ensure protection of public health under specific use conditions. For example, Class B biosolids are not applied to public access areas, or to crops harvested for direct human consumption. About 40 percent of all biosolids produced in the United States are used as Class B biosolids, making this the most common form of biosolids recycling. Typical processes generating Class B biosolids include aerobic and anaerobic (mesophilic temperature) digestion.

All recycled biosolids must be applied at appropriate agronomic rates where available nutrients match crop needs. Special provisions can be made for reclamation projects where application rates may exceed annual crop needs on a one-time for purposes of soil improvement. Monitoring and record keeping is required to document that biosolids treatment, quality and management is consistent with applicable regulations.

Treatment Process and Disposal

Current Conditions

At the Roger Road WWTP and Ina Road WPCF, the primary sludge and secondary sludge are thickened and anaerobically digested. Anaerobic digestion is one of the approved methods of pathogen reduction, which produces Class B biosolids. These biosolids can be land applied as long as various heavy metal concentrations in the biosolids are less than the limits specified in Table 1 in 40 CFR 503 regulations, and meet at least one of the vector attraction reduction requirements specified in the regulations. The 503 rules also specifies what crops may be grown in the biosolids applied land and when the crop may be harvested. Guidelines and rules have been published for the use of Class B biosolids on farmlands. These include rules about the minimum distances to be set aside from the wells, dwelling units, and public right-of-way where the biosolids can be stored or applied.

Currently, about 63 million gallons per day (MGD) of wastewater is treated at the Roger Road WWTP and Ina Road WPCF, generating an average of 350,000 gallons per day of Class B biosolids per day. The processing and disposal of biosolids constitute some of the highest cost items in wastewater treatment operation. The existing regional biosolids management infrastructure and equipment have operated since 1987.

PCWMD retained Engineering and Environmental Consultants, Inc. (EEC) to evaluate the status of the biosolids-processing infrastructure and provide recommendations for improving the biosolids handling and disposal facilities. The following is a partial summary of their recommendations from their June 2002 report.

The evaluation revealed the following deficiencies in the biosolids handling system:

- Cavitation in the sludge pumps at Roger Road WWTP.
- Lack of backup equipment which has affected the scheduled maintenance.
- Degradation of the interior lining at pipe joints in the 8-inch Ductile Iron (DI) force main conveying sludge from Roger Road WWTP to Ina Road WPCF.
- Lack of sufficient capacity in the centrate return sump and pumping system complicated by struvite build up.
- Inadequate sludge cake pumping equipment.
- Inadequate odor scrubber at the centrifuge facility.
- Aging biosolids storage bladder and cover.
- Emissions of noxious odors from biosolids transfer manifold system.
- Substandard electrical system at the biosolids transfer area.
- Lack of maintenance in the biosolids storage and transfer facility.

Future Treatment Options

PCWMD is interested in the possibility of transferring all the solids handling facilities to the Ina Road WPCF in lieu of having facilities at both the Ina Road WPCF and the Roger Road WWTP. To this end, it is expected that the following modifications will be required:

1) Decommission the existing digestion process at the Roger Road WWTP. These digesters are in need of major repairs, and it may be more cost effective to build replacement units at the Ina Road WPCF.
2) Modify one or two of the existing digesters at the Roger Road WWTP to act as sludge holding tanks.
3) Upgrade solids pumping/piping facilities for pumping thickened undigested solids from the Roger Road WWTP to the Ina Road WPCF.
4) Provide a second solids line interconnecting the Roger Road WWTP and the Ina Road WPCF or provide an option, in case of emergency, or pump the solids into the proposed plant interconnect line.
5) Install additional digestion facilities at the Ina Road WPCF to accommodate the Roger Road WWTP solids.
6) Upgrade digestion facilities at the Ina Road WPCF to allow production of Class A biosolids.
7) Upgrade dewatering facilities at the Ina Road WPCF to increase solids concentration of the dewatered sludge and minimize transport and disposal costs.
8) Upgrade ancillary solids handling facilities, as needed, to provide for Class A biosolids and allow handling of the increased solids concentration.
9) Possible upgrade of the treatment process at the Ina Road WPCF to accommodate the additional centrate.
10) Evaluate modifications to the digester gas fueled co-generation facility to accommodate the additional gas expected from digesting Roger Road WWTP sludge at the Ina Road WPCF.

The above modifications should be further investigated as part of a comprehensive study to verify the viability of these modifications, as well as, the estimated cost impacts.

Future Disposal Options

It is generally accepted that biosolids reuse is the preferred method of disposal to make use of the valuable nutrient it contains. The following paragraphs discuss the range of general disposal options, ranging from the simplest landfilling to some of the most regulatory intensive. There are several alternatives for beneficial utilization which are described in the following section.

Landfill Disposal

For landfill disposal, biosolids do not need to be Class A or Class B; however, landfill regulations require the biosolids be non-hazardous and pass the paint filter test to limit the moisture content of the material received at the landfill. This method of biosolids disposal will consume the capacity of sanitary landfills. Biosolids should be dewatered prior to hauling to landfill in order to: 1) ensure the biosolids can meet the paint filter test; and 2) reduce the cost of haul and disposal. Most landfills charge tipping fees on the basis of wet tons disposed.

Land Application

Biosolids land application includes the beneficial use on agricultural land to supply nutrients and replenish soil organic matter. It improves soil properties, such as texture and water holding capacity, which make conditions more favorable for root growth and increases the drought tolerance of vegetation. Biosolids can also serve as an alternative or substitute for expensive chemical fertilizers. The nutrients in the biosolids offer several advantages over those in inorganic fertilizers because they are organic and are released slowly to growing plants. These organic forms of nutrients are less water-soluble and, therefore, less likely to leach into groundwater or run off into surface waters.

Land application is well suited for managing biosolids as it offers cost advantages, benefits to the environment, and value to the agricultural community. In Southern Arizona, with its dry and mild climate, biosolids can be land applied throughout the year, requiring minimal storage capacity. The disadvantage of land application is potential public opposition, particularly when the beneficial use site is close to residential areas. The primary reason for public concern is odor and the resultant perception that odors signify the presence of pathogens. Most odors associated with land application are a nuisance rather than threat to human health or the environment. Odor controls focus on reducing the odor potential of the biosolids or incorporating them into the soil. Stabilization processes such as digestion can decrease the potential for odor generation.

Runoff from rainfall may also carry excess nutrients to surface water. However, this potential impact is mitigated by proper management practices, including the application of biosolids at agronomic rates, and maintenance of buffer zones between application areas and surface water bodies and soil conservation practices minimize impacts to surface water.

Agencies which operate a land application program must treat their sludge to reduce pathogen and vector attraction potential. After dewatering, the biosolids are loaded into transport vehicles, transferred to application equipment, and then applied. The land application operation, whether operated by the agency or a private contractor, must comply with State and local requirements as well as Federal regulations, which include calculation of agronomic rates and record keeping.

The biosolids generator should also allocate time to communicate with farmers, landowners and neighbors about the benefits of biosolids recycling. Control of odors, along with a viable monitoring program, is most important for public acceptance.

Minetailing Reclamation

Human activities, such as strip mining, often disturb native landscapes and underlying soils. Heavy equipment used in strip mining can severely damage soil structure by removing top soils or by pulverizing and compacting soils. Following this damage, soils are often unable to support plant life due to lack of nutrients and organic matter, compaction, altered pH and other ecosystem changes.

Disturbed soils can be restored and revitalized through the addition of organic matter. Nutrient-rich, organic biosolids can replace lost topsoil and improve soil fertility and stability, thus decreasing erosion and aiding in revegetation.

Biosolids have been used successfully to reclaim surface strip mines and mine tailings. One time or infrequent applications of large quantities of biosolids have been used to increase the amount of nutrients and organic matter in the poor or damaged soil. The nutrients in the biosolids “jump-start” the micro-biotic activity in the soil and provide a pool of nutrients from which the plants can draw for immediate growth as well as on a long-term basis. The organic matter that enters the soil from the biosolids allows the soil to become aerated and replaces lost or compacted topsoil, especially when plowed into the surface of the existing soil and help establish vegetation. Most nutrients (nitrogen, phosphorus, potassium, sulfur, zinc and boron) will remain in the plant root zone bound to organic matter much longer than would traditional inorganic, commercial fertilizers.

Since 1996, Pima County has been involved in an long-range research and demonstration project with the ASARCO Mission Mine Facility and the University of Arizona to evaluate the effective utilization of biosolids to re-vegetate minetailings. This project has been very successful in accomplishing its objectives and has significant potential for future large-scale disposal of biosolids from the Metropolitan Treatment Facilities.

Drying & Pelletizing

Heat drying is one of the processes to significantly reduce pathogens (PSRP) defined in Appendix B to Part 503. This means that dried biosolids, if less than 10 percent moisture, are considered to be Class A.

Sludge leaving wastewater plants is often dewatered on site through either belt filter presses, centrifuges, or some other process. This initial dewatering is vital to economics for the heat drying by reducing the energy and fuel required for the process. Wastewater sludge is fed to a dryer typically at 15 to 25 percent solids.

Two main modes of biosolids drying that can be used in the heat drying/pelletization process are direct dryers and indirect dryers. Direct dryers, such as flash dryers, rotary dryers, and fluid-bed dryers, involve bringing the feed material into direct contact with a heated air stream at 750° F to 900° F to facilitate evaporation. The dried sludge is over 90 percent solids, which allows for easy handling and storage. The unit heat rate of the system is approximately 1,450 to 1,550 BTU/lb of water evaporated. Direct dryers typically produce a marketable product when the sludge is digested prior to the dewatering process.

Indirect dryers, such as Paddle dryers, hollow-flight dryers, disc dryers, and effect evaporation dryers use a heat transfer medium (typically steam) to conduct heat through the shell to heat biosolids to temperatures of approximately 212°F. In this process, the biosolids never come into direct contact with the heat source; they are moved through the tube by a heated auger. As outside air (oxygen) does not enter the drying area, it eliminates the chance of combustion within the system. The moisture removed from the biosolids is collected as steam and removed from the dryer using a blower.

A critical aspect of any drying technology is its ability to produce pelletized biosolids that are marketable as a fertilizer with respect to size, dryness, elimination of dust, microbiological cleanliness, and durability. Handling of dried biosolids in enclosed spaces creates safety issues related to dust and resulting explosion hazards. These hazards can be mitigated with proper engineering and operation, including providing and maintaining nitrogen blanketing systems for dried solids storage.

It must be recognized that dried pellets of sludge will be substantially different than dewatered cake; most significantly, there will be very little moisture with the sludge. For this to be a viable technology, potential users of the dried biosolids pellets must be identified, and if possible, commitments with Pima County made to take the dried pelletized material.

Biosolids Composting

Biosolids are a nutrient-rich organic material and a renewable resource that can be safely returned to the soil. Biosolids, in combination with other renewable resources such as, yard trimmings, leaves, and food wastes, can be composted to produce a Class A soil conditioner. Composting provides high-grade products that can be used by farmers, horticulturists, landscapers and nurseries.

Composting can be achieved in various processes including windrow, aerated static pile or en-vessel systems. Each can be designed to handle a wide variety of organic materials, such as biosolids, green waste, animal manures, etc., and turn them into high quality, marketable end products.

Appendix B to Part 503, Composting indicates the biosolids can satisfy the Class A pathogen reduction requirements when composted using (either an en-vessel or static aerated pile process) when the

temperature of the biosolids is maintained at 55º C or higher for three days. Alternatively, using the windrow composting method can be used by, maintaining the temperature of the biosolids at 55º C or higher for at least 15 days during which the windrow must be turned at least five times.

In summary, all the above applications provide effective disposal of the biosolids residuals; however, going forward with most of these alternatives will require PCWMD to improve the quality of the biosolids residuals to meet the requirements for Class A biosolids. Class A biosolids will allow the Department the regulatory and technical flexibility to utilize a wide variety of disposal options at favorable cost to PCWMD and the ratepayers ensuring Class A biosolids have the following advantages:

- Increase in the number of parties (i.e., potential users of the biosolids) interested in participating in the biosolids management program.
- Decrease volume of biosolids production.
- Reduce hauling effort and associated costs.
- Lower monitoring and reporting requirements.
- Reduce administrative costs.
- Increase options for reuse of the material such as commercial fertilizer and landfill cover material usable in parks and mine tailings.

Therefore, PCWMD should plan to retrofit the existing biosolids management facilities to allow for the production of biosolids with Class A pathogen reduction. Options for the production of Class A biosolids are described in the following section.

Options for the Production of Class A Biosolids

The selection of the Class A treatment process must consider, as a minimum, the disposal option(s) available to PCWMD, and the markets for the various Class A products that could be produced. For example, composting may not be a viable option for treatment to Class A standards if the markets for a compost product are not robust enough to provide a reliable means of solids disposal. The determination of the most cost-effective and reliable combination of Class A treatment option and product market requires a thorough study considering economics, market reliability, treatment reliability and public acceptance. The following paragraphs provide examples of some broad categories of Class A treatment technologies together with the Class A product market they will address.

Class A process and Biosolids Enrichment – Example Process: BER (Biosolids Enrichment & Recycling) Systems

The Biosolids Enrichment Recycling (BER) process converts wastewater biosolids to a Class A, phosphate-rich, organic-based fertilizer of exceptional quality. The fertilizer contains nutrient levels five to ten times higher than intrinsically found in untreated sludge. This process is designed to produce a product that is not only compatible with agricultural land application, but is marketable as fertilizer product.

According to BER Systems, Inc. it has developed a continuous-flow process, which sterilizes, stabilizes and deodorizes the biosolids mass produced during wastewater treatment, converting the biosolids to an exceptional-quality fertilizer, which is ready-for-market eliminating the need for digestion and disposal.

The BER process consists of a proprietary chemical pasteurization and nutrification technology utilizing agricultural grade chemicals to sterilize, stabilize, deodorize, and add value in the form of macro-plant nutrients.

A Supervisory Control and Data Acquisition (SCADA) system manages and automates the BER process and ensures the production of a Class A, exceptional quality fertilizer. The BER Process is recognized as a PFRP (Process for the Further Reduction of Pathogens).

The BER Process components can be housed in a single building, where the biosolids enter the building as a liquid containing as low as 0.4 percent total suspended solids (TSS), and leave as a granular, free-flowing, 95 percent dry fertilizer product, in bulk bags or 50 lb retail bags.

Online monitoring through SCADA meets all EPA requirements providing for continuous reporting of the entire process, assuring production of a Class A biosolids and beyond, to an "exceptional quality" fertilizer. The SCADA system also assures quality control of the fertilizer produced.

Thermal Hydrolysis – Example Process: Cambi

A patented thermal hydrolysis process developed in Norway in 1990-95 is called the Cambi Process. Cambi states, in this process, sludge is processed under high pressure and temperature (133 to 200°C). The organic components in the sludge dissolve in water in the same way as when you boil meat, fish, etc. Cell structures in the sludge break open under the temperature and pressure used and, as a result, energy-rich compounds from the cells are then dissolved. In addition, the sludge becomes fully sterilized so the final product is disinfected. This process is reported to achieve higher volatile solids reduction and also allows for easier dewatering of the biosolids.

Flash Drying

Flash drying involves processing sewage sludge in a cage mill or by an atomized suspension technique in the presence of hot gases. The process is based on exposing fine sewage sludge particles to turbulent hot gases long enough to accomplish mass transfer of moisture from the sludge to the gases. The operating temperature varies from 650ºC to 760ºC; the thermal energy requirement could vary from 450 to 1,000 kwh/ton of moisture removed. It is possible to achieve 90 to 98 percent solids content in this operation. With the retention time, temperature and solids content of the product qualifies for Class A pathogen reduction. However, for these processes most states mandate air quality permits.

Thermophilic Anaerobic Digestion

Anaerobic digestion is one of the most widely used processes for the stabilization of the primary and secondary sludges generated in the municipal wastewater treatment plants. The majority of the anaerobic digesters currently in use are operating in the mesophilic temperature range, i.e. from 35ºC to 40ºC during which the volatile compounds are converted by microbes into methane gas.

Anaerobic digestion also occurs at higher temperature range, named thermophilic range, from 45ºC to 65ºC, by the action of different group of microbes. This is being studied because of its superior ability to disinfect biosolids to meet Class A standard. The disadvantages of this process are higher energy requirements for heating, poor process stability, increased odor of the digested biosolids, and lower quality supernatant (filtrate/centrate). In the past, thermophilic digestion was also observed to be less stable than mesophilic digestion; however, more recently, better understanding of the thermophilic process and its biology has resulted in operating thermophilic digestion facilities that are equally as stable as mesophilic operations. The potential advantages of thermophilic anaerobic digestion over mesophilic anaerobic digestion are increased stabilization of sludge and methane production rates, and improvements in the sludge dewatering properties.

Pathogen reduction in anaerobic digesters is dependent on a time/temperature regime, higher temperature requiring shorter digestion period. Studies have shown that thermophilic digestion by itself achieves about two orders of magnitude higher pathogenic bacteria reduction than mesophilic digestion, and is good candidate for meeting the pathogenic bacteria levels required for Class A biosolids. However, to achieve Class A status in terms of the Part 503 regulations, the process must include a batch time-temperature step that holds all particles of sludge at the elevated temperature for the requisite period of time as dictated by the Part 503 rule. This can be achieved in tanks that are separate from the digestion tanks, or can be achieved by a strict feed/withdrawal regime in the operating digesters.

To improve the odor characteristics of the digested solids stability and performance of the thermophilic digesters, a two-stage digestion system with thermophilic first stage and a mesophilic second stage may be used. A fast start-up method produces a more robust thermophilic culture that is relatively tolerant to temperature fluctuations. Multiple stage digestion reduces the potential for short-circuiting. If the second stage reactor is mesophilic, the product is of a higher quality in terms of odor and supernatant.

Summary

During the late 1990s, a few counties in California passed restrictive ordinances banning the land application of anything but Class A or B biosolids. In October 1999, Kern County adopted an ordinance that banned Class B biosolids beginning January 1, 2003. A number of adjacent counties, including King and Fresno, adopted ordinances banning the use of Class B biosolids. In June 2001, the Riverside County Health Officer increased the setback requirement from residences for Class B biosolids application from 500 feet to 2,640 feet based on concern over potential health impacts. This reduced the available permitted land from 9,500 acres to 900 acres, effectively eliminating any significant Class B biosolids application in Southern California. In San Bernardino County the permitting procedures effectively banned any biosolids application. These incidences forced Los Angeles to begin their effort to achieve Class A status for its biosolids.

The foregoing demonstrates the political/social environment for biosolids in our neighboring State, which is frequently a leading indicator of future national trends. In addition, in northern Pima County, agricultural areas are rapidly transformed into housing developments. In the future, as the need for urban land increases, and the farmlands are converted to residential areas, land application sites become increasingly scarce. As far as Pima County's biosolids land application program is concerned, most of the available farmlands for biosolids application are in Pinal County at distances greater than 25 miles from the Regional Biosolids facility. Land application of biosolids is most cost effective if the available farmlands are in the vicinity of the biosolids processing facility to minimize hauling costs.

For an effective biosolids management program, PCWMD should explore and plan for establishing Class A biosolids production facilities. It should also diversify land application program to minetailings in addition to agricultural lands. The Industrial Wastewater Ordinance of Pima County has been very effective in controlling the heavy metal pollutants in the industrial wastewater tributary to Pima County's sewerage system. As a result, the heavy metal pollutants in PCWMD's biosolids have been lower than the limits specified for the exceptional quality biosolids. In addition to this, if the biosolids undergo Class A pathogen reduction process in the Regional Biosolids Facility, the resulting exceptional quality biosolids will have a better value than the Class B product currently being generated at that facility, and the reuse of the Class A product will have very few restrictions. If the final product is dried or pelletized, handling, storage and reuse of biosolids will be very efficient.

Given the transfer of solids from Roger Road WWTP to Ina Road WPCF is planned, and recognizing the capital investment to modify Ina Road WPCF solids treatment to accommodate Roger Road WWTP solids is significant, it is recommended PCWMD consider moving to Class A treatment process to operate a higher rate to accommodate Roger Road WWTP solids at the existing Ina Road WPCF. In this way, PCWMD will achieve the highest value for their capital investment.

Finally, it is recommended that prior to implementing any solids treatment modifications and improvements to either Roger Road WWTP or Ina Road WPCF, a thorough evaluation of alternatives be conducted. This evaluation should focus on determining the most cost-effective system to address the following issues:

- Provide adequate biosolids treatment capacity.
- Provide Class A biosolids that are marketable in Southern Arizona.
- Provide reliability in terms of the robustness of the mechanical and biological processes.
- Improve odor control in and around both Roger Road WWTP, Ina Road WPCF, and the Regional Biosolids Management Facility.
- Provide flexibility in terms of the ability to modify the process to address changing markets for biosolids products.
- Provide options for biosolids handling facilities for outlying facilities.

Conclusions and Recommendations

Based on the discussion in this chapter, PCWMD should:

- Perform a comprehensive biosolids processing study.
- Rehabilitate the existing biosolids facility at Ina Road WPCF.
- Relocate the biosolids handling at Roger Road WWTP to the Ina Road WPCF and centralize the biosolids processing at the Ina Road WPCF.
- Upgrade the treatment process for biosolids to produce Class A pathogen-free biosolids.
- Develop an increased diversity of biosolids disposal systems, including (at a minimum) land application and mine tailings.
- Participate in the National Biosolids Partnership Environmental Management System (best practices) program.

Chapter 8 Capital Improvement Program

CHAPTER OVERVIEW

The long-range Capital Improvement Program (CIP) for Pima County Wastewater Management Department (PCWMD) reflects an overall integrated vision of the future of the system. The main concepts are:

- Existing metropolitan treatment capacity is sufficient for the next 20 years. However, more flows should be redistributed to Ina Road Wastewater Pollution Control Facility (WPCF) to take advantage of the recent 12.5 million gallons per day (MGD) expansion. The Plant Interconnect, funded by the 2004 Bond Authorization and scheduled for completion in 2009, will accomplish the redistribution of flows.
- Expansion of the Ina Road WPCF will need to be initiated in 2020 with the addition of another 12.5 MGD expansion and be completed by 2025.
- The Roger Road Wastewater Treatment Plant (WWTP) needs: significant process improvement including building and structural upgrades, denitrification, significant odor reductions and off-loading all biosolids treatment to Ina Road WPCF.
- The Ina Road WPCF needs: denitrification of the original 25 MGD plant, (funded with 2004 Bond Authorization and augmented by another allocation in the proposed 2008 bond issuance, the new lab/administration building; an electrical upgrade and significant miscellaneous rehabilitation upgrades.
- Major conveyance needs are the Santa Cruz and the Tanque Verde interceptor, Plant Interconnect, and the Park/18th Street Interceptor. The Santa Cruz Interceptor, Tanque Verde Interceptor, and Plant Interconnect will be completed with 2004 Bond Authorization.
- A major conveyance capital rehabilitation and proactive Capacity, Management, Operations and Maintenance (CMOM) program will be initiated during this period funded in part by the Miscellaneous Conveyance Rehabilitation project in the 2004 Bond Authorization.
- Outlying Treatment Facilities needs include: treatment capacity improvements and expansions at Marana, Corona de Tucson and Avra Valley WWTFs, in the first part of planning period and Mt. Lemmon and Green Valley WWTFs at the end of the 20-year period.
- Significant regulatory expenditures during this 20 year period are:

Denitrification Ina Road WPCF/Roger Road WWTP	$132 million.
Implement Comprehensive Biosolids program	$40 million.

CHAPTER 8.0 CAPITAL IMPROVEMENT PROGRAM

The CIP prepared for the 2006 Pima County Metropolitan Facility Plan Update provides a 20-year forecast of the necessary infrastructure rehabilitation, capacity expansion, and anticipated regulatory driven improvements in treatment and conveyance. Chapter 8 will address maximizing capitalized assets, the 20-year funding requirements, and details of the 20-year capital requirements presented in four, 5-year programs. The four, 5-year CIPs are shown in Tables 8.1 through 8.4 respectively. Estimated costs are in 2005 dollars. The 20-year plan is outlined in Table 8.5 (see inserted pocket).

In Table 8.1 both projects and sub-projects are shown. For example, under the 2004 bond projects there is a bond project for Roger Road Rehabilitation with sub projects listed underneath. The dollar amounts listed under the projects are the accompanying sub-project costs. Tables 8.1 through 8.4 generally only show the active projects in the 5-year period for the specific table.

The 20-year CIP was developed based upon both currently known and future anticipated needs. System capacity requirements were determined from population projections, whereas rehabilitation/ replacement needs were developed through condition assessments of the facilities, and the regulatory needs are based upon the best current understanding of the regulatory community.

Treatment Capacity

As previously identified in Sub-chapter 5.2, there appears to be sufficient capacity in the Metropolitan Area for the current and estimated population for the next 20 years. Therefore, no new metropolitan treatment capacity will be required until the end stages of this planning period. For the Outlying Areas, new treatment capacity is identified for Marana, Corona de Tucson, Green Valley and Avra Valley WWTPs. For these Outlying Treatment Facilities, the population growth model has predicted needed capacity and plant expansions, which are identified in the 20-year CIP plan.

Based on the results from the model, PCWMD has determined the expected plant expansion requirements and locations and prepared basic cost estimates for this work. However, as the predictions go out 10, 15 and 20 years into the future, the likelihood of 'if and where' the growth will occur becomes less certain. In reviewing these projections, it is important to remember that flexibility is essential. The CIP was prepared assuming the PAG growth figures used are accurate predictions of the overall current and future population growth for locating new and for expanding existing facilities. However, the future population growth patterns can change very quickly changing the predicted flows from one facility to another. This will require PCWMD to reallocate plant expansion funding from one facility to the other if the population growth location changes.

Conveyance Capacity

Only four major conveyance capacity improvement projects were identified for the Metropolitan Area. Most of the conveyance projects identified are associated with rehabilitation/replacement.

The four metropolitan capacity conveyance projects are:

- Construction of the Plant Interconnect: scheduled to commence in FY2007/08.
- Completion of the Tanque Verde Interceptor – Tucson Country Club: due for completion FY2008/09.
- Completion of the Santa Cruz Interceptor – Prince to Franklin: due for completion in FY2008/09.
- Construction of the Southeast Interceptor from Osborn and 18th Street to Park and Interstate-10 (I-10): scheduled for FY2009/10 through FY2011/12.

Expansion of the conveyance systems to the outlying facilities is being done and will be accomplished by developers as provided in Pima County's sewer user fee ordinance.

Regulatory

The three most driving regulatory issues impacting the CIP at the present time are Nitrification/Denitrification, CMOM and biosolids. PCWMD proposes to implement Nitrification/Denitrification at both the Ina Road WPCF and Roger Road WWTP going forward. The proposed Arizona Department of Environmental Quality (ADEQ) Aquifer Protection Permit rules will require an extensive expansion of its current CMOM program. And finally, PCWMD sees a need to upgrade its biosolids processing and disposal activities, ultimately leading to Class A biosolids. PCWMD has included all these goals in the Facility Plan.

Denitrification

PCWMD has plans to install Nitrification/Denitrification processes at both the Ina Road WPCF and Roger Road WWTP based on the schedule in the respective Arizona Pollutant Discharge Elimination System (AZPDES) permit. The 2004 Bond Authorization funds $17 million for initial design and construction of process modification to the 1979 high-pressure oxygen (HPO), 25-MGD Ina Road WPCF. The HPO facility will also require an additional $10 million in 2008 bonds to allow for completion of the modifications. Upon completion of this project, Ina Road WPCF will have a total on-line capacity of 37.5 MGD producing denitrified effluent.

The Plant Interconnect Facilitates offloading flows from the Roger Road WWTP and completing rehabilitation as well as process modifications. The rehabilitation and process modification work is to be funded with 2008 bonds.

It has been PCWMD policy that all new Outlying Treatment Facilities should include denitrification. The existing wastewater processing facilities at Marana, Green Valley, Avra Valley, and Corona de Tucson WWTFs all produce denitrified effluent.

Biosolids

Presently PCWMD anaerobically digests sludge at both Ina Road WPCF and Roger Road WWTP. The Roger Road WWTP sludge is transported to Ina Road WPCF via a buried sludge line. The combined sludge from the two treatment facilities is centrifuged to approximately 6 percent solids and land applied for final disposal. The Ina Road WPCF sludge centrifuge facility also receives sludge from the Avra Valley and Marana WWTFs, which is commingled with the Ina Road WPCF and Roger Road WWTP sludge prior to centrifuging.

This Facility Plan recommends a comprehensive study to determine the best way for PCWMD to handle sludge at its Metropolitan Treatment Facilities as well as move toward producing Class A biosolids. Several PCWMD drivers for this analysis include:

- The costs for hauling and disposing of 6 percent sludge versus 12-18 percent sludge.
- The age and condition of the facilities at Roger Road WWTP.
- The benefit of digesting all the metropolitan sludge at the Ina Road WPCF.
- The replacement of natural gas with more methane at the Ina Road WPCF Power Generation Facility.

Additionally, a parallel study should be undertaken for determining a long-term management plan for dealing with biosolids at the outlying facilities. A significant driver for this analysis is the economics of transporting biosolids from the Outlying Treatment Facilities to the Ina Road WPCF for processing.

Conveyance and Treatment

Rehabilitation

The CIP outlined in Table 8.5 shows both bond and System Development Fund (SDF) rehabilitation projects. Under the 2004 Bond Authorization Program, specific rehabilitation projects are identified for Roger Road WWTP and miscellaneous conveyance (see top blue section of Tables 8.1 through 8.5). The SDF portion of rehabilitation costs are to be funded with user fees.

Conveyance

The Class 4 rehabilitation projects will be accomplished with 2004 bonds. The remaining portion of CMOM would be funded with SDF. This includes funding the CMOM/closed circuit television (CCTV) condition assessment program for the collection system, funding the priority Class 3 sewer line rehabilitation/replacement, and funding the priority manhole rehabilitation/replacement. The CMOM projects are funded as follows:

- Sewer System Condition Assessment (CCTV) 100 percent operation and maintenance (O&M).
- Ongoing Sewer System Condition Assessment (CCTV) 100 percent O&M.
- Condition Assessment of new Sewers (CCTV) 100 percent O&M.
- CMOM - 100 percent O&M.
- Defect Pipe/Manhole replacement - 100 percent CIP.

Based upon best current understanding of the system and the current CMOM program, the CIP has allocated funds to CCTV the conveyance system, CCTV monitoring of the system based upon the full CCTV baseline, and to CCTV new conveyance lines to ensure proper installation and for baseline data. For the non-capital CMOM work, allocated funds are to be used for additional staffing, equipment purchase, repair and maintenance. Equipment purchases include items such as additional rodding trucks, CCTV trucks and any other necessary equipment to facilitate CMOM.

The last category is any residual funds available for the larger conveyance rehabilitation and replacement projects.

As the needs for conveyance rehabilitation and replacement exceeds the cash currently identified, $5 million/year in rehabilitation funding is included in the 2008 through 2020 proposed bonds.

Treatment

Similarly to CMOM, the treatment rehabilitation would be funded with $2.35 million in FY2005/06. $18 million in immediately needed projects were identified, and $231.3 million would be allocated for plant rehabilitation directly over the 20-year period from SDF and bonds. The remaining SDF funds, generated over 20 years, will be utilized for financing bonds for treatment plants and outlying facilities rehabilitation.

Five Year Plans

The CIP program is divided into four, 5-year segments starting in 2006 and ending in 2026. The first 5-year plan identifies currently known needs and little deviation from this plan is expected. In contrast, the remaining three 5-year increments are based upon long-term model projections given today's circumstances and should be viewed as such. The long-term forecasted dollars required for future expansion, repair/replacement, and regulatory needs are considered reliable given known data. However, specific projects may change due to changes in growth patterns and regulatory climate.

CIP From 2006 to 2011

The major projects in this period include completion of the 1997 Bond Authorization projects and implementation of the 2004 and 2008 Bond Authorization projects. The major highlights of the future bond programs in this period are:

Conveyance

- Complete the Santa Cruz Interceptor; Prince to Franklin - 2004 bonds.
- Construct the Tanque Verde Interceptor from Craycroft to Country Club – 1997 and 2004 bonds.
- Utilize $15 million for conveyance rehabilitation of Class 4 sewers - 2004 bonds.
- Complete the Roger Road WWTP to Ina Road WPCF Plant Interconnect – 2004 bonds.
- Complete the new line servicing the New Federal Prison – U. S. Bureau of Prisons.
- Complete CCTV of the collection system - SDF.
- Initiate sewer and manhole rehabilitation/replacement – CMOM SDF.

Treatment

- Add 0.5 MGD at Marana WWTF Phase I – 1997 bonds.
- Add 1.0 /1.5 MGD BNROD Plant at Marana WWTF Phase II – 2004 bonds.
- Utilize initial 2004 bond slated for odor and rehabilitation at Roger Road WWTP.
- Start Biosolids Enhancement Project - SDF.
- Build new 4 MGD BNROD plant in Avra Valley – SDF and unknown source.
- Initiate Ina Road WPCF denitrification 25 MGD HPO facility - 2004 bonds.
- Upgrade Avra Valley WWTF BNROD plant capacity to 1.6 MGD - SDF.
- Expand Corona de Tucson WWTF an additional 0.5 MGD.
- Extend sewer service to Marana Airport - 2004 bonds.

CIP From 2011 to 2016

The major projects in this period include completion of the 2004 Bond Authorization projects and implementation of the 2008 and 2012 Bond Authorization projects. The major highlights of the bond programs include:

Conveyance

- Expand Mt. Lemmon WWTF services - 2004 bonds.
- Complete new Southeast Interceptor from Osborn and 18th to Park and I-10 – proposed 2008 bonds.
- Repair class 4 sewers – 2004 bonds.
- Fund ongoing sewer and manhole rehabilitation/replacement - SDF.
- Utilize remainder of 2004 bonds for conveyance rehabilitation.

Treatment

- Finish Ina Road WPCF and Roger Road WWTP denitrification - 2004 and 2008 bonds.
- Build new lab and office building – 2008 bonds.
- Expand power generation and electrical upgrades – 2008 bonds.

- Complete additional Ina Road WPCF and Roger Road WWTP rehabilitation – 2008 bonds.
- Complete class A biosolids – 2008 bonds.
- Initiate expansion of Marana WWTF 1.5 MGD – 2012 bonds.
- Continue Roger Road WWTP and Ina Road WPCF rehabilitation –2012 bonds.
- Expand Green Valley WWTF 2 MGD – 2012 bonds.
- Initiate 2 WRFs (location to be determined) – 2012 bonds.
- Initiate outlying facilities biosolids handling improvements – 2012 bonds.

CIP From 2016 to 2021

The major projects in this period are projected to include completion of the 2009 and 2012 Bond Authorization projects and implementation of the 2016 to 2020 Bond Authorization project. The major highlights of the bond programs include:

Conveyance

- On going SDF, 2016 and 2020 bonds, funded sewer and manhole rehabilitation/replacement.

Treatment

- Complete Southeast and Northeast WRF – 2012 bonds.
- Complete Outlying Treatment Facilities biosolids handling improvements – 2012 bonds.
- Initiate 12.5 MGD expansion at Ina Road WPCF – 2016/20 bonds.
- Initiate Tangerine/I-10 treatment plant – 2016/20 bonds.
- Roger Road WWTP rehabilitation – 2016/20 bonds.
- Initiate 2 unidentified WRF – 2016/20 bonds.

CIP From 2021 to 2026

The major projects in this period include completion of the 2016 to 2020 Bond Authorization projects. The major highlights include:

Conveyance

- On going SDF funded sewer and manhole rehabilitation/replacement.

Treatment

- Complete 12.5 MGD expansion at Ina Road WPCF – 2016/20 bonds.
- Complete Ina Road WPCF rehabilitation – 2020 bonds.
- Complete Tangerine/I-10 treatment plant – 2016/20 bonds.
- Complete Outlying Treatment Facilities rehabilitation – 2020 bonds.
- Add 2 MGD at Green Valley WWTF – 2012 bonds.
- Add 1 MGD at Corona de Tucson WWTF - 2020 bonds.
- Complete two unidentified WRF – 2016/20 bonds.

Conclusions and Recommendations

The Facility Plan presented herein, additional bond packages of approximately $245 to $355 million, $225 to $275 million, and $325 to $400 million will be required in 2008, 2012, and 2016/20 bonds respectively. Implementation of the 20-year Facility Plan is projected to cost approximately $1.4 billion funded with $795 to $1,030 million in existing and new bonds, of which $645 to $880 million will require voter approval, and $5 million from the U.S. Bureau of Prison already secured.

Table 8.1. 5 Year CIP For FY2006/12

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Bond #	To Director & Deputies 12-7-05	2004 Bond Totals	2008 Bond Totals	Totals	FY 05-06 Budget SDF	FY 05-06 Budget Bond/WIFA	FY 05-06 Projected SDF	FY 05-06 Projected Bond/WIFA	FY 06-07 Proposed Budget SDF	FY 06-07 Proposed Budget Bond/WIFA	FY 07-08 Projected SDF	FY 07-08 Projected Bond/WIFA	FY 08-09 Projected SDF	FY 08-09 Projected Bond/WIFA	FY 09-10 Projected SDF	FY 09-10 Projected Bond/WIFA	FY 10-11 Projected SDF	FY 10-11 Projected Bond/WIFA
	1997 Bond Projects																	
SS-01	Ina Rd WPCF Proc Chg & Exp to 37.5 mgd			$ 3,460,037			$ 3,089,672		$ 370,365									
SS-11	Arivaca Junction WWTF Extension Sewer			$ 3,098,339		$ -	$ 4,794	$ -		$ 100,000	$ -	$ 322,600	$ 1,370,945		$ 1,300,000		$ -	
SS-14	Misc. Wastewater Reclamation Facility (Randolph)			$ (250,504)			$ (250,504)		$ -									
SS-02	Green Valley Upgrade & Expansion			$ 11,094			$ 11,094				$ -		$ -					
SS-03	Santa Cruz Interceptor, Prince-Franklin (Phase II & III))			$ 2,288			$ 2,288	$ -										
SS-05	TV Int., Craycroft-Tucson Country Club			$ 3,704,095				$ 260,079		$ 110,000	$ 171,618	$ 3,162,398						
SS-08	New Marana WWTF Interim Expansion			$ 1,488,720		$ 1,464,612		$ 1,488,720	$ -									
Sub-Totals	**2004 Bond Projects/Related Projects With 2008 Bonds**	**$ 5,443,797**	**$ -**	**$ 11,514,069**	**$ -**	**$ 1,464,612**	**$ 2,857,344**	**$ 1,748,799**	**$ 370,365**	**$ 210,000**	**$ 171,618**	**$ 3,484,998**	**$ 1,370,945**	**$ -**	**$ 1,300,000**	**$ -**	**$ -**	**$ -**
SS-6.1	***Roger Road WWTF Rehabilitation (Rollup)***	$ 20,000,000		**$ 75,165,274**		$ 1,000,000	**$ 2,506,704**	**$ 1,000,000**	**$ 2,314,365**	**$ 2,000,000**	$ 3,500,000	$ 2,000,000	$ 7,500,000	$ 2,000,000	$ 2,314,365	$ 2,000,000	$ 2,314,365	$ 5,000,000
	R R Rehab Electrical Study			*$ 10,062,162*				*$ 562,162*		*$ 1,000,000*		*$ 1,500,000*		*$ 1,500,000*		*$ 1,500,000*		*$ 2,000,000*
	R R Rehab Aeration Basins			*$ 1,591,163*				*$ 91,163*		*$ 500,000*		*$ 1,000,000*						
	R R Rehab Prim Clarifier Cov			*$ 2,000,673*				*$ 673*		*$ 1,000,000*		*$ 1,000,000*						
	RR New Media			*$ 10,000,000*				*$ -*				*$ 2,000,000*		*$ 8,000,000*				
	Plant Rehabilitation (C - SDF 2004-05 "D" Budget) % Split by Proj		**$ 40,000,000**	**$ 51,094,255**			**$ 1,812,540**		**$ 1,781,715**	**$ -**	**$ 2,500,000**		**$ -**	**$ 2,500,000**	**$ -**	**$ 2,500,000**	**$ -**	**$ 2,500,000**
	RR Operational Efficiency Eval			*$ 150,000*			*$ 150,000*											
	SCADA Upgrade*			*$ 1,970,000*			*$ 170,000*		*$ 500,000*		*$ 500,000*		*$ 500,000*		*$ 300,000*			
	Ina - Replace pond #3 liner - concert*			*$ 1,200,000*			*$ -*		*$ 150,000*		*$ 1,050,000*							
	Ina - Fix process tank structural*			*$ 500,000*			*$ -*		*$ 100,000*		*$ 400,000*							
	Ina - Heat exchange upgrade*			*$ 200,000*			*$ -*		*$ 50,000*		*$ 150,000*							
	Plant Security			*$ 600,000*			*$ -*		*$ 85,000*		*$ 315,000*		*$ 200,000*					
	R R New Admin Bldg			*$ 3,500,000*			*$ -*		*$ 150,000*		*$ 850,000*		*$ 2,500,000*					
	R R New Roads			*$ 1,500,000*			*$ -*				*$ 1,500,000*							
	Randolph - Clean Screens with reclaim - not potable*			*$ 200,000*			*$ -*		*$ 50,000*		*$ 150,000*							
	Above plan "D"			*$ 3,115,000*			*$ -*		$ -		$ 2,415,000		$ 700,000					
SS-6.2	***Misc. Conveyance System Rehab. (Rollup)***	$ 15,000,000		**$ 78,216,565**		**$ 2,000,000**	**$ 1,039,743**	**$ 4,992,380**	**$ 1,376,822**	**$ 2,000,000**	$ 3,200,000	$ 3,000,000	$ 3,200,000	$ 3,000,000	$ 3,200,000	$ 2,007,620	$ 3,200,000	$ -
	Conveyance Rehab		$ 16,000,000	$ 17,500,000					$ -	$ -	$ 1,500,000	$ -	$ -	$ 1,500,000	$ -	$ 1,500,000	$ -	$ 1,500,000
SS-6.3	Santa Cruz Interceptor, Prince-Franklin (Phase II & III))	$ 25,000,000		$ 33,143,363		$ 2,000,000		$ 626,825		$ 12,035,687	$ 1,643,363	$ 12,337,488	$ 6,500,000	$ -		$ -		
SS-6.4	Roger Rd. WWTF to Ina Rd WPCF Plant Inter.	$ 23,000,000		$ 23,350,000		$ 500,000		$ 303,261	$ 350,000	$ -		$ 1,000,000		$ 13,196,739		$ 8,500,000		
SS-6.5	TV Int., Craycroft-Tucson Country Club	$ 5,000,000		$ 5,588,500				$ -			$ 185,000	$ 2,310,000	$ 403,500	$ 2,690,000				
SS-6.6	Marana Regional Airport Sewer Con.	$ 2,800,000		$ 2,800,000				$ -		$ 500,000		$ 2,300,000		$ -				
SS-6.7	***Ina/Roger Road WPCF - Denitrification (To Be Rollup)***	$ -		**$ 132,082,165**				$ -										
	Ind Road Nitrification Denitrification - (A)	$ *17,000,000*		*$ 17,000,000*	$ 1,000,000	$ -	$ -	$ -	$ -	$ -		$ 3,000,000		$ 7,000,000	$ -	$ 7,000,000	$ -	
	SCR Basin Ina/Roger Rd NdN Imp Study (A)	*$ -*		*$ 2,082,165*			$ 391,082	$ -	$ 1,300,000	$ -	$ 391,082.4							
	Ind/Roger Road Nitrification (2008 New Bonds)		*$ 100,000,000*	*$ 113,000,000*				$ -					$ -	$ 5,000,000	$ -	$ 20,000,000	$ -	$ 43,000,000
	Biosolids (2008 Bonds)*		$ 30,000,000	$ 39,700,000					$ 85,000		$ 615,000.0		$ 1,000,000	$ 1,393,000	$ 1,000,000	$ 1,000,000	$ 5,000,000	$ 5,000,000
	System Wide Odor Control (2008 Bonds)		$ 30,000,000	$ 30,000,000	$ 700,000			$ -	$ -		$ -		$ -	$ 2,000,000	$ -	$ 2,000,000	$ -	$ 4,000,000
SS-6.8	Ina Rd. WPCF Central Plant & Electric Upgrade (BIP Need Revision)	$ -	$ -	$ -				$ -						$ -	$ -	$ -	$ -	$ -
	Electrical (Supplemented 2008 Bonds)		$ 30,000,000	$ 30,000,000				$ -								$ 1,350,000		$ 6,000,000
SS-6.9	Ina Rd. WPCF Laboratory & Office Bldg.	$ -	$ -	$ -				$ -						$ -	$ -	$ -	$ -	$ -
	Lab (Supplemented 2008 Bonds)		$ 15,000,000	$ 15,000,000				$ -	$ -							$ 1,000,000		$ 5,000,000
SS-6.10	New Marana WWTF Expansion BNROD	$ 10,000,000		$ 12,395,878	$ 44,225	$ 3,000,000		$ 1,577,534	$ 795,878	$ 7,430,728	$ 1,600,000	$ 991,738		$ -				
SS-6.11	Misc. Water Reclamation Projects (Avra Valley)	$ 25,000,000		$ 35,549,000				$ -	$ -	$ 6,000,000	$ 1,000,000	$ 19,000,000	$ 9,549,000	$ -				
	Avra Valley Environmental Restoration			$ -							$ -		$ -					
	Avra Valley 4.0 MGD Expansion Design			$ 222,682	$ 350,000		$ 222,682											
	Avra Valley 1.2 to 1.6 & 1.6 to 2.2			$ 164,482			$ 164,482											
SS-6.12	Mt. Lemon Sewer System	$ 7,200,000		$ 7,193,306			$ (6,694)			$ 250,000		$ 1,250,000		$ 2,500,000		$ 3,200,000		
	Added to bond to max draw / reimbursement			$ -			$ (0)	$ 0										
Sub-Totals	**SDF Projects**	**$ 150,000,000**	**$ 295,000,000**	**$ 592,280,469**	**$ 3,040,291**	**$ 8,500,000**	**$ 6,130,539**	**$ 8,500,000**	**$ 8,003,780**	**$ 30,216,415**	**$ 18,549,445**	**$ 47,189,226**	**$ 28,852,500**	**$ 42,779,739**	**$ 6,514,365**	**$ 52,057,620**	**$ 10,514,365**	**$ 72,000,000**
	With 2004-2008 Bonds																	
	Santa Cruz Interceptor /Lincoln-Drexel			$ 51,054	$ -	$ 500,000	$ 1,054	$ -				$ -	$ 50,000			$ -		
SS-06	TV Int., Hidden Hills Wash to Arbor Circle			$ 94			$ 94											
	Misc. Eng. Design Services			$ 5,000,000	$ 250,000		$ -		$ 250,000		$ 250,000		$ 250,000		$ 250,000		$ 250,000	
	Miscellaneous Sewer Relocations *			$ 9,900,000	$ 750,000		$ -		$ 400,000		$ 500,000		$ 500,000		$ 500,000		$ 500,000	
	Regional Transportation Authority*			$ 4,875,000			$ -		$ 125,000		$ 250,000		$ 250,000		$ 250,000		$ 250,000	
	River Road / Alvernon Way			$ 19,107			$ 19,107											
	Green Valley CC Estates Trunk Reloc.@ DW #7			$ 515,370	$ 10,000		$ 28,924		$ -		$ 486,446							
	S. Rillito Int. RS, Glenn-Kleindale			$ 2,894,713	$ 112,800		$ 9,113		$ -		$ 555,300		$ 2,330,300					
	Green Valley Sewer Protection			$ 112,350			$ 24,350		$ 88,000									
	Santa Cruz River Relief Sewer (W.Branch Xing)			$ 162,288			$ 1,093		$ 161,195									
	Houghton Area Master Plan (HAMP)*			$ 70,000			$ 50,000		$ 20,000									
	Sewer System Inventory & Inspection			$ 651,527	$ 720,000		$ 411,527		$ 240,000									
	Tanuri Drive Relief Sewer			$ 108,158			$ -						$ 50,000		$ 58,158			
	Tangerine Rd. Sewer X-sing @ Big Wash			$ 2,542,974			$ (607)				$ 543,581		$ 2,000,000					
	Park & 18th Capacity Expansion (2008 Bonds)		$ 30,000,000	$ 30,000,000			$ -									$ 6,000,000		$ 18,000,000
Sub-Totals	**CIP Treatment Projects**	**$ 30,000,000**	**$ 30,000,000**	**$ 57,077,606**	**$ 1,842,800**	**$ 500,000**	**$ 719,626**	**$ -**	**$ 1,284,195**	**$ -**	**$ 2,585,327**	**$ -**	**$ 5,430,300**	**$ -**	**$ 1,058,158**	**$ 6,000,000**	**$ 1,000,000**	**$ 18,000,000**
		$ 57,077,606																
	Corona de Tucson 0.8 to 1.3 MGD			$ 2,206,138	$ 300,000		$ 106,138		$ 30,000		$ 2,070,000							
	Corona de Tucson WWTF Ancillary Impvmts.			$ 2,541,146			$ 141,146		$ 900,000		$ 1,500,000							
Sub-Totals	**Other Jurisdictions**	**$ -**	**$ -**	**$ 4,761,595**	**$ 300,000**	**$ -**	**$ 261,595**	**$ -**	**$ 930,000**	**$ -**	**$ 3,570,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
	Arroyo Chico Drainage Under Construction			$ 85,000			$ 85,000											
	ADOT Relocation: I-19-& I-10			$ -	$ 600,415		$ -		$ -									
Sub-Totals	**Outside Agency /Jurisdiction Funded**	**$ -**	**$ -**	**$ 85,000**	**$ 600,415**	**$ -**	**$ 85,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
	New Federal Prison			$ 5,887,414	$ 3,761,097		$ 577,636		$ 2,747,822		$ 2,561,956							
Sub-Totals	**New CIP Projects**	**$ -**	**$ -**	**$ 7,247,385**	**$ 3,761,097**	**$ -**	**$ 1,937,607**	**$ -**	**$ 2,747,822**	**$ -**	**$ 2,561,956**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	
	Continental Pump Station Improvements Rollup			*$ 480,000*	$ 100,000		***$ 222,000***		***$ 258,000***		***$ -***							
	CRRPS Scrubber Replacement			$ 214,000			$ 22,000		$ 192,000		$ -							
	CRRPS Electric Room AC			$ 266,000			$ 200,000		$ 66,000		$ -							
	Capstan Lift Station			$ 831,000	$ 100,000		$ 99,000		$ 732,000									
	I-10 Widening: Grant to St Mary's			$ 3,365	$ 450,000		$ 3,365		$ -									
	Arthur Pack Force Main (design)			$ (27,598)			$ (27,598)											
	Arthur Pack Force Main (construction)			$ 695,907			$ 695,907											
	Green Valley Flood Control Protection Wall			$ 305,000	$ 55,000		$ 40,000		$ 265,000									
	Green Valley Recharge Monitoring System			$ 30,000	$ 40,000		$ 26,000		$ 4,000		$ -		$ -		$ -			
	KERP Chlor/DeChlor			$ 303,763	$ 100,000		$ 78,763		$ 175,000		$ 50,000							
	Richey Yard Master Facility Plan			$ 2,956,329	$ 150,000		$ 606,329		$ 230,000		$		$ 2,120,000					
	Wet Lab*			$ 250,000	$ 250,000		$ -		$ 25,000		$ 225,000							
	Flow Modeling*			$ 254,203	$ 150,000		$ 101,703		$ 152,500									
	Process Simulating Training			$ 154,234	$ 110,000		$ 154,234		$ -									
	SCC Out-of Service			$ 529,473			$ -		$ -		$ 85,000		$ 444,473					
	CCTV Grade 4 Re-Evaluation #1*			$ 218,750			$ 218,750											
	System Wide Odor Control Study*			$ 510,000			$ 125,000		$ 335,000		$ 50,000							
	Lift Station Rehabilitation (rollup)*		***$ 4,000,000***	**$ 19,100,000**					***$ 100,000***		***$ 1,000,000***		***$ -***	***$ 1,000,000***	***$ -***	***$ 1,000,000***	***$ -***	***$ 1,000,000***
	SDF W6 Evaluation Projects			$ 56,890,000	$ 320,000				$ 300,000		$ 2,590,000		$ 3,000,000		$ 3,000,000		$ 3,000,000	
	SCADA Fail Over Review process sim (05-06)			$ 30,000			$ 30,000											
Sub-Totals		**$ 4,000,000**		**$ 83,514,427**	**$ 1,825,000**	**$ -**	**$ 2,373,454**	**$ -**	**$ 2,576,500**	**$ -**	**$ 4,000,000**	**$ -**	**$ 5,564,473**	**$ 1,000,000**	**$ 3,000,000**	**$ 1,000,000**	**$ 3,000,000**	**$ 1,000,000**
Sub-Totals		**$ 251,000,000**		**$ 251,000,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
	2016 & 2020 Bond Authorization	**$ 251,000,000**																
Sub-Totals		**$ 357,500,000**		**$ 357,500,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
	CIP GRAND TOTAL	**$ 1,058,943,797**		**$ 1,364,980,552**	**$ 11,369,603**	**$ 10,464,612**	**$ 14,365,166**	**$ 10,248,799**	**$ 15,912,662**	**$ 30,426,415**	**$ 31,438,346**	**$ 50,674,224**	**$ 41,218,218**	**$ 43,779,739**	**$ 11,872,523**	**$ 59,057,620**	**$ 14,514,365**	**$ 91,000,000**
		1364980552		$ 1,364,980,552	**Total**	**$ 21,834,215**	**Total**	**$ 24,613,965**	**Total**	**$ 46,339,077**	**Total**	**$ 82,112,570**	**Total**	**$ 84,997,957**	**Total**	**$ 70,930,143**	**Total**	**$ 105,514,365**
					Left to right	FY 05-06 Budget		FY 05-06 Projected		FY 06-07 Proposed Budget		FY 07-08 Projected		FY 08-09 Projected		FY 09-10 Projected		FY 10-11 Projected

* Projects show as W^ in the Pima County Project Management Application Data Base

Table 8.2. 5 Year CIP For FY2012/17

3/2/2006 14:13

Bond #	To Director & Deputies 12-7-05	CIP Number	Center Number	Totals	FY 11-12 Projected SDF	FY 11-12 Projected Bond/WIFA	FY 12-13 Projected SDF	FY 12-13 Projected Bond/WIFA	FY 13-14 Projected SDF	FY 13-14 Projected Bond/WIFA	FY 14-15 Projected SDF	FY 14-15 Projected Bond/WIFA	FY 15-16 Projected SDF	FY 15-16 Projected Bond/WIFA
	1997 Bond Projects													
Sub-Totals	**2004 Bond Projects/Related Projects With 2008 Bonds**			**$ 11,514,069**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
SS-6.1	***Roger Road WWTF Rehabilitation (Rollup)***			**$ 75,165,274**	$ 2,314,365	$ 6,000,000	$ 2,314,365		$ 2,314,365		$ 2,314,365		$ 2,314,365	
	R R Rehab Struct. Assessment	WL-04-601	W746011	*$ 272,348*										
	R R Rehab Electrical Study	WL-04-601	W746016	*$ 10,062,162*		*$ 2,000,000*								
			-	$ -										
	Plant Rehabilitation (C - SDF 2004-05 "D" Budget) % Split by Proj			**$ 51,094,255**	**$ -**	**$ 2,500,000**	**$ -**	**$ 2,500,000**	**$ -**	**$ 2,500,000**	**$ -**	**$ 2,500,000**	**$ -**	**$ 2,500,000**
SS-6.2	***Misc. Conveyance System Rehab. (Rollup)***			**$ 78,216,565**	$ 3,200,000		$ 3,200,000		$ 3,200,000		$ 3,200,000		$ 3,200,000	
	Conveyance Rehab			$ 17,500,000	$ -	$ 1,500,000	$ -	$ 1,500,000	$ -	$ 1,500,000	$ -	$ 1,500,000	$ -	$ 1,500,000
SS-6.7	***Ina/Roger Road WPCF - Denitrification (To Be Rollup)***	N/A		**$ 132,082,165**										
	Ind Road Nitrification Denitrification - (A)	WL-04-607	W746070	*$ 17,000,000*										
	SCR Basin Ina/Roger Rd NdN Imp Study (A)	WL-05-0L4	W750145	*$ 2,082,165*										
	Ind/Roger Road Nitrification (2008 New Bonds)	N/A	N/A	*$ 113,000,000*	$ 13,000,000	$ 32,000,000								
	Biosolids (2008 Bonds)*	N/A		$ 39,700,000	$ 2,000,000	$ 5,000,000		$ 15,000,000		$ 2,607,000		$ -		$ -
	System Wide Odor Control (2008 Bonds)	N/A	N/A	$ 30,000,000	$ -	$ 4,000,000		$ 5,000,000		$ 5,000,000		$ 5,000,000		$ 3,000,000
SS-6.8	Ina Rd. WPCF Central Plant & Electric Upgrade (BIP Need Revision)	WL-04-608	N/A	$ -		$ -								
	Electrical (Supplemented 2008 Bonds)	N/A	N/A	$ 30,000,000		$ 10,650,000		$ 12,000,000						
SS-6.9	Ina Rd. WPCF Laboratory & Office Bldg.	WL-04-609	N/A	$ -		$ -								
	Lab (Supplemented 2008 Bonds)	N/A	N/A	$ 15,000,000		$ 9,000,000								
Sub-Totals	**SDF Projects**			**$ 592,280,469**	**$ 20,514,365**	**$ 70,650,000**	**$ 5,514,365**	**$ 36,000,000**	**$ 5,514,365**	**$ 11,607,000**	**$ 5,514,365**	**$ 9,000,000**	**$ 5,514,365**	**$ 7,000,000**
	With 2004-2008 Bonds													
	Santa Cruz Interceptor /Lincoln-Drexel	WL-97-5L1	W700049	$ 51,054										
SS-06	TV Int., Hidden Hills Wash to Arbor Circle	~~WL-97-4L4~~	~~W700036~~	$ 94										
	Misc. Eng. Design Services	N/A	N/A	$ 5,000,000	$ 250,000		$ 250,000		$ 250,000		$ 250,000		$ 250,000	
	Miscellaneous Sewer Relocations *	N/A	N/A	$ 9,900,000	$ 500,000		$ 500,000		$ 500,000		$ 500,000		$ 500,000	
	Regional Transportation Authority*	N/A	N/A	$ 4,875,000	$ 250,000		$ 250,000		$ 250,000		$ 250,000		$ 250,000	
	Park & 18th Capacity Expansion (2008 Bonds)	N/A	N/A	$ 30,000,000		$ 6,000,000								
	Sewer Replacement @ Alvernon and Hayne St.	WL-01-2L1	W700025	$ 85,000										
Sub-Totals	**CIP Treatment Projects**			**$ 57,077,606**	**$ 1,000,000**	**$ 6,000,000**	**$ 1,000,000**	**$ -**	**$ 1,000,000**	**$ -**	**$ 1,000,000**	**$ -**	**$ 1,000,000**	**$ -**
Sub-Totals	**Other Jurisdictions**			**$ 4,761,595**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
	Arroyo Chico Drainage Under Construction	N/A	0	$ 85,000										
	ADOT Relocation: I-19-&_I-10	WL-00-2L1	W700076	$ -										
Sub-Totals	**Outside Agency /Jurisdiction Funded**			**$ 85,000**	**$ -**		**$ -**		**$ -**		**$ -**		**$ -**	
	New Federal Prison	WL-03-4L1	W700079	$ 5,887,414										
	Marana Colonia Sewer/Redev. Honea Hgts.	WL-00-3L1	W700018	$ 1,359,971										
Sub-Totals	**New CIP Projects**			**$ 7,247,385**	**$ -**		**$ -**		**$ -**		**$ -**		**$ -**	
	Lift Station Rehabilitation (rollup)*	N/A	N/A	**$ 19,100,000**	***$ -***	***$ 1,000,000***	***$ 1,000,000***		***$ 1,000,000***		***$ 1,000,000***		***$ 1,000,000***	
	SDF W6 Evaluation Projects	N/A	N/A	$ 56,890,000	$ 3,000,000		$ 3,000,000		$ 3,000,000		$ 3,000,000		$ 3,000,000	
	SCADA Fail Over Review process sim (05-06)	WL-05-1L2	W750157	$ 30,000										
				$ -										
Sub-Totals				**$ 83,514,427**	**$ 3,000,000**	**$ 1,000,000**	**$ 4,000,000**		**$ 4,000,000**		**$ 4,000,000**		**$ 4,000,000**	
	2012 Bond Authorization													
	Roger & Ina Road WWTF/WWCF Rehab			$ 25,000,000				$ 2,000,000		$ 5,000,000		$ 5,000,000		$ 5,000,000
	Expand Marana WWTF Expansion BNROD 1.5 mgd to 3.0 mgd			$ 13,000,000				$ 8,000,000		$ 5,000,000				
	Conveyance Rehabilitation			$ 30,000,000				$ 5,000,000		$ 5,000,000		$ 5,000,000		$ 5,000,000
	Expand Roger			$ 55,000,000		$ -		$ 25,000,000		$ 25,000,000		$ 5,000,000		
				$ -										
	Central, Northwest and Southeast Reclamation WRFs			$ 45,000,000										$ 10,000,000
				$ -						$ -		$ -		$ -
	Rehab Ina Bio BNR			$ 15,000,000								$ 5,000,000		$ 5,000,000
	Outlying Solids			$ 15,000,000								$ 5,000,000		$ 5,000,000
	Green Valley BNROD (an additional 2 mgd)			$ 25,000,000						$ 5,000,000		$ 10,000,000		$ 10,000,000
	Conveyance Rehabilitation			$ 25,000,000						$ 5,000,000		$ 5,000,000		$ 5,000,000
	SCADA & Control System			$ 3,000,000						$ -		$ 1,000,000		$ 1,000,000
				$ -								$ -		$ -
Sub-Totals				**$ 251,000,000**	**$ -**	**$ -**	**$ -**	**$ 40,000,000**	**$ -**	**$ 50,000,000**	**$ -**	**$ 41,000,000**	**$ -**	**$ 46,000,000**
	2016 & 2020 Bond Authorization													
Sub-Totals				**$ 357,500,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 5,000,000**
	CIP GRAND TOTAL			**$ 1,364,980,552**	**$ 24,514,365**	**$ 77,650,000**	**$ 10,514,365**	**$ 76,000,000**	**$ 10,514,365**	**$ 61,607,000**	**$ 10,514,365**	**$ 50,000,000**	**$ 10,514,365**	**$ 58,000,000**
				$ 1,364,980,552	**Total**	**$ 102,164,365**	**Total**	**$ 86,514,365**	**Total**	**$ 72,121,365**	**Total**	**$ 60,514,365**	**Total**	**$ 68,514,365**
						FY 11-12 Projected		FY 12-13 Projected		FY 13-14 Projected		FY 14-15 Projected		FY 15-16 Projected

* Projects show as W^ in the Pima County Project Management Application Data Base

Table 8.3. 5 Year CIP For FY2017/21

3/2/2006 14:13

Bond #	To Director & Deputies 12-7-05	CIP Number	Center Number	Totals	FY 16-17 Projected SDF	FY 16-17 Projected Bond/WIFA	FY 17-18 Projected SDF	FY 17-18 Projected Bond/WIFA	FY 18-19 Projected SDF	FY 18-19 Projected Bond/WIFA	FY 19-20 Projected SDF	FY 19-20 Projected Bond/WIFA	FY 20-21 Projected SDF	FY 20-21 Projected Bond/WIFA
	1997 Bond Projects													
Sub-Totals	**2004 Bond Projects/Related Projects With 2008 Bonds**			**$ 11,514,069**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
SS-6.1	***Roger Road WWTF Rehabilitation (Rollup)***			**$ 75,165,274**	$ 2,314,365		$ 2,314,365		$ 2,314,365		$ 2,314,365		$ 2,314,365	
	Plant Rehabilitation (C - SDF 2004-05 "D" Budget) % Split by Proj			**$ 51,094,255**	**$ -**	**$ 2,500,000**	**$ -**	**$ 2,500,000**	**$ -**	**$ 2,500,000**	**$ -**	**$ 2,500,000**	**$ -**	**$ 2,500,000**
SS-6.2	***Misc. Conveyance System Rehab. (Rollup)***			**$ 78,216,565**	$ 3,200,000		$ 3,200,000		$ 3,200,000		$ 3,200,000		$ 3,200,000	
	Conveyance Rehab			$ 17,500,000	$ -	$ 1,500,000	$ -	$ 1,500,000	$ -	$ 1,000,000	$ -	$ -	$ -	$ -
Sub-Totals	**SDF Projects**			**$ 592,280,469**	**$ 5,514,365**	**$ 4,000,000**	**$ 5,514,365**	**$ 4,000,000**	**$ 5,514,365**	**$ 3,500,000**	**$ 5,514,365**	**$ 2,500,000**	**$ 5,514,365**	**$ 2,500,000**
	With 2004-2008 Bonds													
	Santa Cruz Interceptor /Lincoln-Drexel	WL-97-5L1	W700049	$ 51,054										
SS-06	TV Int., Hidden Hills Wash to Arbor Circle	~~WL-97-4L4~~	~~W700036~~	$ 94										
	Misc. Eng. Design Services	N/A	N/A	$ 5,000,000	$ 250,000		$ 250,000		$ 250,000		$ 250,000		$ 250,000	
	Miscellaneous Sewer Relocations *	N/A	N/A	$ 9,900,000	$ 500,000		$ 500,000		$ 500,000		$ 500,000		$ 500,000	
	Regional Transportation Authority*	N/A	N/A	$ 4,875,000	$ 250,000		$ 250,000		$ 250,000		$ 250,000		$ 250,000	
	River Road / Alvernon Way	WL-87-001	W700005	$ 19,107										
Sub-Totals	**CIP Treatment Projects**			**$ 57,077,606**	**$ 1,000,000**	**$ -**	**$ 1,000,000**	**$ -**	**$ 1,000,000**	**$ -**	**$ 1,000,000**	**$ -**	**$ 1,000,000**	**$ -**
Sub-Totals	**Other Jurisdictions**			**$ 4,761,595**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Sub-Totals	**Outside Agency /Jurisdiction Funded**			**$ 85,000**	**$ -**		**$ -**		**$ -**		**$ -**		**$ -**	
Sub-Totals	**New CIP Projects**			**$ 7,247,385**	**$ -**		**$ -**		**$ -**		**$ -**		**$ -**	
	Continental Pump Station Improvements Rollup			*$ 480,000*										
	Lift Station Rehabilitation (rollup)*	N/A	N/A	***$ 19,100,000***	***$ 1,000,000***		***$ 1,000,000***		***$ 1,000,000***		***$ 1,000,000***		***$ 1,000,000***	
	SDF W6 Evaluation Projects	N/A	N/A	$ 56,890,000	$ 3,000,000		$ 3,000,000		$ 3,000,000		$ 3,000,000		$ 3,000,000	
	SCADA Fail Over Review process sim (05-06)	WL-05-1L2	W750157	$ 30,000										
				$ -										
Sub-Totals				**$ 83,514,427**	**$ 4,000,000**		**$ 4,000,000**		**$ 4,000,000**		**$ 4,000,000**		**$ 4,000,000**	
	2012 Bond Authorization													
	Roger & Ina Road WWTF/WWCF Rehab			$ 25,000,000		$ 5,000,000				$ 3,000,000				
	Expand Marana WWTF Expansion BNROD 1.5 mgd to 3.0 mgd			$ 13,000,000										
	Conveyance Rehabilitation			$ 30,000,000		$ 5,000,000		$ 5,000,000						
	Expand Roger			$ 55,000,000										
				$										
	Central, Northwest and Southeast Reclamation WRFs			$ 45,000,000		$ 20,000,000		$ 10,000,000		$ 5,000,000				
				$ -		$ -		$ -		$ -				
	Rehab Ina Bio BNR			$ 15,000,000		$ 5,000,000								
	Outlying Solids			$ 15,000,000		$ 5,000,000								
	Green Valley BNROD (an additional 2 mgd)			$ 25,000,000										
	Conveyance Rehabilitation			$ 25,000,000		$ 5,000,000		$ 5,000,000						
	SCADA & Control System			$ 3,000,000		$ 1,000,000								
				$ -										
				$ -										
Sub-Totals				**$ 251,000,000**	**$ -**	**$ 46,000,000**	**$ -**	**$ 20,000,000**	**$ -**	**$ 8,000,000**	**$ -**	**$ -**	**$ -**	**$ -**
	2016 & 2020 Bond Authorization													
	Ina Road WPCF Expansion 37.5 to 50 mgd (Phase I - 2016)			$ 40,000,000								$ 5,000,000		$ 15,000,000
	Ina Road WPCF Expansion 37.5 to 50 mgd (Phase II - 2020)			$ 75,000,000										
	Tangerine & I-10 WWTF BNROD			$ 35,000,000						$ 2,500,000		$ 10,000,000		$ 15,000,000
	Major Rehab Ina			$ 25,000,000		$ 5,000,000		$ 5,000,000						
	Roger Rehab			$ 25,000,000		$ 5,000,000		$ 5,000,000						
	Outlying Rehab			$ 55,000,000		$ 5,000,000		$ 5,000,000		$ 5,000,000		$ 5,000,000		$ 5,000,000
	Conveyance Rehab			$ 50,000,000				$ 5,000,000		$ 5,000,000				$ 5,000,000
	Unidentified WRF 3 mgd			$ 30,000,000				$ 5,000,000		$ 10,000,000		$ 10,000,000		$ 5,000,000
	Corona de Tucson BNROD (1 MGD)			$ 22,500,000										
				$ -										
				$ -										
Sub-Totals				**$ 357,500,000**	**$ -**	**$ 15,000,000**	**$ -**	**$ 25,000,000**	**$ -**	**$ 22,500,000**	**$ -**	**$ 30,000,000**	**$ -**	**$ 45,000,000**
	CIP GRAND TOTAL			$ 1,364,980,552	**$ 10,514,365**	**$ 65,000,000**	**$ 10,514,365**	**$ 49,000,000**	**$ 10,514,365**	**$ 34,000,000**	**$ 10,514,365**	**$ 32,500,000**	**$ 10,514,365**	**$ 47,500,000**
				$ 1,364,980,552	**Total**	**$ 75,514,365**	**Total**	**$ 59,514,365**	**Total**	**$ 44,514,365**	**Total**	**$ 43,014,365**	**Total**	**$ 58,014,365**
						FY 16-17 Projected		FY 17-18 Projected		FY 18-19 Projected		FY 19-20 Projected		FY 20-21 Projected

* Projects show as W^ in the Pima County Project Management Application Data Base

Table 8.4. 5 Year CIP For FY2021/26

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Bond #	To Director & Deputies 12-7-05	CIP Number	Center Number	Totals	FY 21-22 Projected SDF	FY 21-22 Projected Bond/WIFA	FY 22-23 Projected SDF	FY 22-23 Projected Bond/WIFA	FY 23-24 Projected SDF	FY 23-24 Projected Bond/WIFA	FY 24-25 Projected SDF	FY 24-25 Projected Bond/WIFA	FY 25-26 Projected SDF	FY 25-26 Projected Bond/WIFA
	1997 Bond Projects													
Sub-Totals	**2004 Bond Projects/Related Projects With 2008 Bonds**			**$ 11,514,069**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
SS-6.1	***Roger Road WWTF Rehabilitation (Rollup)***			**$ 75,165,274**	$ 2,314,365		$ 2,314,365		$ 2,314,365		$ 2,314,365		$ 2,314,365	
	Plant Rehabilitation (C - SDF 2004-05 "D" Budget) % Split by Proj			**$ 51,094,255**	**$ -**	**$ 2,500,000**	**$ -**	**$ 2,500,000**	**$ -**	**$ 2,500,000**	**$ 2,500,000**	**$ -**	**$ 2,500,000**	
	Sludge Line	WL-053R1	W755010	*$ 837,989*										
	VFD at P.S. #4	WL-05-3R2	W755020	*$ 180,000*										
		0	0	$ -										
SS-6.2	***Misc. Conveyance System Rehab. (Rollup)***			**$ 78,216,565**	$ 3,200,000		$ 3,200,000		$ 3,200,000		$ 3,200,000		$ 3,200,000	
	Conveyance Rehab			$ 17,500,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
SS-6.7	***Ina/Roger Road WPCF - Denitrification (To Be Rollup)***	N/A		**$ 132,082,165**										
	Added to bond to max draw / reimbursement			$ -										
Sub-Totals	**SDF Projects**			**$ 592,280,469**	**$ 5,514,365**	**$ 2,500,000**	**$ 5,514,365**	**$ 2,500,000**	**$ 5,514,365**	**$ 2,500,000**	**$ 8,014,365**	**$ -**	**$ 8,014,365**	**$ -**
	With 2004-2008 Bonds													
	Santa Cruz Interceptor /Lincoln-Drexel	WL-97-5L1	W700049	$ 51,054										
SS-06	TV Int., Hidden Hills Wash to Arbor Circle	~~WL-97-4L4~~	~~W700036~~	$ 94										
	Misc. Eng. Design Services	N/A	N/A	$ 5,000,000	$ 250,000		$ 250,000		$ 250,000		$ 250,000		$ 250,000	
	Miscellaneous Sewer Relocations *	N/A	N/A	$ 9,900,000	$ 500,000		$ 500,000		$ 500,000		$ 500,000		$ 500,000	
	Regional Transportation Authority*	N/A	N/A	$ 4,875,000	$ 250,000		$ 250,000		$ 250,000		$ 250,000		$ 250,000	
	River Road / Alvernon Way	WL-87-001	W700005	$ 19,107										
	Green Valley CC Estates Trunk Reloc.@ DW #7	WL-90-019	W700007	$ 515,370										
	Sewer Replacement @ Alvernon and Hayne St.	WL-01-2L1	W700025	$ 85,000										
Sub-Totals	**CIP Treatment Projects**			**$ 57,077,606**	**$ 1,000,000**	**$ -**	**$ 1,000,000**	**$ -**	**$ 1,000,000**	**$ -**	**$ 1,000,000**	**$ -**	**$ 1,000,000**	**$ -**
Sub-Totals	**Other Jurisdictions**			**$ 4,761,595**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
	Arroyo Chico Drainage Under Construction	N/A	0	$ 85,000										
	ADOT Relocation: I-19-&_I-10	WL-00-2L1	W700076	$ -										
Sub-Totals	**Outside Agency /Jurisdiction Funded**			**$ 85,000**	**$ -**		**$ -**		**$ -**		**$ -**		**$ -**	
	New Federal Prison	WL-03-4L1	W700079	$ 5,887,414										
	Marana Colonia Sewer/Redev. Honea Hgts.	WL-00-3L1	W700018	$ 1,359,971										
	Old Nogales Hwy. Colonia	WL-99-2L1	W700027	$ -										
Sub-Totals	**New CIP Projects**			**$ 7,247,385**	**$ -**		**$ -**		**$ -**		**$ -**		**$ -**	
	Continental Pump Station Improvements Rollup			*$ 480,000*										
	Lift Station Rehabilitation (rollup)*	N/A	N/A	**$ 19,100,000**	***$ 1,000,000***		***$ 1,000,000***		***$ 1,000,000***		***$ 1,000,000***		***$ 1,000,000***	
	SDF W6 Evaluation Projects	N/A	N/A	$ 56,890,000	$ 3,000,000		$ 3,000,000		$ 3,000,000		$ 3,000,000		$ 3,000,000	
	SCADA Fail Over Review process sim (05-06)	WL-05-1L2	W750157	$ 30,000										
				$ -										
Sub-Totals				**$ 83,514,427**	**$ 4,000,000**		**$ 4,000,000**		**$ 4,000,000**		**$ 4,000,000**		**$ 4,000,000**	
	2012 Bond Authorization													
Sub-Totals				**$ 251,000,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
	2016 & 2020 Bond Authorization													
	Ina Road WPCF Expansion 37.5 to 50 mgd (Phase I - 2016)			$ 40,000,000		$ 20,000,000		$ -						
	Ina Road WPCF Expansion 37.5 to 50 mgd (Phase II - 2020)			$ 75,000,000		$ 20,000,000		$ 20,000,000		$ 15,000,000		$ 10,000,000		$ 10,000,000
	Tangerine & I-10 WWTF BNROD			$ 35,000,000		$ 7,500,000								
	Major Rehab Ina			$ 25,000,000						$ 5,000,000		$ 5,000,000		$ 5,000,000
	Roger Rehab			$ 25,000,000						$ 5,000,000		$ 5,000,000		$ 5,000,000
	Outlying Rehab			$ 55,000,000		$ 5,000,000		$ 5,000,000		$ 5,000,000		$ 5,000,000		$ 5,000,000
	Conveyance Rehab			$ 50,000,000		$ 15,000,000		$ 15,000,000		$ 5,000,000				
	Unidentified WRF 3 mgd			$ 30,000,000										
	Corona de Tucson BNROD (1 MGD)			$ 22,500,000						$ 7,500,000		$ 7,500,000		$ 7,500,000
				$ -										
				$ -										
Sub-Totals				**$ 357,500,000**	**$ -**	**$ 67,500,000**	**$ -**	**$ 40,000,000**	**$ -**	**$ 42,500,000**	**$ -**	**$ 32,500,000**	**$ -**	**$ 32,500,000**
	CIP GRAND TOTAL			**$ 1,364,980,552**	**$ 10,514,365**	**$ 70,000,000**	**$ 10,514,365**	**$ 42,500,000**	**$ 10,514,365**	**$ 45,000,000**	**$ 13,014,365**	**$ 32,500,000**	**$ 13,014,365**	**$ 32,500,000**
				$ 1,364,980,552	**Total**	**$ 80,514,365**	**Total**	**$ 53,014,365**	**Total**	**$ 55,514,365**	**Total**	**$ 45,514,365**	**Total**	**$ 45,514,365**
						FY 21-22 Projected		FY 22-23 Projected		FY 23-24 Projected		FY 24-25 Projected		FY 25-26 Projected

* Projects show as W^ in the Pima County Project Management Application Data Base

Table 8.5. 20 Year CIP For FY2006/26

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Bond #		Regulatory (%)	Rehab (%)	Capacity (%)	$ Regulatory	$ Rehab	$ Capacity	Bond #	To Director & Deputies 12-7-05	CIP Number	Center Number	2004 Bond Totals	2008 Bond Totals	Totals	FY 05-06 Budget SDF	FY 05-06 Budget Bond/WIFA
									1997 Bond Projects							
SS-01	100%	0%	0%	100%	$ -	$ -	$ 3,460,037	SS-01	Ina Rd WPCF Proc Chg & Exp to 37.5 mgd	WL-91-001	W700039			$ 3,460,037		
SS-11	100%	20%	0%	80%	$ 619,668	$ -	$ 2,478,671	SS-11	Arivaca Junction WWTF Extension Sewer	WL-87-427	W700048			$ 3,098,339		$ -
SS-14	100%	30%	0%	70%	$ (75,151)	$ -	$ (175,353)	SS-14	Misc. Wastewater Reclamation Facility (Randolph)	WL-97-6L1	W700024			$ (250,504)		
SS-02	100%	0%	0%	100%	$ -	$ -	$ 11,094	SS-02	Green Valley Upgrade & Expansion	WL-96-3L2	W700033			$ 11,094		
SS-03	100%	0%	0%	100%	$ -	$ -	$ 2,288	SS-03	Santa Cruz Interceptor, Prince-Franklin (Phase II & III)	WL-96-3L2	W700034			$ 2,288		
SS-05	100%	0%	80%	20%	$ -	$ 2,963,276	$ 740,819	SS-05	TV Int., Craycroft-Tucson Country Club	WL-97-6L3	W700035			$ 3,704,095		
SS-08	100%	0%	0%	100%	$ -	$ -	$ 1,488,720	SS-08	New Marana WWTF Interim Expansion	WL-98-3L1	W700011			$ 1,488,720		$ 1,464,611
					$ 544,517	$ 2,963,276	$ 8,006,276	Sub-Totals	**2004 Bond Projects/Related Projects With 2008 Bonds**			$ 5,443,797	$ -	$ 11,514,069	$ -	$ 1,464,611
												$ 11,514,069				
	100%	10%	90%	0%	$ 7,516,527	$ 67,648,746	$ -	SS-6.1	***Roger Road WWTF Rehabilitation (Rollup)***			$ 20,000,000		$ 75,165,274		$ 1,000,000
									R R Rehab Struct. Assessment	WL-04-601	W746011			$ 272,348		
									R R Rehab Electrical Study	WL-04-601	W746016			$ 10,062,162		
									R R Rehab Hdwks Compactors	WL-04-601	W746013			$ 400,977		
									R R Rehab Storm water Basin (New Overflow Basins)	WL-04-601	W746015			$ 1,686,092		
									R R Rehab Aeration Basins	WL-04-601	W746017			$ 1,591,163		
									R R Rehab Truck Ramp Covers	WL-04-601	W746018			$ 54,708		
									R R Rehab Prim Clarifier Cov	WL-04-601	W746019			$ 2,000,673		
									R R New Thickeners	WL-04-601	W746025			$ 1,150,000		
									RR Biosolids	WL-04-601	W74602			$ 28,581		
									Rehab Exist'g. Storm Water Bas	WL-04-601	W755030			$ 585,000		
									RR New Media					$ 10,000,000		
	0%	0%	0%	0%	$ -	$ -	$ -							$ -		
						$ 35,970,000			**Plant Rehabilitation (C - SDF 2004-05 "D" Budget) % Split by Proj**				$ 40,000,000	$ 51,094,259		
	100%	0%	100%	0%	$ -	$ 837,989	$ -		Sludge Line	WL-05-3R1	W755010			$ 837,989		
	100%	0%	100%	0%	$ -	$ 180,000	$ -		VFD at P.S. #4	WL-05-3R2	W755020			$ 180,000		
	0%	0%	0%	0%	$ -	$ -	$ -			0	0			$ -		
	100%	0%	0%	100%	$ -	$ -	$ 150,000		RR Operational Efficiency Eval	WL-05-3R	W755070			$ 150,000		
	100%	80%	0%	20%	$ 1,576,000	$ -	$ 394,000		SCADA Upgrade*	WL-05-3R	W755110			$ 1,970,000		
	100%	0%	100%	0%	$ -	$ 75,401	$ -		Ina Biosolids Transfer Station	WL-05-SF2	W900309			$ 75,401		
	100%	0%	100%	0%	$ -	$ 750,000	$ -		Ina Safety - Railings	WL-05-SF1	W755040			$ 750,000		
	100%	100%	0%	0%	$ 75,000	$ -	$ -		Sodium Hypochlorite Containment	WL-05-3R2	W755050			$ 75,000		
	100%	0%	100%	0%	$ -	$ 100,254	$ -		Ina Scum Pumping System*	WL-05-SF3	W900310			$ 100,254		
	100%	0%	100%	0%	$ -	$ 75,611	$ -		Ina Recycle Line Modifications*	WL-05-SF4	W900311			$ 75,611		
	100%	0%	0%	100%	$ -	$ -	$ 95,000		Ina Struvite Management*	WL-05-SF5	W900312			$ 95,000		
	100%	0%	100%	0%	$ -	$ -	$ -		NEW - From O&M to CIP		0			$ -		
	100%	0%	100%	0%	$ -	$ 1,200,000	$ -		Ina - Replace pond #3 liner - concert*		0			$ 1,200,000		
	100%	0%	100%	0%	$ -	$ 500,000	$ -		Ina - Fix process tank structural*		0			$ 500,000		
	100%	0%	100%	0%	$ -	$ 200,000	$ -		Ina - Heat exchange upgrade*		0			$ 200,000		
	100%	100%	0%	0%	$ 600,000	$ -	$ -		Plant Security		0			$ 600,000		
	100%	0%	100%	0%	$ -	$ 3,500,000	$ -		R R New Admin Bldg		0			$ 2,500,000		
	100%	0%	100%	0%	$ -	$ 1,500,000	$ -		R R New Roads		0			$ 1,500,000		
	100%	0%	0%	100%	$ -	$ -	$ 200,000		Randolph - Clean Screens with reclaim - not potable*		0			$ 200,000		
	100%	0%	100%	0%	$ -	$ 3,115,000	$ -		Above plan "D"					$ 3,115,000		
	100%	0%	100%	0%	$ -	$ 78,216,565	$ -	SS-6.2	***Misc. Conveyance System Rehab. (Rollup)***			$ 15,000,000		$ 78,216,565		$ 2,000,000

Chapter 9 Funding

CHAPTER OVERVIEW

Chapter 9 details the various funding sources for Pima County Wastewater Management Department (PCWMD) to perform routine operation and maintenance on the existing system and build future facilities. PCWMD was established as an enterprise fund in Pima County's financial structure – a utility operation funded by the revenue it generates from fees charged for its services. Revenues are collected and transferred to Pima County's Finance Department where they are organized and allocated according to the flow of funds adopted in the Board of Supervisors Resolution 1991-138. Major capital improvements to the system are generally funded by Sewer Revenue Bonds through Bond Sales or Water Infrastructure Finance Authority (WIFA) loan following authorization by the voters.

The principal sources of revenue are Sewer User Fees and Sewer Connection Fees paid by customers of the system as established and modified by ordinances authorized by the Board of Supervisors. Preliminary benchmarking reports indicate some common factors regarding PCWMD's fees:

- **User Fee Rates:** Pima County's user fees are consistently among the lowest in any of the surveys for agencies of similar size and mission in all surveys nationwide.
- **Connection Fee Rates:** Pima County collects a reasonable amount of funding from the development industry for growth related expenses.

CHAPTER 9.0 FUNDING

Pima County Wastewater Management Department is accounted for as an enterprise fund of Pima County, and is responsible for the management and operation of all liquid waste programs in Pima County. An administrator appointed by the Pima County Board of Supervisors directs PCWMD's management. However, ultimate financial accountability for the Department remains with Pima County. PCWMD's accounts are maintained in accordance with the principles of fund accounting to ensure that limitations and restrictions on PCWMD's available resources are observed. The principles of fund accounting require resources be classified for accounting and reporting purposes into funds in accordance with activities or objectives specified for those resources. A fund is considered a separate accounting entity, and its operations are accounted for in a separate set of self-balancing accounts comprising its assets, liabilities, net assets, revenues and expenses.

PCWMD's financial transactions are recorded and reported as an enterprise fund because its operations are financed and operated in a manner similar to private business enterprises, in which the intent is that the costs (expenses, including depreciation) of providing goods or services to the general public on a continuing basis be financed or recovered primarily through user charges.

The Board of Supervisors Resolution 1991-138 sets the flow of funds for PCWMD. All revenues generated by the enterprise, whether operating or non-operating, must be deposited in the Revenue Fund. Once available for current uses they pay for the operations and maintenance of the sewerage system, bond/loan principal and interest expenses, reserve fund guaranties, reserve requirements of parity bonds, arbitrage rebate expenses and finally flow through to the System Development Fund (SDF), in that order. System Development Funds may then be used to: provide funding for sewerage system extensions or betterments and unbudgeted operating and maintenance expenses, to redeem bonds subject to redemption (if rates are favorable), to pay general obligation bonds issued by Pima County for acquisition of the system or for construction of additions or improvements to the system and to make loans to Pima County to be used for any lawful purpose under equitable terms prescribed by the Board or used for any lawful purpose.

Revenue Sources

The principal source of operating revenues is Sewer User Fees. Sewer User Fees are the monthly charges billed to existing customers to cover the expense of administration, system operation and system maintenance. Other operating revenues include fees for engineering review of plans and inspections of physical improvements, permits and fines as well as sanitation fees charged for the dumping of septic waste at a treatment facility. Sewer User Fees generate approximately 97 percent of all operating revenues with the remainder being generated by the sources previously mentioned. Non-operating revenues include Sewer Connection Fees, grant revenue, interest income and other miscellaneous sources of revenues. Sewer Connection Fees are the charges levied upon new customers to cover the cost of conveyance system extensions and increased treatment capacity necessary to serve new connections to the sewerage system. Connection Fee revenues account for the majority of all non-operating revenues.

PCWMD reviews its revenues and expenses annually and presents recommendations, in conjunction with the Wastewater Management Advisory Committee, for adjustments to these fees and expenses (budget) to the Board of Supervisors in the Department's annual Financial Plan and proposed budget.

As stated earlier, Board of Supervisor's Resolution 1991-138 dictates for what purposes and in what order Pima County must use PCWMD's revenues to satisfy its obligations to the ratepayers and bondholders as follows:

- Revenue Fund: Depository Fund all revenues flow into.
- Operations and Maintenance Fund: Operational expenses only.
- Bond Fund: Principal and interest expenses.
- Reimbursement Fund: Policy costs to pay reserve Fund guarantors.
- Reserve Fund: Reserve requirements rebated to parity bonds.
- Rebate Fund: Arbitrage rebate expenses.
- System Development Fund: system extensions or betterments, unbudgeted operations and maintenance (O&M) expenses, redemption of bonds.

Most revenues are used for the daily payment of operating and maintenance expenses. PCWMD also utilizes a portion of its revenues in an un-leveraged manner for a Pay-As-You-Go capital construction program through the SDF, which are the funds remaining after all mandatory payments required by Resolution 1991-138 are made.

However, revenues used to pay the debt service for the Sewer Revenue Bonds and WIFA loans are used as leveraged revenues (similar to a multi-year mortgage or car payment). The principle theory for leveraging future revenues to finance the acquisition, construction, addition to or major repair of capital assets is these expenses are intended to benefit not only the current users of the sewerage system but future users as well.

In addition, PCWMD receives developer contributions of capital improvements to the sewerage system. All capital improvements (i.e. on and off-site sewer lines) are required to be constructed to public standards and provide a bill of sale to Pima County in order for the new construction to be accepted and maintained as part of the regional system. This allows the Department to obtain off-site, flow-through and over-sized sewer construction at minimal cost, thus leaving existing revenues available for other capital projects.

Current and Recent Financial Results

Table 9.1, compiled from financial data from the last five fiscal years provides the highlights of PCWMD's current and recent financial status.

Another key indicator of the Department's current and recent financial results is the Debt Service Rate Covenant. Pima County Resolution 1991-138 requires PCWMD "establish and maintain rates, fees and other charges for all services supplied by the System to provide revenues fully sufficient, after making reasonable allowance for contingencies and errors in estimates, to pay all Operating Expenses and produce aggregate Net Revenues in each Fiscal Year equal to at least 120 percent of the principal and interest requirements on all Outstanding Bonds for the corresponding Bond Year." As noted in the proceeding Comparative Statements of System Revenues, Expenditures and Net Revenues Available for Debt Service Schedule the lowest Debt Service Coverage Ratio in the last five-year period was 1.36 and in three of the past five fiscal years the ratio has exceeded 2.0 percent.

In terms of historical trends compared to recent events, it should be noted, the impact of the Northwest Outfall/Speedway Sinkhole event in FY2002/03 and an increase in funding necessary to complete the Randolph Park WRF resulted in a severe reduction in available O&M and capital spending. Even though the revenue stream remained constant, as all available revenues for the next 18 months were applied to the resulting financial obligations until all had been repaid. Since repayment, PCWMD is pursuing an enhanced rehabilitation program starting in FY2005/06 and has increased the CIP from $6 million dollars in FY2004/05 to $28 million dollars in FY2005/06.

Table 9.1.1 PCWMD Compiled Financial Data

	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005
REVENUES					
Sewer Utility Service	$40,837,314	$40,935,336	$45,318,741	$47,685,465	$50,393,306
Sewer Connection Revenue	16,768,587	17,479,915	20,279,607	29,404,130	36,906,421
Engineering Review & Inspection Fees	15,064	61,564	245,820	104,062	171,914
Other Income [1]	4,513,271	2,367,825	2,530,600	2,334,645	1,295,589
Gross Revenues	62,134,236	60,844,640	68,374,768	79,528,302	88,767,230
MAINTENANCE AND OPERATIONS COSTS					
Employee Compensation	17,962,678	20,350,669	23,290,692	25,367,949	24,730,566
Consultants/Outside Services	2,929,587	2,918,701	2,523,079	2,510,706	3,112,112
Treatment Supplies and Chemicals	6,671,822	6,069,710	7,276,779	6,375,637	4,712,606
Repair & Maintenance	1,726,453	3,204,525	4,699,452	1,430,383	2,603,772
General and Administrative	6,081,183	6,102,213	8,320,189	8,749,542	6,438,499
Capital Expenses	4,270,845	3,925,136	827,240	132,247	147,116
Maintenance and Operation Cost	39,642,568	42,570,954	46,937,431	44,566,464	41,744,681
NET REVENUE	22,491,668	18,273,686	21,437,337	34,961,838	47,522,549
REVENUE BONDED DEBT SERVICE					
Principal	5,006,080	7,661,855	8,886,774	7,979,721	4,705,000
Interest	4,531,118	5,782,368	5,912,681	5,377,763	2,276,249
Total Debt Service Payments	9,537,198	13,444,223	14,799,455	13,357,484	6,981,249
Debt Service Coverage	2.36X	1.36X	1.45X	2.62X	2.38X
NET REVENUES REMAINING AFTER DEBT SERVICE	12,954,470	4,829,463	6,637,882	21,604,354	22,228,452

1. Other income includes revenue generated from licenses, permits and fines, sanitation fees, net interest income, and other miscellaneous income.

Source: For fiscal years 1999-00 through 2003-04 prepared by the Department from its audited financial statements, excluding all grant activities.

Benchmarking – Comparisons With Other Agencies

Financial and rate comparisons among wastewater agencies, regionally and nationally, are difficult due to the wide ranges in governance structure (cities, districts and regional authorities), rate structures, size and geography, composition of customers and utility function (retail, wholesale or combination). A number of industry surveys are compiled and published periodically to assist utility managers and governing Boards review of these issues from a wider perspective. PCWMD has used the surveys by the Association of Metropolitan Sewerage Agencies (AMSA), the City of Phoenix, and the "Water and Wastewater Survey" by Raftelis Financial Consulting, a nationally recognized authority on water and wastewater financing. Raftelis Financial Consulting is the Financial Consultant to PCWMD for the Facility Plan and has extensively discussed these topics with staff since the initiation of the Facility Plan Study. In addition, the recent audit of PCWMD by Black & Veatch conducted a benchmarking assessment of PCWMD against other agencies they selected for this purpose.

Benchmarking Observations

Some of the common factors noted in these reports regarding the Department fees were:

- **User Fee Rates:** Pima County's User Fees are consistently among the lowest in any of the surveys for agencies of similar size and mission nationwide.
- **Connection Fee Rates:** Pima County collects a reasonable amount of funding from the development industry for growth related expenses.

Some pertinent observations from the 2002 Raftelis survey are:

- The Water and Wastewater Survey categorizes the participating utilities into three groups, A, B and C, dependent upon size. PCWMD is in group A (large) with the following comparisons to others in this group of 35.
- PCWMD user fee of $17.52 (2005/06) per month for the typical (10Ccf) customer billing and the average connection fee of $4,050 for a typical residence as well as the Pima County data contained in the survey were discussed.
- The PCWMD rate structure (Administrative Fee plus Service Charge) was found to be among the lowest nationwide:
  - ✓ PCWMD Administrative Fee of $5.72 versus a nationwide average of $5.74.
  - ✓ Median Monthly User Fee charges for group A was $20.11 (10 Ccf) in the 2002 survey, compared to $11.80 for PCWMD customers in 2005.
  - ✓ PCWMD Average Monthly Bill was ranked lower than the average monthly bill for Group A which was $21.79.

Association of Metropolitan Sewerage Agencies 2002 Survey

- PCWMD's cost for O&M were 25 percent higher than the average, but has a conveyance system length 220 percent greater than the average.
- PCWMD's O&M costs were $3,215 per sewer mile compared to the national average of $5,681 per sewer mile. This is approximately 43 percent less than the average for all reporting agencies on a cost per mile basis.
- PCWMD devotes one FTE for every 32 miles of maintained sewer main, while the national average is one FTE for every 23 miles of sewer main. Therefore, PCWMD maintained 39 percent more system miles per FTE than the national average within a sewer service area that is geographically 36 percent greater than the average.
- Pima County's average residential customer bill is $17.52 compared to the national average of $21.79 per month. Therefore, Pima County's average bill is only 80 percent of the average reported.
- Pima County's Biosolids Management cost per Dry Ton is $96.28 as compared to 63 other agencies that reported an average of $219.85 per Dry Ton.
- The Department's debt principal at the end of FY2003/04 is $149 million compared to an average outstanding debt of $460 million for the 72 agencies responding.
- Influent heavy metal concentration evaluation of pretreatment trends reveals the national average was higher than Pima County's experience for cadmium, chromium, lead, nickel, silver and zinc, but slightly lower for copper and mercury.
- The total suspended solids removal efficiency for Pima County was greater than the average. In fact, PCWMD's removal efficiency for conventional pollutants was comparable to national averages.

Other Potential Revenue Mechanisms

While the current Pima County user fee and connection fee systems have accomplished their goal of generating revenue for the utility while having an equity basis that is generally supported by the community, it is worthwhile to look at other systems briefly to have a suitable context for evaluating these revenue mechanisms. It should be noted, all communities are required by the Clean Water Act to have a user fee allocating the O&M costs of the system equitably across all classes of sewer users, but the collection of fees for capital improvement financing has no formal structure required in the Clean Water Act.

User Fee Structures of Other Public Wastewater Utilities

The City of Phoenix has developed an environmental fee specified in their rate ordinance that addresses environmental concerns. Phoenix also adds the environmental fee to wastewater services it wholesales to other municipalities that are participants in its wastewater treatment facilities through a Sub-Regional Operating Group (SROG).

Many utilities have uncoupled their current rehabilitation costs from their general user fees and have a special notation on the bills for a separate charge for these expenditures. In this manner, utilities with older systems can reflect necessary rehabilitation and replacement costs associated with aging infrastructure more accurately in their billing.

Charlotte, North Carolina has added a nitrogen assessment to their fees. Thus costs associated with wastewater processing to meet the ever more restrictive allowable nitrogen discharge levels are clearly identified.

Many utilities are anticipating the necessity to increase revenues to cover the costs associated with the government mandated Capacity, Management, Operations and Maintenance (CMOM) Program. Further, some utilities have allocated conveyance system costs with classes of users.

PCWMD does not directly bill customers for sewer service but enters into Intergovernmental Agreements (IGA) with water service providers (Tucson Water, Metropolitan Water, Oro Valley, etc.) to bill their customers. This will limit the Departments ability to add “line items” to sewer bills reflecting government-mandated programs; however, based on the *Sewer User Fee Billing Evaluation Study* (June 2001), performed by Black & Veatch, the practice of billing for sewer services through the use of IGAs with water providers was deemed to be the least costly.

Capital Improvement Revenue Mechanisms of other Public Wastewater Utilities

The Connection Fee revenue mechanisms present the greatest funding challenges. The areas below represent the full range of urbanization from completely rural to urban margin with different utility services in place. PCWMD currently uses low-interest Sewer Revenue Bond funding and/or WIFA loans (State of Arizona sewer revenue bond pools). The debt service, principal and interest, related to these financing alternatives are paid for with user fees (rehabilitation projects) and connection fees (new capacity projects).

Revenue mechanisms used by other wastewater agencies and their governing bodies include:

- **Zoning Taxes:** Each parcel within a service area would be assessed a specific portion of the cost of wastewater utility development based upon the type of zoning and intensity of intended use. The assessment would be a fixed sum, paid for a specified number of years or paid in total upon filing of development plans, that once paid would entitle that parcel of land to connect to the system without further charges. Comment: The assessment would increase the value

of the land so the owner of the land should ultimately recover their costs, plus inflation, upon sale of the land. Any change in zoning or use would cause a rebate or additional charge. This would insulate PCWMD should housing starts drop.

- **Incentives for prepayment of connection fees:** Self-explanatory. Comment: This would require a discounting of future revenue streams as this specifically relates to the time value of money, and would only become an option should no other sources be available for capital funding.
- **Sewer Capacity Development Fees:** These fees would be essentially the same as our present connection fees, if paid at the time of development. Comment: This concept does have some appeal, if the fees were assessed at the time of rezoning as a non-refundable charge for incorporating the capacity needs of the development into our facility and regional planning – perhaps calculated as 10 percent of the potential connection fees from the development.
- **Developer Participation in Expansions:** This has been a highly useful tool for conveyance. Comment: PSWMD's connection fee ordinance has recently been amended to explicitly authorize its use in providing treatment facilities. This concept has been actively pursued in the Marana and Corona de Tucson areas, which were especially suited for it, due to the size of the developments being proposed along with their timing. However, this is a less viable option for assistance in the Avra Valley area, as many of the developments and developers involved in these efforts are too small to provide sufficient capital to construct a treatment facility.
- **Impact Fees:** Pima County impact fees are regulated by Arizona State statute, which place significant restrictions on their assessment, timing and use. Comment: The connection fee, regulated by Pima County, is far more versatile and manageable.
- **Collection of Fees at an earlier stage of development:** Self-explanatory. Comment: See capacity fee above. Otherwise, it's a simple transfer of future revenue to present revenue, which may be good in the short term, but long-term neutral.
- **A "Mileage Charge:"** Connection Fees would be based upon the distance to available treatment. Comment: Difficult to assess and administer, but intriguing.
- **Special Taxing District:** Used in Peoria, Arizona whereby all wastewater infrastructure within the district was installed from taxes specifically leveled on the land within the service area. Comment: This is the traditional "Sanitary District" concept.

Future Revenue Requirements

Future Operations and Maintenance Requirements

In recent years PCWMD, as have wastewater agencies throughout the United States, has been mandated to treat wastewater to ever-increasing levels of purity by Federal and State environmental agencies and reduce the occurrences of system malfunctions. These demands have caused the Department to forecast O&M expenses increasing at a rate beyond inflation and the "normal" expense increases of past years. The anticipated O&M expenses to reduce conveyance system accidental discharges and to increase the quality of liquid and solid residuals of the treatment process will require significant increases in either existing user and connection fees or the development of alternate fees more descriptive of their causes. Since these expenses have to do with the ongoing operations of the system, they are typically considered expenses that should be allocated to existing users. The quantification of these expenses is not yet clear from an O&M standpoint, but our best estimates, at this time are contained in Table 9.1. In addition, Black & Veatch (2005 Audit Report and 2005 Rate Study) and others, have noted that user fees should carry more of the debt service expense for capital projects that benefit existing users and increased O&M and regulatory expenses.

Future Capital Requirements: Growth, Regulatory and Rehabilitation

Pima County has experienced significant population increases since the turn of the century, and anticipates this growth to go forward in the next decade. The population predictions were relatively accurate in magnitude; however, the prediction of the location of population growth has been less reliable. Several factors, such as the variations in the sale of the large parcels of State land which surround the Metropolitan Area, endangered species listing of plants and animals and the commitment of communities to planned growth, caused developers to change focus from previously anticipated areas to new areas. This resulted in unexpected stress on all utilities serving the community, but especially the wastewater system with its large project cost factors and time commitments for permitting and facility development.

The 2006 Pima County Metropolitan Area Facility Plan (Facility Plan) has identified fast-growing areas in both the Metropolitan and Outlying Treatment Facilities such as:

- The Town of Marana north of the Lambert Lane/Avra Valley Alignment.
- The Houghton Road Area from Irvington Road to Sahuarita Road.
- The area tributary to Corona de Tucson WWTF.
- The area south of Hughes Access Road to Coronado Forest boundary and from Old Nogales Highway east to Sonoita Highway.
- The area tributary to the Avra Valley WWTF.
- The Rincon Valley.
- The Vail Area.

The Facility Plan Capital Improvement Plan (CIP) has identified major improvements for these areas in order to provide sewer capacity in a timely manner. Many of these improvements will be made directly by the developments requiring this capacity, but others will require bond issuances to be paid by developers through their connections fees.

The 20-year CIP makes it clear that a significant number and dollar amount of capital projects must be bond-funded during this next planning period. Towards this end, all new growth projects must be funded either through direct developer contributions or bond debt service paid by connection fees. These would include expansions to treatment facilities and sewer interceptors for new growth areas.

Regulatory

A number of regulatory projects are identified. Some, like the Ina Road WPCF Nitrification/ Denitrification Project, are included in the 2004 Bond Authorization, but the bonds must be issued and user fees must rise to initiate the projects. Others, like the improvements to biosolids processing will require new bond authorizations. The funding for these projects relate both to user and connection fees and an engineering estimate for percentage of funding from each source will be required.

Rehabilitation

The capital rehabilitation projects mentioned previously will begin to have a more significant impact on PCWMD capital needs in the years ahead. The principal policy question for these projects is, how the capital rehabilitation expenses should be covered (i.e., with unleveraged revenues on a pay as you go basis or through the use of bonding to leverage the annual revenues against a loan or bond for all or some of these capital projects). The question then becomes how much of the future user fee revenue-generating capability should fund these expenses, directly, and how

much should be applied to cover the expenses and obligations of bond funding. In FY2004/05, the Department's depreciation expense was $17 million, so the depreciation value each year can be used as a surrogate for the capital rehabilitation needed.

The proposed Capital Projects for growth, regulatory and rehabilitation purposes are discussed and shown on spreadsheets in Chapter 8.

Financial Policies and Benchmarks

From PMCWD's perspective in looking at appropriate levels of funding and appropriate use of revenue mechanisms for capital project financing, several industry financial standards for municipal utility funding are of interest:

- Working Capital should equal 30 percent of one year non-bond Capital Expenses.
- Capital Reserves should equal one years non bond Capital Expenses.
- Working Capital (Working Reserve) should equal 12.5 percent of Total Yearly Revenues.
- Stabilization Fund should equal 12.5 percent of Total Reserve.
- Debt Service can consume 25 to 40 percent of Total Revenue.
- Debt Service coverage 120 percent (minimum, more if possible).
- Emergency Reserve Funding could be 15 percent of Operating Expenses.

As the 20-year CIP indicates, PCMWD is entering a period of extensive capital construction for growth, regulatory and rehabilitation demands. Currently, the voters of Pima County approved a $150 million Wastewater Bond Program in May 2004. Prior to this, PCWMD was authorized to issue $105 million in bonds in 1997 and $54 million in 1986.

From the data presented, it is clear to meet all the needs evidenced in the Facility Plan, will need more frequent bond/loan authorizations at higher dollar values than in the past. In that regard, it is important to note, the current Connection Fee income could support much more debt; the application of User Fees to pay the debt for rehabilitation projects would augment the funds available for debt service with an even more reliable source of the funds.

The financial policies of PCWMD should include the requirement that depreciation is primarily funded from the User Fees. These fees could be leveraged and applied to the bond debt service for capital rehabilitation, thus enabling significantly more capital infrastructure to be replaced and rehabilitated.

Conclusions and Recommendations

Revenue Sources/Structure

- User and Connection Fees should continue to provide the majority of PCWMD's revenue.
- Other fees and charges should be considered to augment revenue streams.

Revenue Policies

- Accounting/fund structure should be transparent to source and uses of funds.
- User Fees should be allocated to pay the majority of the debt service for rehabilitation capital projects.
- Contingency plans should be developed for Connection Fee shortfalls in the event of a housing start slowdown.
- Raftelis Financial Benchmarks, as modified by PCWMD staff, should be adopted as part of the Department's financial goals.

- Financial goals and forecasts (Capital and O&M) should be incorporated in PCWMD's business plan going forward.
- Automation and cost-saving capital construction and treatment process concepts should be an important part of the business plan.

Future Capital

- Bond authorizations are projected for 2008 ($245 to $355 million), 2012 ($225 to $275 million) and 2016/20 ($325 to $400 million) for a total of $795 to $1,030 million. In addition, $400 to $600 million in SDF funds will be required for capital projects.
- An increased emphasis on capital replacement and rehabilitation will drive approximately 37 percent of the $1.4 billion 20-year Capital Improvement Program.
- Regulatory upgrades will generate approximtely 22 percent of the total expenditures.
- Treatment and conveyance capacity increases will account for approximately 41 percent of the remaining expenditures.

A detailed estimate of the 20-year CIP is provided in Table 8.5.

Appendix A Arid West Quality Research Project

A number of AWWQRP research projects have been completed or are in progress. A brief description of each follows:

- Pre-Research Survey of Municipal NPDES Dischargers in the Arid and Semi-Arid West (Discharger Survey) - This research was implemented following a recommendation that the Project survey as many arid West dischargers as possible to obtain information necessary to properly characterize arid West discharges and associated water quality concerns. A key finding of the resulting report, completed in March 2000, was that there was a general lack of data that effectively described effluent-dependent water habitats.
- Habitat Characterization Study - Based on the findings of the Discharger Survey, the Habitat Characterization Study was commissioned for the purpose of characterizing the physical, chemical and biological characteristics of selected effluent-dependent waters across the arid West. It is believed that this effort represents the first attempt to focus data gathering efforts on this type of aquatic ecosystem. The final report was published in winter 2002.
- Extant Criteria Evaluation - The primary focus of this project was to evaluate existing methods for generating federal ambient water quality criteria (AWQC), methods for site-specific modifications to criteria and, if appropriate, develop an approach for regional AWQC modification that takes into account the unique characteristics of ephemeral and effluent-dependent watercourses in the arid West. Four "model" AWQC, which represent different types of pollutants, were used as the basis for this evaluation: copper, selenium, diazinon and ammonia. The final report was completed with a limited publication in September 2003 and is expected to be published by the Society of Environmental Toxicology and Chemistry (SETAC) in 2005/2006.
- Evaluation of Whole Effluent Toxicity Testing as an Indicator of Aquatic Health - This recently initiated project is a collaborative research effort between the AWWQRP and the Water Environment Research Foundation (WERF, Project No. 03-ECO-2). WERF is managing and directing the research project. The AWWQRP, as a collaborative partner, is contributing research funds and technical oversight. The objectives of this pilot study include identifying which biological assemblages should be sampled to assess effluent impacts, appropriate sampling methods for macroinvertebrates, and determining if proposed data and measurement quality objectives are achievable on a regular basis. The project will be completed in 2006.
- Evaluation of the Reliability of the Biotic Ligand Model (BLM) Predictions for Copper Toxicity in Waters Characteristic of the Arid West - The focus of this newly initiated research project is a series of studies designed to further evaluate the reliability

of the BLM to predict copper toxicity in arid West waters. Additionally, a series of tests to further evaluate the different roles of calcium vs. magnesium in controlling copper toxicity to invertebrates and fishes will also be conducted. This project will be completed in late 2005.

- Use of EPA Recalculation Procedure in Arid West Effluent-Dependent Waters – The contract for this work is in the final approval stage. The research will include pilot studies on selected arid West effluent-dependent waters and the development of a resident species list for each of those sites. An evaluation of the appropriateness of species in the EPA toxicity database and identification of arid West species which would improve the effectiveness of using the Recalculation Procedure in the pilot study sites will be conducted.
- Water-Effect Ratio (WER) for Ammonia to Take Into Account Local or Regional Water Quality Characteristics in Arid West Effluent-Dependent Waters – Project will soon be initiated to conduct WER tests with selected species to evaluate acute ammonia toxicity under varying water quality conditions (e.g., hardness, alkalinity, pH, anions, cations, and temperature) representative of arid West effluent-dependent waters.

Appendix B PCWWM Facility Plan Permit Information

AIR QUALITY

The Environmental Protection Agency has promulgated primary and secondary National Ambient Air Quality Standards (NAAQS) for six criteria pollutants (carbon monoxide, nitrogen dioxide, particulate matter, ozone, sulfur dioxide, and lead). Primary standards are adopted to protect public health. Secondary standards are adopted to protect public welfare. States are required to adopt ambient air quality standards, which are at least as stringent as the federal NAAQS, however, the state standards may be more stringent. Arizona has adopted the federal NAAQS as indicated in the following table:

State and Federal Ambient Air Quality Standards

Pollutant		Averaging Time	Primary Standard	Secondary Standard
Carbon Monoxide (CO) in parts per million (ppm)		1-hr 8-hr	35 9	--- ---
Nitrogen Dioxide (NO_2) in ppm		Annual	0.05	0.05
Particulate Matter (micrograms per cubic meter)	PM_{10} [a]	24-hr Annual	150 50	150 50
	$PM_{2.5}$ [b,c]	8-hr[c] Annual[c]	65 15	--- ---
Ozone in ppm		1-hr 8-hr[c]	0.12 0.08	0.12 ---
Sulfur Dioxide (SO_2) in ppm		3-hr 24-hr Annual	--- 365(0.14) 80(0.03)	1300(0.5) --- ---
Lead in micrograms per cubic meter		Calendar Quarter	1.5	1.5

[a] Particulate matter with a diameter of 10 microns or smaller
[b] Particulate matter with a diameter of 2.5 microns or smaller
[c] Federal standard implemented July 18, 1997

Title 17, Chapter 16, Article 160 of the Pima County Code covers air quality regulations for general fuel burning equipment that burns fuel for the primary purpose of producing power, steam, hot water, hot air or other liquids, gases or solids and in the course of doing so the products of combustion do not come into direct contact with process materials. When any products or by-products of a manufacturing process are burned for the same purpose or in conjunction with any fuel, the same maximum emission limitation shall apply.

The Ina Road WPCF is permitted and classified as a major source. A new permits for the existing major source is expected in early 2004. The Roger Road WWTP is currently permitted as a minor source. Additional emission monitoring may be necessary to confirm that Roger Road WWTP is still a minor source. The Pima County PCWWM also has two permits for portable engine generators.

CCTV EVALUATION, Aviation Corridor to Santa Cruz (ACSC) Interceptor Reaches, Condition Grade 4 Total
Pima County Wastewater Management Department, Systems Design Section

Project Name: INTERCEPTOR SEWER SYSTEM, CCTV ASSESMENT FINAL 180 MILES (NON-RCP)
Date : 3/30/2005

S#	Interceptor	Feet from Start	Start MH	Stop MH	Condition Grade	Priority	Affected Length	Reach Length	Dia	COMMENTS	REPAIR COST	MATERIAL
16	ACSC	141.9	9907-36	9907-35	4	1		207	24"	Pipe Failure, Hole from 11 to 12 o´clock	$37,000	CIPP
9	ACSC-T	131	8808-68	9885-49	4	1		188	20"	Pipe Failure, Hole from 10 to 11 o´clock	--	VCP
9	ACSC-T	147.8	8808-68	9885-49	4	1		188	20"	Pipe Failure, Broken, Soil Visible from 11 to 01 o´clock	--	VCP
9	ACSC-T	152	8808-68	9885-49	4	1		188	20"	Pipe Failure, Broken, Soil Visible from 11 to 01 o´clock	--	VCP
9	ACSC-T		8808-68	9885-49	4	1		188	20"	--, *	$158,000	VCP
										Note: *Repair Cost of $158,000 includes all 4 S#'s with 9		
CONDITION GRADE 4, PRIORITY 1 TOTAL								**960**	**feet**		**$195,000**	
ENGINEERING AND ADMINISTRATION (15%)											**$ 29,250**	
TOTAL											**$224,250**	
ACSC INTERCEPTOR, CONDITION GRADE 4, GRAND TOTAL								**960**	**feet**		**$224,250**	

CCTV EVALUATION, Aviation Coridor to South East (ACSE) Interceptor Reaches, Condition Grades 3 & 4 Total
Pima County Wastewater Management Department, Systems Design Section

Project Name: INTERCEPTOR SEWER SYSTEM, CCTV ASSESMENT FINAL 180 MILES (NON-RCP)
Date : 3/30/2005

S#	Interceptor	Feet from Start	Start MH	Stop MH	Condition Grade	Priority	Affected Length	Reach Length	Dia	COMMENTS	REPAIR COST	MATERIAL
40	ACSE-T		9838-18	9838-17	4	1		450	15"	Fracture, Multiple	$49,000	VCP
42	ACSE-T		9838-16	9838-15	4	1		400	15"	Fracture, Multiple	$45,000	VCP
43	ACSE-T		9838-15	9838-14	4	1		413	15"	Fracture, Multiple	$46,000	VCP
CONDITION GRADE 4, PRIORITY 1 TOTAL								**1,263**	**feet**		**$140,000**	

S#	Interceptor	Feet from Start	Start MH	Stop MH	Condition Grade	Priority	Affected Length	Reach Length	Dia	COMMENTS	REPAIR COST	MATERIAL
2	ACSE-TGOLF	276.9	5549-17	5549-16	4	3	313	313.4	15"	Pipe Corrosion	$59,000	DIP
5	ACSE-TGOLF	597.6	5549-14	5549-13	4	3	22	619.3	15"	Pipe Corrosion	$29,000	DIP
CONDITION GRADE 4, PRIORITY 3 TOTAL							**335**	**feet**			**$88,000**	
CONDITION GRADE 4, TOTAL							**1,598**	**feet**			**$228,000**	
ENGINEERING AND ADMINISTRATION (15%)											**$ 34,200**	
TOTAL											**$262,200**	

S#	Interceptor	Feet from Start	Start MH	Stop MH	Condition Grade	Priority	Affected Length	Reach Length	Dia	COMMENTS	REPAIR COST	MATERIAL
13	ACSE-TGOLF	204	8101-05	8101-04	3	1	56	389.5	15"	Bubbles	$30,000	DIP
20	ACSE-TGOLF	122.5	5549-11	5549-12	3	1	21	622	15"	Flakes/Corrosion	$30,000	DIP
CONDITION GRADE 3, PRIORITY 1 TOTAL							**77**	**feet**			**$60,000**	

S#	Interceptor	Feet from Start	Start MH	Stop MH	Condition Grade	Priority	Affected Length	Reach Length	Dia	COMMENTS	REPAIR COST	MATERIAL
8	ACSE-TGOLF	85.1	8101-10	8101-09	3	2	22	107.3	15"	Blisters	$26,000	DIP
9	ACSE-TGOLF	98	8101-09	8101-08	3	2	17	426.3	15"	Blisters	$27,000	DIP

S#	Interceptor	Start MH	Stop MH	MAT'L	Reach Length	Dia	Condition Rating	Priority	$'s / Ft	CIPP COST	CLEAN	CIP BUDGET NUMBER ($'s)	FAILURE DESCRIPTION
7	ACSE-TGOLF	8101-11	8101-10	DIP	74	15"	3	2	$206	$15,131	50%	$22,696	JOINT FAILURES
CONDITION GRADE 3, PRIORITY 2 TOTAL					**113**	**feet**						**$75,696**	
CONDITION GRADE 3, TOTAL					**190**	**feet**						**$135,696**	
ENGINEERING AND ADMINISTRATION (15%)												**$ 20,354**	
TOTAL												**$156,050**	
ACSE INTERCEPTOR, CONDITION GRADES 3 & 4, GRAND TOTAL							**1,788**	**feet**				**$418,250**	

CCTV EVALUATION, Cañada del Oro (CDO) Interceptor Reaches, Condition Grades 3 & 4 Total
Pima County Wastewater Management Department, Systems Design Section

Project Name: INTERCEPTOR SEWER SYSTEM, CCTV ASSESMENT FINAL 180 MILES
Date : 3/30/2005

S#	Interceptor	Feet from Start	Start MH	Stop MH	Condition Grade	Priority	Affected Length	Reach Length	Dia	COMMENTS	REPAIR COST	MATERIAL	LINER
130	CDO-A		1732-04A	1732-03A	4	1		799.8	36"	HOLE	$27,000	DIP	ZZ
94	CDO-T1NORT		5310-02	5310-03	4	1		101.3	24"	LINING FAILURE @ MH	$24,000	DIP	ZZ
44	CDO-T2 THO	163.5	5245-01	5247-09	4	1		301	15"	Pipe Failure, Hole, Soil Visible from 11 to 01 o´clock	$36,000	VCP	
18	CDO-T6 INA	3	6094-01	9549-06	4	1		330	15"	Fracture, Multiple from 11 to 05 o´clock	$39,000	VCP	
5	CDO-T7 HAR	179.9	5333-13	5333-12	4	1		192	15"	Fracture, Multiple from 09 to 03 o´clock	$36,000	VCP	
CONDITION GRADE 4, PRIORITY 1 TOTAL								**1,725**	**feet**		**$162,000**		

S#	Interceptor	Start MH	Stop MH	MAT'L	Reach Length	Dia	Condition Rating	Priority	$'s / Ft	CIPP COST	CLEAN	CIP BUDGET NUMBER ($'s)	FAILURE DESCRIPTION
1	CDO-B	4660-1052	4660-1085	DIP	479	16"	4	3	$206	$98,607	50%	$147,910	BLISTER/FLAKES
2	CDO-B	4660-1085	4660-1076	DIP	476	16"	4	3	$206	$98,051	50%	$147,076	BLISTER/FLAKES
74	CDO-T4 CMO	5339-08	1728-06	DIP	8	24"	4	3	$223	$1,784	50%	$2,676	BLISTER/FLAKES
75	CDO-T4 CMO	1728-06	5339-08	DIP	290	24"	4	3	$223	$64,594	50%	$96,890	BLISTER/FLAKES
76	CDO-T4 CMO	1728-05	1728-06	DIP	493	24"	4	3	$223	$109,834	50%	$164,750	BLISTER/FLAKES
77	CDO-T4 CMO	1728-05	5222-01	DIP	167	24"	4	3	$223	$37,191	50%	$55,786	BLISTER/FLAKES
78	CDO-T4 CMO	5222-01	5222-03	DIP	275	24"	4	3	$223	$61,361	50%	$92,041	BLISTER/FLAKES
79	CDO-T4 CMO	5222-03	1728-04	DIP	141	24"	4	3	$223	$31,438	50%	$47,158	BLISTER/FLAKES
45	CDO-T6 INA	9553-02	9553-01	DIP	166	24"	4	3	$223	$36,923	50%	$55,385	BLISTER/FLAKES
CONDITION GRADE 4, PRIORITY 3 TOTAL					**2,494**	**feet**						**$809,672**	
CONDITION GRADE 4, TOTAL					**4,219**	**feet**						**$971,672**	
ENGINEERING AND ADMINISTRATION (15%)												**$145,751**	
												$1,117,423	

S#	Interceptor	Start MH	Stop MH	MAT'L	Reach Length	Dia	Condition Rating	Priority	$'s / Ft	CIPP COST	CLEAN	CIP BUDGET NUMBER ($'s)	FAILURE DESCRIPTION
64	CDO T4 OES	1728-13	1728-12	DIP	45	15"	3	1	$206	$9,181	50%	$13,772	FLAKEY
105	CDO-A	1732-28A	4064-01	DIP	272	30"	3	1	$223	$60,736	50%	$91,104	SURFACE DAMAGE
65	CDO-T1	5310-20	5310-19	DIP	415	18"	3	1	$206	$85,494	50%	$128,240	BLISTER
67	CDO-T1	5310-18	5310-17	DIP	169	18"	3	1	$206	$34,790	50%	$52,185	BLISTER
68	CDO-T1	5310-17	5310-16	DIP	318	18"	3	1	$206	$65,381	50%	$98,072	BLISTER

S#	Interceptor	Feet from Start	Start MH	Stop MH	Condition Grade	Priority	Affected Length	Reach Length	Dia	COMMENTS	REPAIR COST	MATERIAL
4	CDO-T6 INA	545	9521-03	9521-02	3	1	25	600	15"	Blisters/Flakes	$29,000	DIP
CONDITION GRADE 3, PRIORITY 1 TOTAL					**1,244**	**feet**						**$412,374**

S#	Interceptor	Start MH	Stop MH	MAT'L	Reach Length	Dia	Condition Rating	Priority	$'s / Ft	CIPP COST	CLEAN	CIP BUDGET NUMBER ($'s)	FAILURE DESCRIPTION
60	CDO-A	1732-72A	1732-73A	DIP	318	24"	3	2	$223	$70,970	50%	$106,456	JOINT FAILURES
61	CDO-A	1732-71A	1732-72A	DIP	231	24"	3	2	$223	$51,438	50%	$77,158	JOINT FAILURES
62	CDO-A	1732-70A	1732-71A	DIP	254	24"	3	2	$223	$56,656	50%	$84,984	JOINT FAILURES
63	CDO-A	1732-70A	1732-69A	DIP	442	24"	3	2	$223	$98,596	50%	$147,894	JOINT FAILURES
64	CDO-A	1732-69A	1732-68A	DIP	632	24"	3	2	$223	$140,960	50%	$211,440	JOINT FAILURES
65	CDO-A	1732-68A	1732-67A	DIP	509	24"	3	2	$223	$113,468	50%	$170,202	JOINT FAILURES
66	CDO-A	1732-67A	1732-66A	DIP	594	24"	3	2	$223	$132,465	50%	$198,697	JOINT FAILURES
67	CDO-A	1732-66A	1732-65A	DIP	417	24"	3	2	$223	$93,022	50%	$139,533	JOINT FAILURES
68	CDO-A	1732-65A	1732-64A	DIP	266	24"	3	2	$223	$59,332	50%	$88,997	JOINT FAILURES
69	CDO-A	1732-64A	1732-63A	DIP	592	24"	3	2	$223	$132,086	50%	$198,128	JOINT FAILURES
70	CDO-A	1732-63A	1732-62A	DIP	591	24"	3	2	$223	$131,684	50%	$197,526	JOINT FAILURES
71	CDO-A	1732-62A	1732-61A	DIP	596	24"	3	2	$223	$132,933	50%	$199,399	JOINT FAILURES
72	CDO-A	1732-61A	1732-60A	DIP	596	24"	3	2	$223	$132,911	50%	$199,366	JOINT FAILURES
73	CDO-A	1732-60A	1732-59A	DIP	596	24"	3	2	$223	$132,821	50%	$199,232	JOINT FAILURES
11	CDO-T1	6430-04	6430-03	DIP	30	15"	3	2	$206	$6,176	50%	$9,264	BLISTER

S#	Interceptor	Feet from Start	Start MH	Stop MH	Condition Grade	Priority	Affected Length	Reach Length	Dia	COMMENTS	REPAIR COST	MATERIAL
39	CDO T4 OES	300.2	4722-02	4722-01	3	2	44	457.1	15"	Slight blister/Joint peeling	$26,000	DIP
CONDITION GRADE 3, PRIORITY 2 TOTAL					**6,709**	**feet**						**$2,254,276**
CONDITION GRADE 3, TOTAL					**7,953**	**feet**						**$2,666,649**
ENGINEERING AND ADMINISTRATION (15%)												**$ 399,997**
TOTAL												**$3,066,646**
CDO INTERCEPTOR, CONDITION GRADES 3 & 4, GRAND TOTAL								**12,171**	**feet**			**$4,184,069**

CCTV EVALUATION, Green Valley (GV) Interceptor Reaches, Condition Grades 3 & 4 Total
Pima County Wastewater Management Department, Systems Design Section

Project Name: INTERCEPTOR SEWER SYSTEM, CCTV ASSESMENT FINAL 180 MILES (NON-RCP)
Date : 3/30/2005

S#	Interceptor	Feet from Start	Start MH	Stop MH	Condition Grade	Priority	Affected Length	Reach Length	Dia	COMMENTS	REPAIR COST	MATERIAL
17	GV.CENTRAL	190.8	6834-04	6834-05	4	1	161	352	21"	Bubbles/Peeling	$30,000	DIP
CONDITION GRADE 4, PRIORITY 1 TOTAL							**161**	**feet**			**$30,000**	

S#	Interceptor	Feet from Start	Start MH	Stop MH	Condition Grade	Priority	Affected Length	Reach Length	Dia	COMMENTS	REPAIR COST	MATERIAL
21	GV.CENTRAL	34	4042-41	6834-01	4	2	23	122.5	12"	Bubbles	$25,000	DIP

S#	Interceptor	Start MH	Stop MH	MAT'L	Reach Length	Dia	Condition Rating	Priority	$'s / Ft	CIPP COST	CLEAN	CIP BUDGET NUMBER ($'s)	FAILURE DESCRIPTION
34	GV.CENTRAL	1633-01	1606-15	DIP	69	16"	4	2	$206	$14,184	50%	$21,276	LINING FAIL/CORROSION
17	GV.SOUTH	9970-03	9970-02	DIP	423	30"	4	2	$223	$94,337	50%	$141,506	BUBBLES/FAIL
18	GV.SOUTH	9970-02	9970-01	DIP	170	30"	4	2	$223	$37,904	50%	$56,857	BUBBLES/FAIL
17	GV.WEST	7050-08A	7050-07A	DIP	357	15"	4	2	$206	$73,410	50%	$110,114	LINING FAIL/CORROSION
23	GV.WEST	7050-03A	8760-01	DIP	25	16"	4	2	$206	$5,044	50%	$7,565	LINING FAIL/CORROSION
24	GV.WEST	8760-01	7050-02A	DIP	65	16"	4	2	$206	$13,422	50%	$20,133	LINING FAIL/CORROSION
CONDITION GRADE 4, PRIORITY 2 TOTAL					**1,131**	**feet**						**$382,451**	
CONDITION GRADE 4, TOTAL					**1,292**	**feet**						**$412,451**	
ENGINEERING AND ADMINISTRATION (15%)												**$ 61,868**	
TOTAL												**$474,319**	

S#	Interceptor	Start MH	Stop MH	MAT'L	Reach Length	Dia	Condition Rating	Priority	$'s / Ft	CIPP COST	CLEAN	CIP BUDGET NUMBER ($'s)	FAILURE DESCRIPTION
49	GV.CENTRAL	1606-03	1606-04	DIP	85	18"	3	1	$206	$17,539	50%	$26,309	LINING FAIL/PEEL
51	GV.CENTRAL	6635-01	6635-02	DIP	117	18"	3	1	$206	$24,065	50%	$36,097	JOINT FAILURES
96	GV.CENTRAL	8865-I	8865-J	DIP	538	30"	3	1	$223	$119,845	50%	$179,767	LINING FAIL/PEEL
97	GV.CENTRAL	8865-I	8865-H	DIP	478	30"	3	1	$223	$106,511	50%	$159,767	LINING FAIL/PEEL
98	GV.CENTRAL	8865-H	8865-G	DIP	572	30"	3	1	$223	$127,604	50%	$191,406	LINING FAIL/PEEL
99	GV.CENTRAL	8865-F	8865-G	DIP	391	30"	3	1	$223	$87,180	50%	$130,770	LINING FAIL/PEEL
100	GV.CENTRAL	8865-E	8865-F	DIP	419	30"	3	1	$223	$93,468	50%	$140,202	LINING FAIL/PEEL
101	GV.CENTRAL	8865-E	8865-D	DIP	480	30"	3	1	$223	$107,046	50%	$160,570	LINING FAIL/PEEL
102	GV.CENTRAL	8865-D	8865-C	DIP	283	30"	3	1	$223	$63,033	50%	$94,549	LINING FAIL/PEEL
103	GV.CENTRAL	8865-C	8865-B	DIP	293	30"	3	1	$223	$65,285	50%	$97,927	LINING FAIL/PEEL
104	GV.CENTRAL	8865-B	8865-A	DIP	92	30"	3	1	$223	$20,468	50%	$30,703	LINING FAIL/PEEL
105	GV.CENTRAL	8865-A	8865-01	DIP	170	30"	3	1	$223	$37,949	50%	$56,923	LINING FAIL/PEEL
106	GV.CENTRAL	8865-01	8865-IN	DIP	19	30"	3	1	$223	$4,259	50%	$6,388	LINING FAIL/PEEL

S#	Interceptor	Feet from Start	Start MH	Stop MH	Condition Grade	Priority	Affected Length	Reach Length	Dia	COMMENTS	REPAIR COST	MATERIAL
2	GV-WEST	360.9	7050-14	6038-02	3	1	33	469.7	15"	Bubbles/Peeling	$29,000	DIP
CONDITION GRADE 3, PRIORITY 1 TOTAL					**3,970**	**feet**						**$1,340,378**
CONDITION GRADE 3, TOTAL					**3,970**	**feet**						**$1,340,378**
ENGINEERING AND ADMINISTRATION (15%)												**$ 201,057**
TOTAL												**$1,541,435**
GV INTERCEPTOR, CONDITION GRADES 3 & 4, GRAND TOTAL								**5,262**	**feet**			**$2,015,754**

CCTV EVALUATION, North Rillito Interceptor (NRI) Reaches, Condition Grade 3 Total
Pima County Wastewater Management Department, Systems Design Section

Project Name: INTERCEPTOR SEWER SYSTEM, CCTV ASSESMENT FINAL 180 MILES (NON-RCP)
Date : 3/30/2005

S#	Interceptor	Start MH	Stop MH	MAT'L	Reach Length	Dia	Condition Rating	Priority	$'s / Ft	CIPP COST	CLEAN	CIP BUDGET NUMBER ($'s)	FAILURE DESCRIPTION
33	NRI-T VENT	1781-09	6518-01	DIP	270	15"	3	1	$206	$55,479	50%	$83,219	BLISTER/FLAKES
34	NRI-T VENT	6518-01	1781-08	DIP	104	15"	3	1	$206	$21,389	50%	$32,083	BLISTER/FLAKES
73	NRI-T VENT	8240-02	8240-01	DIP	63	18"	3	1	$206	$12,866	50%	$19,299	BLISTER/FLAKES
CONDITION GRADE 3, PRIORITY 1 TOTAL					**436**	**feet**						**$134,601**	
CONDITION GRADE 3, TOTAL					**436**	**feet**						**$134,601**	
ENGINEERING AND ADMINISTRATION (15%)												**$ 20,190**	
TOTAL												**$154,791**	
NRI, CONDITION GRADE 3, GRAND TOTAL								**436**	**feet**			**$154,791**	

CCTV EVALUATION, Old Nogales Highway (ONH) Interceptor Reaches, Condition Grade 4 Total
Pima County Wastewater Management Department, Systems Design Section

Project Name: INTERCEPTOR SEWER SYSTEM, CCTV ASSESMENT FINAL 180 MILES
Date : 3/30/2005

S#	Interceptor	Start MH	Stop MH	MAT'L	Reach Length	Dia	Condition Rating	Priority	$'s / Ft	CIPP COST	CLEAN	CIP BUDGET NUMBER ($'s)	FAILURE DESCRIPTION
1	ONH	4707-38	4707-39	DIP	14	18"	4	1	$206	$2,964	50%	$4,447	LINING FAIL/PEEL
2	ONH	4707-38	4707-37	DIP	324	18'	4	1	$206	$66,699	50%	$100,048	LINING FAIL/PEEL
3	ONH	4707-36	4707-37	DIP	216	18"	4	1	$206	$44,507	50%	$66,760	LINING FAIL/PEEL
4	ONH	4707-35	4707-36	DIP	36	18"	4	1	$206	$7,432	50%	$11,147	LINING FAIL/PEEL
5	ONH	4707-35	4707-34	DIP	113	18"	4	1	$206	$23,242	50%	$34,862	LINING FAIL/PEEL
6	ONH	4707-34	4707-33	DIP	392	18"	4	1	$206	$80,635	50%	$120,953	LINING FAIL/PEEL
7	ONH	4707-32	4707-33	DIP	370	18"	4	1	$206	$76,209	50%	$114,314	LINING FAIL/PEEL
8	ONH	4707-32	4707-31	DIP	71	18'	4	1	$206	$14,616	50%	$21,924	LINING FAIL/PEEL
9	ONH	4707-30	4707-31	DIP	467	18"	4	1	$206	$96,095	50%	$144,143	LINING FAIL/PEEL
10	ONH	4707-30	4707-29	DIP	469	18"	4	1	$206	$96,548	50%	$144,822	LINING FAIL/PEEL
11	ONH	4707-29	4707-28	DIP	211	18"	4	1	$206	$43,436	50%	$65,155	LINING FAIL/PEEL
12	ONH	4707-28	4707-29 OVERL	DIP	404	18"	4	1	$206	$83,167	50%	$124,751	LINING FAIL/PEEL
13	ONH	4707-28	4707-27	DIP	628	18"	4	1	$206	$129,198	50%	$193,796	LINING FAIL/PEEL
14	ONH	4707-27	4707-26	DIP	627	18"	4	1	$206	$129,156	50%	$193,734	LINING FAIL/PEEL
15	ONH	4707-25	4707-26	DIP	627	18"	4	1	$206	$129,095	50%	$193,642	LINING FAIL/PEEL
16	ONH	4707-25	4707-24	DIP	608	18"	4	1	$206	$125,224	50%	$187,837	LINING FAIL/PEEL
17	ONH	4707-24	4707-23	DIP	638	18"	4	1	$206	$131,338	50%	$197,008	LINING FAIL/PEEL
18	ONH	4707-23	4707-22	DIP	508	18"	4	1	$206	$104,618	50%	$156,927	LINING FAIL/PEEL
19	ONH	4707-22	4707-21	DIP	516	18"	4	1	$206	$106,224	50%	$159,335	LINING FAIL/PEEL
20	ONH	4707-21	4707-20	DIP	516	18"	4	1	$206	$106,244	50%	$159,366	LINING FAIL/PEEL
21	ONH	4707-20	4707-19	DIP	634	18"	4	1	$206	$130,433	50%	$195,649	LINING FAIL/PEEL
22	ONH	4707-19	4707-18	DIP	619	18"	4	1	$206	$127,407	50%	$191,110	LINING FAIL/PEEL
23	ONH	4707-18	4707-17	DIP	623	18"	4	1	$206	$128,189	50%	$192,283	LINING FAIL/PEEL
24	ONH	4707-17	4707-16	DIP	630	18"	4	1	$206	$129,692	50%	$194,537	LINING FAIL/PEEL
25	ONH	4707-16	4707-15	DIP	617	18"	4	1	$206	$126,912	50%	$190,369	LINING FAIL/PEEL
26	ONH	4707-15	4707-14	DIP	365	18"	4	1	$206	$75,118	50%	$112,677	LINING FAIL/PEEL
27	ONH	4707-13	4707-14	DIP	489	18"	4	1	$206	$100,748	50%	$151,122	LINING FAIL/PEEL
28	ONH	4707-13	4707-12	DIP	375	18"	4	1	$206	$77,218	50%	$115,827	LINING FAIL/PEEL
29	ONH	4707-12	4707-11	DIP	372	18"	4	1	$206	$76,580	50%	$114,870	LINING FAIL/PEEL
30	ONH	4707-11	4707-10	DIP	614	18"	4	1	$206	$126,315	50%	$189,473	LINING FAIL/PEEL
31	ONH	4707-10	4707-09	DIP	614	18"	4	1	$206	$126,398	50%	$189,597	LINING FAIL/PEEL
32	ONH	4707-09	4707-08	DIP	153	18"	4	1	$206	$31,538	50%	$47,307	LINING FAIL/PEEL
33	ONH	4707-08	4707-07	DIP	262	18"	4	1	$206	$53,935	50%	$80,903	LINING FAIL/PEEL
34	ONH	4707-07	4707-06	DIP	613	18"	4	1	$206	$126,192	50%	$189,288	LINING FAIL/PEEL
35	ONH	4707-06	4707-05	DIP	615	18"	4	1	$206	$126,563	50%	$189,844	LINING FAIL/PEEL
36	ONH	4707-05	4707-04A	DIP	517	18"	4	1	$206	$106,388	50%	$159,582	LINING FAIL/PEEL
37	ONH	4707-04A	4707-04	DIP	410	18"	4	1	$206	$84,464	50%	$126,696	LINING FAIL/PEEL
38	ONH	4707-04	4707-03	DIP	247	18"	4	1	$206	$50,909	50%	$76,364	LINING FAIL/PEEL
39	ONH	4707-03	4707-02	DIP	516	18"	4	1	$206	$106,182	50%	$159,274	LINING FAIL/PEEL
40	ONH	4707-02	4707-01	DIP	63	18"	4	1	$206	$12,887	50%	$19,330	LINING FAIL/PEEL
49	ONH	8994-03	8994-04	DIP	307	18"	4	1	$206	$63,199	50%	$94,798	LINING FAIL/PEEL

CONDITION GRADE 4, PRIORITY 1 TOTAL	**17,410**	**feet**		**$5,375,870**
ENGINEERING AND ADMINISTRATION (15%)				**$ 806,381**
SUBTOTAL				**$6,182,251**
ONH INTERCEPTOR, CONDITION GRADE 4, TOTAL (NON-RCP)		**17,410**	**feet**	**$6,182,251**
ONH INTERCEPTOR, CONDITION GRADE 4, TOTAL (RCP)		**8,649**	**feet**	**$1,928,727**
ENGINEERING AND ADMINISTRATION (15%)				**$289,309**
				$2,218,036
ONH INTERCEPTOR, CONDITION GRADE 4, GRAND TOTAL				**$8,400,287**

CCTV EVALUATION, Pantano Interceptor (PTI) Reaches, Condition Grades 3 & 4 Total
Pima County Wastewater Management Department, Systems Design Section

Project Name: INTERCEPTOR SEWER SYSTEM, CCTV ASSESMENT FINAL 180 MILES (NON-RCP)
Date : 3/30/2005

S#	Interceptor	Start MH	Stop MH	MAT'L	Reach Length	Dia	Condition Rating	Priority	$'s / Ft	CIPP COST	CLEAN	NUMBER ($'s)	FAILURE DESCRIPTION
36	PTI	6592-02	6592-01	DIP	11	21"	4	2	$206	$2,285	50%	$3,428	BLISTER/DELAM
49	PTI	2741-03	2741-02	DIP	564	12"	4	2	$206	$116,125	50%	$174,188	LINING FAIL/PEEL
164	PTI	8964-22	8964-21	DIP	115	36"	4	2	$223	$25,730	50%	$38,596	BLISTER/DELAM
165	PTI	8964-21	8964-20	DIP	234	36"	4	2	$223	$52,085	50%	$78,128	BLISTER/DELAM
CONDITION GRADE 4, PRIORITY 2 TOTAL					**924**	**feet**						**$294,339**	

S#	Interceptor	Start MH	Stop MH	MAT'L	Reach Length	Dia	Condition Rating	Priority	$'s / Ft	CIPP COST	CLEAN	CIP BUDGET NUMBER	FAILURE DESCRIPTION
169	PTI	8964-17	8964-16	DIP	170	36"	4	3	$223	$37,949	50%	$56,923	BLISTER/DELAM

S#	Interceptor	Feet from Start	Start MH	Stop MH	Condition Grade	Priority	Affected Length	Reach Length	Dia	COMMENTS	REPAIR COST	MATERIAL
163	PTI	105	8964-22A	8964-22	4	3	172	277.4	36"	Blisters/Flakes	$40,000	DIP
CONDITION GRADE 4, PRIORITY 3 TOTAL							**342**	**feet**			**$96,923**	
CONDITION GRADE 4, TOTAL					**1,266**	**feet**					**$391,262**	
ENGINEERING AND ADMINISTRATION (15%)											**$ 58,689**	
TOTAL											**$449,951**	

S#	Interceptor	Feet from Start	Start MH	Stop MH	Condition Grade	Priority	Affected Length	Reach Length	Dia	COMMENTS	REPAIR COST	MATERIAL
35	PTI	514	6592-03	6592-02	3	1	79	592.7	21"	Blisters/Flakes	$31,000	DIP

S#	Interceptor	Start MH	Stop MH	MAT'L	Reach Length	Dia	Condition Rating	Priority	$'s / Ft	CIPP COST	CLEAN	CIP BUDGET NUMBER	FAILURE DESCRIPTION
52	PTI	2741-01	6036-37	DIP	55	18"	3	1	$206	$11,405	50%	$17,107	BLISTER
21	PTI-T1	8030-09	8030-08	DIP	63	16"	3	1	$206	$12,907	50%	$19,361	JOINT FAIL
CONDITION GRADE 3, PRIORITY 1 TOTAL					**197**	**feet**						**$67,468**	

S#	Interceptor	Feet from Start	Start MH	Stop MH	Condition Grade	Priority	Affected Length	Reach Length	Dia	COMMENTS	REPAIR COST	MATERIAL
29	PTI	263	6592-09	6592-08	3	2	119	382.3	21"	Blisters	$34,000	DIP

S#	Interceptor	Start MH	Stop MH	MAT'L	Reach Length	Dia	Condition Rating	Priority	$'s / Ft	CIPP COST	CLEAN	CIP BUDGET NUMBER	FAILURE DESCRIPTION
30	PTI	6592-08	6592-07	DIP	132	21"	3	2	$206	$27,153	50%	$40,729	BLISTER
31	PTI	6592-07	6592-06	DIP	377	21"	3	2	$206	$77,588	50%	$116,383	BLISTER
135	PTI	5364-03	5364-02	DIP	447	33"	3	2	$223	$99,555	50%	$149,332	JOINT FAIL
CONDITION GRADE 3, PRIORITY 2 TOTAL					**1,074**	**feet**						**$340,444**	
CONDITION GRADE 3, TOTAL					**1,271**	**feet**						**$407,912**	
ENGINEERING AND ADMINISTRATION (15%)												**$ 61,187**	
TOTAL												**$469,099**	
PTI, CONDITION GRADES 3 & 4, GRAND TOTAL								**2,538**	**feet**			**$919,050**	

CCTV EVALUATION, Santa Cruz Central (SCC) Reaches, Condition Grade 3 Total
Pima County Wastewater Management Department, Systems Design Section

Project Name: INTERCEPTOR SEWER SYSTEM, CCTV ASSESMENT FINAL 180 MILES
Date : 3/30/2005

S#	Interceptor	Start MH	Stop MH	MAT'L	Reach Length	Dia	Condition Rating	Priority	$'s / Ft	CIPP COST	CLEAN	CIP BUDGET NUMBER ($'s)	FAILURE DESCRIPTION
40	SCC	6677-04	6677-03	DIP	293	24"	3	2	$223	$65,329	50%	$97,994	BLISTER
41	SCC	6677-04	6677-03	DIP	293	24"	3	2	$223	$65,419	50%	$98,128	BLISTER
42	SCC	6677-04	6677-03	DIP	293	24"	3	2	$223	$65,262	50%	$97,894	BLISTER
CONDITION GRADE 3, PRIORITY 2 TOTAL					**879**	**feet**						**$294,015**	
CONDITION GRADE 3, TOTAL (NON-RCP)					**879**	**feet**						**$294,015**	
ENGINEERING AND ADMINISTRATION (15%)												**$44,102**	
NON-RCP SUBTOTAL												**$338,118**	
CONDITION GRADE 3, TOTAL (RCP)					**1,108**	**feet**						**$250,000**	
ENGINEERING AND ADMINISTRATION (15%)												**$37,500**	
RCP SUBTOTAL												**$287,500**	

CCTV EVALUATION, Santa Cruz Interceptor (SCI) Reaches, Condition Grade 4 Total
Pima County Wastewater Management Department, Systems Design Section

Project Name: INTERCEPTOR SEWER SYSTEM, CCTV ASSESMENT FINAL 180 MILES (NON-RCP)
Date : 3/30/2005

S#	Interceptor	Feet from Start	Start MH	Stop MH	Condition Grade	Priority	Affected Length	Reach Length	Dia	COMMENTS	REPAIR COST	MATERIAL
14	SCI-B	156.7	4366-60	4366-59B	4	2	21	203.5	21"	Bubbles	$28,000	DIP
16	SCI-B	93.2	4366-59	4366-59A	4	2	70	361.9	21"	Bubbles	$32,000	DIP
CONDITION GRADE 4, PRIORITY 2 TOTAL							**91**	**feet**			**$60,000**	

S#	Interceptor	Feet from Start	Start MH	Stop MH	Condition Grade	Priority	Affected Length	Reach Length	Dia	COMMENTS	REPAIR COST	MATERIAL
5	SCI-B	83.9	8893-61	9912-36	4	3	38	153.5	18"	Badly Corroded	$30,000	DIP

S#	Interceptor	Start MH	Stop MH	MAT'L	Reach Length	Dia	Condition Rating	Priority	$'s / Ft	CIPP COST	CLEAN	CIP BUDGET NUMBER ($'s)	FAILURE DESCRIPTION
49	SCI	4360-06	4360-05	DIP	368	20"	4	3	$206	$75,798	50%	$113,696	LINING FAIL/CORROSION
99	SCI	9918-12A	4366-70	DIP	10	30"	4	3	$223	$2,207	50%	$3,311	LINING FAIL/CORROSION
100	SCI	4366-70	4366-69	DIP	67	30"	4	3	$223	$14,872	50%	$22,308	LINING FAIL/CORROSION
101	SCI	4366-69	4366-68	DIP	202	30"	4	3	$223	$45,106	50%	$67,659	LINING FAIL/CORROSION
102	SCI	4366-68	4366-67	DIP	118	30"	4	3	$223	$26,310	50%	$39,465	LINING FAIL/CORROSION
103	SCI	4366-67	4366-66	DIP	63	30"	4	3	$223	$13,958	50%	$20,937	LINING FAIL/CORROSION
104	SCI	4366-66	4366-65	DIP	70	30"	4	3	$223	$15,585	50%	$23,378	LINING FAIL/CORROSION
121	SCI	4360-11	4360-10	DIP	305	20"	4	3	$206	$62,684	50%	$94,026	LINING FAIL/CORROSION
CONDITION GRADE 4, PRIORITY 3 TOTAL					**1,240**	**feet**						**$414,781**	
CONDITION GRADE 4, TOTAL					**1,331**	**feet**						**$474,781**	
ENGINEERING AND ADMINISTRATION (15%)												**$71,217**	
TOTAL												**$545,998**	
SCI CONDITION GRADE 4, GRAND TOTAL								**1,331**	**feet**			**$545,998**	

CCTV EVALUATION, Southeast Interceptor (SEI) Reaches, Condition Grades 3 & 4 Total
Pima County Wastewater Management Department, Systems Design Section

Project Name: INTERCEPTOR SEWER SYSTEM, CCTV ASSESMENT FINAL 180 MILES
Date : 3/30/2005

S#	Interceptor	Feet from Start	Start MH	Stop MH	Condition Grade	Priority	Affected Length	Reach Length	Dia	COMMENTS	REPAIR COST	MATERIAL
46	SEI-DWNTWN	95.5	5662-10	5662-09	4	1	110	110	15"	Bubbled/Blocked	$45,000	DIP
10	SEI-C	221.3	9917-28	9917-27	4	1		857	30"	Pipe Failure, Broken from 08 to 10 o´clock	$38,000	VCP
25	SEI-DWNTWN	572.3	5654-10	5654-09	4	1		608	15"	Fracture, Longitudinal at 11 o´clock	$27,000	VCP
17	SEI-DWNTWN	278.8	5654-18	5654-17	4	1		501	12"	Pipe Failure, Hole from 11 to 12 o´clock	$37,000	VCP
CONDITION GRADE 4, PRIORITY 1 TOTAL								**2,075**	**feet**		**$147,000**	

S#	Interceptor	Start MH	Stop MH	MAT'L	Reach Length	Dia	Condition Rating	Priority	$'s / Ft	CIPP COST	CLEAN	CIP BUDGET NUMBER ($'s)	FAILURE DESCRIPTION
34	SEI-B	8033-24	8033-23	DIP	120	30"	4	3	$223	$26,734	50%	$40,101	BLISTER/FLAKES
35	SEI-B	8033-23	8033-22	DIP	162	30"	4	3	$223	$36,188	50%	$54,281	BLISTER/FLAKES
80	SEI-B	8130-19	8130-18	DIP	850	36"	4	3	$223	$189,433	50%	$284,149	BLISTER/FLAKES
30	SEI-DWNTWN	8130-22B	8130-22A	DIP	94	16"	4	3	$206	$19,248	50%	$28,872	BLISTER/FLAKES
31	SEI-DWNTWN	8130-22A	8130-22	DIP	22	16"	4	3	$206	$4,447	50%	$6,670	BLISTER/FLAKES
65	SEI-RITA R	4190-11C	4190-10C	DIP	417	18"	4	3	$206	$85,802	50%	$128,703	BLISTER/FLAKES
75	SEI-RITA R	4190-01C	4190-22	DIP	204	18"	4	3	$206	$41,934	50%	$62,900	BLISTER/FLAKES
84	SEI-RITA R	4190-13	4190-14	DIP	132	24"	4	3	$223	$29,365	50%	$44,047	LINING FAILURE @ FL
CONDITION GRADE 4, PRIORITY 3 TOTAL					**1,999**	**feet**						**$649,724**	
CONDITION GRADE 4, TOTAL (NON-RCP)					**4,074**	**feet**						**$796,724**	
ENGINEERING AND ADMINISTRATION (15%)												**$119,509**	
NON-RCP SUBTOTAL												**$916,232**	
CONDITION GRADE 4, TOTAL (RCP)					**2,111**	**feet**						**$470,753**	
ENGINEERING AND ADMINISTRATION (15%)												**$70,613**	
RCP SUBTOTAL												**$541,366**	

S#	Interceptor	Feet from Start	Start MH	Stop MH	Condition Grade	Priority	Affected Length	Reach Length	Dia	COMMENTS	REPAIR COST	MATERIAL
61	SEI-DWNTWN	129.2	5667-11	5667-10A	3	2	22	231	15"	Slight Corrosion	$33,000	DIP

S#	Interceptor	Start MH	Stop MH	MAT'L	Reach Length	Dia	Condition Rating	Priority	$'s / Ft	CIPP COST	CLEAN	CIP BUDGET NUMBER ($'s)	FAILURE DESCRIPTION
1	SEI-RITA R	4636-34A	4636-35A	DIP	159	18"	3	2	$206	$32,649	50%	$48,974	JOINT FAILURES
2	SEI-RITA R	4636-34A	4636-33A	DIP	240	18"	3	2	$206	$49,489	50%	$74,233	JOINT FAILURES
3	SEI-RITA R	4636-33A	4636-32A	DIP	169	18"	3	2	$206	$34,729	50%	$52,093	JOINT FAILURES
4	SEI-RITA R	4636-32A	4636-31A	DIP	167	18"	3	2	$206	$34,358	50%	$51,537	JOINT FAILURES
5	SEI-RITA R	4636-31A	4636-30A	DIP	356	18"	3	2	$206	$73,245	50%	$109,867	JOINT FAILURES
6	SEI-RITA R	4636-30A	4636-29A	DIP	349	18"	3	2	$206	$71,907	50%	$107,860	JOINT FAILURES
7	SEI-RITA R	4636-28A	4636-29A	DIP	609	18"	3	2	$206	$125,410	50%	$188,115	JOINT FAILURES
8	SEI-RITA R	4636-27A	4636-28A	DIP	494	18"	3	2	$206	$101,695	50%	$152,542	JOINT FAILURES
9	SEI-RITA R	4636-27A	4636-26A	DIP	327	18"	3	2	$206	$67,234	50%	$100,851	JOINT FAILURES
10	SEI-RITA R	4636-26A	4636-25A	DIP	328	18"	3	2	$206	$67,584	50%	$101,376	JOINT FAILURES
11	SEI-RITA R	4636-25A	4636-23A	DIP	607	18"	3	2	$206	$124,916	50%	$187,373	JOINT FAILURES
12	SEI-RITA R	4636-22A	4636-23A	DIP	355	18"	3	2	$206	$73,121	50%	$109,682	JOINT FAILURES
13	SEI-RITA R	6761-01	4636-22A	DIP	531	18"	3	2	$206	$109,291	50%	$163,936	JOINT FAILURES
14	SEI-RITA R	4636-21A	6761-01	DIP	76	18"	3	2	$206	$15,542	50%	$23,314	JOINT FAILURES
15	SEI-RITA R	4636-21A	4636-24A	DIP	236	18"	3	2	$206	$48,521	50%	$72,782	JOINT FAILURES
16	SEI-RITA R	4636-24A	4636-20A	DIP	370	18"	3	2	$206	$76,086	50%	$114,129	JOINT FAILURES
17	SEI-RITA R	4636-20A	4636-19A	DIP	607	18"	3	2	$206	$124,854	50%	$187,281	JOINT FAILURES
18	SEI-RITA R	4636-18A	4636-19A	DIP	553	18"	3	2	$206	$113,779	50%	$170,668	JOINT FAILURES
19	SEI-RITA R	4636-17A	4636-18A	DIP	458	18"	3	2	$206	$94,181	50%	$141,271	JOINT FAILURES
20	SEI-RITA R	4636-17A	4636-16A	DIP	600	18"	3	2	$206	$123,413	50%	$185,119	JOINT FAILURES
21	SEI-RITA R	4636-16A	4636-15A	DIP	313	18"	3	2	$206	$64,516	50%	$96,775	JOINT FAILURES
22	SEI-RITA R	4636-15A	4636-14A	DIP	615	18"	3	2	$206	$126,521	50%	$189,782	JOINT FAILURES
23	SEI-RITA R	4636-14A	4636-13A	DIP	308	18"	3	2	$206	$63,302	50%	$94,953	JOINT FAILURES
24	SEI-RITA R	4636-13A	4636-12A	DIP	612	18"	3	2	$206	$125,924	50%	$188,887	JOINT FAILURES
25	SEI-RITA R	4636-11A	4636-12A	DIP	614	18"	3	2	$206	$126,377	50%	$189,566	JOINT FAILURES
26	SEI-RITA R	4636-11A	4636-10A	DIP	616	18"	3	2	$206	$126,748	50%	$190,122	JOINT FAILURES
27	SEI-RITA R	4636-10A	4636-09A	DIP	615	18"	3	2	$206	$126,542	50%	$189,813	JOINT FAILURES
28	SEI-RITA R	4636-09A	4636-08A	DIP	326	18"	3	2	$206	$67,110	50%	$100,665	JOINT FAILURES
29	SEI-RITA R	4636-08A	4636-07A	DIP	326	18"	3	2	$206	$67,131	50%	$100,696	JOINT FAILURES
30	SEI-RITA R	4636-07A	4190-06A	DIP	109	18"	3	2	$206	$22,500	50%	$33,751	JOINT FAILURES
31	SEI-RITA R	4190-06A	4190-05A	DIP	114	18"	3	2	$206	$23,447	50%	$35,171	JOINT FAILURES
32	SEI-RITA R	4636-17B	4636-16B	DIP	613	18"	3	2	$206	$126,192	50%	$189,288	JOINT FAILURES
33	SEI-RITA R	4636-15B	4636-16B	DIP	614	18"	3	2	$206	$126,315	50%	$189,473	JOINT FAILURES
34	SEI-RITA R	4979-01	4636-15B	DIP	72	18"	3	2	$206	$14,842	50%	$22,264	JOINT FAILURES
35	SEI-RITA R	4979-01	4636-14B	DIP	542	18"	3	2	$206	$111,617	50%	$167,426	JOINT FAILURES
36	SEI-RITA R	4636-14B	4636-13B	DIP	612	18"	3	2	$206	$125,966	50%	$188,948	JOINT FAILURES
37	SEI-RITA R	4636-12B	4636-13B	DIP	388	18"	3	2	$206	$79,935	50%	$119,903	JOINT FAILURES
38	SEI-RITA R	4190-11B	4636-12B	DIP	330	18"	3	2	$206	$68,016	50%	$102,024	JOINT FAILURES
39	SEI-RITA R	4190-10B	4190-11B	DIP	86	18"	3	2	$206	$17,704	50%	$26,556	JOINT FAILURES
40	SEI-RITA R	4190-10B	4190-09B	DIP	394	18"	3	2	$206	$81,150	50%	$121,725	JOINT FAILURES
41	SEI-RITA R	4190-09B	4190-08B	DIP	424	18"	3	2	$206	$87,346	50%	$131,019	JOINT FAILURES
42	SEI-RITA R	4190-08B	4190-07B	DIP	463	18"	3	2	$206	$95,251	50%	$142,877	JOINT FAILURES
43	SEI-RITA R	4190-07B	4190-06B	DIP	387	18"	3	2	$206	$79,668	50%	$119,502	JOINT FAILURES
44	SEI-RITA R	4190-05B	4190-06B	DIP	379	18"	3	2	$206	$78,000	50%	$117,000	JOINT FAILURES
45	SEI-RITA R	4190-04B	4190-05B	DIP	381	18"	3	2	$206	$78,350	50%	$117,525	JOINT FAILURES
46	SEI-RITA R	4190-03B	4190-04B	DIP	496	18"	3	2	$206	$102,024	50%	$153,036	JOINT FAILURES
47	SEI-RITA R	4190-03B	4190-02B	DIP	271	18"	3	2	$206	$55,850	50%	$83,775	JOINT FAILURES
48	SEI-RITA R	4190-02B	4190-01B	DIP	360	18"	3	2	$206	$74,048	50%	$111,072	JOINT FAILURES
49	SEI-RITA R	4190-01B	4190-05A	DIP	520	18"	3	2	$206	$107,026	50%	$160,540	JOINT FAILURES
50	SEI-RITA R	4190-05A	4190-04A	DIP	452	24"	3	2	$223	$100,670	50%	$151,004	JOINT FAILURES
51	SEI-RITA R	4190-04A	4190-03A	DIP	512	24"	3	2	$223	$114,137	50%	$171,205	JOINT FAILURES
52	SEI-RITA R	4190-02A	4190-03A	DIP	504	24"	3	2	$223	$112,398	50%	$168,597	JOINT FAILURES
53	SEI-RITA R	4190-02A	4190-01A	DIP	505	24"	3	2	$223	$112,688	50%	$169,031	JOINT FAILURES
54	SEI-RITA R	4190-01A	4190-13	DIP	502	24"	3	2	$223	$111,818	50%	$167,727	JOINT FAILURES
61	SEI-B	8130-39	8130-38	DIP	595	36"	3	2	$223	$132,732	50%	$199,098	JOINT FAILURES
CONDITION GRADE 3, PRIORITY 2 TOTAL					**22,578**	**feet**						**$7,076,796**	
CONDITION GRADE 3, TOTAL (NON-RCP)					**22,578**	**feet**						**$7,076,796**	
ENGINEERING AND ADMINISTRATION (15%)												**$1,061,519**	
TOTAL												**$8,138,315**	
SEI, CONDITION GRADES 3 & 4, GRAND TOTAL								**26,652**	**feet**			**$9,595,913**	

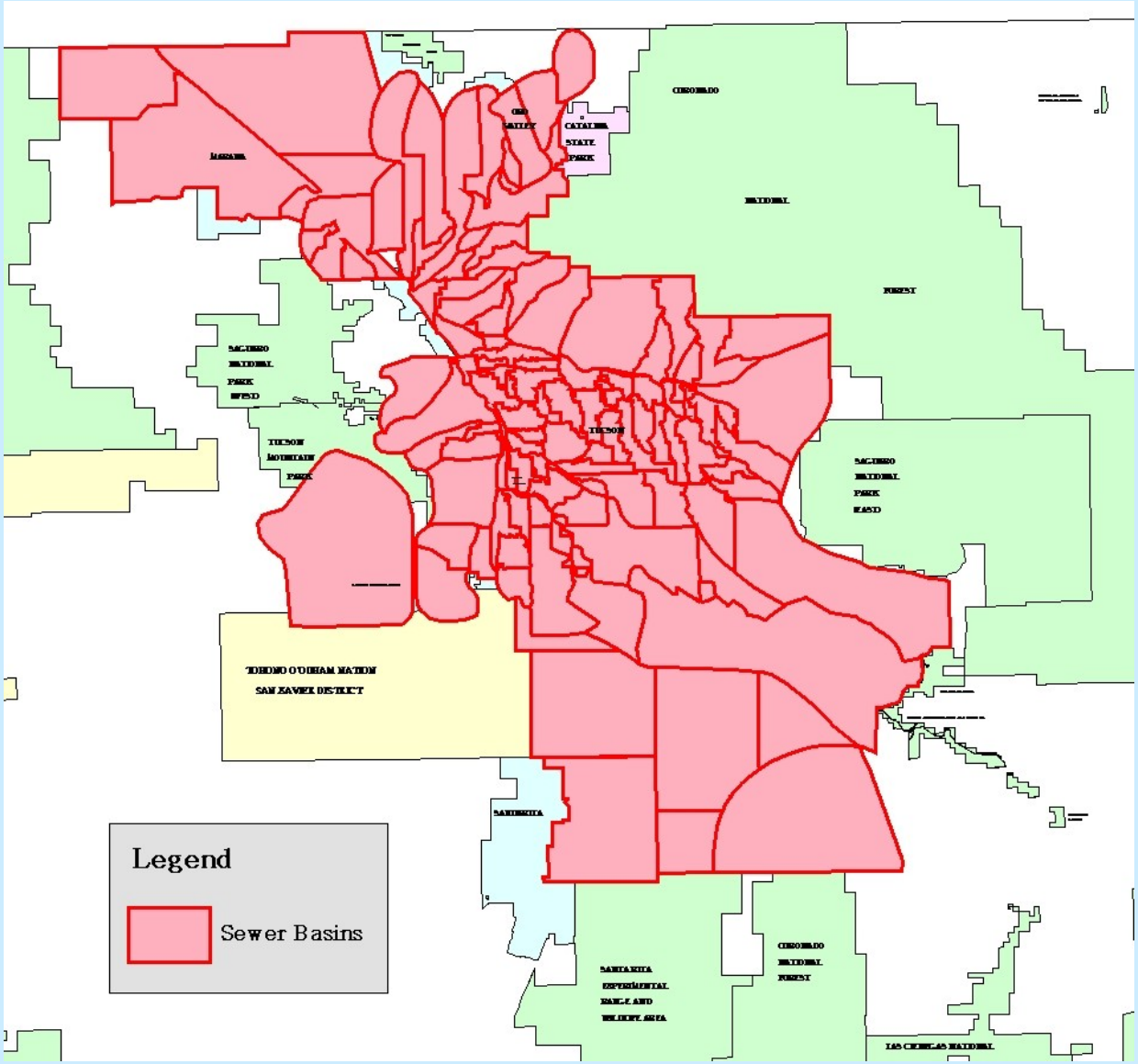
CCTV EVALUATION, South Rillito Roger Road (SRRR) Interceptor Reaches, Condition Grade 4 Total
Pima County Wastewater Management Department, Systems Design Section

Project Name: INTERCEPTOR SEWER SYSTEM, CCTV ASSESMENT FINAL 180 MILES
Date : 3/30/2005

S#	Interceptor	Start MH	Stop MH	MAT'L	Reach Length	Dia	Condition Rating	Priority	$'s / Ft	CIPP COST	CLEAN	CIP BUDGET NUMBER ($'s)	FAILURE DESCRIPTION
22	SRRR	6804-02	6804-02A	DIP	59	24"	4	3	$223	$13,066	50%	$19,599	BUBBLED
CONDITION GRADE 4, PRIORITY 3 TOTAL					**59**	**feet**						**$19,599**	
CONDITION GRADE 4, TOTAL					**59**	**feet**						**$19,599**	
ENGINEERING AND ADMINISTRATION (15%)												**$2,940**	
TOTAL												**$22,539**	
SRRR INTERCEPTOR, CONDITION GRADE 4, GRAND TOTAL									**59**	**feet**		**$22,539**	

Pima County Sewer Facility Plan Conveyance Model Pilot Project

- **Create sewer basins**
- Obtain projected population numbers
- Transfer population numbers to sewer basins using area proportion method
- Multiply population numbers by 85 gallons per day per person to obtain total sewer flow for each basin
- Identify specific manholes used in connecting basins
- Connect manholes based upon flow logic provided by Wastewater Management
- Transfer population and flow numbers from basin polygons to sewer arcs using the Arc command Identity
- QC data layer to ensure arcs flow in the proper direction and that population and flow numbers are not duplicated
- Calculate sewer capacities at manholes with data provided by Wastewater Management
- Run sewer model



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Projected population data was obtained from Pima Association of Governments, in the ArcInfo format as census tracts.

The following population totals are based upon that portion of Pima County which is contained within the sewer basins.

Total population for year 2005	804,110
Total population for year 2010	863,397
Total population for year 2015	938,384
Total population for year 2020	1,009,308
Total population for year 2025	1,080,716
Total population for year 2030	1,145,292

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Area proportion is a popular GIS tool which allows for recalculation of numbers after the original boundaries have been altered.

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85 gallons per person per day is the average volume of liquid waste produced per capita.

The following basin flow totals are based upon the previous population projections.

Total population for year 2005	804,110	x 85	68,349,350 gpd
Total population for year 2010	863,397	x 85	73,388,745 gpd
Total population for year 2015	938,384	x 85	79,762,640 gpd
Total population for year 2020	1,009,308	x 85	85,791,180 gpd
Total population for year 2025	1,080,716	x 85	91,860,860 gpd
Total population for year 2030	1,145,292	x 85	97,349,820 gpd

Pima County Sewer Facility Plan Conveyance Model Pilot Project

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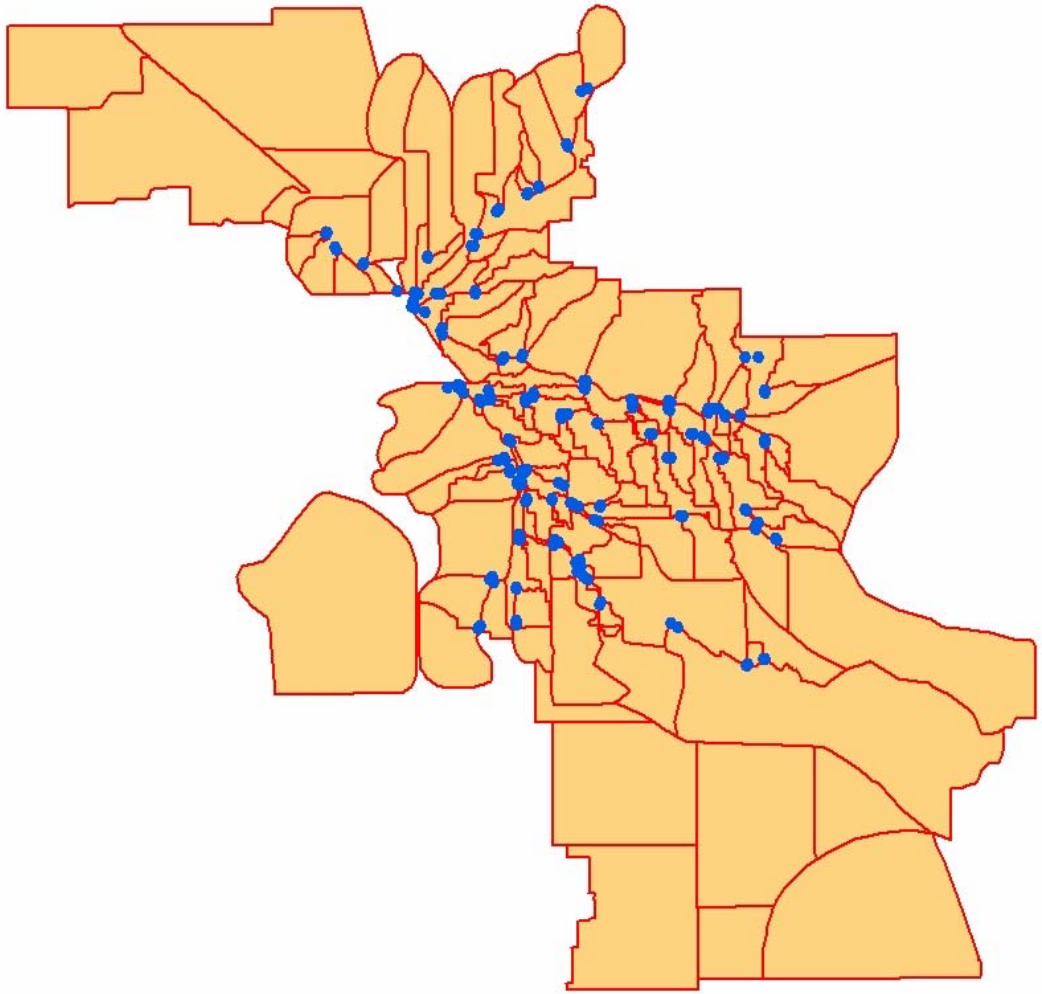

Pima County Sewer Facility Plan Conveyance Model Pilot Project

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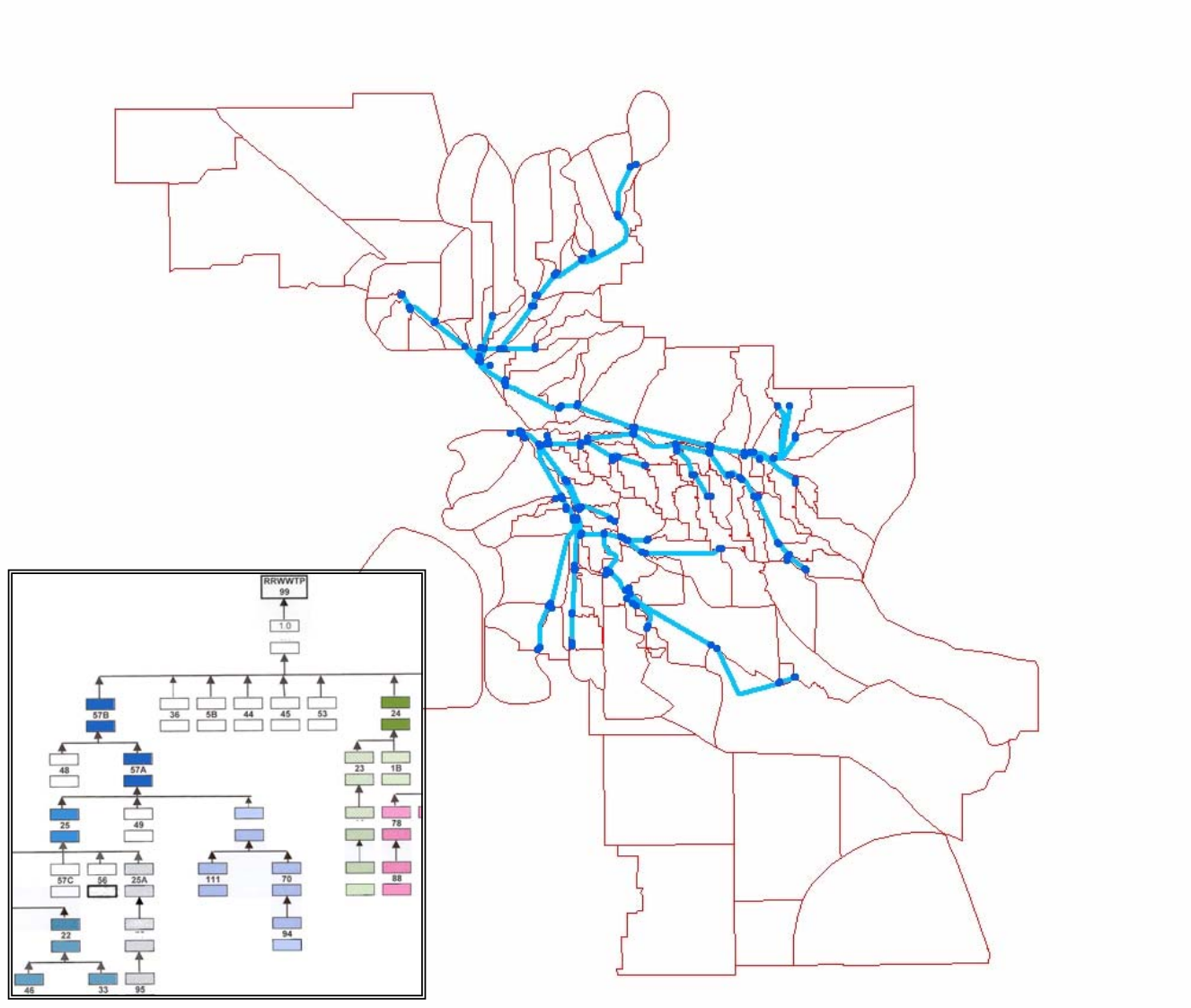

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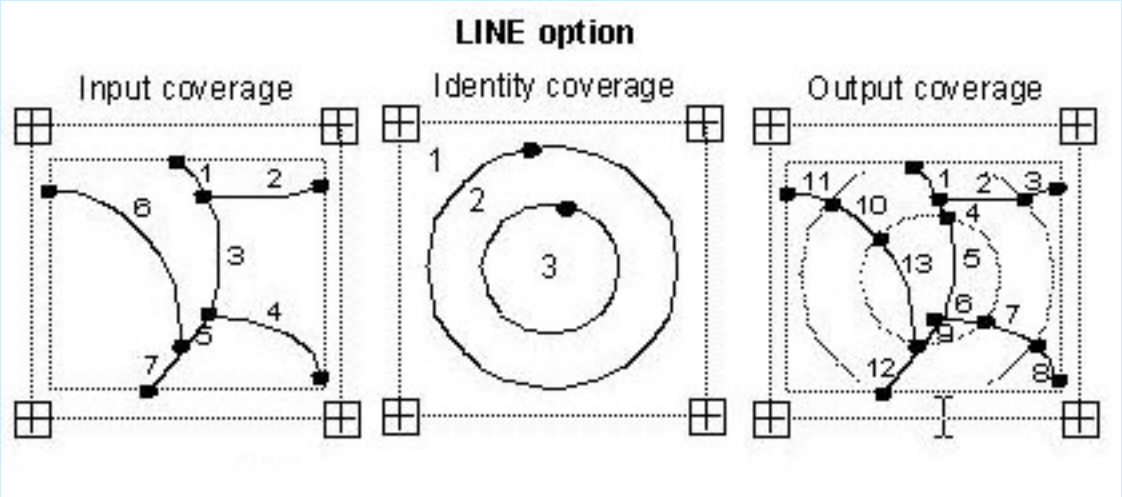
ArcInfo description of IDENTITY command:

Computes the geometric intersection of two data layers.
All features of the input data layer, as well as those features of the identity data layer that overlap the input data layer, are preserved in the output data layer.



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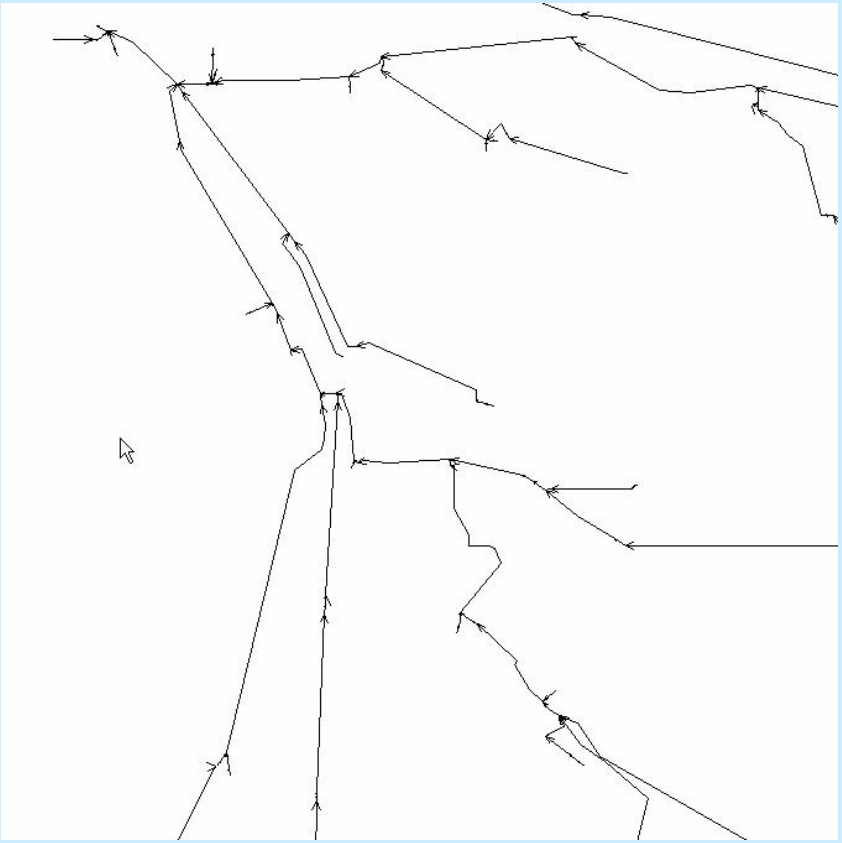
Quality Control issues that need to be analyzed are:

1. Proper direction for each arc representing sewer flow.
2. Duplicate population and flow values resulting from an arc being split by the basins during the identity process.



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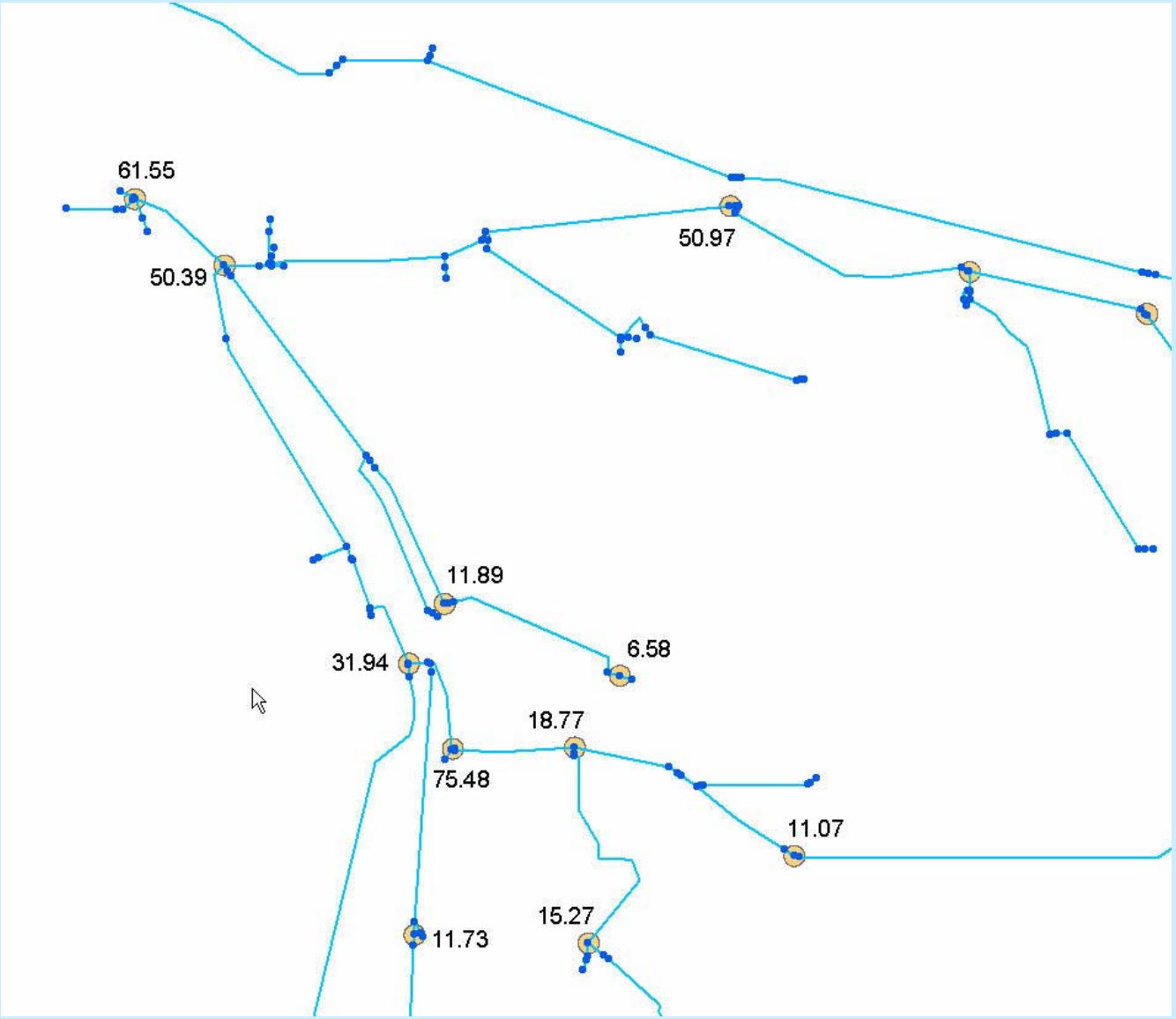

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- Identify specific manholes used in connecting basins
- Connect manholes based upon flow logic provided by Wastewater Management
- Transfer population and flow numbers from basin polygons to sewer arcs using the Arc command Identity
- QC data layer to ensure arcs flow in the proper direction and that population and flow numbers are not duplicated
- Calculate sewer capacities at manholes with data provided by Wastewater Management
- **Run sewer model**

The following slides will demonstrate the actual Sewer Model in use.

Sewer Model: zoom in to detail

```
Arc: &r trace

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ARCPLOT 8.2 (Thu Mar 14 16:26:27 PST 2002)

(thread0001, trace.aml)

  5:  shadeset cal999.shd
  6:  lineset plotter8.lin
  8:  mape wwm_model3
  9:  linesymbol 7
 10:  polygonshades targets 100
 11:  arcs wwm_model3
 12:  nodes wwm_model3
 13:  mape *
Define the box
 14:  clear
 15:  polygonshades targets 100
 16:  arcs wwm_model3
 17:  nodes wwm_model3
 18:  reselect wwm_model3 nodes box *
Define the box
WWM_MODEL3 nodes : 1 of 297 selected.
 19:  list wwm_model3 node capacity
Record        capacity
  81          61.55 MGD

 20:  asel wwm_model3 nodes
WWM_MODEL3 nodes : 297 of 297 selected.
 21:  &pause
Hit <return> to continue:
 22:  trace upstream wwm_model3 trace2 # *
Enter point
wwm_model3 nodes : 189 of 297 traced.
wwm_model3 arcs : 188 of 295 traced.
 23:  &type ENTER 9 TO QUIT
ENTER 9 TO QUIT
 24:  mape wwm_model3
 25:  clear
 26:  polygonshades targets 100
```

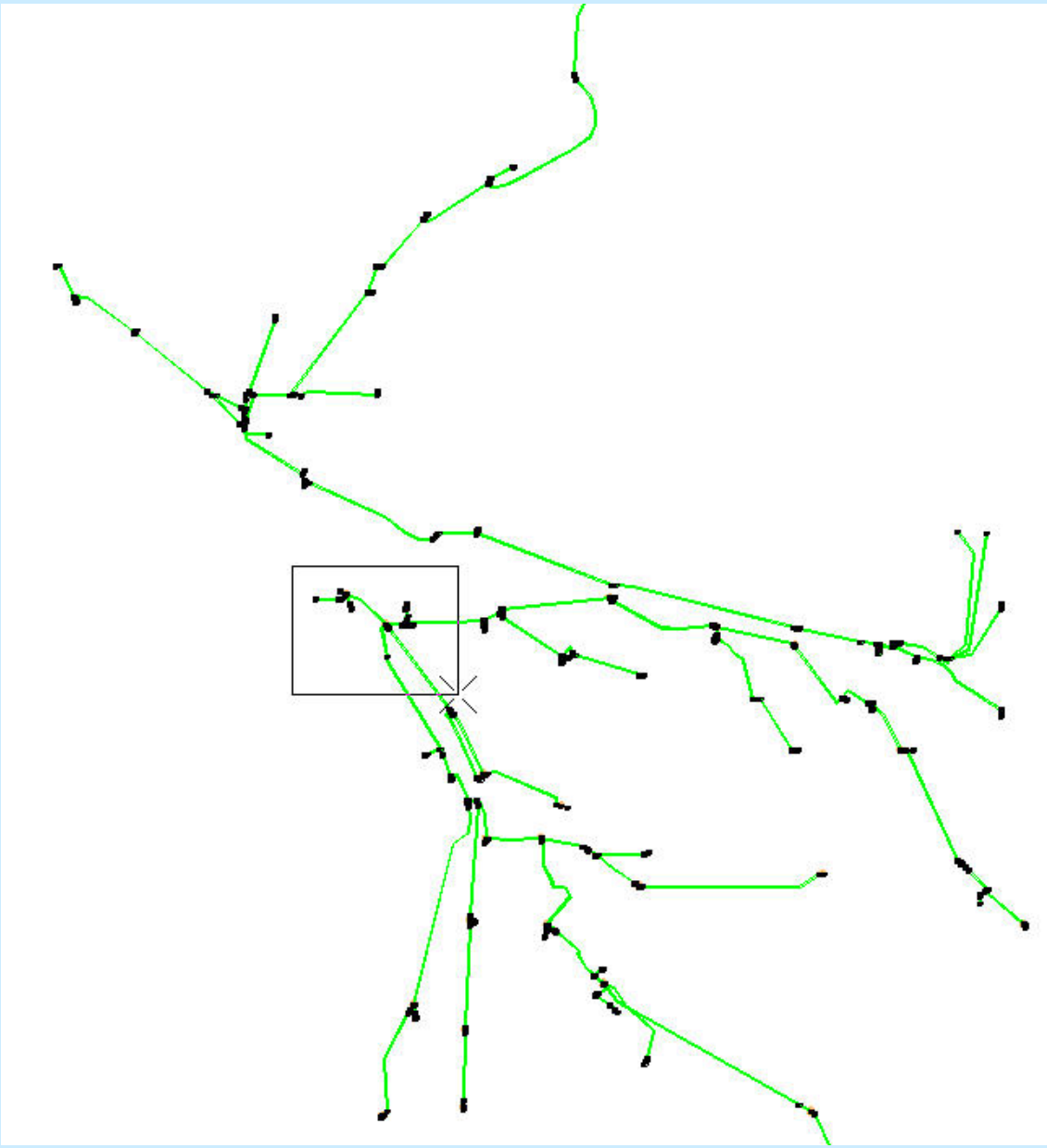

Sewer Model: select target manhole for baseline capacity

```
Arc: &r trace

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ARCPLOT 8.2 (Thu Mar 14 16:26:27 PST 2002)

(thread0001, trace.aml)

  5:  shadeset cal999.shd
  6:  lineset plotter8.lin
  8:  mape wwm_model3
  9:  linesymbol 7
 10:  polygonshades targets 100
 11:  arcs wwm_model3
 12:  nodes wwm_model3
 13:  mape *
Define the box
 14:  clear
 15:  polygonshades targets 100
 16:  arcs wwm_model3
 17:  nodes wwm_model3
 18:  reselect wwm_model3 nodes box *
Define the box
WWM_MODEL3 nodes : 1 of 297 selected.
 19:  list wwm_model3 node capacity
Record        capacity
  81          50.39 MGD

 20:  asel wwm_model3 nodes
WWM_MODEL3 nodes : 297 of 297 selected.
 21:  &pause
Hit <return> to continue:
 22:  trace upstream wwm_model3 trace2 # *
Enter point
wwm_model3 nodes : 189 of 297 traced.
wwm_model3 arcs : 188 of 295 traced.
 23:  &type ENTER 9 TO QUIT
ENTER 9 TO QUIT
 24:  mape wwm_model3
 25:  clear
 26:  polygonshades targets 100
```

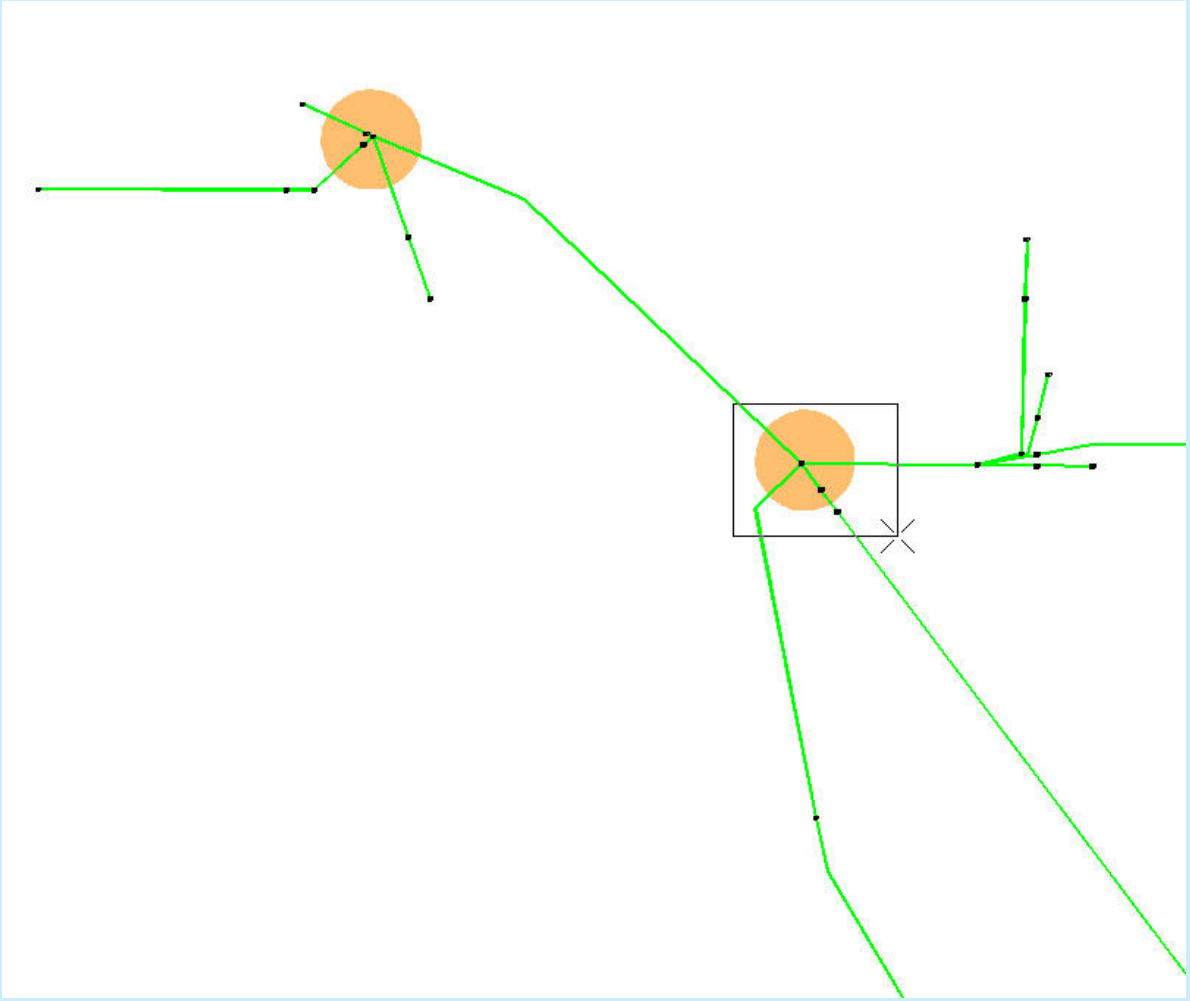

Sewer Model: initiate upstream network trace

```
Arc: &r trace

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ARCPLOT 8.2 (Thu Mar 14 16:26:27 PST 2002)

(thread0001, trace.aml)

  5:  shadeset cal999.shd
  6:  lineset plotter8.lin
  8:  mape wwm_model3
  9:  linesymbol 7
 10:  polygonshades targets 100
 11:  arcs wwm_model3
 12:  nodes wwm_model3
 13:  mape *
Define the box
 14:  clear
 15:  polygonshades targets 100
 16:  arcs wwm_model3
 17:  nodes wwm_model3
 18:  reselect wwm_model3 nodes box *
Define the box
WWM_MODEL3 nodes : 1 of 297 selected.
 19:  list wwm_model3 node capacity
Record        capacity
  81          50.39 MGD

 20:  asel wwm_model3 nodes
WWM_MODEL3 nodes : 297 of 297 selected.
 21:  &pause
Hit <return> to continue:
 22:  trace upstream wwm_model3 trace2 # *
Enter point
wwm_model3 nodes : 189 of 297 traced.
wwm_model3 arcs : 188 of 295 traced.
 23:  &type ENTER 9 TO QUIT
ENTER 9 TO QUIT
 24:  mape wwm_model3
 25:  clear
 26:  polygonshades targets 100
```
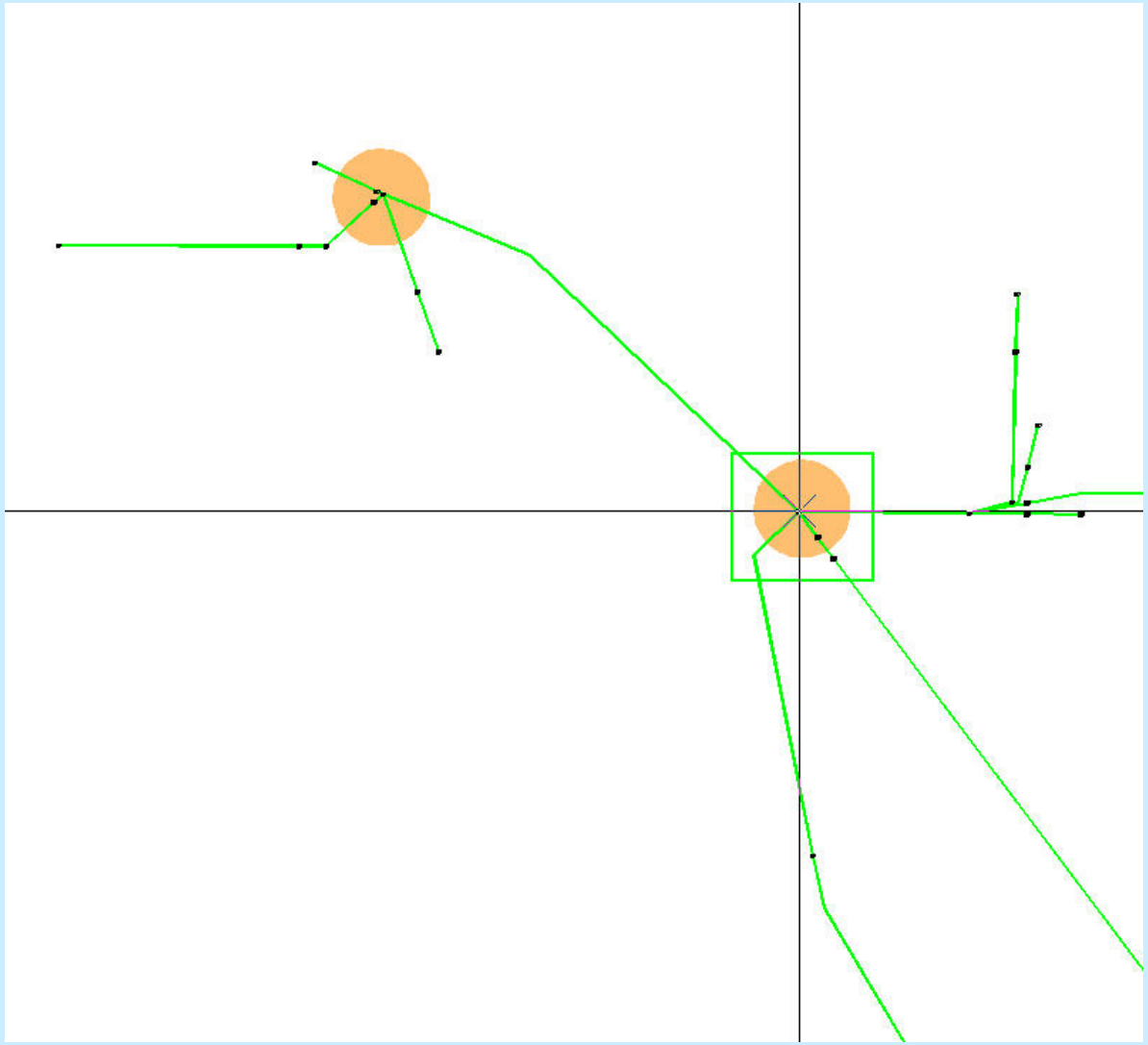
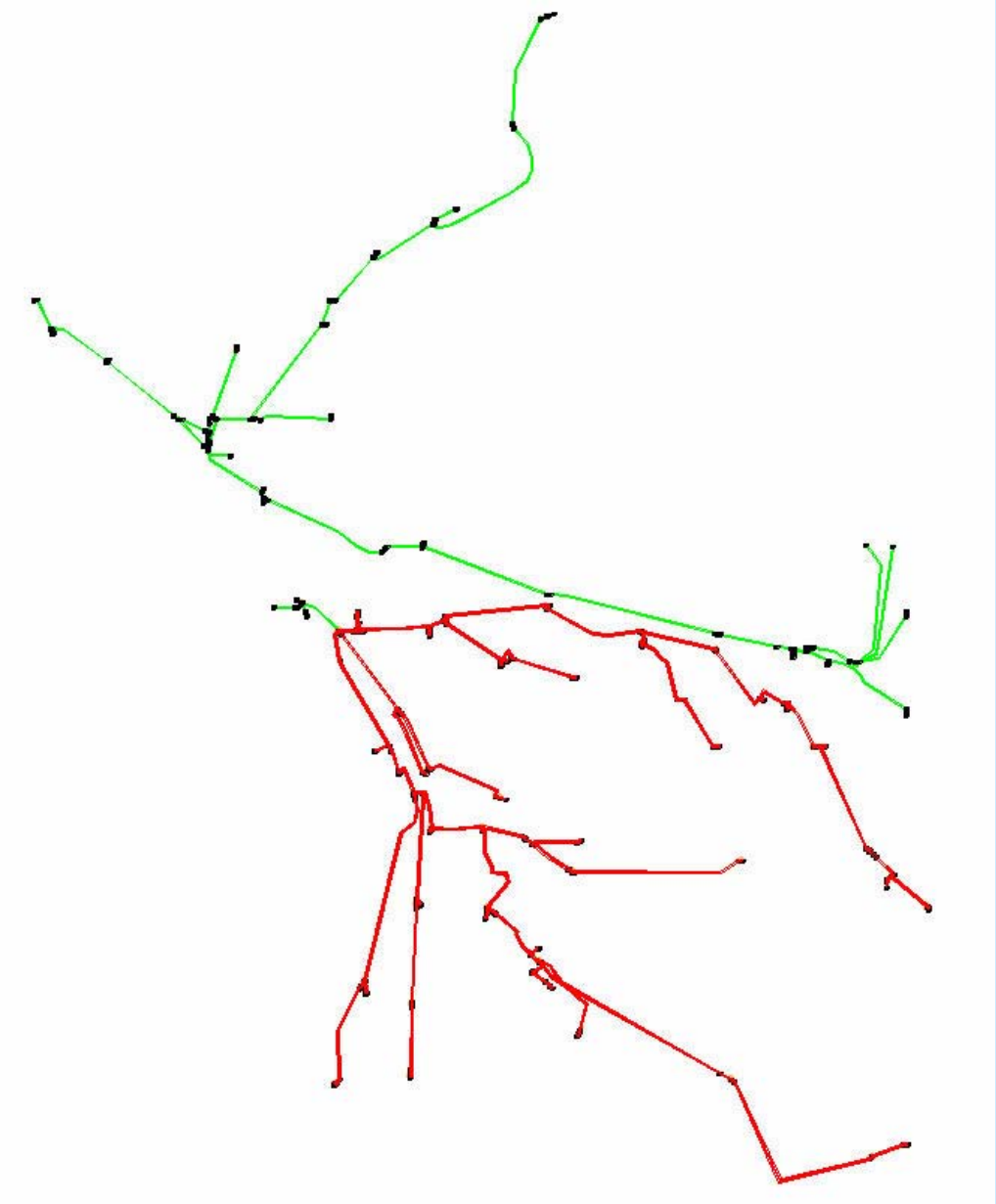



Sewer Model: display traced upstream sewer network

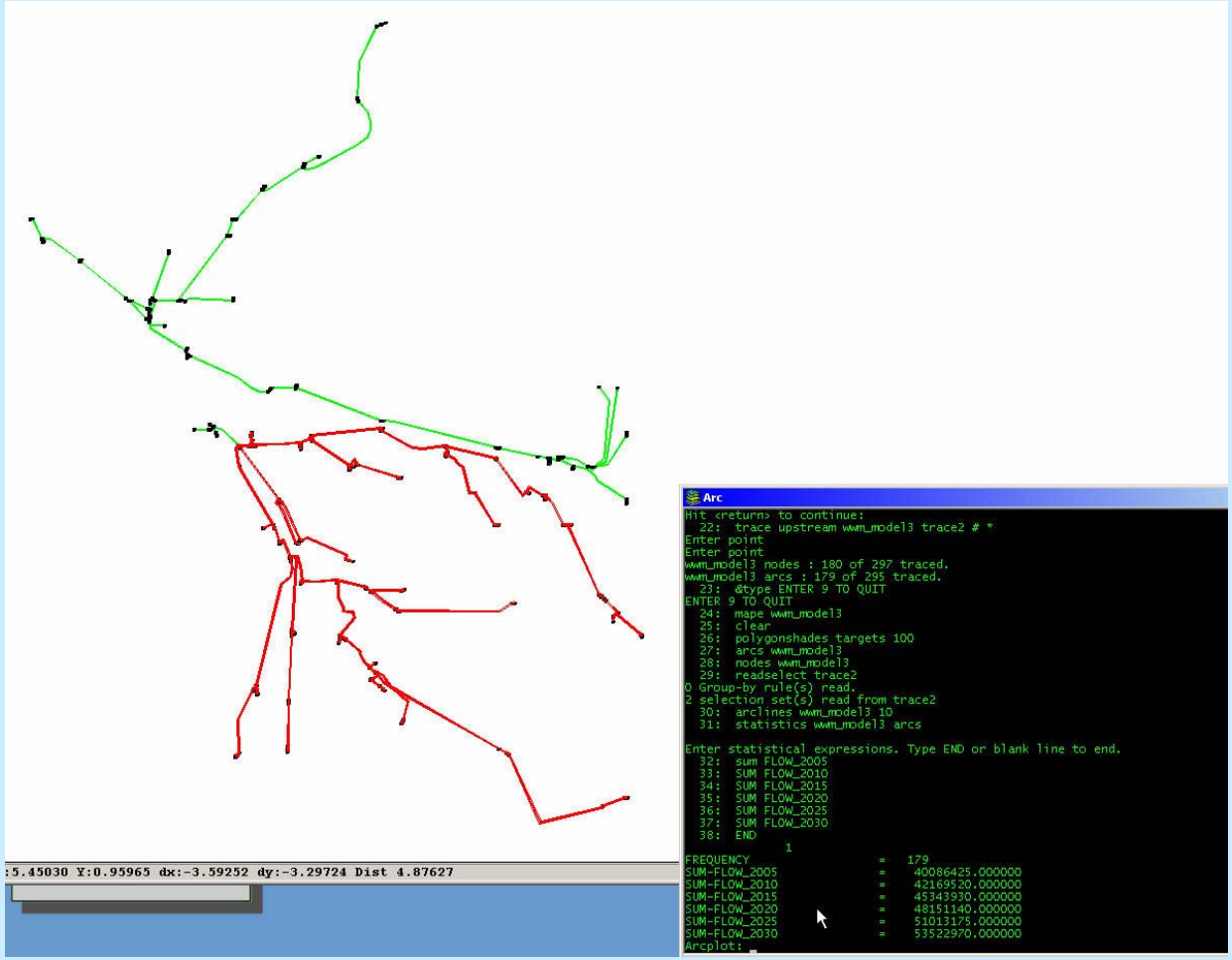
```
20: asel wwm_model3 nodes
WWM_MODEL3 nodes : 297 of 297 selected.
21: &pause
Hit <return> to continue:
22: trace upstream wwm_model3 trace2 # *
Enter point
wwm_model3 nodes : 189 of 297 traced.
wwm_model3 arcs : 188 of 295 traced.
23: &type ENTER 9 TO QUIT
ENTER 9 TO QUIT
24: mape wwm_model3
25: clear
26: polygonshades targets 100
27: arcs wwm_model3
28: nodes wwm_model3
29: readselect trace2
30: arclines wwm_model3 10
31: statistics wwm_model3 arcs

Enter statistical expressions. Type END or
blank line to end.
32: SUM FLOW_2005
33: SUM FLOW_2010
34: SUM FLOW_2015
35: SUM FLOW_2020
36: SUM FLOW_2025
37: SUM FLOW_2030
38: END
1
FREQUENCY          =  188
SUM-FLOW_2005      =  41,594,835
SUM-FLOW_2010      =  43,758,765
SUM-FLOW_2015      =  47,025,740
SUM-FLOW_2020      =  49,926,280
SUM-FLOW_2025      =  52,880,285
SUM-FLOW_2030      =  55,479,585
Arcplot:
```



Sewer Model: generate network flow statistics

- 20: asel wwm_model3 nodes
- WWM_MODEL3 nodes : 297 of 297 selected.
- 21: &pause
- Hit <return> to continue:
- 22: trace upstream wwm_model3 trace2 # *
- Enter point
- wwm_model3 nodes : 189 of 297 traced.
- wwm_model3 arcs : 188 of 295 traced.
- 23: &type ENTER 9 TO QUIT
- ENTER 9 TO QUIT
- 24: mape wwm_model3
- 25: clear
- 26: polygonshades targets 100
- 27: arcs wwm_model3
- 28: nodes wwm_model3
- 29: readselect trace2
- 30: arclines wwm_model3 10
- **31: statistics wwm_model3 arcs**

- **Enter statistical expressions. Type END or blank line to end.**
- **32: SUM FLOW_2005**
- **33: SUM FLOW_2010**
- **34: SUM FLOW_2015**
- **35: SUM FLOW_2020**
- **36: SUM FLOW_2025**
- **37: SUM FLOW_2030**
- **38: END**
- **1**
- **FREQUENCY = 188**
- **SUM-FLOW_2005 = 41,594,835**
- **SUM-FLOW_2010 = 43,758,765**
- **SUM-FLOW_2015 = 47,025,740**
- **SUM-FLOW_2020 = 49,926,280**
- **SUM-FLOW_2025 = 52,880,285**
- **SUM-FLOW_2030 = 55,479,585**
- Arcplot:



```
20: asel wwm_model3 nodes
WWM_MODEL3 nodes : 297 of 297 selected.
21: &pause
Hit <return> to continue:
22: trace upstream wwm_model3 trace2 # *
Enter point
wwm_model3 nodes : 189 of 297 traced.
wwm_model3 arcs : 188 of 295 traced.
23: &type ENTER 9 TO QUIT
ENTER 9 TO QUIT
24: mape wwm_model3
25: clear
26: polygonshades targets 100
27: arcs wwm_model3
28: nodes wwm_model3
29: readselect trace2
30: arclines wwm_model3 10
31: statistics wwm_model3 arcs

Enter statistical expressions. Type END or blank line to end.
32: SUM FLOW_2005
33: SUM FLOW_2010
34: SUM FLOW_2015
35: SUM FLOW_2020
36: SUM FLOW_2025
37: SUM FLOW_2030
38: END
1
FREQUENCY = 188
SUM-FLOW_2005 = 41,594,835
SUM-FLOW_2010 = 43,758,765
SUM-FLOW_2015 = 47,025,740
SUM-FLOW_2020 = 49,926,280
SUM-FLOW_2025 = 52,880,285
SUM-FLOW_2030 = 55,479,585

MANHOLE CAPACITY = 50.39 MGD
```

Sewer Model: summary

Conclusion:

The capacity of the selected manhole is reported as 50.39 MGD (million gallons per day) and based on this particular trace, the Sanitary Sewer should reach its capacity somewhere between the years 2020 and 2025.

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Technical Memorandum

To:	Pima County
From:	Hydromantis, Inc.
Date:	9 February 2005
Subject:	Additional Modeling of Ina Road and Roger Road WWTP - Final
Project:	799-01

1. INTRODUCTION

Hydromantis Inc., was retained by Pima County to provide additional modeling services for the Ina and Roger Road WWTP. This technical memorandum summarizes the results of a simulation-based analysis of the two plants.

The results were based on the calibrated and preliminary models developed in a number of projects and described in the following reports:

1. Modeling of Ina Road WWTP – Final, 30 August 2003
2. Modeling of Ina Road WWTP HPO – Final, 30 June 2003
3. Modeling of Ina Road WWTP Biosolids Stream – Final, August 2003
4. Modeling of Roger Road WWTP – Final, 26 July 2004 (includes the biosolids stream and RSHF models)

The scope of work for the additional simulation scenarios resulted from conversations with PIMA County and it included (the e-mail containing the original scope of work has been included in Appendix A):

Ina Road WWTP

Task 1a: Run the un-calibrated BNRAS and calibrated HPO layouts with 25 MGD going to the HPO plant and 12.5 MGD going to the BNRAS plant (4 trains). All currently produced centrate (200,000 gpd) will be returned to the BNRAS. Evaluate the effluent from each plant and the blended effluent for BOD, TSS, nitrate, ammonia and TN.

Task 1b: Run the uncalibrated BNRAS and calibrated HPO layout with 25 MGD going to the HPO plant and the maximum flow providing complete nitrification going to the BNRAS plant (4 of 5 trains) and with all of the currently produced flow of centrate (200,000 gpd) returned to the BNRAS. The effluent from each plant and the blended effluent will be evaluated for BOD, TSS, nitrate, ammonia, and TN.

Task 2a: Convert the HPO to a nutrient removal plant by adding fixed film carriers and an anoxic zone. The HPO plant will receive 25MGD and the BNRAS will receive 25 MGD. The BNRAS plant will be the existing plant if it can fully nitrify 25 MGD and if not it will have an additional 4 trains of BNRAS plant. The centrate added to the BNRAS will correspond to Ina centrate plus centrate from a 20 MGD Roger (IFAS NdeN) operation.

Task 2b: Convert the HPO to nutrient removal plant by adding fixed film carriers and an anoxic zone. The HPO plant will receive 25MGD and the BNRAS will receive 12.5 MGD. The centrate added to the BNRAS train will correspond to Ina centrate plus centrate from a 50 MGD Roger (IFAS NdeN) operation.

Roger Road WWTP

Task 1a: Run the calibrated layout (20°C and winter influent concentrations) with the "old" operation, with RAS and biofilter effluent recycled upstream of the biofilters and 20 MGD of raw flow. The secondary effluent will be evaluated for BOD, TSS, nitrate, ammonia and TN.

Task 1b: Run the calibrated layout (20°C and winter influent concentrations) with the "old" operation, with RAS and biofilter effluent recycled upstream of the biofilters and 41 MGD of raw flow. The secondary effluent will be evaluated for BOD, TSS, nitrate, ammonia and TN.

Task 2a: Run the calibrated layout (20°C and winter influent concentrations) with the "new" operation, with no RAS recycle to the biofilters (activated sludge operation) and 20 MGD of raw flow. The secondary effluent will be evaluated for BOD, TSS, nitrate, ammonia and TN.

Task 2b: As per task 2a with a raw flow of 41 MGD.

Task 3a: Modify the calibrated layout to include in the aeration lanes fixed film carriers of 60% fill (20°C and winter influent concentrations). RAS will be re-circulating to the head of aeration and no flow will be re-circulating to the biofilters. Both aeration trains will be simulated as one unit with and internal recycle and 1/4 of their combined volume as anoxic. Optimize operations to minimize the effluent TKN and evaluated secondary clarifier effluent and for BOD, TSS, and TN. The raw flow will be 20 MGD.

Task 3b: As per task 3a with raw flow of 41 MGD.

Task 3c: As per task 3a with raw flow of 50 MGD.

The objective of this memorandum is to convey the results of the requested scenario simulations to Pima County and is not intended as a recommendation of any particular course of action at the Ina Road WWTP.

2. REVIEW OF INA ROAD WWTP PLANT MODEL DESCRIPTION

The following sections detail the HPO and the BNRAS model set-up.

2.1. Model Set-Up

The plant layout was constructed from the following process units:

a) **Influent**: For the HPO primary influent, a COD/TSS based influent model was implemented with the major data inputs being COD, TSS and TKN. For the BNRAS primary influent, a COD based influent model was implemented with the major data inputs being COD and TKN. A third influent object was included in the layout to simulate centrate addition to the BNRAS facility. A BOD based model was used for the centrate. A forth influent object was included to simulate methanol addition to the BNRAS facility for specific scenarios where carbon was limited.

b) **Primary Clarifiers:** For the HPO plant, the four (4) primary clarifiers were combined into one single unit with an equivalent surface area. For the BNRAS plant, the two (2) primary clarifiers were combined into one single unit with an equivalent surface area. The clarifiers were modeled with the one dimensional settler model that uses the double exponential settling equation.

c) **HPO**: The HPO tank was modeled as a single, plug flow unit consisting of three (3) completely mixed tanks-in-series. The mathematical model used to simulate the biological conversions in the activated sludge process was ASM2d. ASM2d was implemented to provide the option to evaluate phosphorous removal.

d) **BNRAS**: The BNRAS was modeled as a single, plug flow unit, consisting of eight (8) completely mixed tanks-in-series with an internal recycle flow connecting tank No.8 with tank No. 1. The mathematical model used to simulate the conversions in the activated sludge process was ASM2d, allowing for future phosphorous removal evaluation.

e) **Final Clarifiers:** For the HPO clarifiers, the four (4) secondary clarifiers were combined into one single unit with an equivalent surface area. For the BNRAS plant, the three (3) secondary clarifiers were combined into one single unit with an equivalent surface area. The clarifiers were modeled with the one dimensional settler model that uses the double exponential settling equation. This model is used to describe the vertical suspended solids profile from the sludge blanket to the weir under dynamic conditions.

Figure 2.1 shows the plant layout in GPS-X. The following sections detail the physical and operational parameters used in the plant model for each of the unit processes.

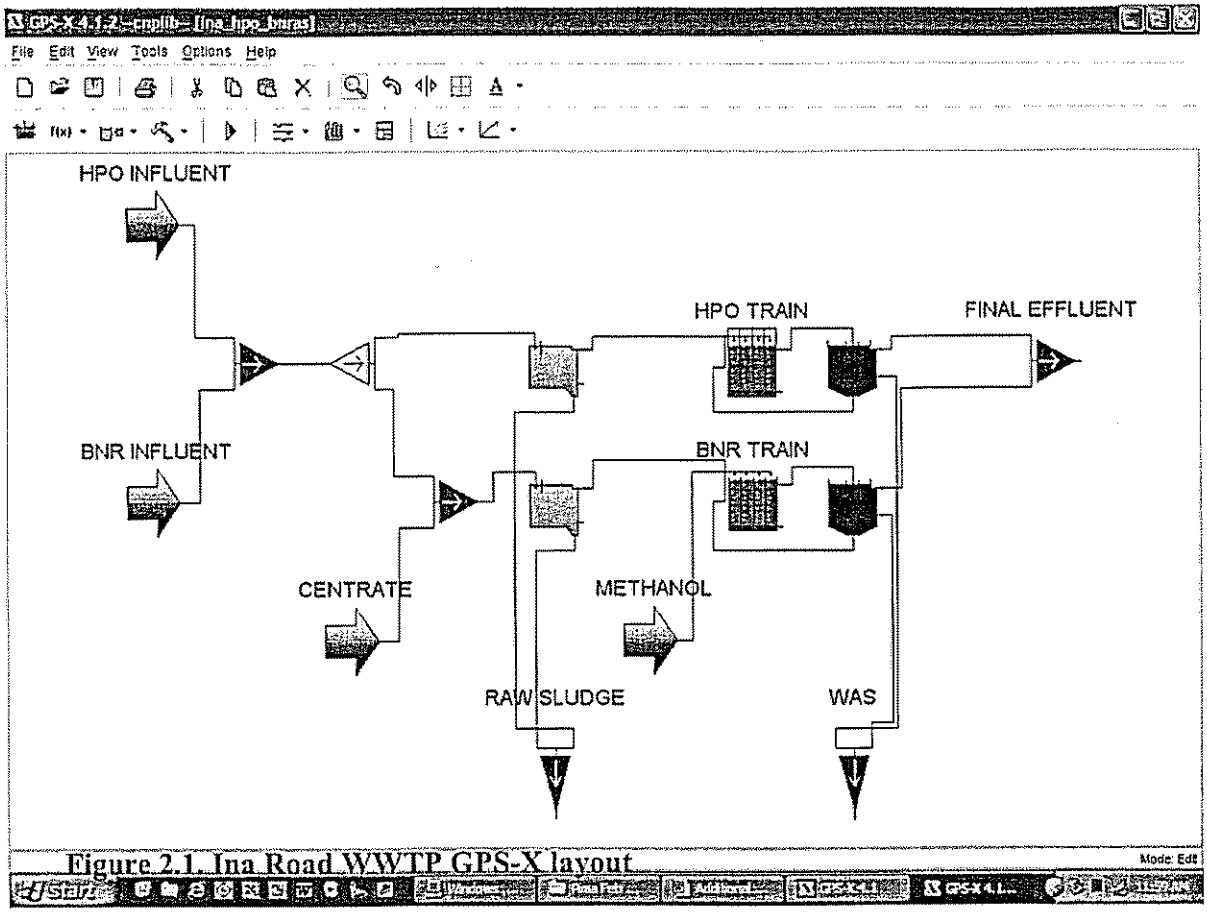


Figure 2.1. Ina Road WWTP GPS-X layout

2.2. Plant Raw Influent and Centrate Characteristics

The detailed profile used to model the Ina Road influent streams was based on the data obtained during an intensive sampling campaign in March 2003. Table 2.1 shows the average influent characteristics included in the model for both the HPO and BNRAS streams. The characteristics of the centrate have also been included.

Table 2.1 – Raw Influent and Centrate Characteristics – Averages for March 2003

Stream	Flow (MGD)	COD (mg/L)	$cBOD_5$ (mg/L)	TSS (mg/L)	VSS (mg/L)	TKN (mg/L)	NH_4-N (mg/L)
HPO Stream	25	590	300	270	220	57	37
BNRAS Stream	12.5	590	300	270	220	57	37
Centrate	0.2	3226	240	1335	1007	1285	1084

The stoichiometric ratios implemented in the raw influent models as well as the centrate are shown in Table 2.2.

Table 2.2 – Raw Influent and Centrate Stoichiometry

Stoichiomtetric ratio	HPO	BNRAS	Centrate
VSS/TSS	0.8	0.8	0.75
Soluble fraction of total COD	0.27	0.27	0.50
Inert fraction of soluble COD	0.33	0.33	0.85
COD content of VSS (XCOD/VSS)	1.9	1.9	0.30
BOD_5/BOD_{ult}	0.68	0.68	0.35

2.3. Ina Road WWTP Model Parameters

Table 2.3 summarizes the physical characteristics of the HPO model.

Table 2.3 – HPO Model Physical Parameters

Unit Object	Diameter (ft)	Total Surface Area (ft^2)	SWD (ft)	Total Volume (ft^3)	Gas Headspace Volume (ft^3)	SVI (mL/g)
Primary Clarifiers	-	34,560	8	-	-	-
Four trains	-	-	-	255,552	139,719	-
Final Clarifiers	115	41,548	14	-	-	150

Note: (-) in the table indicates that parameter is not required as model data entry.

Table 2.4 summarizes the physical characteristics of the BNRAS model.

Table 2.4 – BNRAS Model Primary Clarifiers

	Dimensions per Clarifier (ft)	Total Surface Area (ft^2)	SWD (ft)	Total Volume (gal)	Underflow Rate (gpm)	SVI (mL/g)
Primary Clarifiers	220 x 40	17,600	10	1,316,576	100	-
Anoxic: 4 trains with 4 stages	Each train: 112x28x21	-	-	263,424 (ft3)	-	-
Aerobic: 4 trains with 4 stages	Each train: 264x28x20	-	-	591,360(ft3)	-	-
Final Clarifiers	-	42,942	18	-	8,500 – 39,000	150

In addition to the information included in Tables 2.3 and 2.4 the following were also used in the model:

- BNRAS Train: Internal recycle pumps with an installed capacity of 4x13,000 gpm (1 standby). Operating range: 250-300% of AAF (AAF = 12.5 MGD, 31.25 – 37.5 MGD, average 275% = 34.4 MGD)
- BNRAS Train: The target MLSS concentration for the BNRAS train quoted in the CDM design tables was 3,000 mg/L.
- The maximum specific growth rate (μ_a) of the autotrophic group was 0.9 d^{-1} (@ 20°C) and the decay rate (b_a) was 0.17 d^{-1} (@ 20°C).
- BNRAS Aeration: The design tables provided by Pima County gave the diffuser distribution and blower capacity. The alpha and beta values used in the model were left at the defaults. The SOTE values were assumed to be the same as the target SOTE values shown in the US Filter Clean Water Oxygen Transfer Tests, August 2002. Table 2.5 shows the parameters used to model the aeration system of the BNRAS Train.

Table 2.5 – Ina Road BNRAS Train Aeration System Parameters

Parameter	Ina Road Model Values
α	0.6 - 0.8
β	0.95
θ	1.024
Total air flow installed (cfm)	28,000
Air flow distribution (% of total - stages 5 to 8)	48, 27, 17, 8
Specific oxygen transfer efficiency (% - stages 5 to 8)	31%, 31%, 29.5%, 29.5%

The HPO model set-up in this project did not consider the addition of liquid oxygen. The available oxygen feed was assumed to be provided by the PSA system only.

3. SIMULATION SCENARIOS AND RESULTS FOR THE INA ROAD WWTP PROCESS STREAM

3.1. Task 1a (Benchmark Scenario)

The basic performance of the Ina Road WWTP plant was established using a steady state simulation with the available design information. The un-calibrated BNRAS and calibrated HPO layouts were run with 25 MGD going to the HPO plant and 12.5 MGD going to the BNRAS plant (4 trains). All currently produced centrate (200,000 gpd) was returned to the BNRAS. The following operational parameters, detailed in Table 3.1 were used. This simulation was used as the benchmark case to investigate if the BNRAS train was carbon limited.

Table 3.1 – Task 1a Benchmark Scenario

Scenario Name	HPO Influent Flow (MGD)	BNRAS Influent Flow (MGD)	Centrate Flow (gpd)	Methanol Flow (gpd)	BNRAS Internal Recycle (MGD)	T (°C)
Task 1a	25	12.5	200,000	0	34.4	20

Table 3.2 shows the results for the benchmark scenario.

Table 3.2 – Task 1a Benchmark Scenario Results

	TSS (mg/L)	BOD_5 (mg/L)	TN (mg/L)	NH_4–N (mg/L)	Nitrate (mg/L)
HPO Final Effluent	22.3	16.6	38.0	35.7	0.1
BNRAS Final Effluent	7.0	2.6	35.9	1.1	33.9
Combined Final Effluent	16.9	11.7	37.3	23.6	11.9

The high total nitrogen (TN) concentration in the BNRAS effluent and the high nitrate concentration of the BNRAS effluent are indicative of incomplete denitrification due to a carbon limitation.

3.1.1. Sensitivity Analysis: Plant Performance vs. Methanol Addition

Following identification of a carbon limitation in the BNRAS tank, a sensitivity analysis was performed to evaluate the BNRAS plant performance with varying methanol addition rates. For this analysis, the plant internal recycle rate in the BNRAS tank was kept constant at 34.4 MGD

and the methanol addition was varied from 0 to 2,000 gallons per day (100% methanol solution). Figure 3.1 shows the effect of the variation of methanol addition on final effluent TN. The graphs included in this report are for 20°C. Detailed results and additional figures have been included in Appendix 1: Plant Performance vs. Methanol Addition.

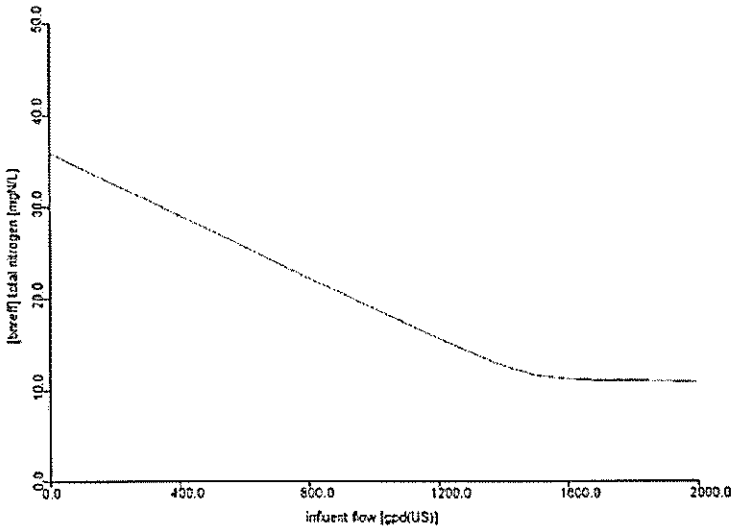


Figure 3.1. Effect of increasing methanol addition on final effluent TN of the BNRAS train

Figure 3.1 shows that no additional effluent TN benefit is achieved once the methanol addition exceeds 1,800 gpd. Furthermore, the results show that irrespective of the carbon addition, the desired effluent TN of 6-8 mgN/L could not be achieved using these model settings.

3.1.2. Sensitivity Analysis: Plant Performance vs. Methanol Addition – High Internal Recycle

A second sensitivity analysis was performed to evaluate the BNRAS plant performance with varying methanol addition rates using a higher internal recycle rate. For this analysis, the plant internal recycle rate in the BNRAS tank was 56.2 MGD (this value exceeds the installed pump capacity but was used to demonstrate the overall effect of internal recycle rates) and the methanol addition was varied from 0 to 2,000 gallons per day (100% methanol solution). Figure 3.2 shows the effect of the variation of methanol addition on final effluent TN with an increased internal recycle rate. The graphs included in this report are for 20°C. Detailed results and additional figures have been included in Appendix 2: Plant Performance vs. Methanol Addition – High IR.

Although these results show that a lower effluent TN may be achieved compared to the previous sensitivity analysis, the concentration it still higher than 8 mgN/L. Figure 3.2 shows that 1,800 gpd pure methanol is required to achieve desired TN. Increasing the internal recycle rate will not enhance denitrification.

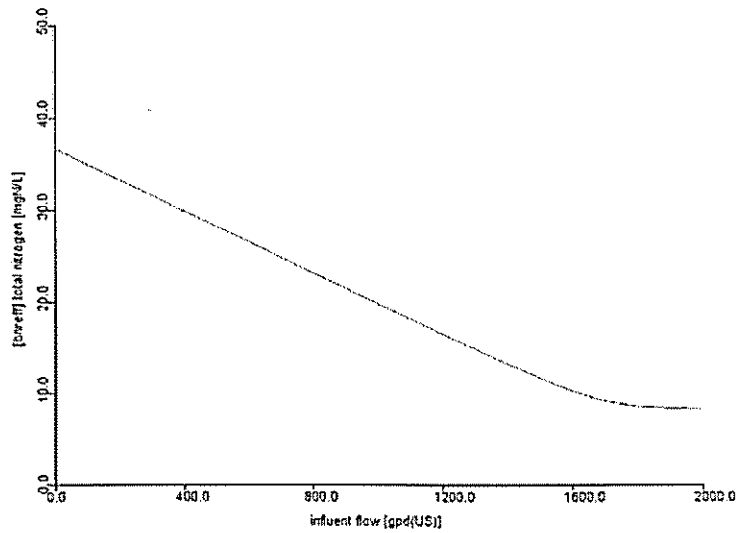


Figure 3.2. Effect of increasing methanol addition on final effluent TN of the BNRAS train.

3.2. Task 1b - BNRAS Nitrification Capacity: Impact of BNRAS Influent Flow on Effluent Ammonia

The preliminary model was used to investigate the capacity of the BNRAS train. A sensitivity analysis was performed varying the raw influent flow to the BNRAS plant from 5 to 25 MGD. The centrate flow was held constant at 200,000 gpd and no methanol was added to the plant. Figures 3.3 & 3.4 show the effect of the variation of the BNRAS influent flow on the influent and effluent ammonia concentrations of the BNRAS. The graphs included in this report are for 20°C. Detailed results and additional figures have been included in Appendix 3: Plant Performance vs. BNRAS Influent Flow.

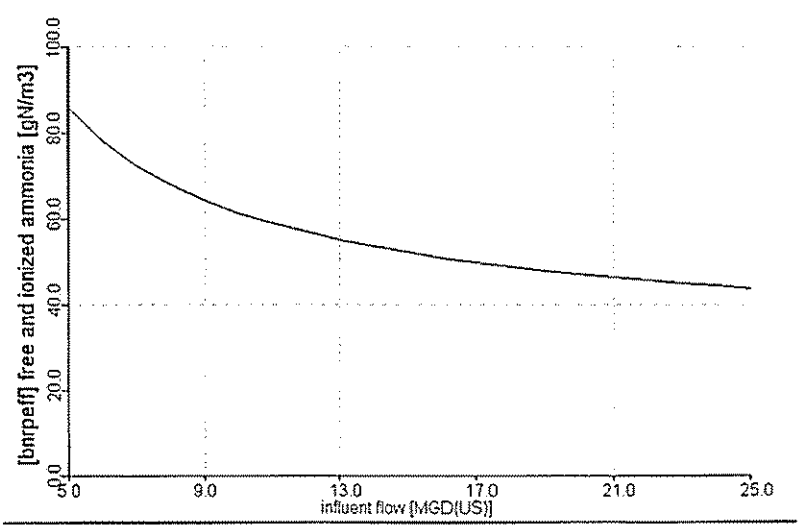


Figure 3.3. Effect of increasing the BNRAS influent flow on the influent ammonia concentration of the BNRAS.

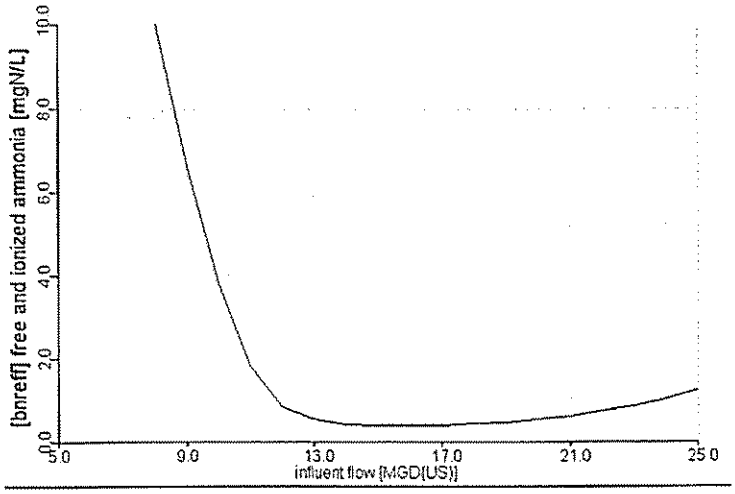


Figure 3.4. Effect of increasing the BNRAS influent flow on final effluent ammonia of the BNRAS (4 trains).

Figure 3.3 shows that the influent ammonia concentration of the BNRAS decreased with the increase of influent flow rate. Figure 3.4 shows that as the influent flow of the BNRAS train increased, the effluent ammonia concentration decreased as a result of dilution (up to 21MGD). At decreased flows, the centrate loading had a greater impact on the BNRAS influent concentration. It should be noted that nitrification occurred at all flows. This analysis was performed with an MLSS controller maintaining the target concentration of 3,500 mg/L. This target MLSS concentration was selected to allow for higher SRTs at the high ammonia loading rates used for the sensitivity analysis, even though it was 500 mg/L higher than the design concentration.

3.3. Task 2a – HPO NdeN Configuration with Centrate from 20 MGD IFAS NdeN Roger Road Operation

For this scenario, the HPO plant was converted to a nutrient removal plant by adding fixed film carriers and an anoxic zone. The HPO plant received a raw influent flow of 18 MGD (maximum flow at which the HPO train can nitrify as shown in the HPO Technical Memorandum) and the BNRAS plant received a raw influent flow of 25 MGD. The model results indicated that the existing BNRAS plant could not fully nitrify at 25 MGD of influent flow, so an additional four (4) trains were added to the BNRAS model (total additional volume - 854,784 ft^3). The centrate added to the BNRAS corresponded to Ina centrate plus centrate from Roger when simulated as an IFAS NdeN plant using an influent flow of 20 MGD. Table 3.3 shows the flow and quality of sludge generated at Roger Road.

Table 3.3 – Roger Road Operation - 20 MGD IFAS NdeN

Sludge Stream	Flow (MGD)	TSS (mg/L)	NH_4–N (mg/L)
Raw	0.84	8,983	22
WAS	1.00	3,607	0.46
Digested	0.173	21,137	2,480

The Ina and Roger sludge were fed into the Regional Solids Handling Facility (RSHF) model. Table 3.4 shows the centrate quality as predicted by the Regional Solids Handling Facility (RSHF) model after combining the Roger Road flow with the estimated Ina Road contribution.

Table 3.4 – New Centrate Quality

	Flow (gpd)	TSS (mg/L)	TKN (mg/L)	NH_4-N (mg/L)
RSHF – Centrate Quality	302,790	2,346	1,738	1,475

Figure 3.5 shows the effect of the variation of the BNRAS influent flow on the effluent ammonia concentration of the BNRAS with the new centrate (Table 3.4) for the 20°C run.

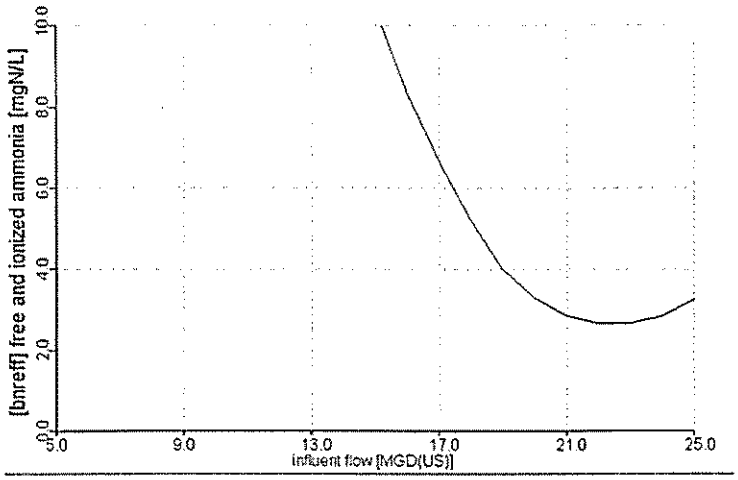


Figure 3.5. Effect of increasing the influent flow on final effluent ammonia of the existing BNRAS (4 trains) – with new centrate addition.

The centrate flow and quality shown in Table 3.4 was fed back into the Ina Road WWTP model and a steady state simulation was run to investigate its impact on the plant effluent quality. Table 3.5 summarizes the effluent quality results for this operational configuration.

Table 3.5 – Task 2a Results

Effluent Stream	TSS (mg/L)	BOD_5 (mg/L)	TN (mg/L)	NH_4-N (mg/L)	NOx-N (mg/L)
HPO Final Effluent	19	9	6	0.8	3.6
BNRAS Final Effluent (8 trains)	13	5	30	1.0	28
Combined Final Effluent	15	7	20	0.9	18

The low ammonia concentration in the BNRAS effluent indicates that the plant can nitrify under this scenario.

3.4. Task 2b – HPO NdeN Configuration with Centrate from 50 MGD IFAS NdeN Roger Road Operation

For this scenario both the HPO tank and the Roger Road facility were modeled as IFAS NdeN systems. The HPO plant was fed a raw influent flow of 18 MGD and the BNRAS plant was fed a raw influent flow of 12.5 MGD. The centrate added to the BNRAS corresponded to Ina centrate plus centrate from Roger when simulated as an IFAS NdeN plant using an influent flow of 50 MGD. Table 3.6 shows the flow and quality of sludge generated at Roger Road.

Table 3.6 – Roger Road Operation - 20 MGD IFAS NdeN

Sludge Stream	Flow (MGD)	TSS (mg/L)	NH_4–N (mg/L)
Raw	0.84	8,983	22
WAS	2.00	2,039	1.34
Digested	0.173	20,970	2,470

The Ina and Roger sludge were fed into the Regional Solids Handling Facility (RSHF) model. Table 3.7 shows the centrate quality as predicted by the Regional Solids Handling Facility (RSHF) model after combining the Roger Road flow with the estimated Ina Road contribution.

Table 3.7 – New Centrate Quality

	Flow (gpd)	TSS (mg/L)	TKN (mg/L)	NH_4 -N (mg/L)
RSHF – Centrate Quality	302,790	2,335	1,732	1,470

The centrate flow produced at the RSHF for the various future flow conditions could not be estimated accurately as it depends heavily on the following unknown operational parameters:

- Future operation of the thickening units at Roger Road
- Future retrofitting and feed pattern of the digesters at Roger Road
- Operation of the blending/dilution and pumping of digested sludge from Roger Road to Ina Road
- Blending and storing of the Ina and Roger sludge in the future, prior to feeding the centrifuge

In view of all these unknown parameters, it was assumed that several optimizations to the sludge processing streams would be undertaken to reduce the sludge produced and therefore the centrate flow was kept constant for the 50 MGD Roger Road operational scenarios and a sensitivity analysis on the impact of increased centrate flow was performed (Figure 3.6).

The centrate flow and quality shown in Table 3.7 was fed back into the Ina Road WWTP model and a steady state simulation was run to investigate its impact on the plant effluent quality. Table 3.8 summarizes the effluent quality results for this operational configuration.

Table 3.8 – Task 2b Results

	TSS (mg/L)	BOD_5 (mg/L)	TN (mg/L)	NH_4-N (mg/L)	NOx-N (mg/L)
HPO Final Effluent	19	9	6	0.8	3.6
BNRAS Final Effluent	7	3	56	18.5	36.5
Combined Final Effluent	14	6	26	8.1	17.1

To investigate the impact of a changing centrate load (due to changes in operation) on nitrification capacity, a sensitivity analysis was performed by varying the centrate flow and noting the resulting effluent ammonia concentrations. Figure 3.6 shows the results.

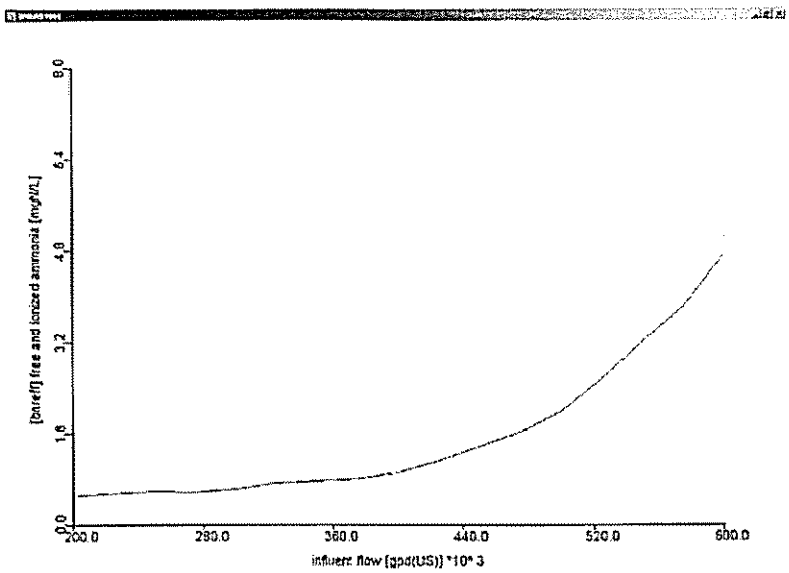


Figure 3.6. Effect of increasing centrate flow on final effluent ammonia concentrations of the BNRAS.

4. INA ROAD MODELLING RESULTS SUMMARY

The simulations results presented in Section 3 can be summarized as follows:

Task 1a: With the current plant configuration the model indicated that the HPO train could not nitrify at 25 MGD. The BNRAS train could produce an effluent ammonia concentration of 1 mg/L when treating 12.5 MGD and 200,000 gpd of centrate of the quality shown in Table 2.1.

Task 1b: The preliminary model indicated that the BNRAS train could treat up to 17 MGD of raw flow and 200,000 gpd of centrate of the quality shown in Table 2.1 and produce an effluent ammonia concentration of 1 mg/L.

Task 2a: The model results indicated that the hybrid HPO configuration combined with eight BNRAS trains could fully nitrify (<1 mg/L of ammonia) 50 MGD of raw flow (25 to the HPO 25

to the BNRAS) and 300,000 gpd of centrate of the quality shown in Table 3.4. The model indicated that the plant was limited in the amount of denitrification it could achieve.

Task 2b: The model results indicated that the hybrid HPO configuration could fully nitrify (<1 mg/L of ammonia) 25 MGD of raw flow. However the BNRAS with four trains could not fully nitrify 12.5 MGD of raw flow and 300,000 gpd of centrate of the quality shown in Table 3.7 (generated from Roger when treating 50 MGD). The model indicated that the plant was limited in the amount of denitrification it could achieve.

It must be noted that all simulation results were steady state runs. Additional evaluations need to be undertaken to verify the impact of plant influent dynamics on plant performance. Furthermore, the results presented here assume an ideal mix between the centrate and raw flows upstream of the primary tanks.

5. REVIEW OF ROGER ROAD WWTP PLANT MODEL DESCRIPTION

The following sections detail the Roger Road model set-up.

5.1. Model Set-Up

The plant layout was constructed from the following process units:

a) **Influent**: A BOD based influent model was implemented with the major data inputs being TSS, BOD and TKN. A second influent object with a BOD based model was included in the layout to simulate all return streams.

b) **Primary Clarifiers:** The six (6) primary clarifiers were simulated as three units, each with the equivalent surface area of two primary tanks. The clarifiers were modeled with the one dimensional settler model that uses the double exponential settling equation.

c) **Biofilters:** The two biofilters were simulated as one unit with the equivalent surface area. The biological model used was **Mantis**, modified to include diffusion in the biofilm.

d) **Aeration Tanks**: Each aeration train was modeled with a single, plug flow object, representing one (for AS 1-2) and four (for AS 3-6) completely mixed tanks-in-series. The bioreactor kinetics were modeled using the **Mantis** model, a modified version of ASM1. This kinetic model is capable of describing BOD-removal, nitrification and denitrification.

e) **Final Clarifiers:** The nine (9) secondary clarifiers were grouped into two units with an equivalent surface area. The clarifiers were modeled with the one dimensional settler model that uses the double exponential settling equation. This model is used to describe the suspended solids profile from the sludge blanket to the weir under dynamic conditions.

Figure 5.1 shows the plant layout in GPS-X. The following sections detail the physical and operational parameters used in the plant model for each of the unit processes.

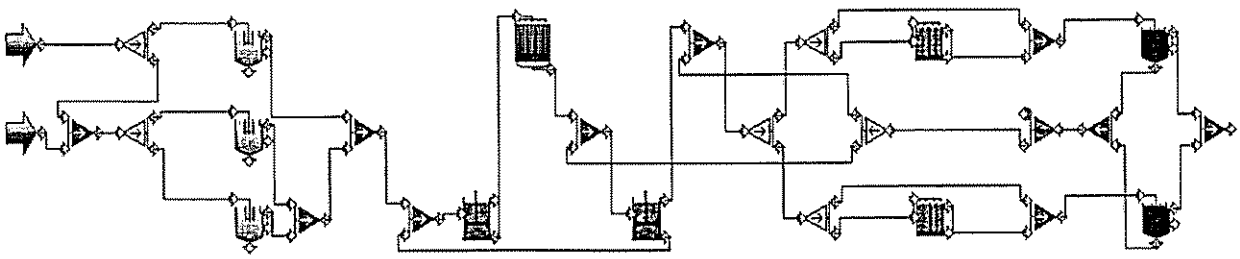


Figure 5.1. Roger Road WWTP GPS-X layout

5.2. Plant Raw Influent Characteristics

Table 5.1 shows the influent characteristics used in the model as determined by field measurements from January 2001 to March 2001. No recycle streams are included in these measurements.

Table 5.1 – Roger Road WWTP Model Influent Characteristics

COD (mg/L)	sCOD (mg/L)	BOD_5 (mg/L)	$sBOD_5$ (mg/L)	TSS (mg/L)	VSS (mg/L)	NH_4-N (mg/L)	TKN (mg/L)
585	261	231	115.5	228	180	25.7	39

From the data in Table 5.1, the following stoichiometric ratios were calculated (Table 5.2).

Table 5.2 – Raw Influent Stoichiometry

Parameter	Values in model - winter
VSS/TSS	0.79
Ammonia/TKN	0.66
Soluble substrate/BOD_{ult}	0.50
XCOD/VSS	1.80
BOD_5/BOD_{ult}	0.50

5.3. Roger Road WWTP Model Parameters

Table 5.3 summarizes the physical characteristics of the Roger Road model.

Table 5.3 – Roger Road WWTP Model Physical Parameters

Unit Process	Diameter /Unit (ft)	Total Surface Area (ft^2)	SWD (ft)	Total Volume (gal)
Primary Clarifiers 5-8	105	34,620	8	-
Primary Clarifiers 9-10	120	22,608	12	-
Biofilters	165	42,744	26	-
Aeration tanks 1, 2 (2 single stage basins)	-	264x41	15	151,000 x 2
Aeration tanks 3-6 (4 two-pass basins)	-	115x25	16.3	94,000 x 4
Final Clarifiers 1, 2	100	15,700	9	-
Final Clarifiers 3, 4	105	17,310	8	-
Final Clarifiers 5, 6	105	17,310	11	-
Final Clarifiers 7, 8, 9	105	25,965	12	-

In addition to the information included in Tables 5.2 and 5.3 the following were also used in the model:

- The raw flow split between the two sets of primary clarifiers was assumed to be 33.4% to PSTs 9-10 and 66.6% to PSTs 5-8.
- A 50% - 50% flow split between aeration trains 1-2 and 3-6 was assumed.
- The maximum specific growth rate (μ_a) of the autotrophic group was 0.9 d^{-1} (@ 20°C) and the decay rate (b_a) was 0.17 d^{-1} (@ 20°C).

- Aeration tanks 1 and 2 send flow to final clarifiers 1 to 4 and aeration tanks 3 to 6 send flow to final clarifiers 5 to 9.

Table 5.4 shows the values used in the model for the aeration system. No design information was available for the parameters included in **Error! Reference source not found.**5.4.

Table 5.4 – Aeration System Parameters

Parameter	Roger Road Model Values
α	0.6-0.8
β	0.95
θ	1.024
Total capacity installed (scfm)	Duty for AS 1-2: 7,000 scfm Duty for AS 3-6: 7,000 scfm Stand-by unit for both: 7,000 scfm
Air flow distribution across tanks (% of total)	Uniform (data not available)
Elevation (ft)	2,250
Specific oxygen transfer efficiency	0.04 (calibrated)

6. SIMULATION SCENARIOS AND RESULTS FOR THE ROGER ROAD WWTP

6.1. Tasks 1 and 2 - Impact of RAS Recirculation on Final Effluent

The calibrated model was used to establish plant secondary treatment performance using average influent flows of 20 MGD and 41 MGD in two modes of operation:

- "Old" operation – RAS and biofilter effluent are recycled upstream of the biofilters
- "New" operation – RAS and biofilter effluent are recycled downstream of the biofilters (i.e. the return stream does not contribute to the loading of the biofilter)

Tables 6.1, 6.2 and 6.3 summarize the operational parameters, biofilter performance and the overall plant performance for each scenario. The individual runs shown in the tables were:

- Task 1a: "old" operation and raw flow of 20 MGD.
- Task 1b: "old" operation and raw flow of 41 MGD.
- Task 2a: "new" operation and raw flow of 20 MGD.
- Task 2b: "new" operation and raw flow of 41 MGD.

The total recycle flow was kept constant at a rate of 12 MGD for all scenarios.

Table 6.1 – Operational Parameters

Scenario	Operation Mode	Raw Flow (MGD)	T (°C)	Last Cell DO AS 1-2 (mg/L)	Last Cell DO AS 3-6 (mg/L)	RAS Flow (MGD)	RAS TSS (mg/L)
Task 1a	Old	20	20	3.2	4.3	12	1204
Task 1b	Old	41	20	0.1	0.2	12	1338
Task 2a	New	20	20	4.4	5.1	12	843
Task 2b	New	41	20	0.2	0.2	12	1169

Table 6.2 – Biofilter Effluent

Scenario	COD (mg/L)	sCOD (mg/L)	BOD_5 (mg/L)	$sBOD_5$ (mg/L)	TSS (mg/L)	TN (mg/L)	NH_4-N (mg/L)	NOx-N (mg/L)
Task 1a	359	46	166	10	193	48	24.0	0.3
Task 1b	320	121	149	60	121	39	23.1	0.1
Task 2a	163	39	53	6	72	31	16.4	3.4
Task 2b	232	111	99	54	69	32	21.2	0.1

Table 6.3 – Final Effluent

Scenario	COD (mg/L)	sCOD (mg/L)	BOD_5 (mg/L)	$sBOD_5$ (mg/L)	TSS (mg/L)	TN (mg/L)	NOx-N (mg/L)
Task 1a	41	31	6	0.4	9	26	0.3
Task 1b	60	41	18	7	15	26	0.1
Task 2a	40	31	5	0.4	8	23	3.4
Task 2b	68	49	22	13	15	22	0.1

6.2. Task 3 - Impact of an Alternative Process Configuration on Final Effluent

The calibrated model was used as the basis for a preliminary model of an alternative process configuration that could be used to provide nitrogen removal. The aeration tanks were converted to hybrid systems containing fixed-film carriers, with 60% fill. An anoxic compartment was added to the head of the tank (¼ of total tank volume). An internal recycle flow was added to recycle nitrate to the head of the hybrid tank. The model was run with the "New" mode of operation, the RAS being re-circulated to the head of the hybrid tanks and no flow re-circulated to the biofilters. Operations were adjusted to minimize the final effluent TN. The performance of the hybrid system was evaluated for the following raw influent flows:

- Task 3a: 20 MGD
- Task 3b: 41 MGD
- Task 3c: 50 MGD

Tables 6.4, 6.5 and 6.6 summarize the operational parameters, biofilter performance and the plant performance for each scenario. The DO concentrations for the aerobic sections of the hybrid system were approximately 2 mg/L.

Table 6.4 – Hybrid System - Operational Parameters

Scenario	Operation Mode	Raw Flow (MGD)	T (°C)	Hybrid TSS (mg/L)	RAS Flow (MGD)	RAS TSS (mg/L)	RAS VSS (mg/L)
Task 3a	New	20	20	590	15	1590	1210
Task 3b	New	41	20	860	40	1870	1600
Task 3c	New	50	20	1010	50	2040	1730

Table 6.5 – Hybrid System – Biofilter Effluent

Scenario	COD (mg/L)	sCOD (mg/L)	BOD_5 (mg/L)	$sBOD_5$ (mg/L)	TSS (mg/L)	TN (mg/L)	NH_4-N (mg/L)	NOx-N (mg/L)
Task 3a	163	39	53	6	72	31	16.4	3.4
Task 3b	232	111	99	54	69	32	21.2	0.1
Task 3c	251	140	111	72	65	32	21.6	0

Table 6.6 – Hybrid System – Final Effluent

Scenario	COD (mg/L)	sCOD (mg/L)	BOD_5 (mg/L)	$sBOD_5$ (mg/L)	TSS (mg/L)	TN (mg/L)	NH_4-N (mg/L)	NOx-N (mg/L)
Task 3a	42	32	5	1	9	17	0.4	12.6
Task 3b	54	32	7	1	17	13	0.5	7.3
Task 3c	56	32	8	1	19	10	1.2	4.0

7. ROGER ROAD MODELLING RESULTS SUMMARY

The simulations results presented in Section 6 can be summarized as follows:

Tasks 1 and 2: The model indicated that, with the existing configuration, the Roger Road plant could not nitrify at either 20 or 41 MGD – with the "new" or the "old" operation. The main reasons for this were the low SRT the plant is currently operated at and the inefficient aeration system.

Task 3: The model results indicated that a hybrid configuration in combination with the existing biofilters could fully nitrify (~1 mg/L of ammonia) 20 to 50 MGD of raw flow. Increasing the DO concentration in the hybrid system for the 50 MGD scenario allows the ammonia to drop below 1 mg/L (results not shown). The model indicated that the plant was limited in the amount of denitrification it could achieve. However the addition of a post denitrification filter would allow complete denitrification.

It must be noted that all simulation results were steady state runs. Additional evaluations need to be undertaken to verify the impact of plant influent dynamics on plant performance.

APPENDIX A – ORIGINAL SCOPE OF WORK DOCUMENT

From: Dennis Froehlich

Sent: Tuesday, January 25, 2005 1:08 PM

To: 'Lina Belia'

Cc: Ed Curley; Steve Munsell

Subject: RE: New tasks

Following our phone conversation (Friday 21st and Monday 24th Jan 2005), the requested Scope of Work tasks are summarized as follows:

Presentation (1-day)

Friday February 11th - full-day meeting to present and discuss Facility Plan Scenario Simulation Results with Facility Plan Team (CDD, Treatment, and Engineering).

Roger Road (1 -day)

1. The calibrated layout (20C winter influent concentrations) will be run and secondary effluent evaluated for BOD, TSS, and nitrate, ammonia, and TN under the following scenarios:

1a. "Old" operation, with RAS and biofilter effluent recycled upstream of biofilters, raw flow 20 MGD.

1b. "Old" operation, with RAS and biofilter effluent recycled upstream of biofilters, raw flow 41 MGD.

2a. "New" operation, no recycle flow to biofilters, raw flow 20 MGD (activated sludge operation).

2b. "New" operation, no recycle flow to biofilters, raw flow 41 MGD (activated sludge operation).

2. The calibrated layout (winter influent concentrations) will be modified to include fixed film carriers of 60% fill, with RAS recirculating to head of aeration, no flow recirculating to biofilters, both aeration trains simulated as one unit with and internal recycle and 1/4 of their combined volume as anoxic, with tertiary denitrification filter. Operations will be optimized to minimize effluent TKN. Secondary Clarifier effluent and denite filter effluent will be evaluated for BOD, TSS, and TN.

2a. Raw flow of 20 MGD

2b. Raw flow of 41 MGD

2c. Raw flow of 50 MGD

Note: I would like to rerun these scenarios later using the new Biofilter media with 40 ft2/ft3 replacing the current 27 ft2/ft3 media that may be compromised.

Ina Road (1-day)

1a. The uncalibrated BNRAS and calibrated HPO layout will be run with 25 MGD going to the HPO plant and 12.5 MGD going to the BNRAS plant (4 trains) and with all of the currently produced flow of centrate returned to the BNRAS. The effluent from each plant and the blended effluent will be evaluated for BOD, TSS, nitrate, ammonia, and TN.

1b. The uncalibrated BNRAS and calibrated HPO layout will be run with 25 MGD going to the HPO plant and the maximum flow providing complete nitrification going to the BNRAS plant (4 of 5 trains) and with all of the currently produced flow of centrate returned to the BNRAS. The effluent from each plant and the blended effluent will be evaluated for BOD, TSS, nitrate, ammonia, and TN.

2a. HPO will be converted to nutrient removal plant by adding fixed film carriers and an anoxic zone (exiting 3 reactor cells /train with first anoxic and second two aerobic - for all four trains and internal recycle), the HPO will receive 25MGD and the BNRAS will receive 25 MGD (the "25 MGD" BNRAS plant will be the existing plant if it can fully nitrify 25 MGD and if it cannot fully nitrify 25 MGD, the 25 MGD BRAS will be an additional 4 trains of BNRAS plant) and the centrate will be that corresponding to Ina centrate plus centrate from a 20 MGD Roger (IFAS NdeN) operation.

2b. HPO will be converted to nutrient removal plant by adding fixed film carriers and an anoxic zone, the HPO will receive 25MGD and the BNRAS will receive 12.5 MGD and the centrate will be that corresponding to Ina centrate plus centrate from a 50 MGD Roger (IFAS NdeN) operation.

The BNRAS volumes will be consistent with the operation of 4 of 5 trains. The HPO volumes will be consistent with the first reactor in each reactor as an anoxic reactor and the second two reactors as aerobic reactors. All IFAS modeling will use a suspended carrier media with the following properties:

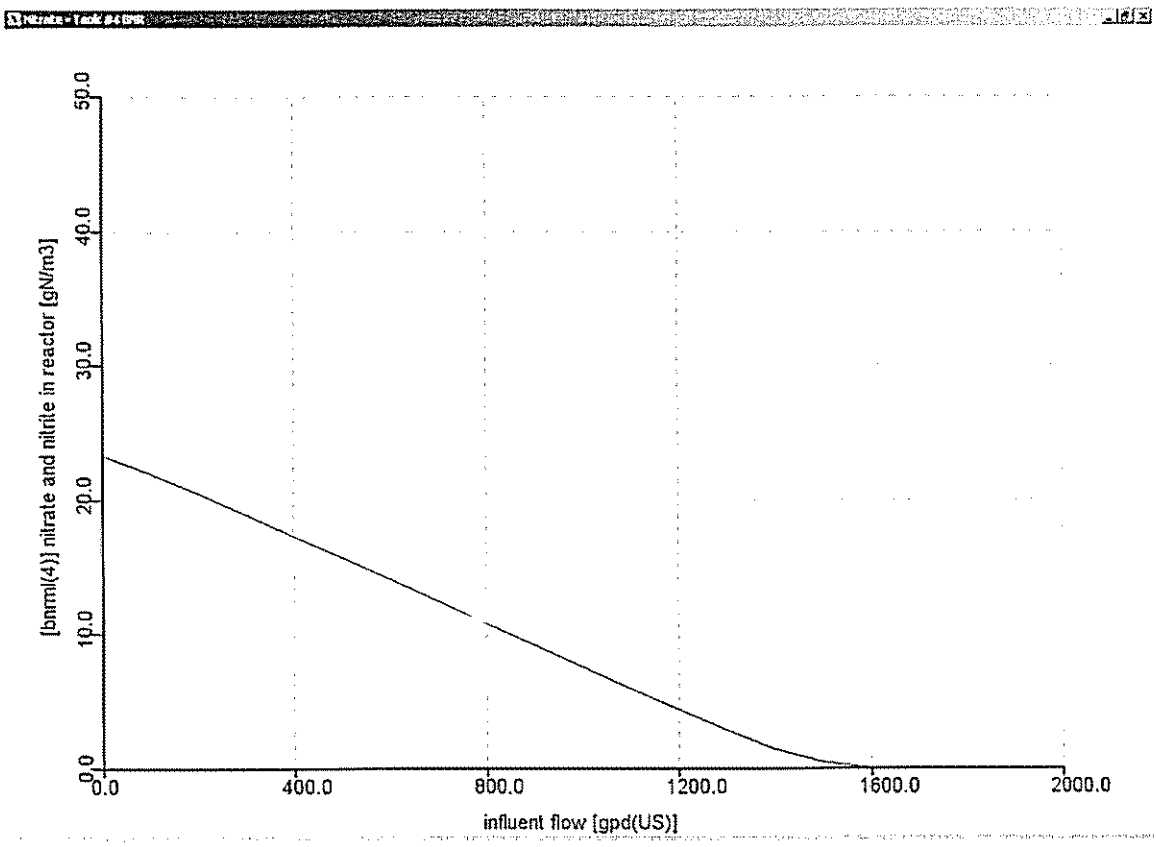
1) ***1200 m2/m3 specific surface area,***
2) ***biofilm thickness of typically 0.2 mm.,***
3) ***12% (volume) displacement of water at 50% fill,***
4) ***specific density of 0.99-1.02 kg/m3 for the media.***

Dennis Froehlich

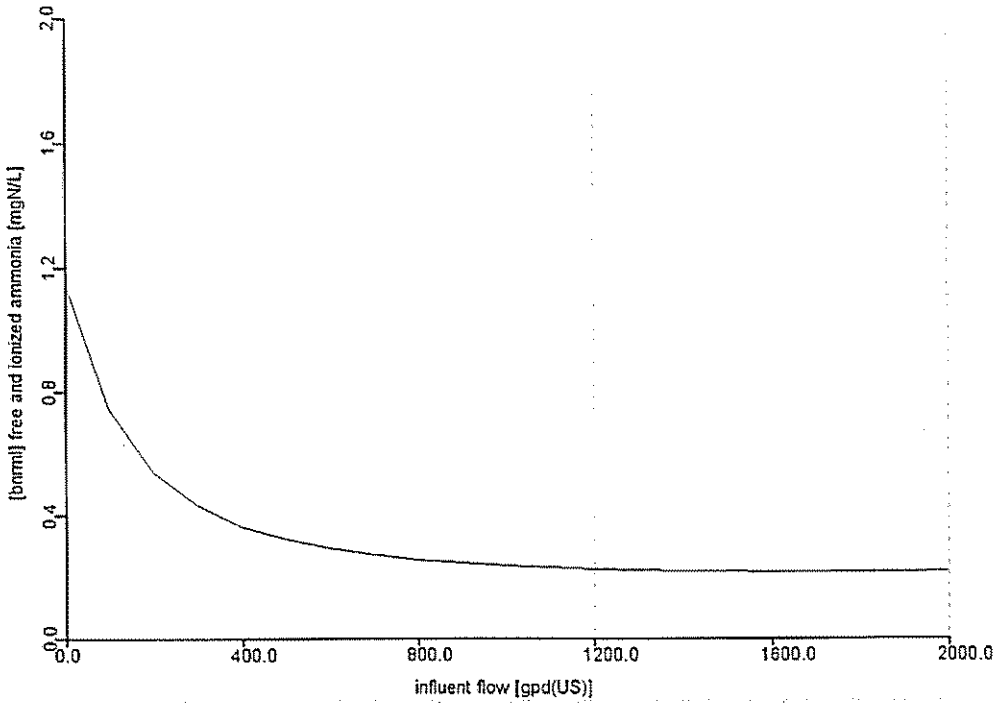
Sensitivity Analysis # 1: Plant Performance vs. Methanol Addition

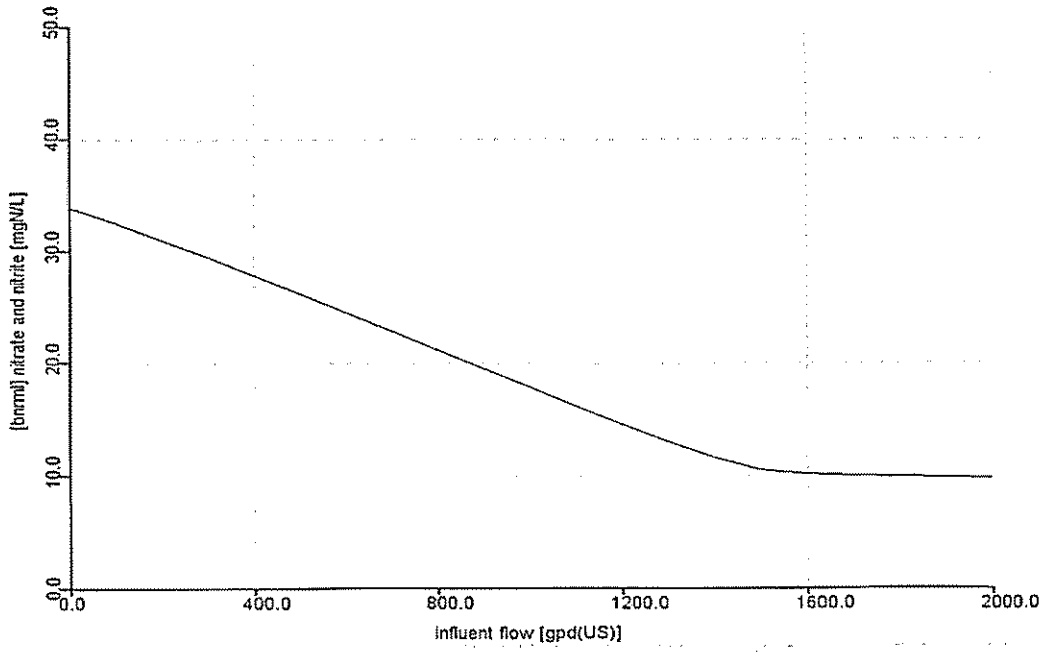
1) HPO FLOW = 25 MGD
2) BNR FLOW = 12.5 MGD
3) CENTRATE FLOW = 200,000 gpd(US)
4) **METHANOL FLOW = 0-2000 gpd(US) (varied on the x-axis)**
5) BNR INTERNAL RECYCLE = 34.4 MGD

Nitrate Concentration – Tank #4 - BNR

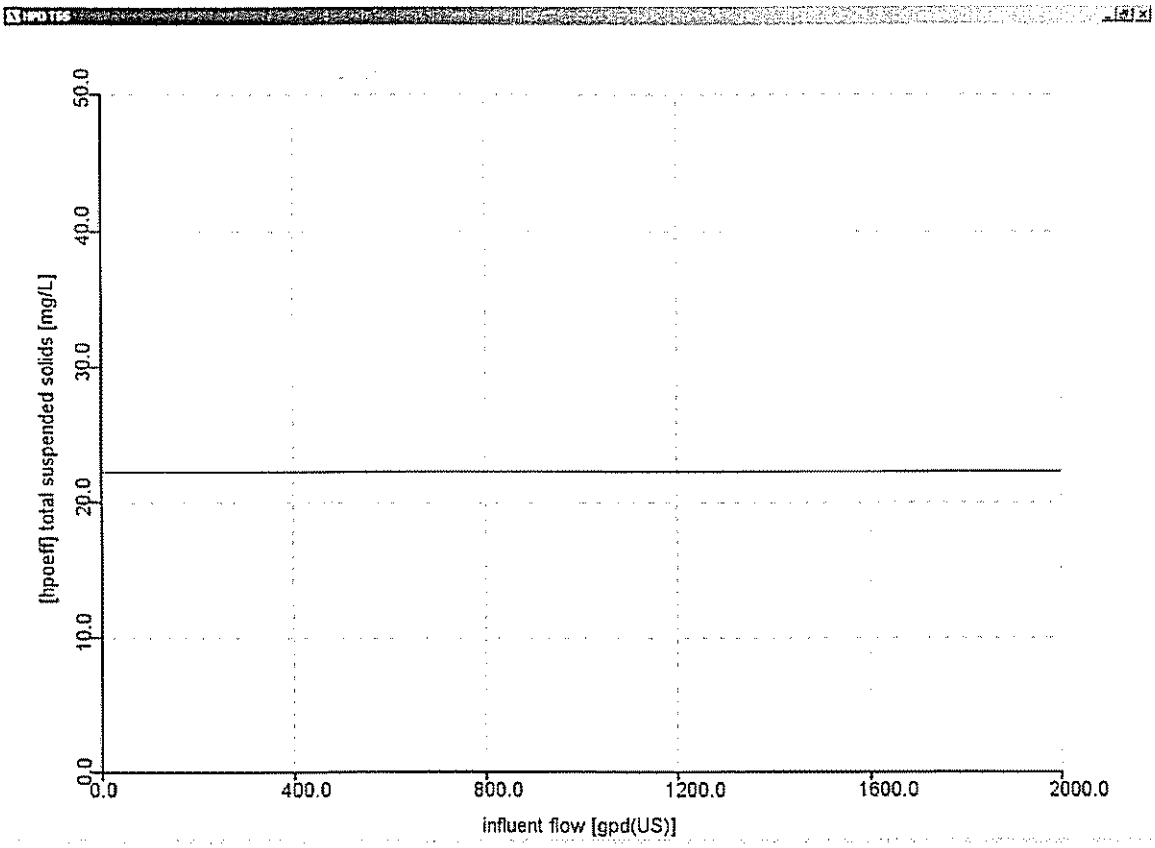


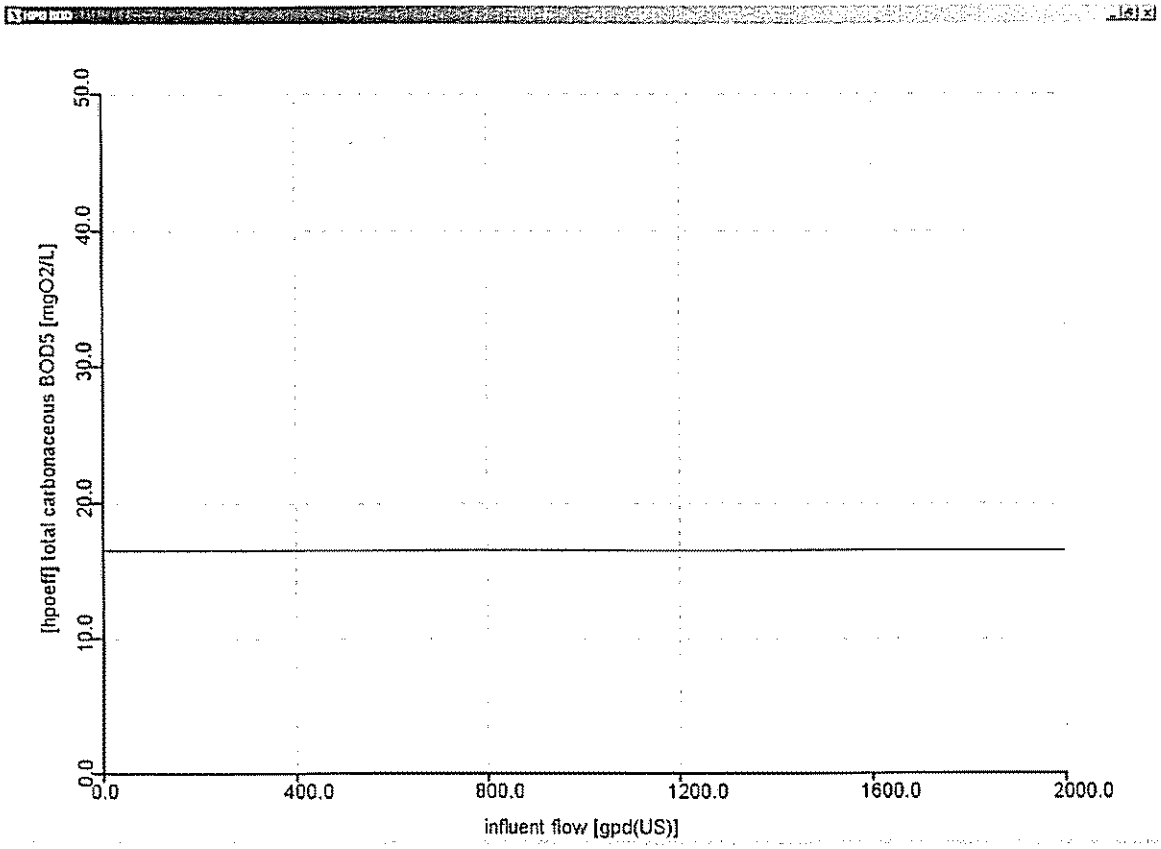
BNR Mixed Liquor Effluent – Ammonia & Nitrate Concentration





HPO Final Effluent – TSS, BOD5, TN, Ammonia, Nitrate

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50.0
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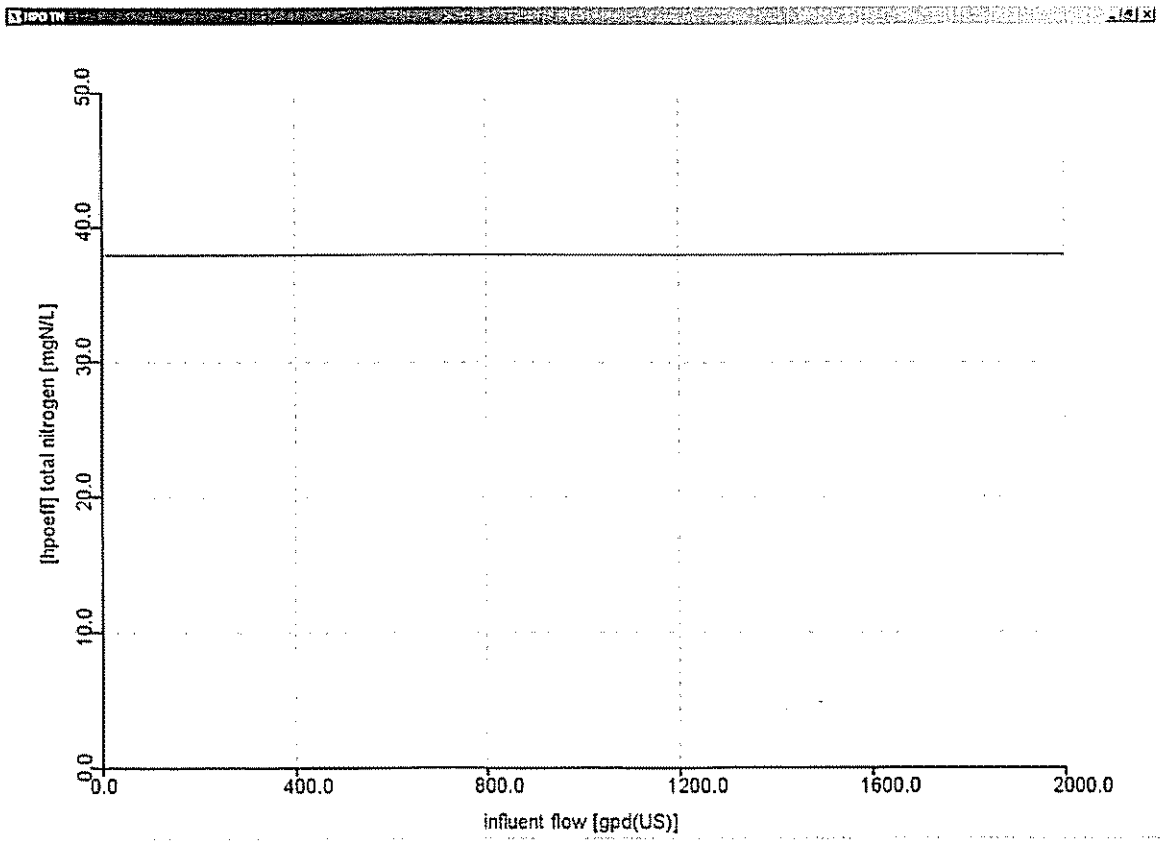
800.0
1200.0
1600.0
2000.0
influent flow [gpd(US)]


[hpoeff] total nitrogen [mgN/L]
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50.0
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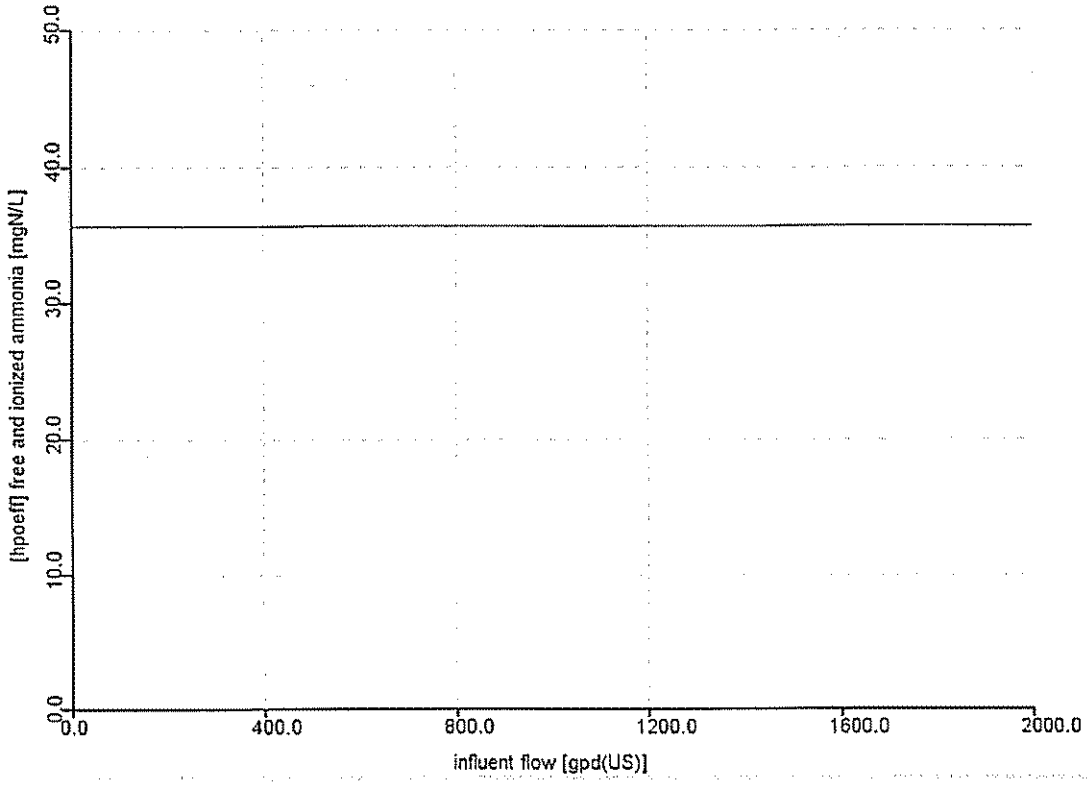
influent flow [gpd(US)]


[hpoeff] free and ionized ammonia [mgN/L]
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30.0
40.0
50.0
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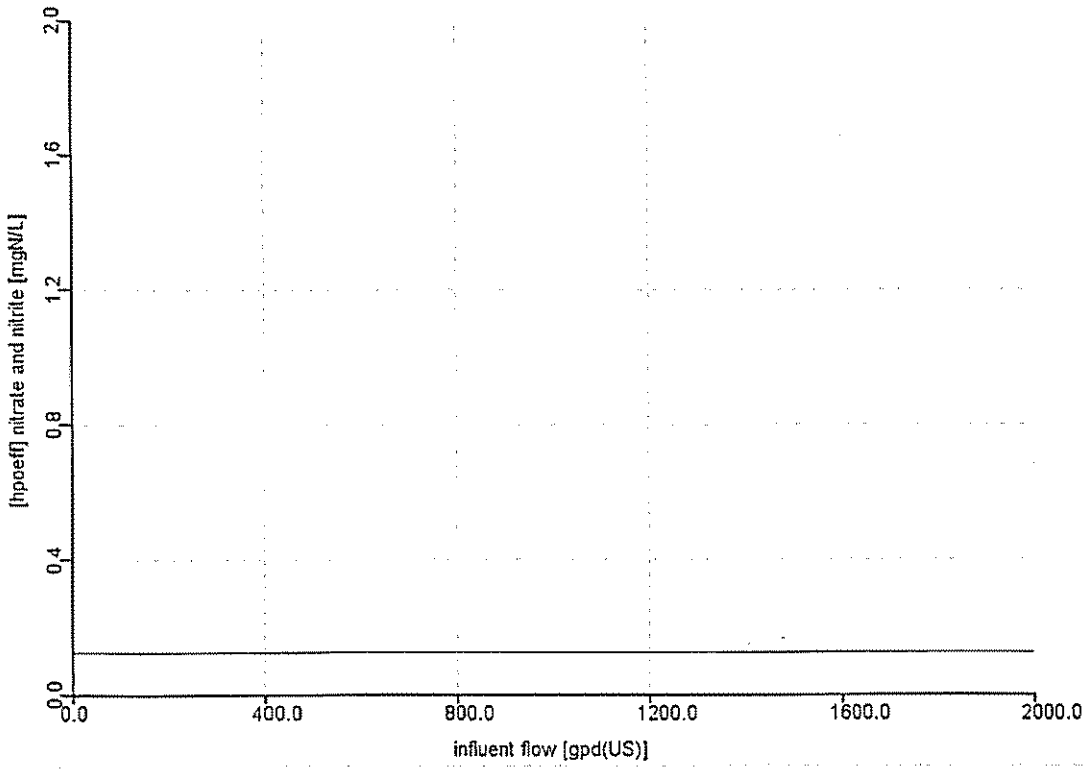
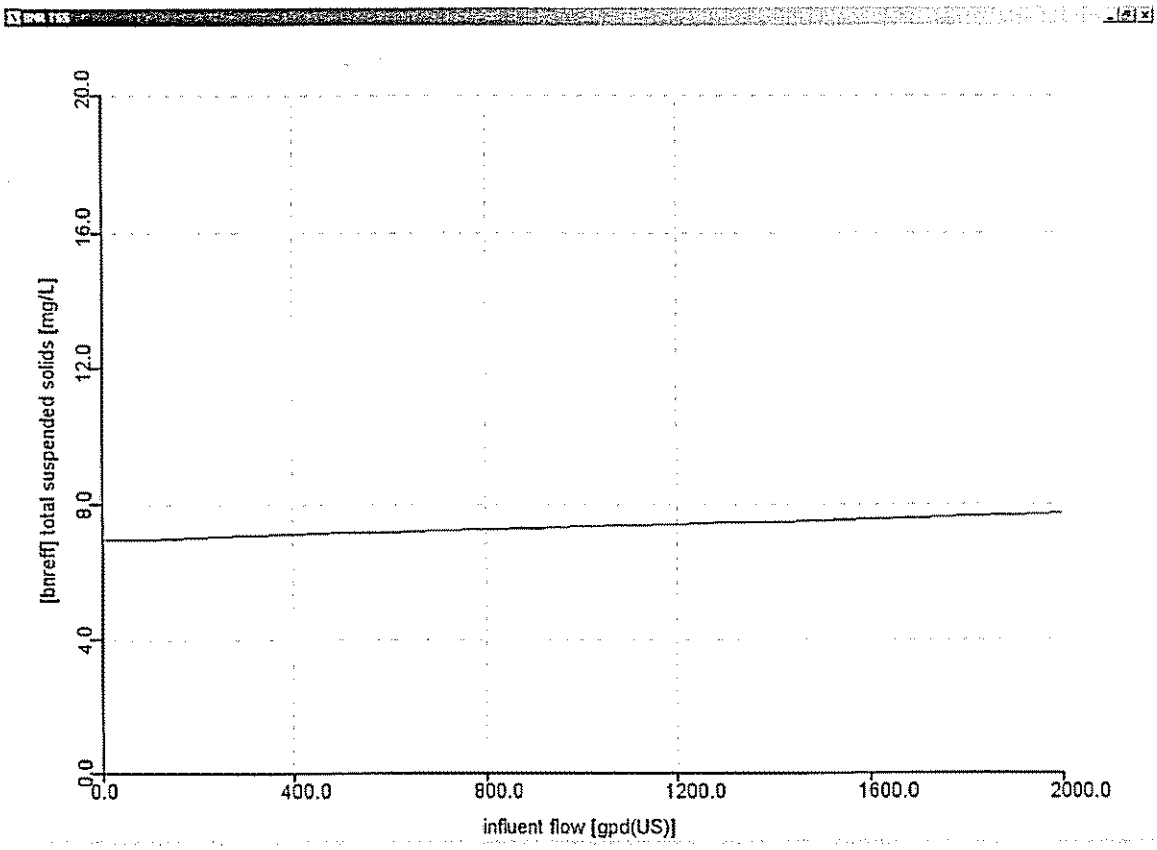
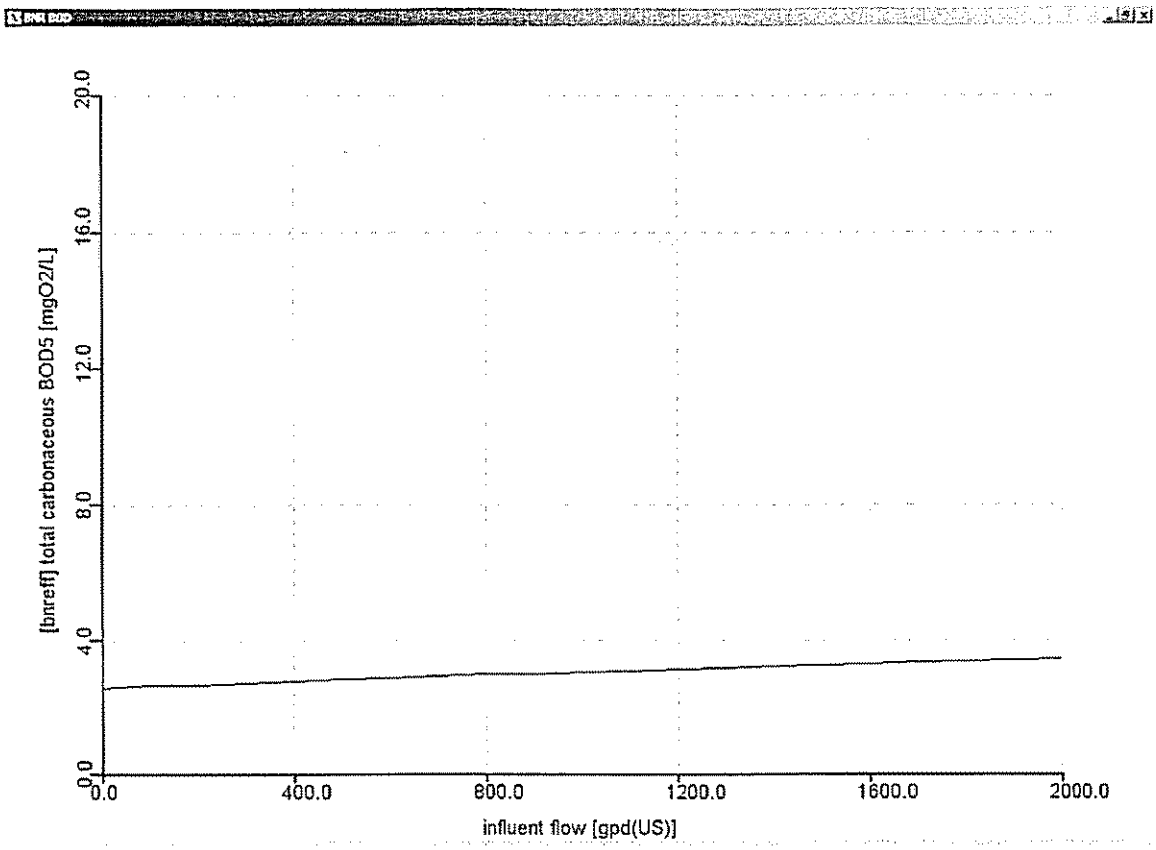
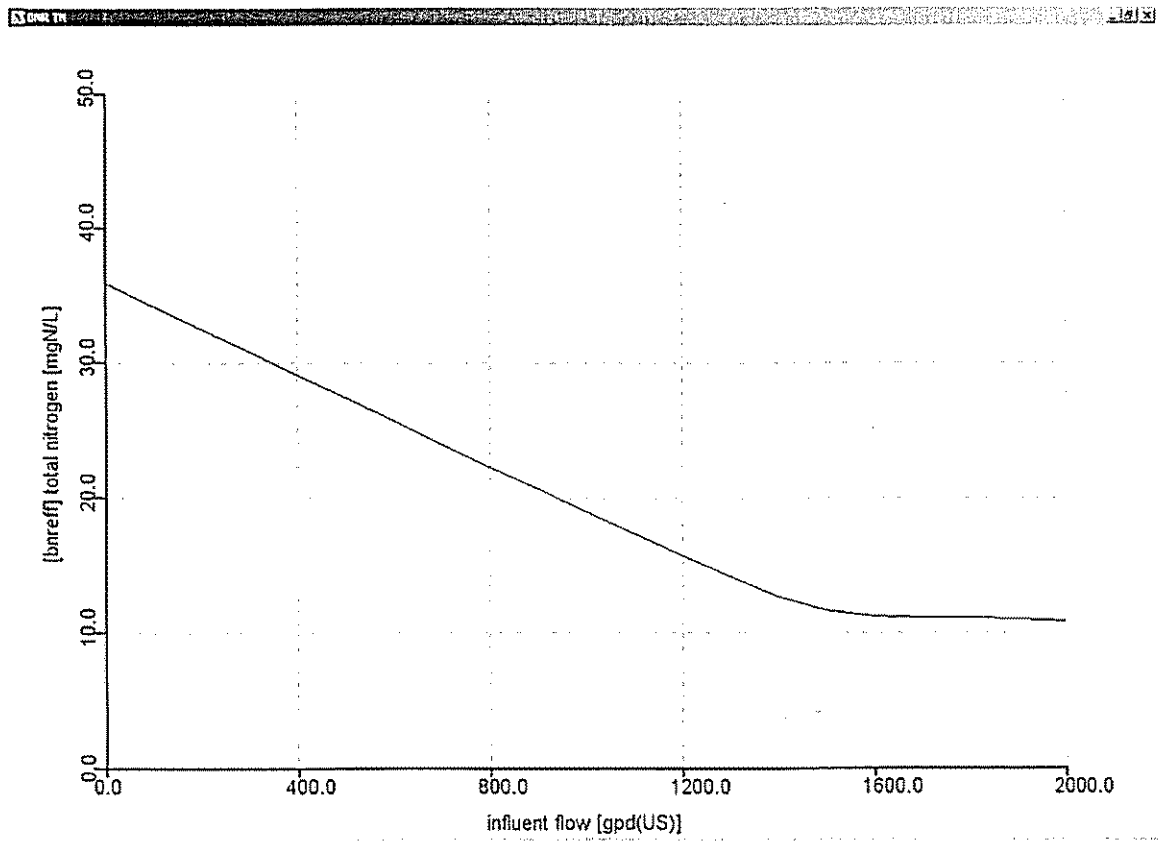
400.0
800.0
1200.0
1600.0
2000.0
influent flow [gpd(US)]

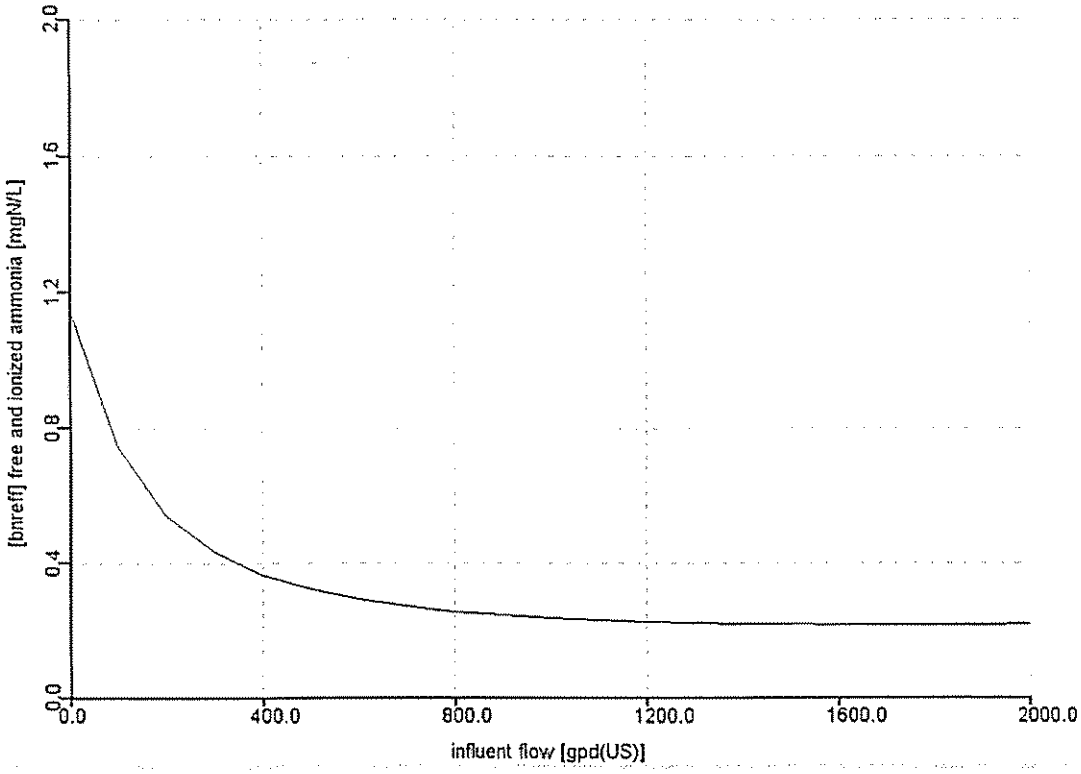

[hpoeff] nitrate and nitrite [mgN/L]
0.0
0.4
0.8
1.2
1.6
2.0
0.0
400.0
800.0
1200.0
1600.0
2000.0
influent flow [gpd(US)]

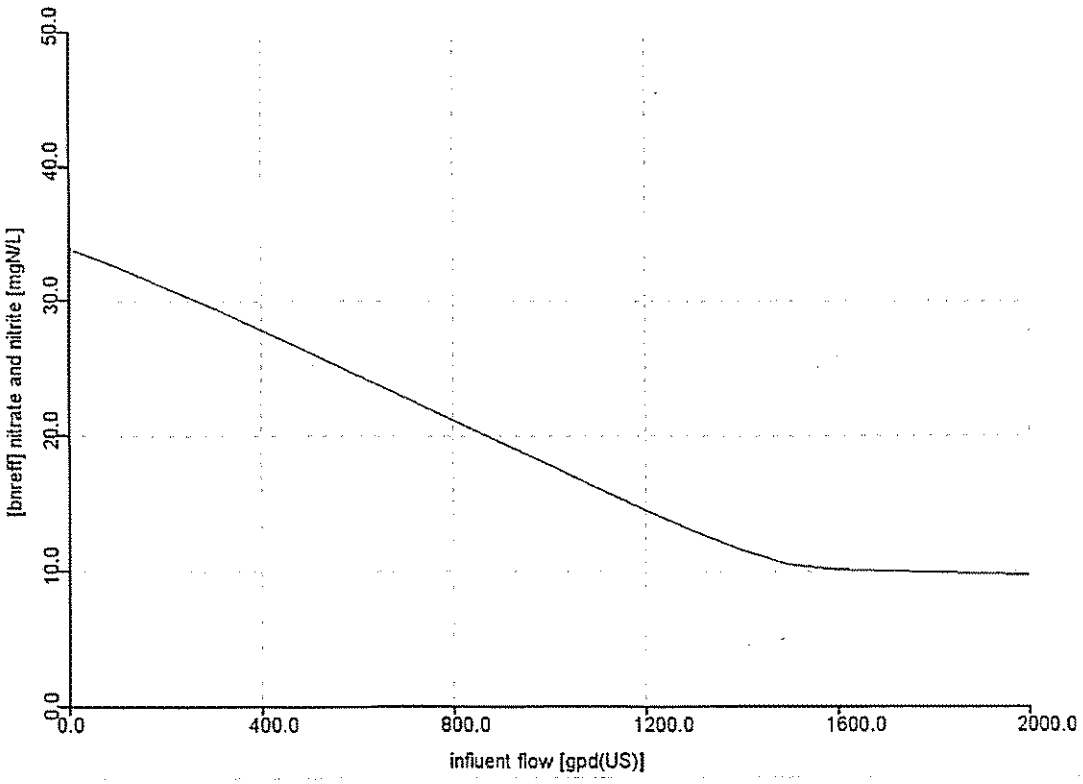
BNR Final Effluent – TSS, BOD5, TN, Ammonia, Nitrate



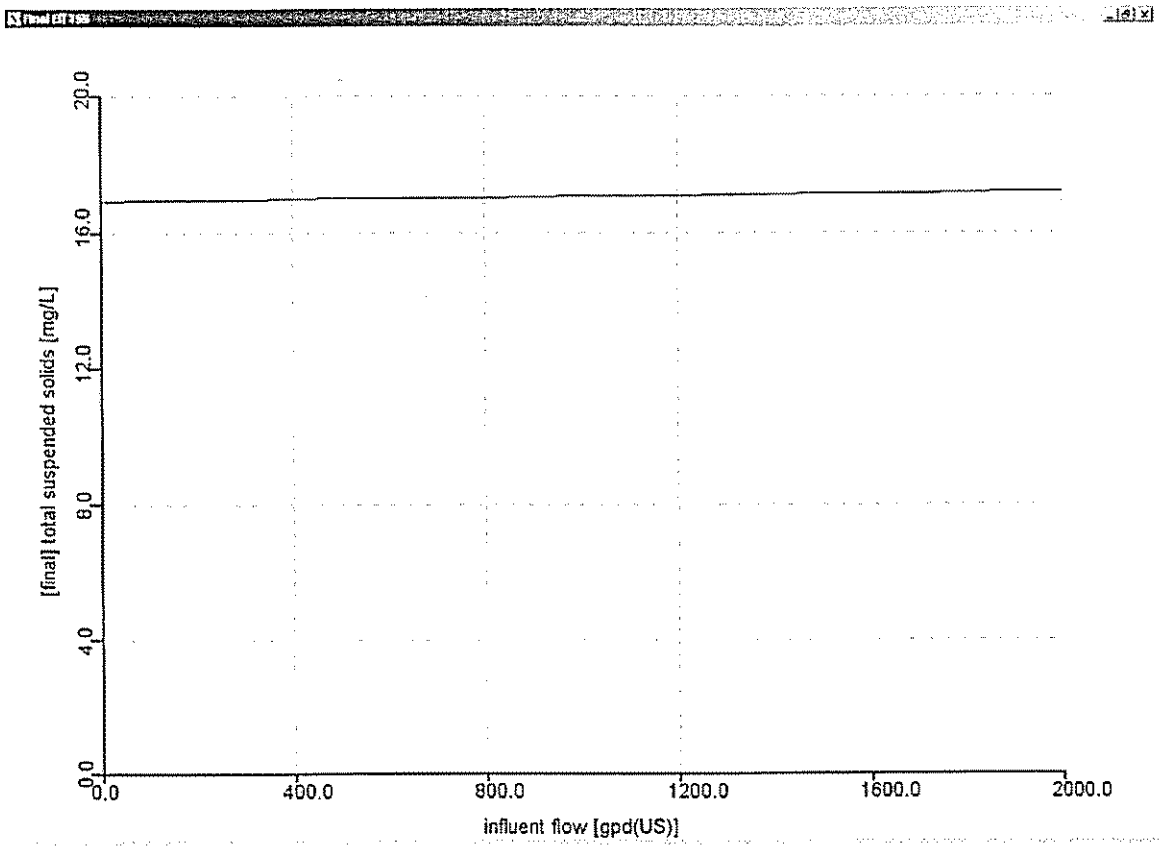

[bnreff] total carbonaceous BOD5 [mgO2/L]
0.0
4.0
8.0
12.0
16.0
20.0
0.0
400.0
800.0
1200.0
1600.0
2000.0
influent flow [gpd(US)]

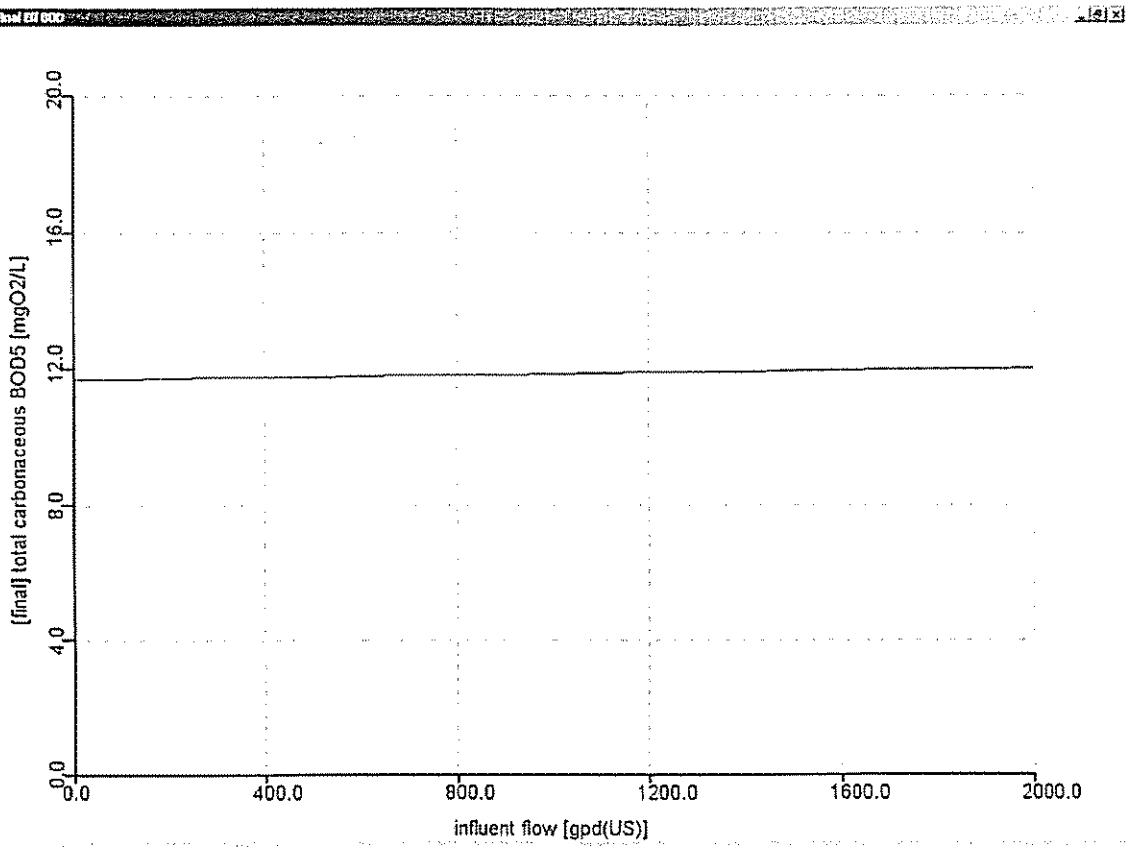

[bnreff] total nitrogen [mgN/L]
0.0
10.0
20.0
30.0
40.0
50.0
0.0
400.0
800.0
1200.0
1600.0
2000.0
influent flow [gpd(US)]

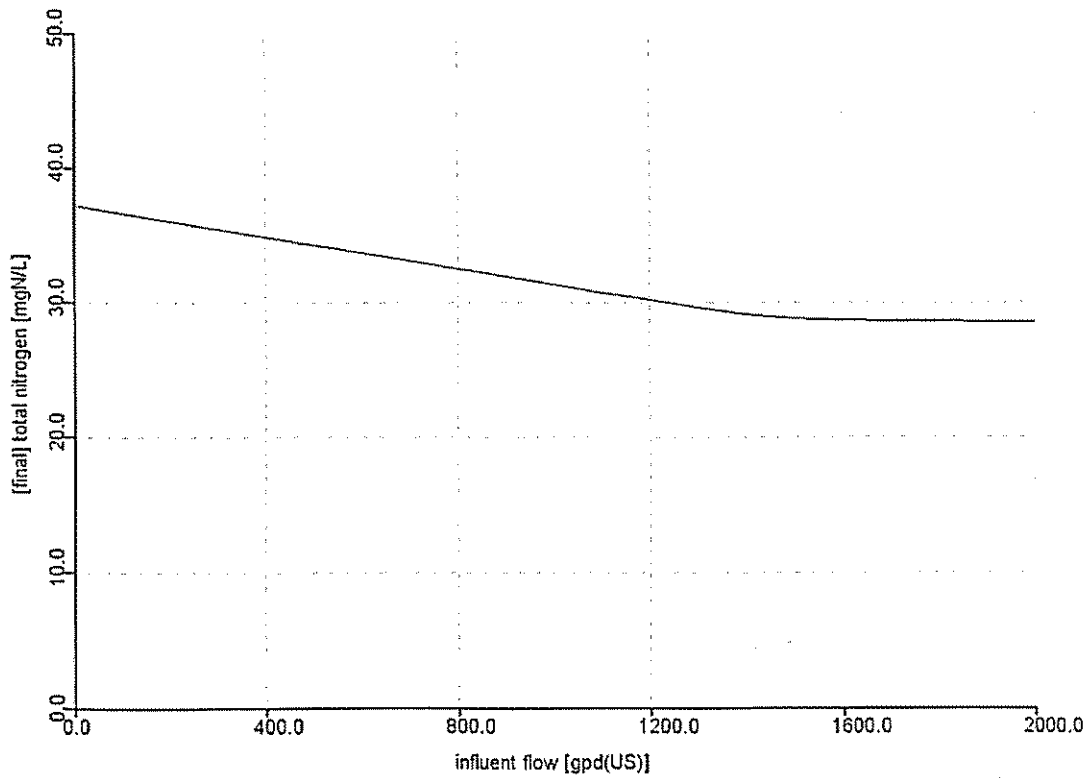

[bnreff] free and ionized ammonia [mgN/L]
0.0
0.4
0.8
1.2
1.6
2.0
0.0
400.0
800.0
1200.0
1600.0
2000.0
influent flow [gpd(US)]

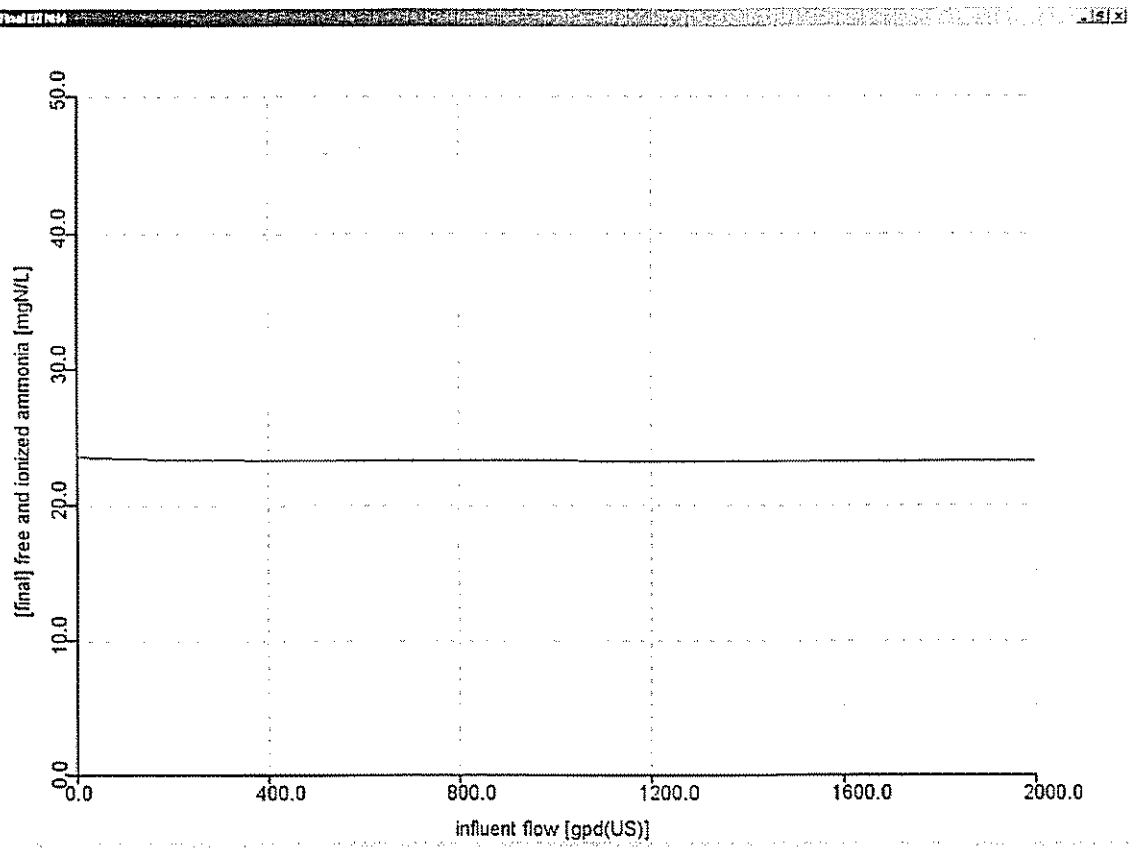

[bnreff] nitrate and nitrite [mgN/L]
0.0
10.0
20.0
30.0
40.0
50.0
0.0
400.0
800.0
1200.0
1600.0
2000.0
influent flow [gpd(US)]

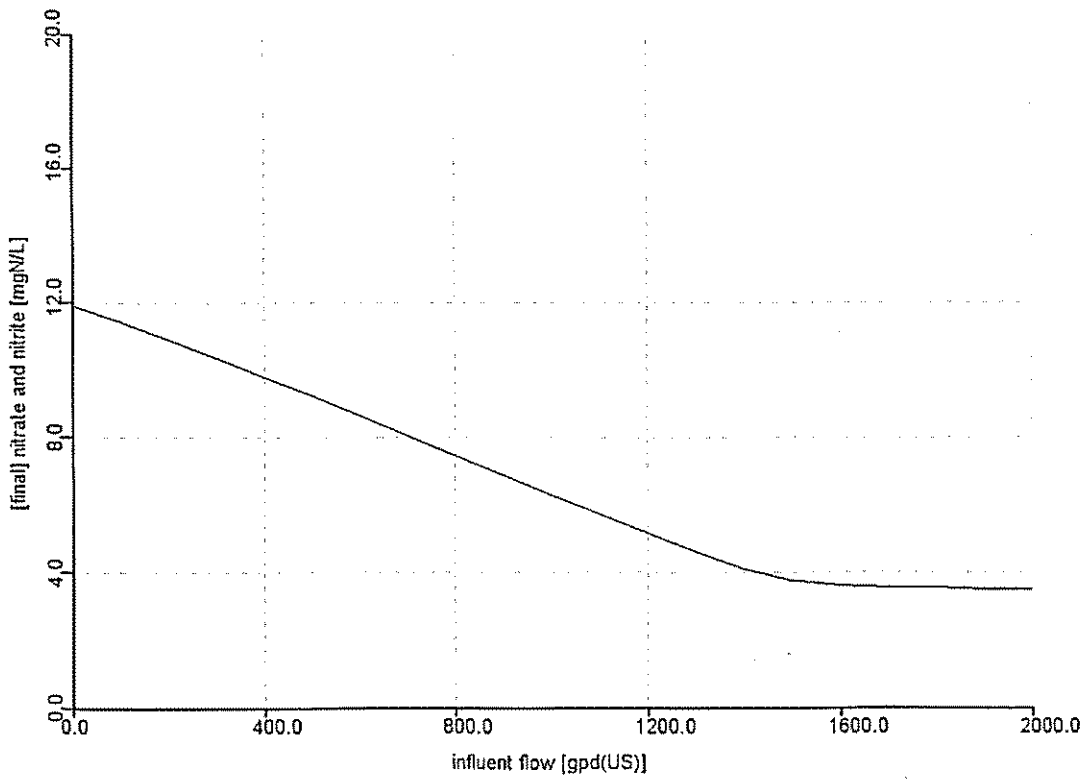
Combined Final Effluent – TSS, BOD5, TN, Ammonia, Nitrate




[final] total carbonaceous BOD5 [mgO2/L]
0.0
4.0
8.0
12.0
16.0
20.0
0.0
400.0
800.0
1200.0
1600.0
2000.0
influent flow [gpd(US)]


[final] total nitrogen [mgN/L]
0.0
10.0
20.0
30.0
40.0
50.0
0.0
400.0
800.0
1200.0
1600.0
2000.0
influent flow [gpd(US)]

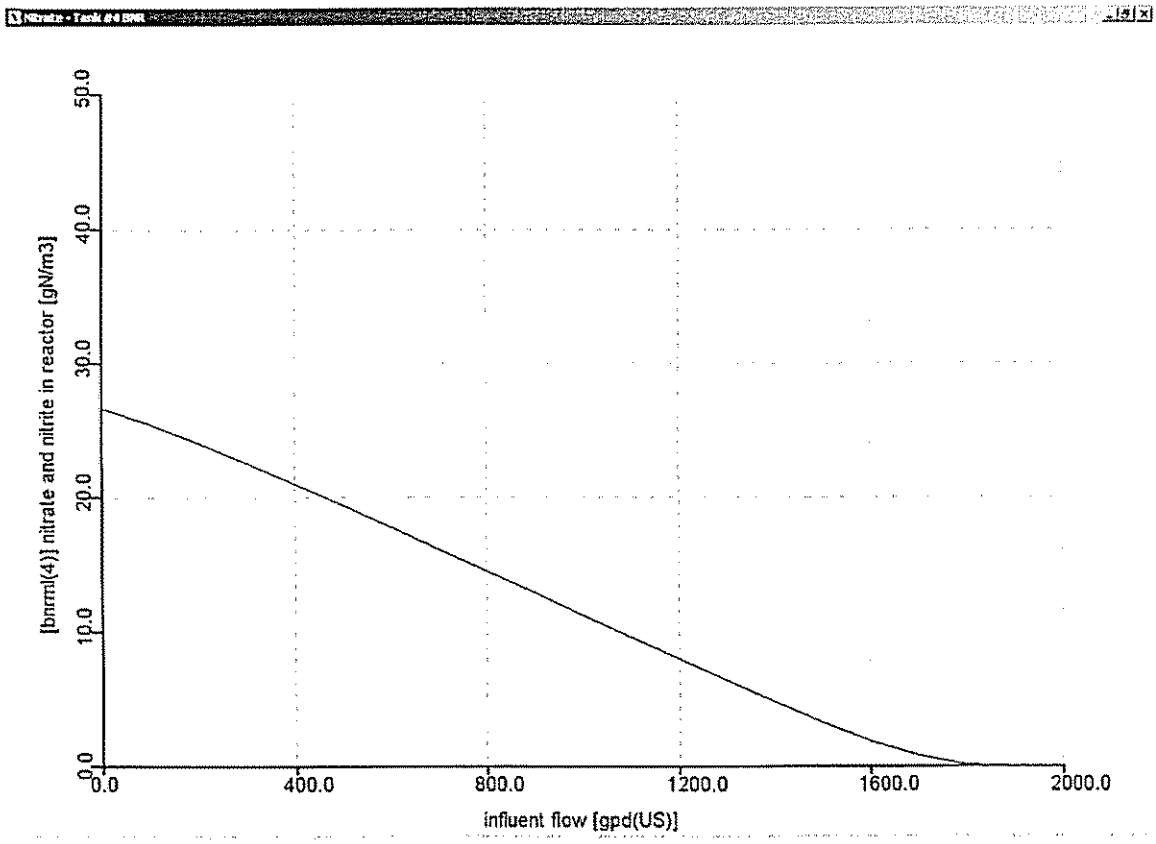

[final] free and ionized ammonia [mgN/L]
0.0
10.0
20.0
30.0
40.0
50.0
0.0
400.0
800.0
1200.0
1600.0
2000.0
influent flow [gpd(US)]


[final] nitrate and nitrite [mgN/L]
0.0
4.0
8.0
12.0
16.0
20.0
0.0
400.0
800.0
1200.0
1600.0
2000.0
influent flow [gpd(US)]

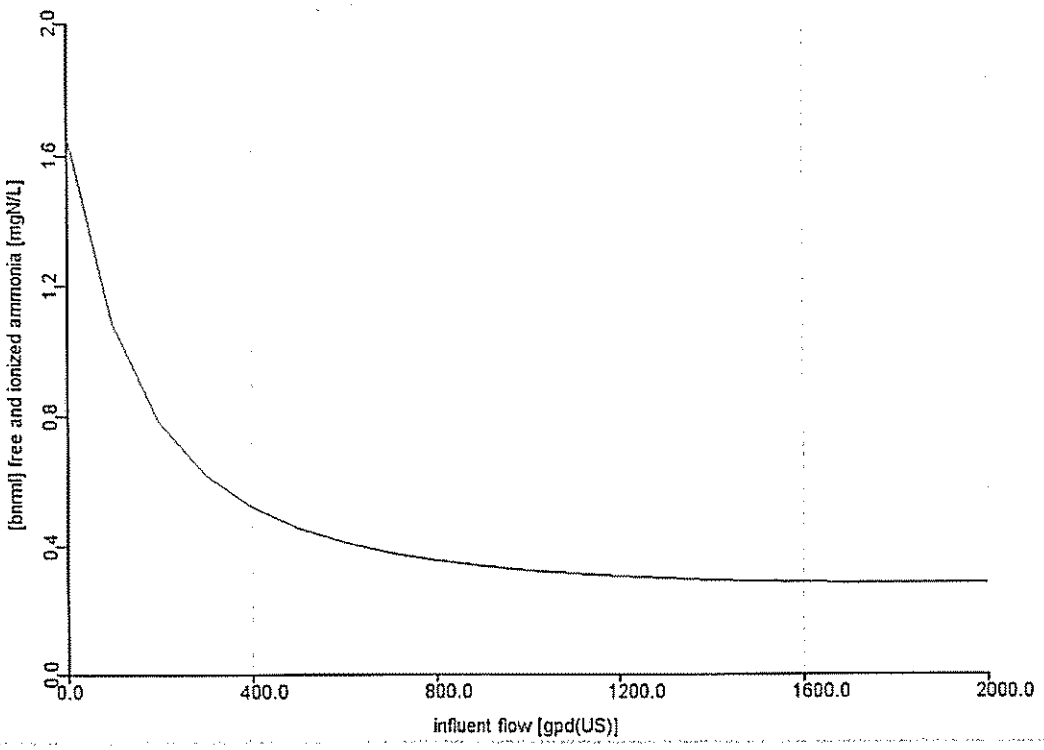
Sensitivity Analysis # 2: Plant Performance vs. Methanol Addition and Maximum Internal Recycle Rate

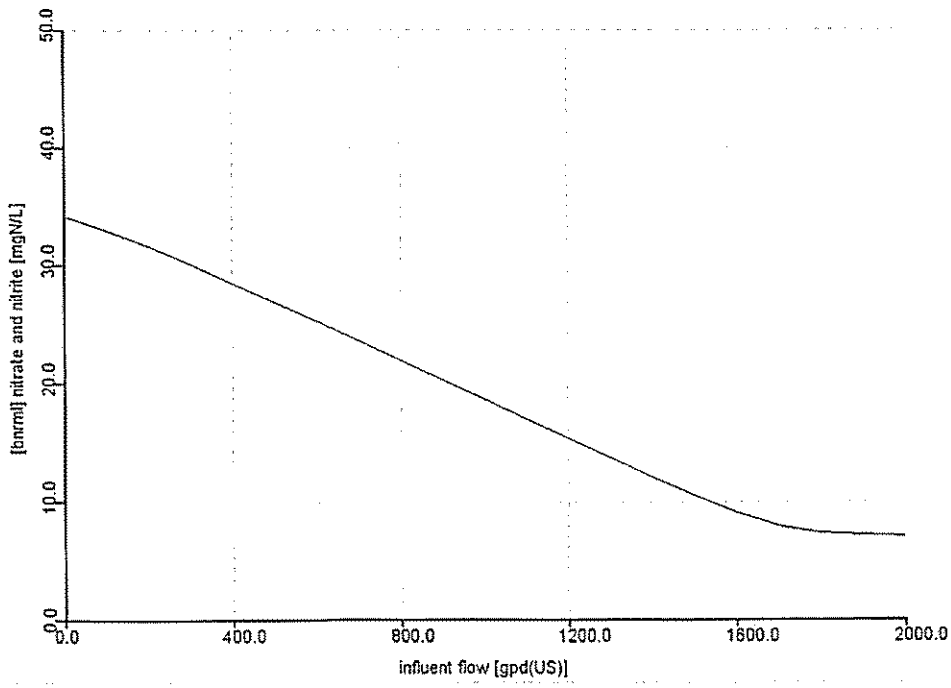
1) HPO FLOW = 25 MGD
2) BNR FLOW = 12.5 MGD
3) CENTRATE FLOW = 200,000 gpd(US)
4) **METHANOL FLOW = 0-2000 gpd(US) (varied on the x-axis)**
5) BNR INTERNAL RECYCLE = 56.2 MGD

Nitrate Concentration – Tank #4 - BNR

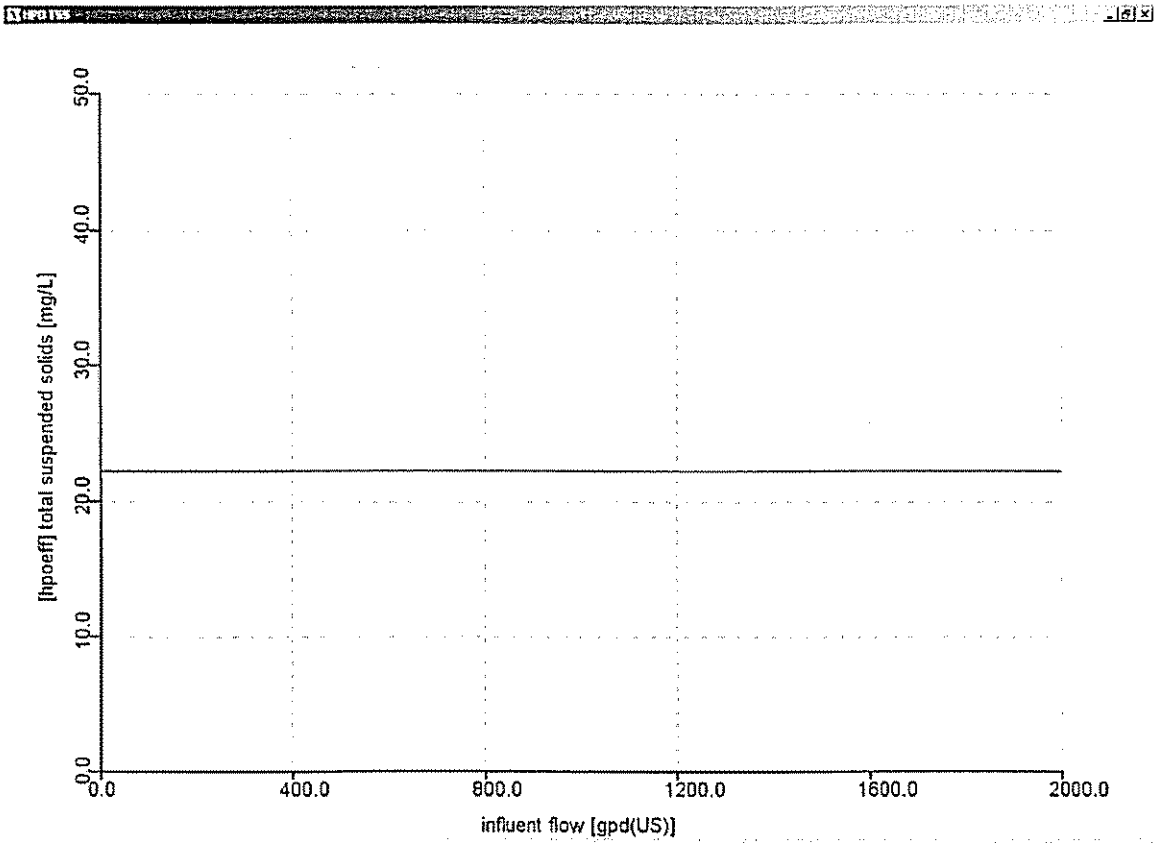


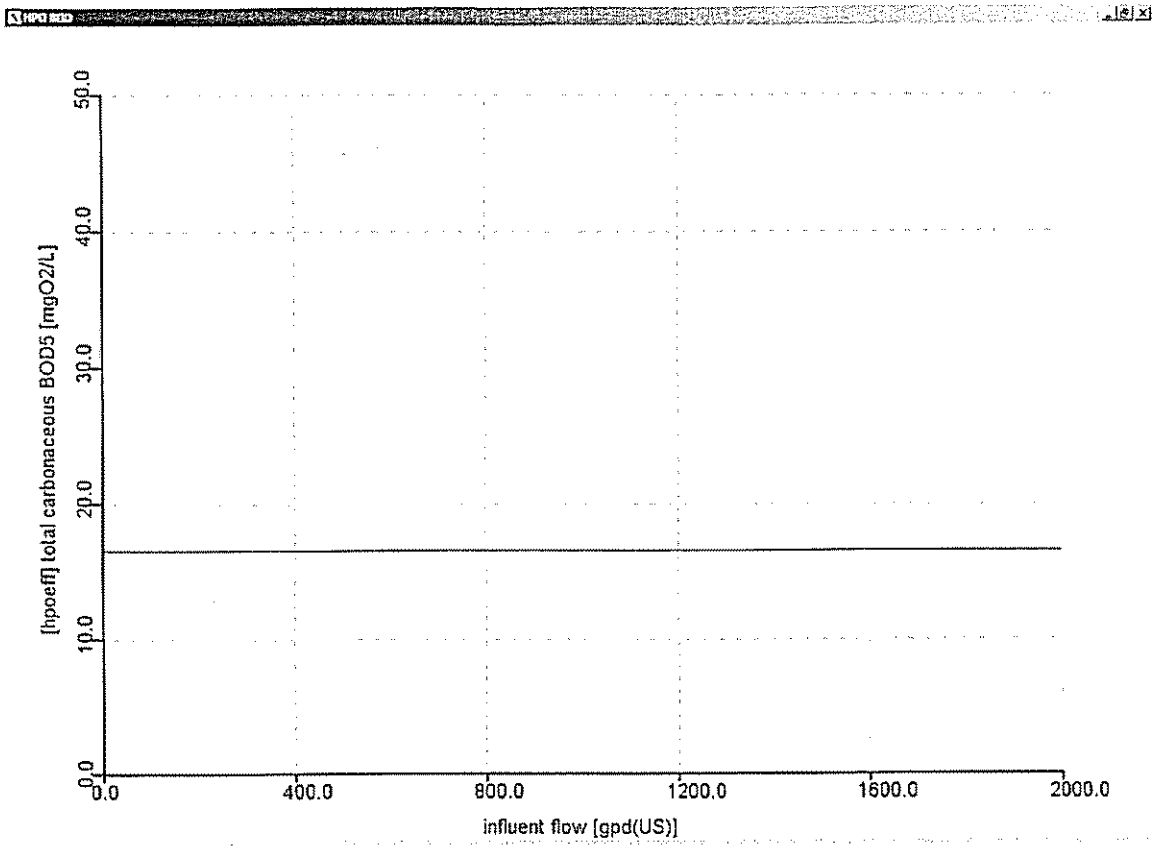
BNR Mixed Liquor Effluent – Ammonia & Nitrate Concentration

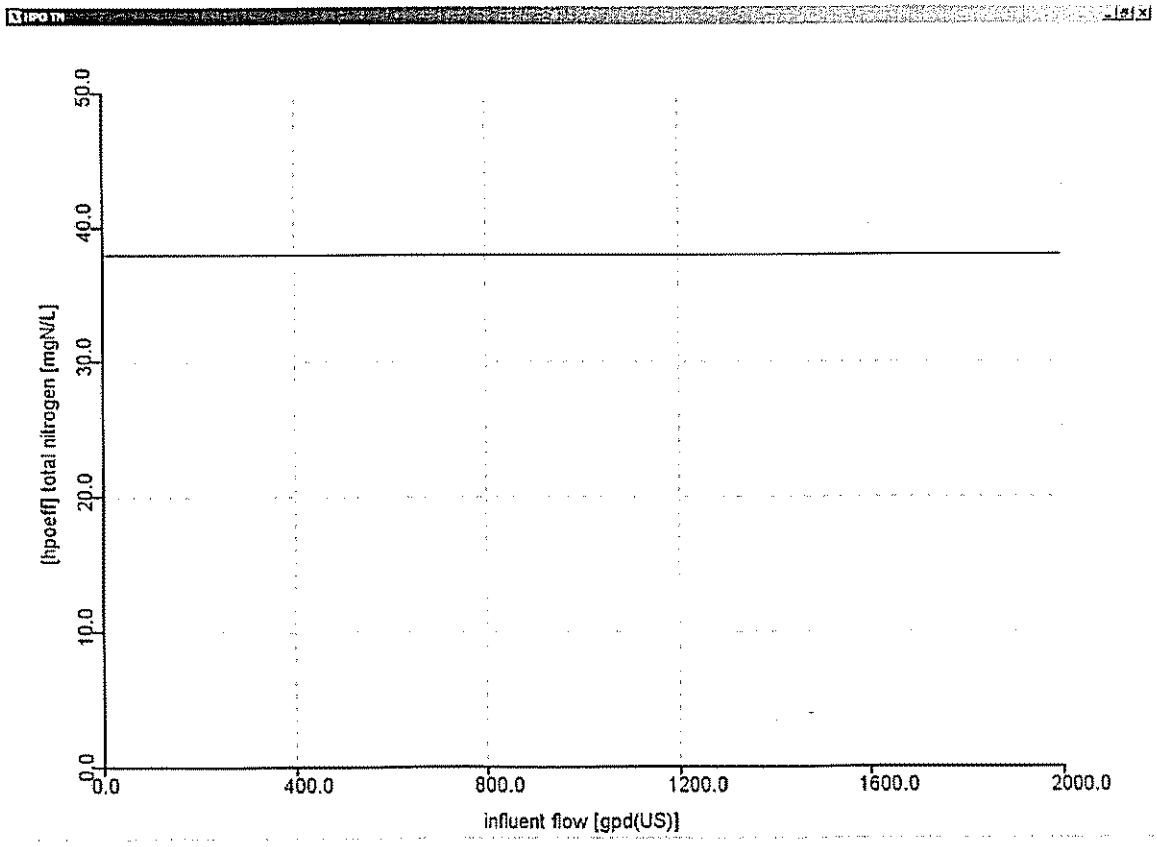


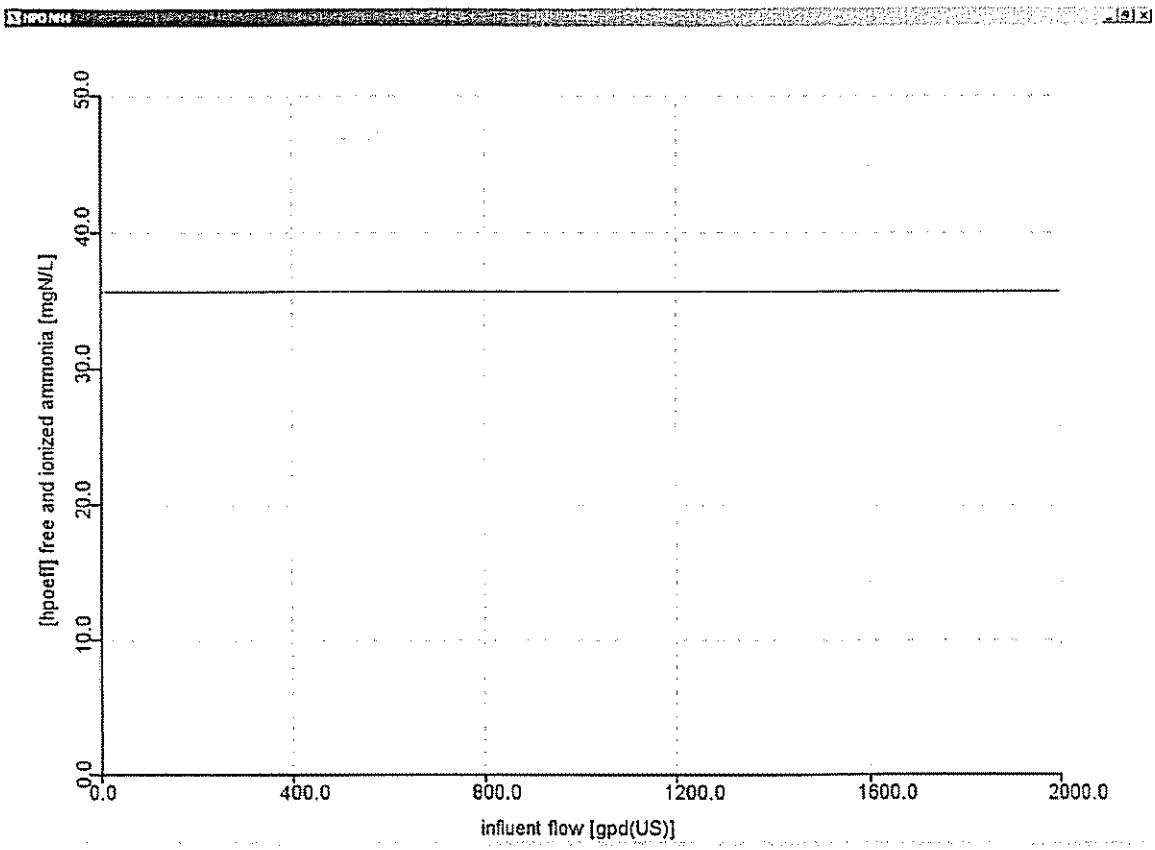


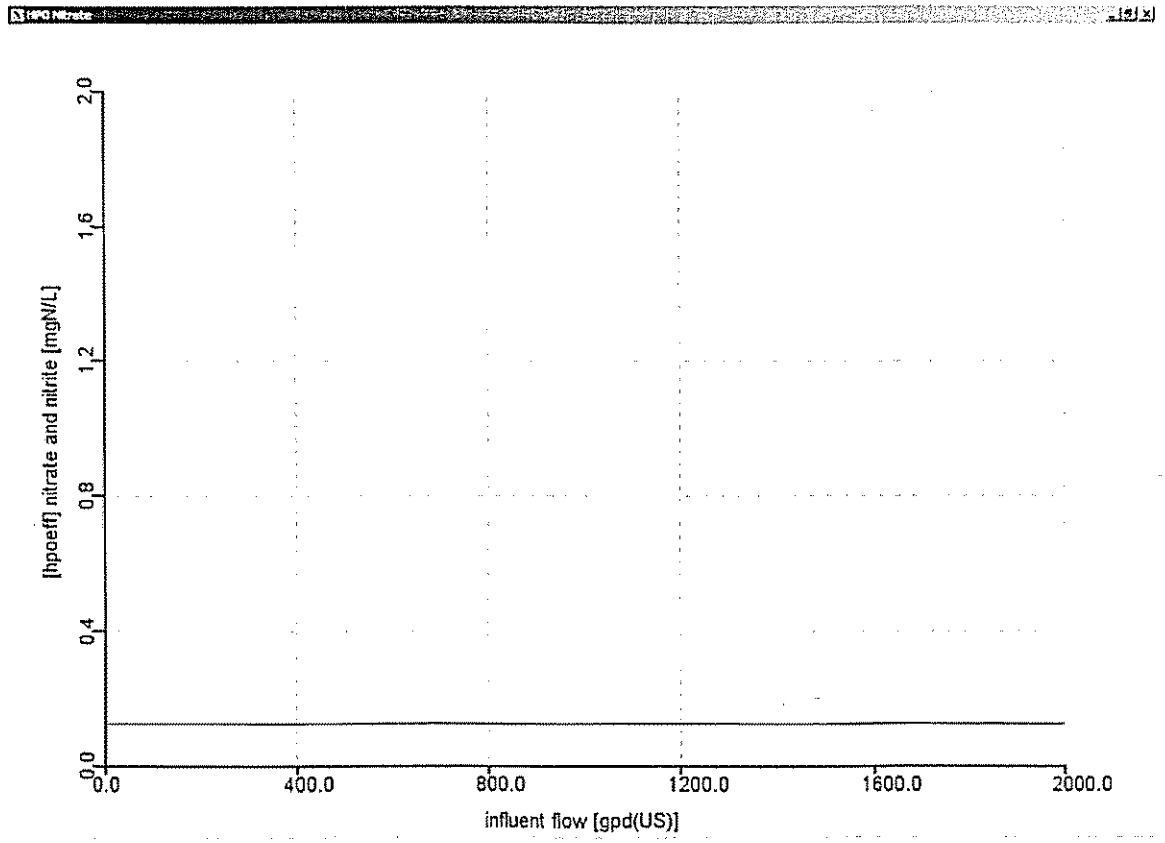
HPO Final Effluent – TSS, BOD5, TN, Ammonia, Nitrate



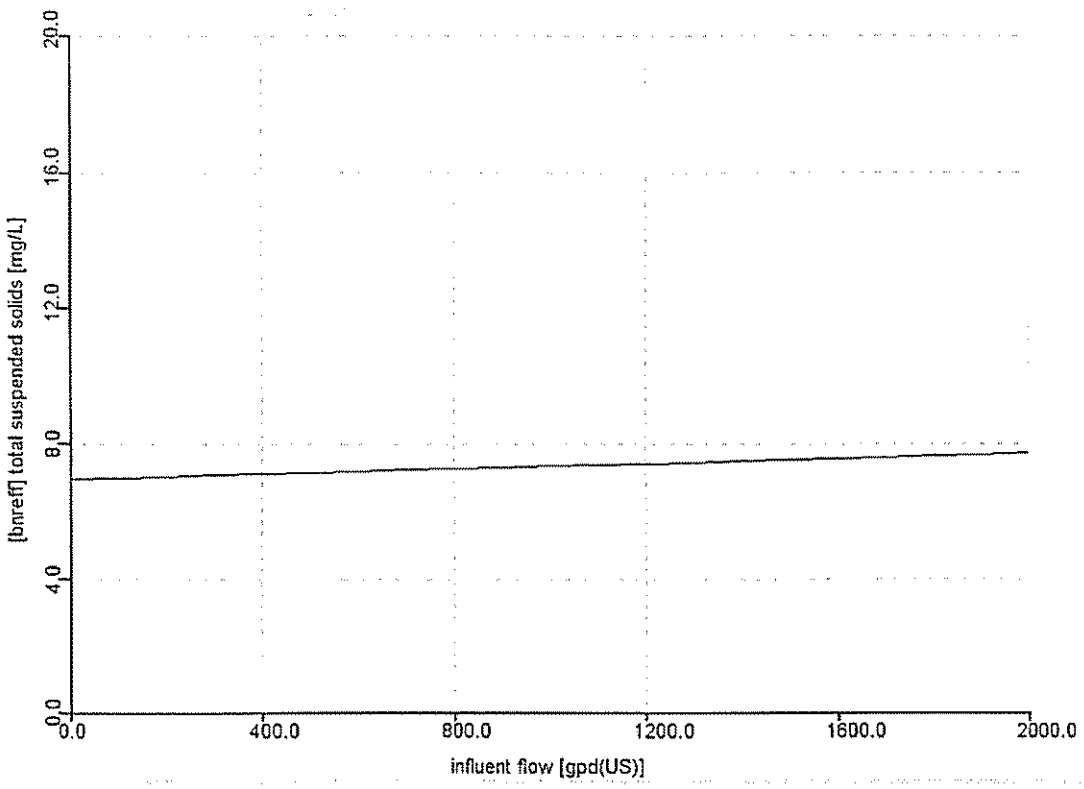

[hpoeff] total carbonaceous BOD5 [mgO2/L]
50.0
40.0
30.0
20.0
10.0
0.0
0.0
400.0
800.0
1200.0
1600.0
2000.0
influent flow [gpd(US)]

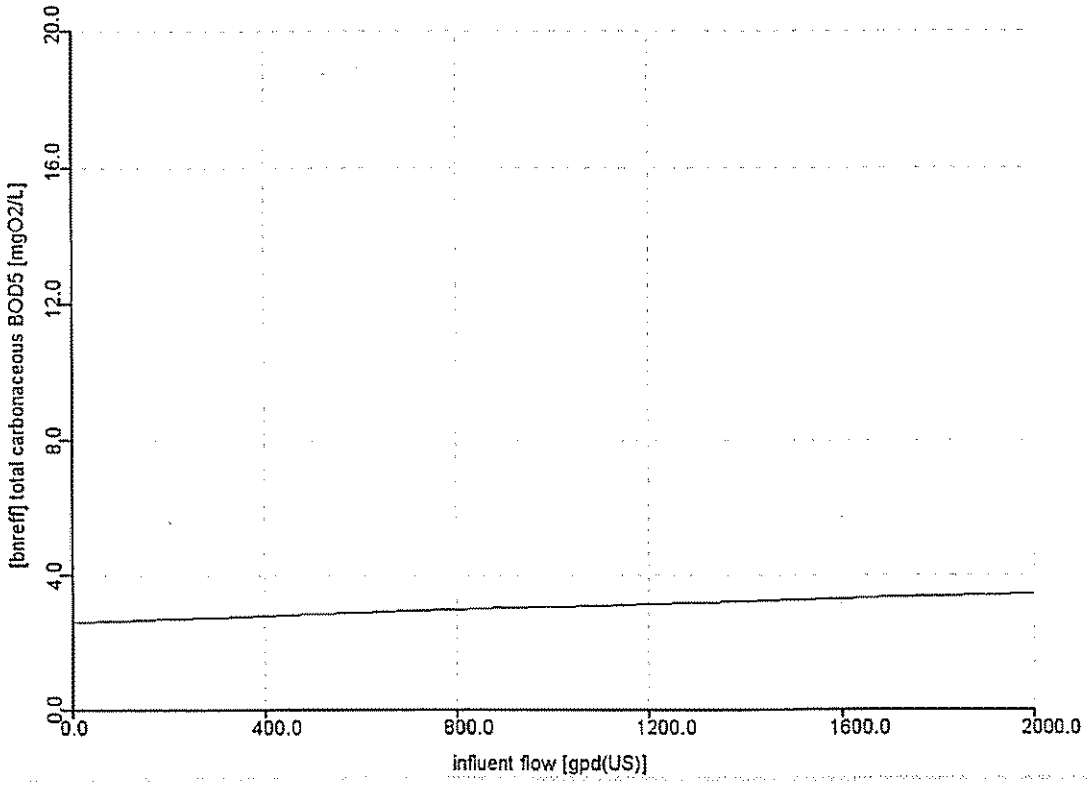

[hpoeff] total nitrogen [mgN/L]
50.0
40.0
30.0
20.0
10.0
0.0
0.0
400.0
800.0
1200.0
1600.0
2000.0
influent flow [gpd(US)]

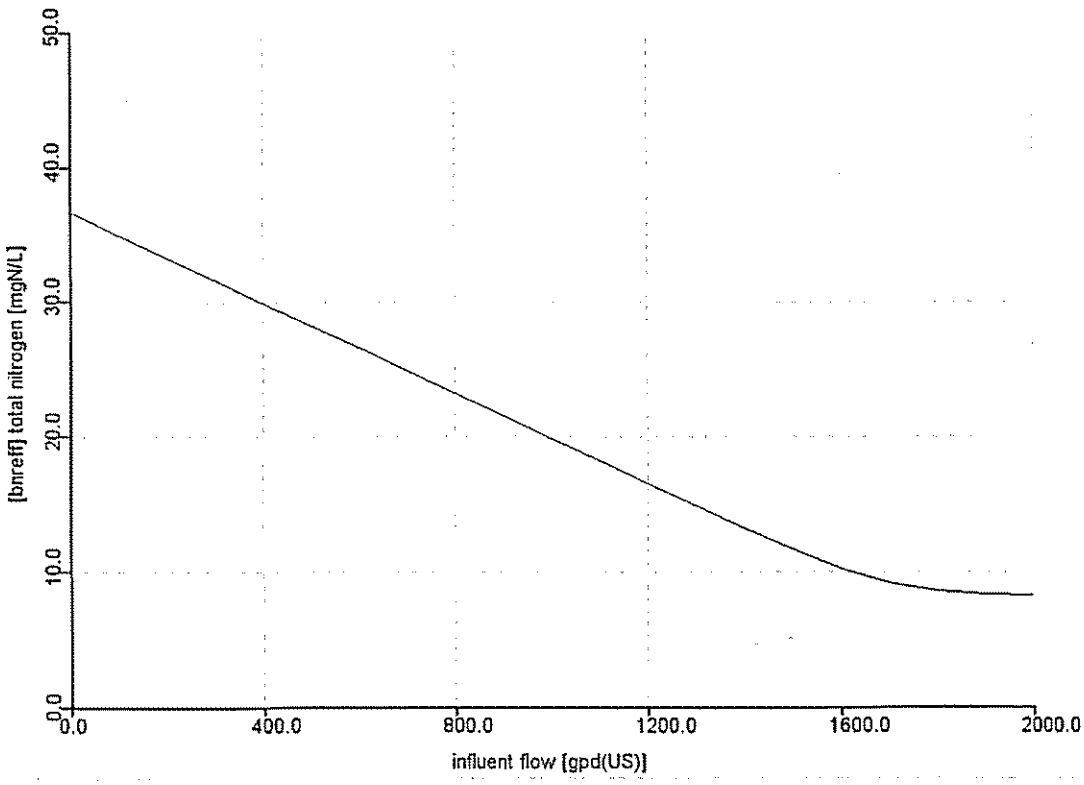

[hpoeff] free and ionized ammonia [mgN/L]
0.0
10.0
20.0
30.0
40.0
50.0
0.0
400.0
800.0
1200.0
1600.0
2000.0
influent flow [gpd(US)]

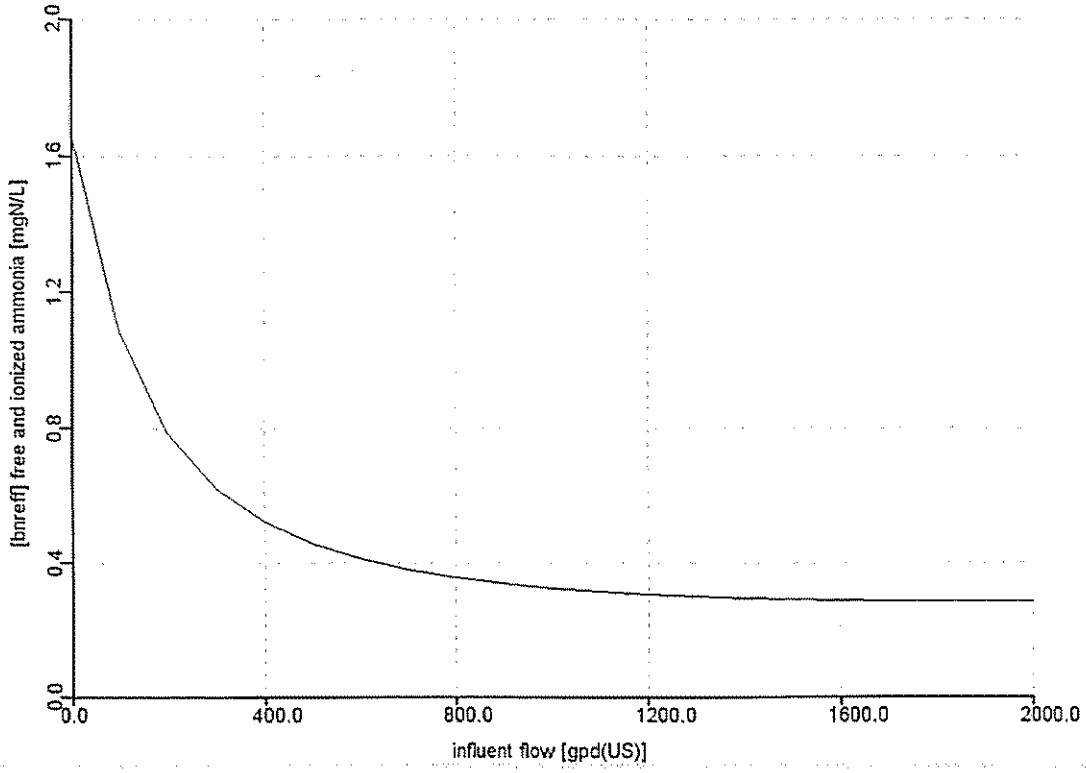

[hpoeff] nitrate and nitrite [mgN/L]
0.0
0.4
0.8
1.2
1.6
2.0
0.0
400.0
800.0
1200.0
1600.0
2000.0
influent flow [gpd(US)]

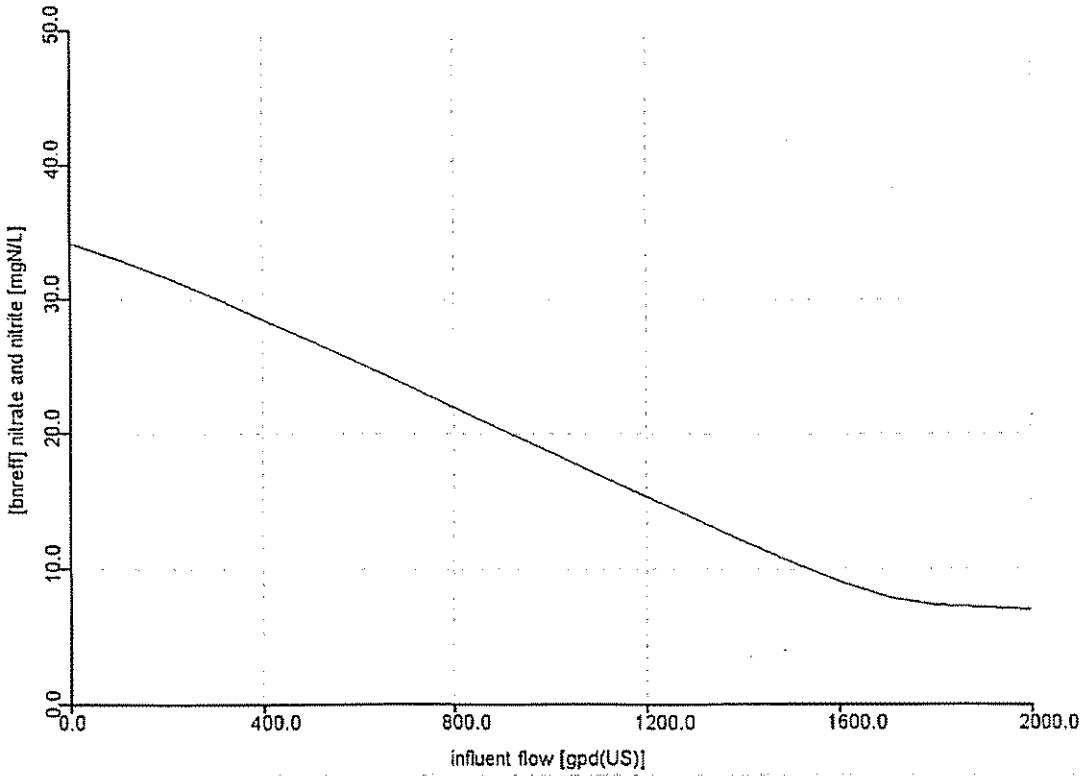
BNR Final Effluent – TSS, BOD5, TN, Ammonia, Nitrate



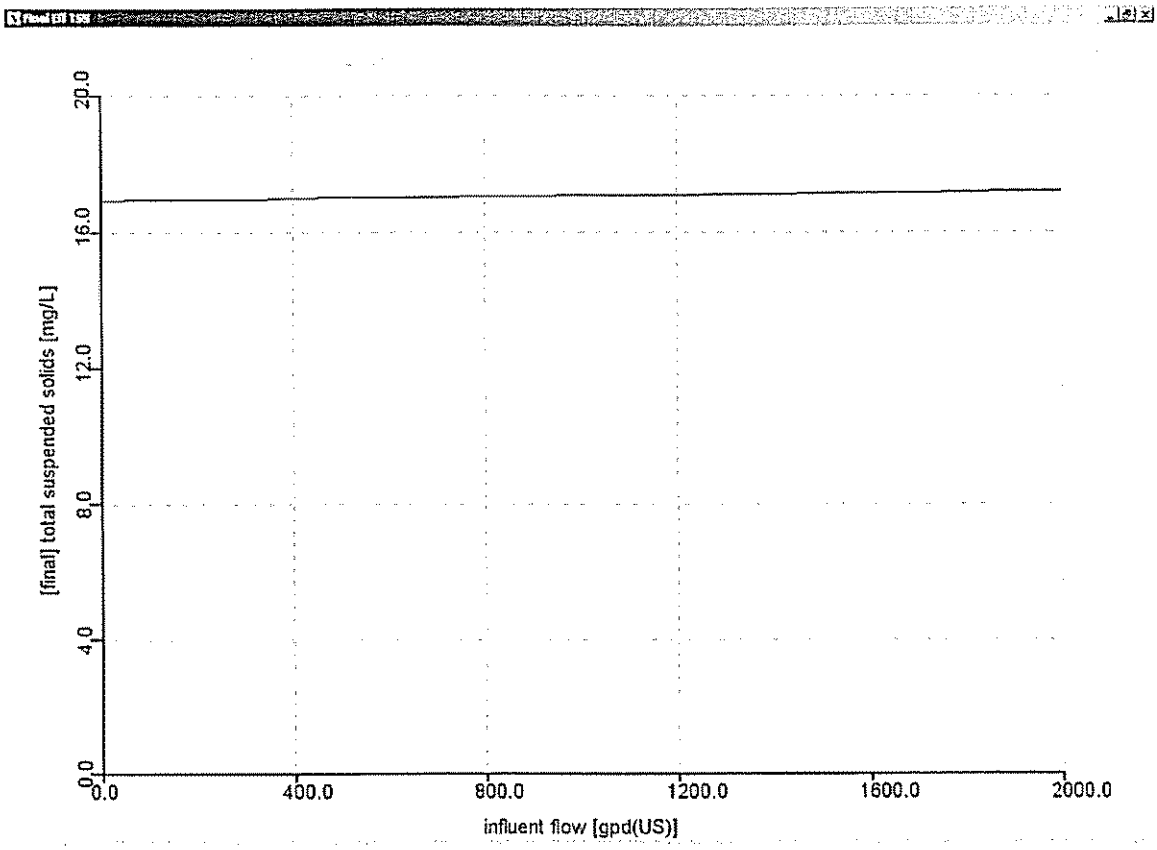

[bnreff] total carbonaceous BOD5 [mgO2/L]
0.0
4.0
8.0
12.0
16.0
20.0
0.0
400.0
800.0
1200.0
1600.0
2000.0
influent flow [gpd(US)]

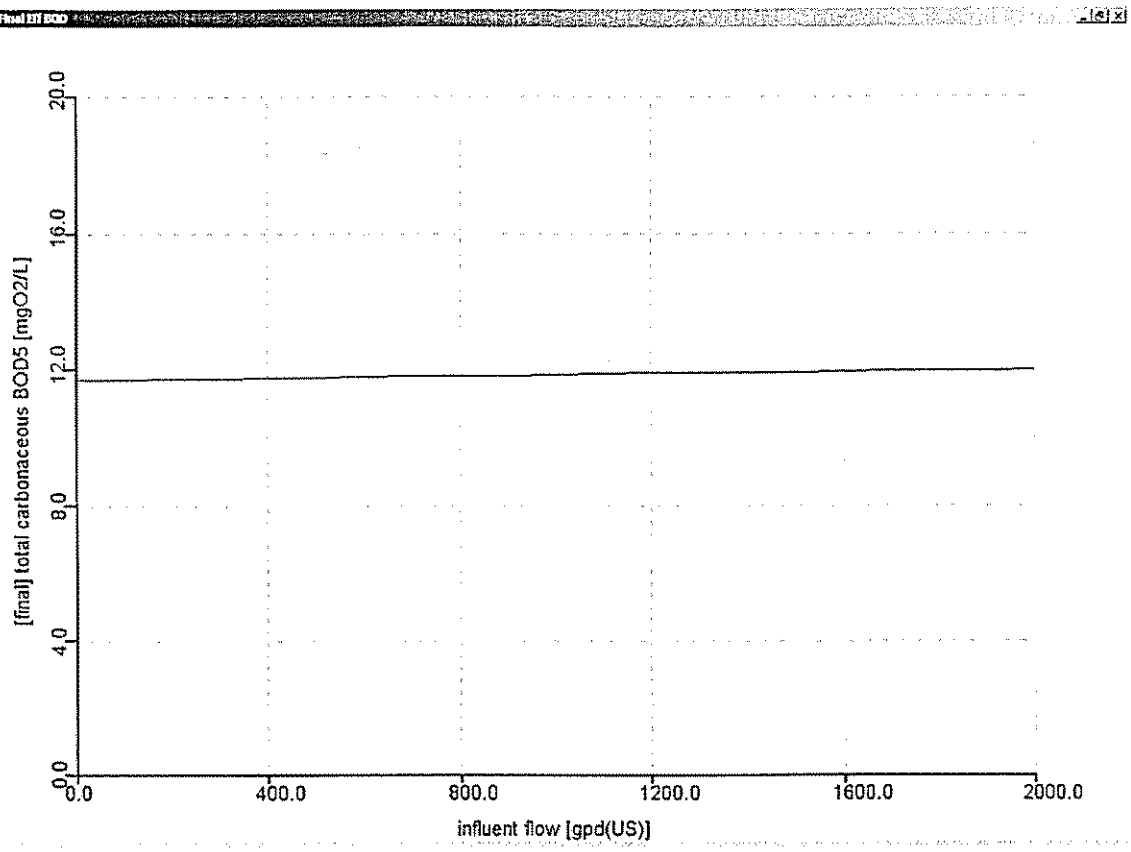

[bnreff] total nitrogen [mgN/L]
0.0
10.0
20.0
30.0
40.0
50.0
0.0
400.0
800.0
1200.0
1600.0
2000.0
influent flow [gpd(US)]

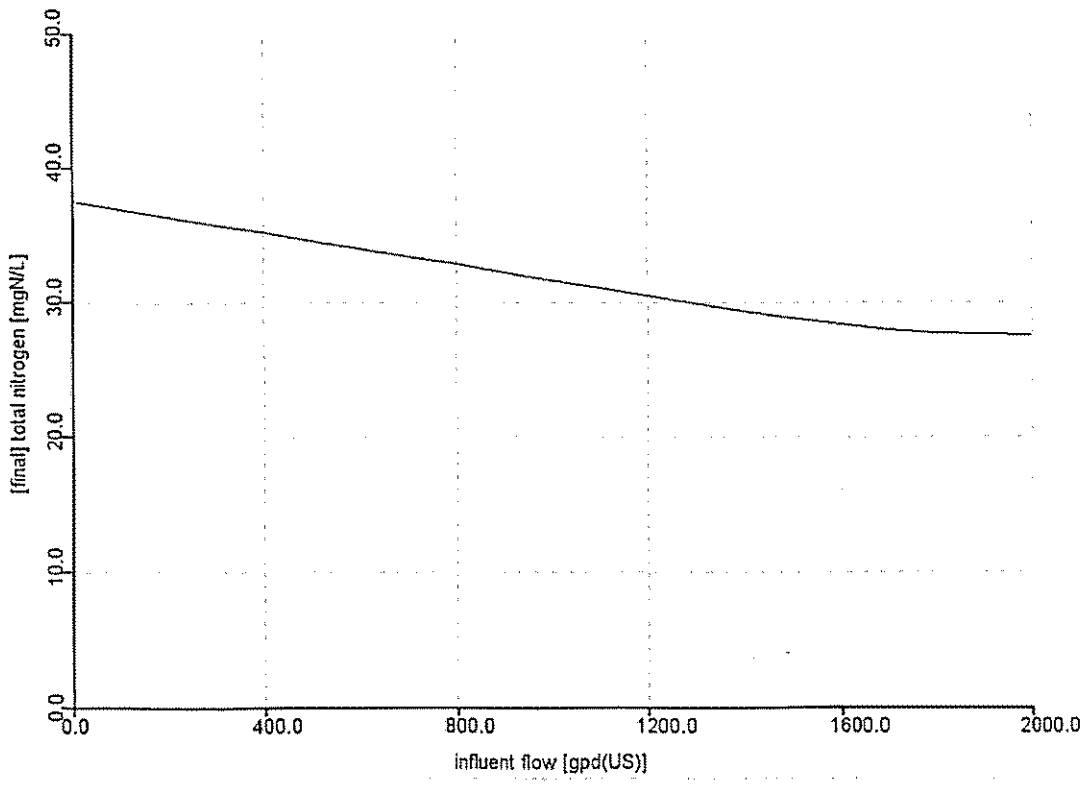

[bnreff] free and ionized ammonia [mgN/L]
0.0
0.4
0.8
1.2
1.6
2.0
0.0
400.0
800.0
1200.0
1600.0
2000.0
influent flow [gpd(US)]

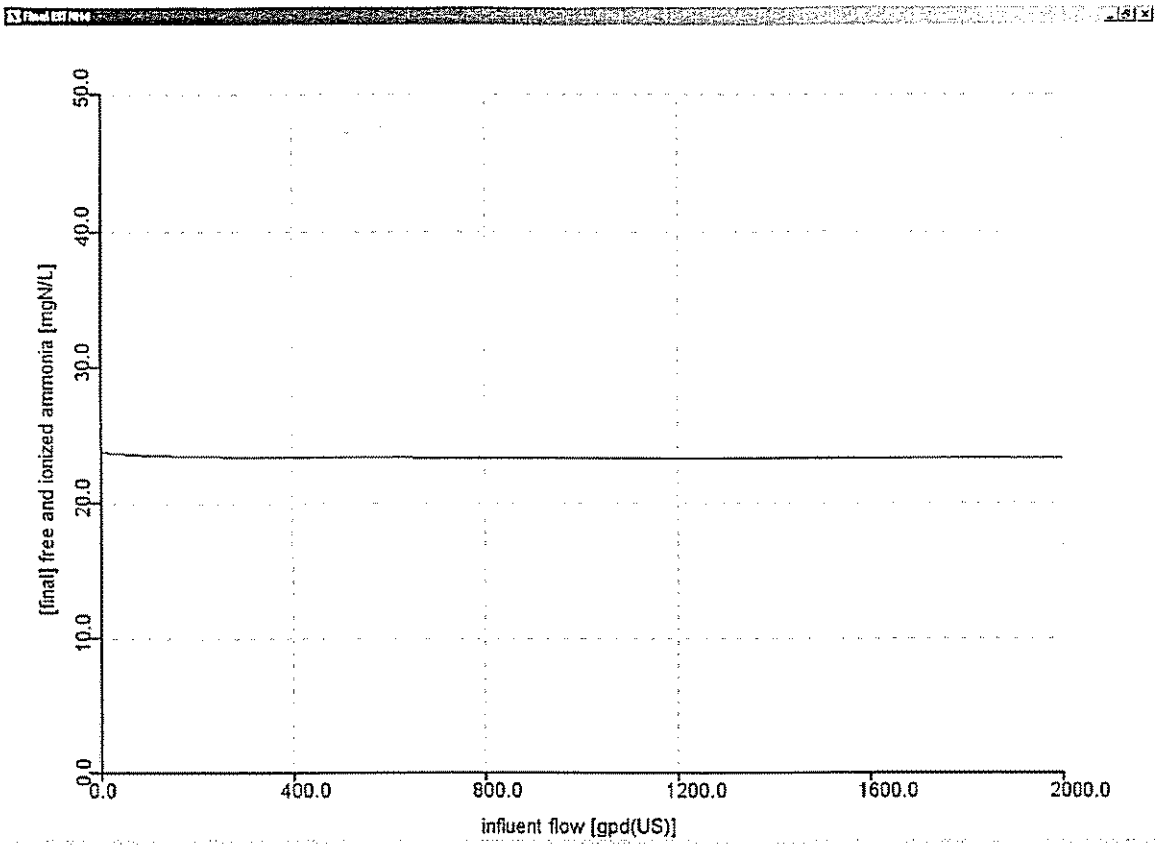

[bnreff] nitrate and nitrite [mgN/L]
0.0
10.0
20.0
30.0
40.0
50.0
0.0
400.0
800.0
1200.0
1600.0
2000.0
influent flow [gpd(US)]

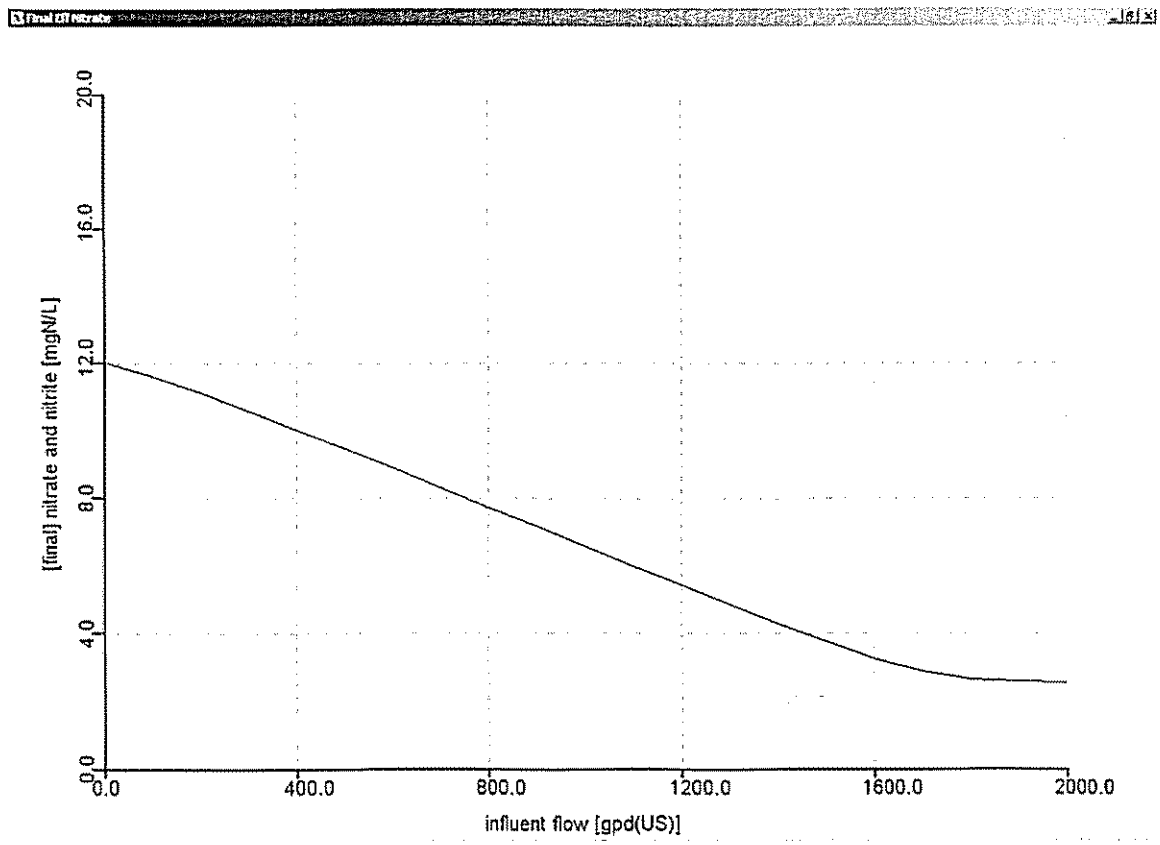
Combined Final Effluent – TSS, BOD5, TN, Ammonia, Nitrate




[final] total carbonaceous BOD5 [mgO2/L]
0.0
4.0
8.0
12.0
16.0
20.0
0.0
400.0
800.0
1200.0
1600.0
2000.0
influent flow [gpd(US)]


[final] total nitrogen [mgN/L]
0.0
10.0
20.0
30.0
40.0
50.0
0.0
400.0
800.0
1200.0
1600.0
2000.0
influent flow [gpd(US)]

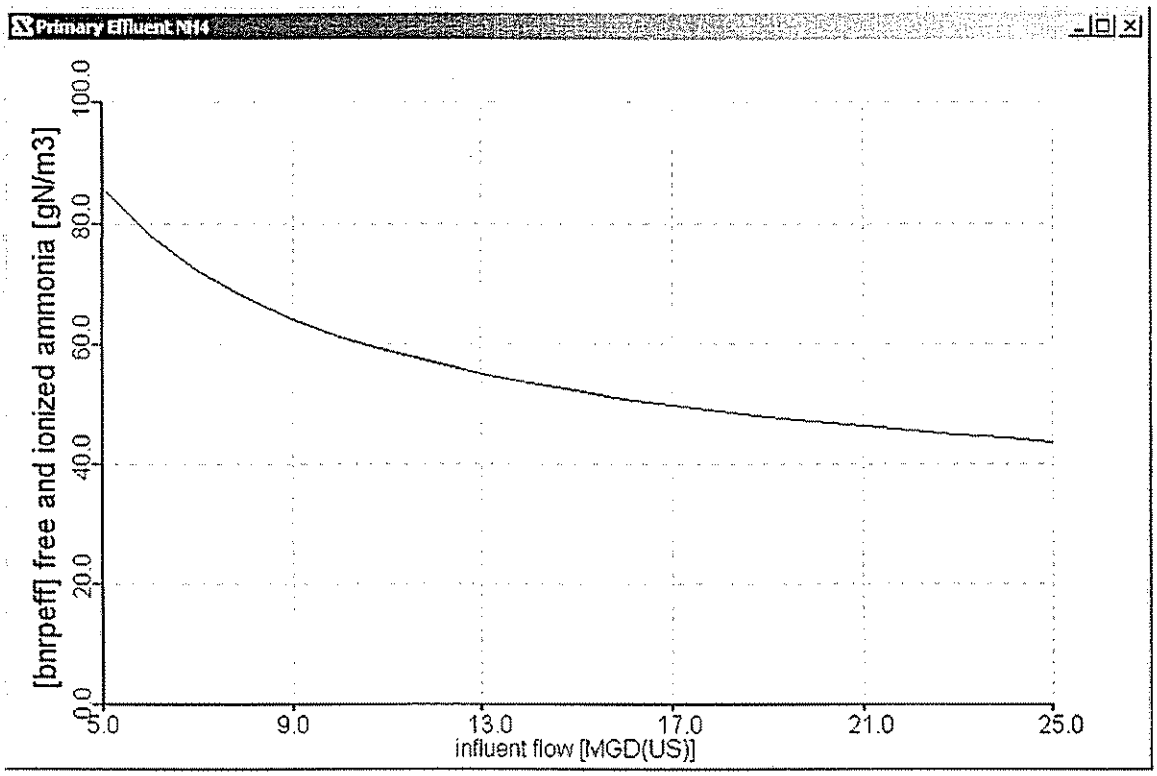

[final] free and ionized ammonia [mgN/L]
0.0
10.0
20.0
30.0
40.0
50.0
0.0
400.0
800.0
1200.0
1600.0
2000.0
influent flow [gpd(US)]


[final] nitrate and nitrite [mgN/L]
0.0
4.0
8.0
12.0
16.0
20.0
0.0
400.0
800.0
1200.0
1600.0
2000.0
influent flow [gpd(US)]

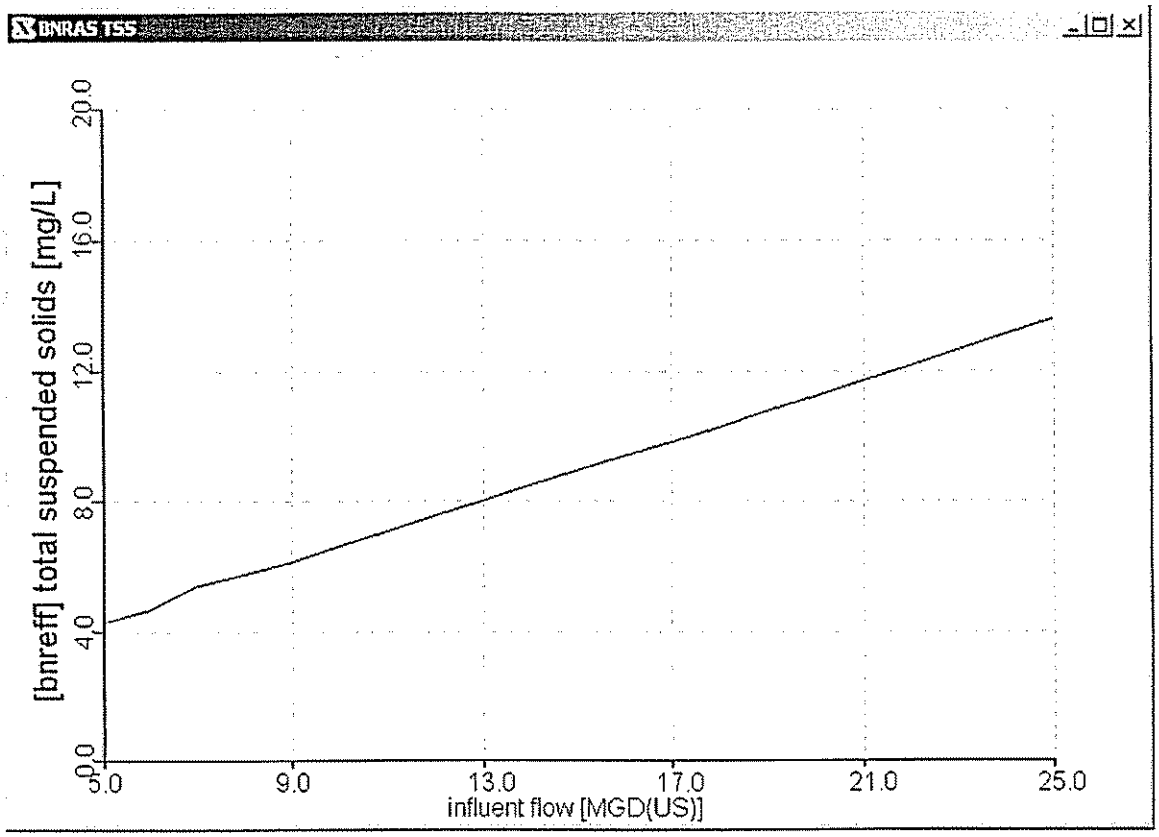
Sensitivity Analysis # 3: Plant Performance vs. BNRAS Raw Influent Flow

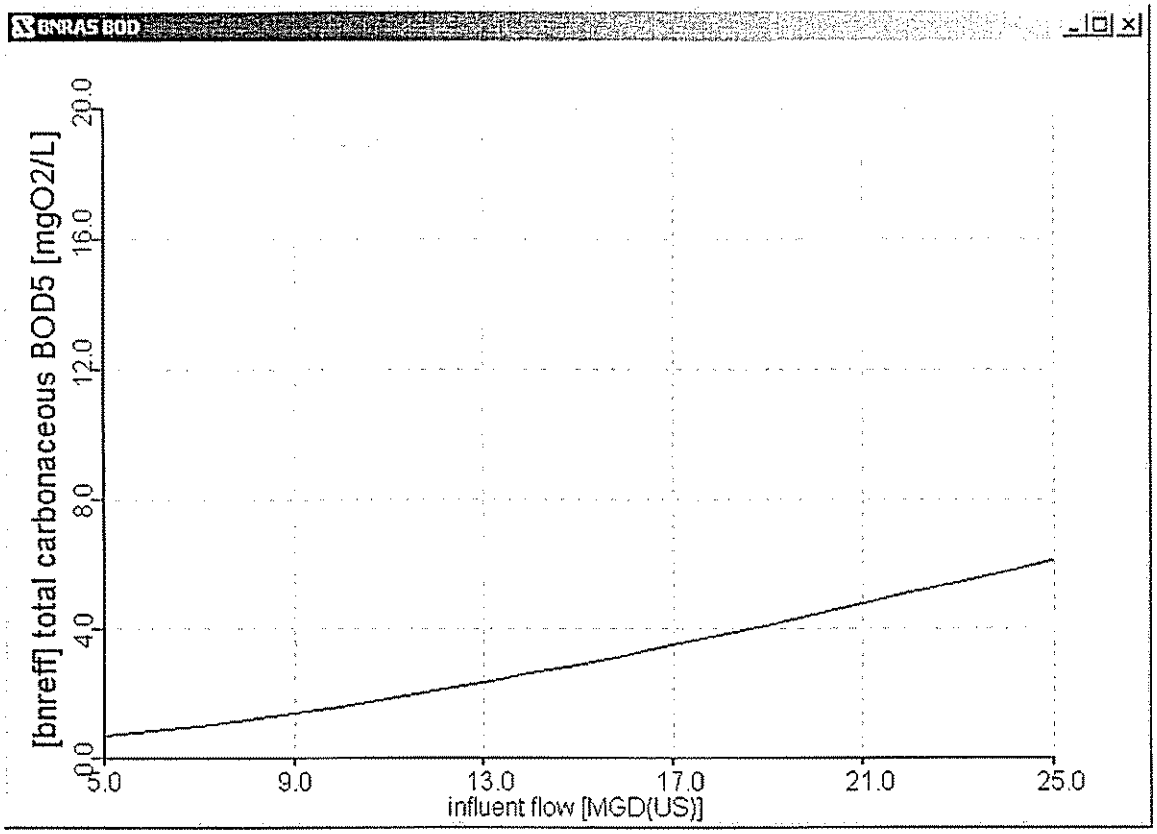
1) HPO FLOW = 25 MGD
2) **BNR FLOW = 5-25 MGD (varied on the x-axis)**
3) CENTRATE FLOW = 200,000 gpd(US)
4) METHANOL FLOW = 0 gpd(US)
5) BNR INTERNAL RECYCLE = 34.4 MGD

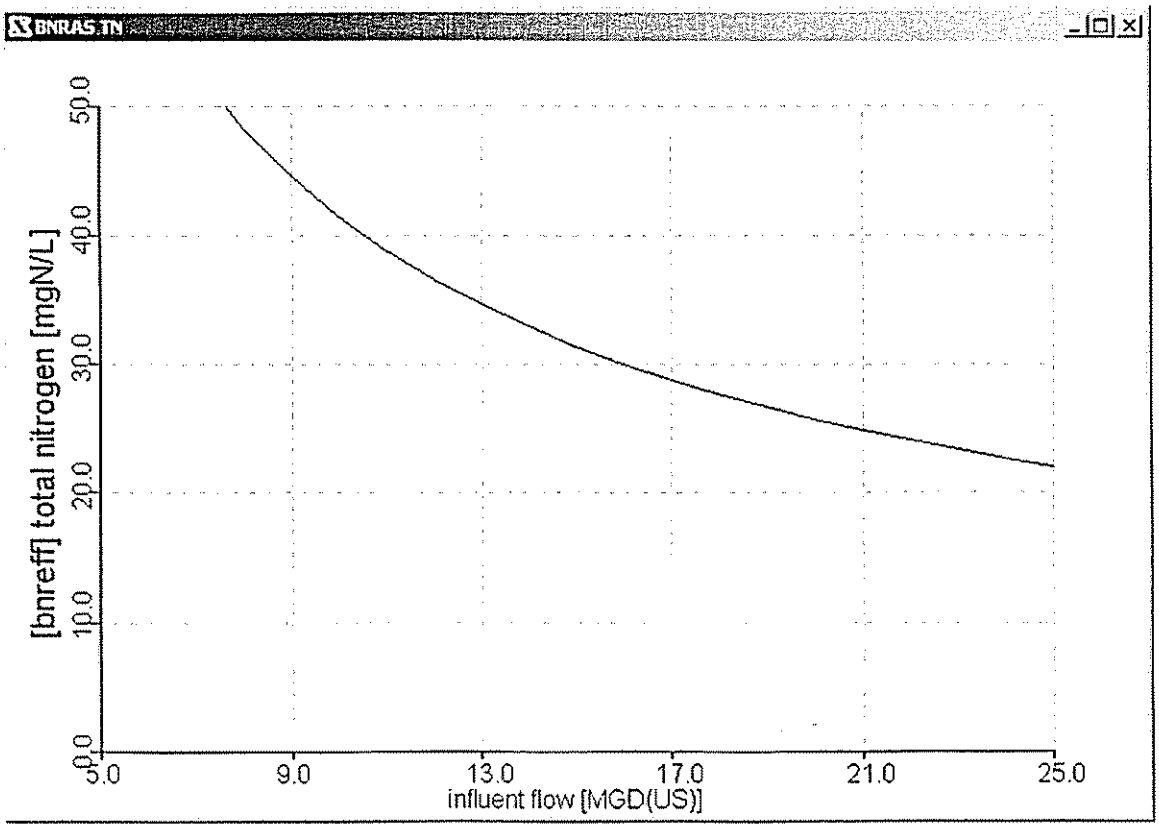
BNR Primary Effluent – Ammonia Concentration

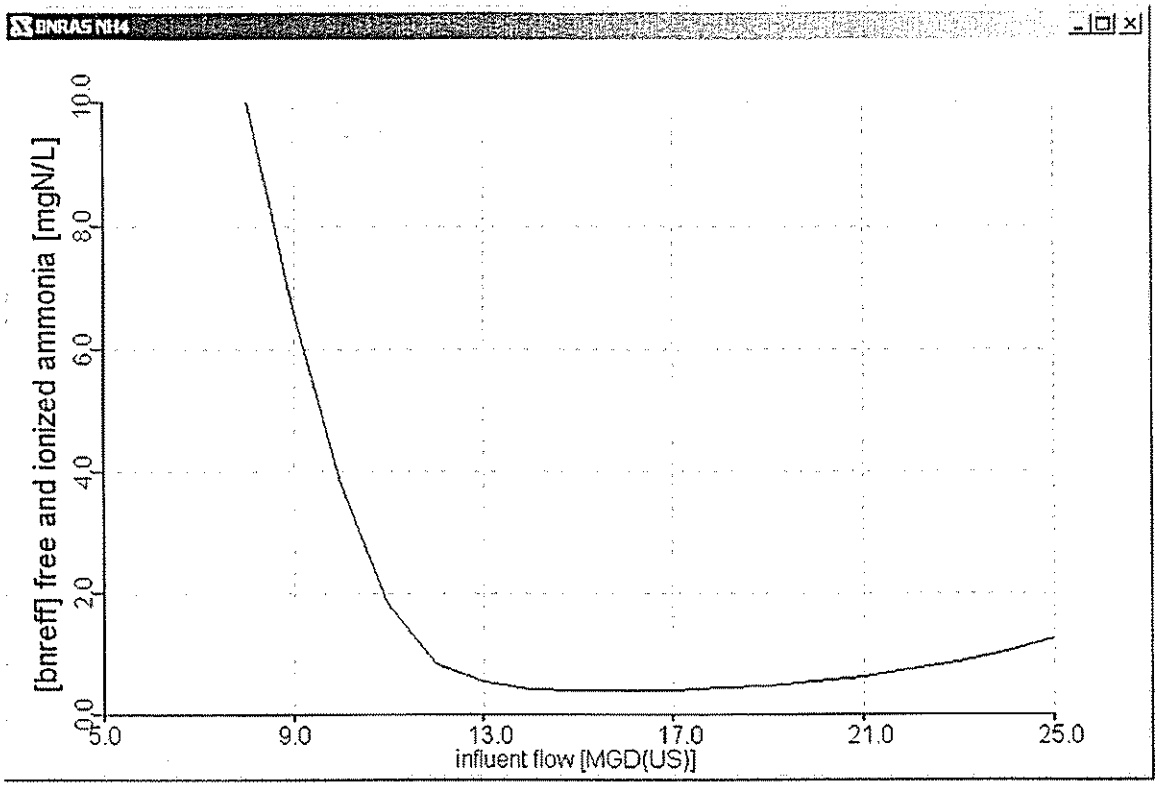


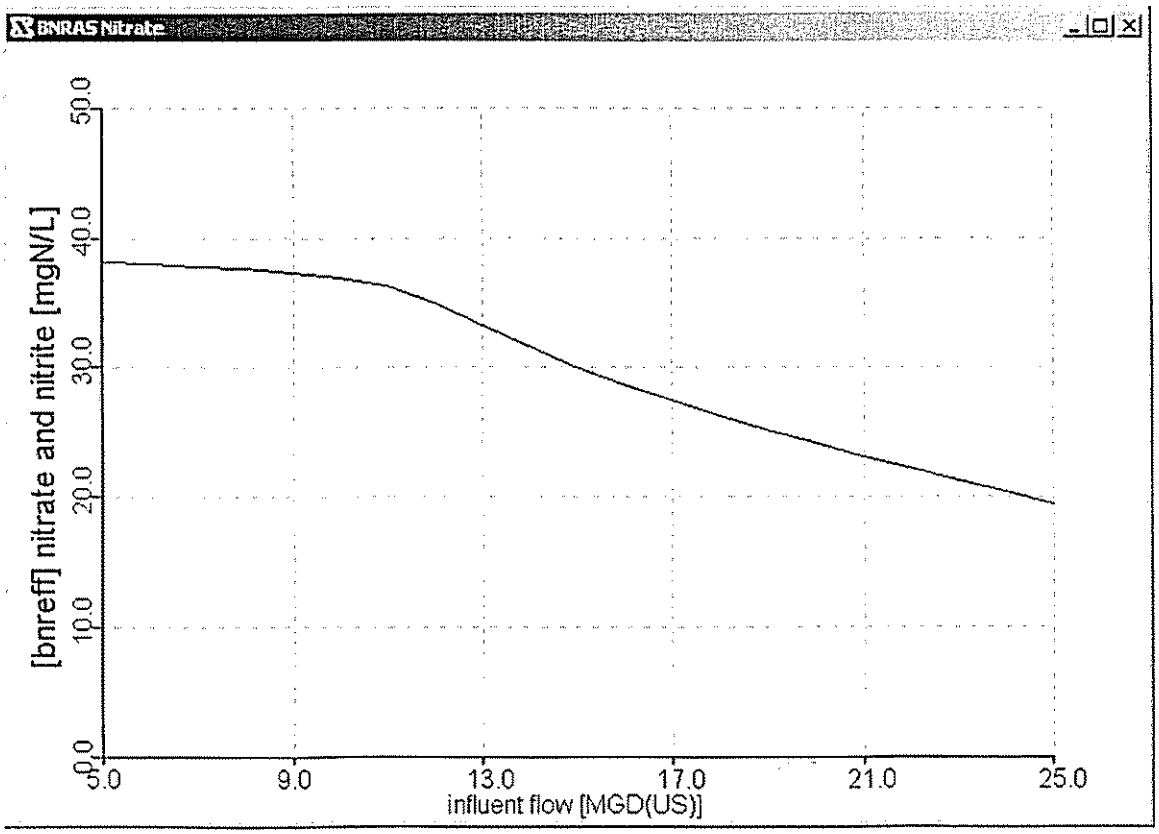
BNR Final Effluent – TSS, BOD5, TN, Ammonia, Nitrate




BNRAS BOD
[bnreff] total carbonaceous BOD5 [mgO2/L]
0.0
4.0
8.0
12.0
16.0
20.0
5.0
9.0
13.0
17.0
21.0
25.0
influent flow [MGD(US)]


BNRAS TN
[bnreff] total nitrogen [mgN/L]
0.0
10.0
20.0
30.0
40.0
50.0
5.0
9.0
13.0
17.0
21.0
25.0
influent flow [MGD(US)]


BNRAS NH4
[bnreff] free and ionized ammonia [mgN/L]
0.0
2.0
4.0
6.0
8.0
10.0
5.0
9.0
13.0
17.0
21.0
25.0
influent flow [MGD(US)]


BNRAS Nitrate
[bnreff] nitrate and nitrite [mgN/L]
0.0
10.0
20.0
30.0
40.0
50.0
5.0
9.0
13.0
17.0
21.0
25.0
influent flow [MGD(US)]

Hydromantis, Inc.
Consulting Engineers

1685 Main Street West, Suite 302
Hamilton, Ontario, Canada
L8S 1G5
Tel: (905) 522-0012 x210
Fax: (905) 522-0031
E-mail: belia@hydromantis.com

Technical Memorandum

To:	Pima County
From:	Hydromantis, Inc.
Date:	15 April 2005
Subject:	Additional Modeling of Ina Road and Roger Road WWTP - Final
Project:	799-01

1. INTRODUCTION

Hydromantis Inc., was retained by Pima County to provide additional modeling services for the Ina and Roger Road WWTP. This technical memorandum summarizes the results of a simulation-based analysis of the two plants.

The results were based on the calibrated and preliminary models developed in a number of projects and described in the following reports:

1. Modeling of Ina Road WWTP – Final, 30 August 2003
2. Modeling of Ina Road WWTP HPO – Final, 30 June 2003
3. Modeling of Roger Road WWTP – Final, 26 July 2004
4. Additional Modeling of Ina Road and Roger Road WWTP - Final, 9 February 2005

The scope of work for the additional simulation scenarios resulted from conversations with PIMA County and it included:

Ina Road WWTP

Task 1: HPO Scenario - Nitrification Activated Sludge

The existing system with no aeration limitation (DO maintained at selected concentrations) will be run to see if the HPO plant can nitrify 20 MGD. The calibrated gas exchange will be implemented and there will be no inhibition due to pH. The current operational DO levels will be used as targets. Since only the DO at the exit of the HPO trains is measured the concentrations maintained in Tanks 1 and 2 have been selected as 8 mg/L. The target DO concentration for Tank 3 will be identical to the currently measured concentration of 14 mg/L.

The target MLSS levels will be the same as the concentrations maintained during the nitrification study, around 2000 mg/L. The current raw influent flow to RAS flow ratio of 0.6 will be used. Lastly, the model will be run under diurnal flow conditions.

Task 2: HPO Scenario - Nutrient Removal with IFAS

With an upgraded aeration system (DO can be maintained at selected concentration) and conversion to an IFAS process, the HPO plant model will be run to see if it can treat 25 MGD to a total nitrogen (TN) concentration of less than 8 mgN/L. A 2 million gallon two CSTR in series anoxic basin filled with biofilm chip will be added directly upstream of the existing hybrid tank. The plant will use Biochip with a specific surface area of 1200 m2/m3. The calibrated gas exchange will be implemented and there will be no inhibition due to pH. The following target DO concentrations will be maintained: Tank 1: 25 mg/L, Tank 2: 15 mg/L, Tank 3: 6 mg/L. The target MLSS levels will be ~ 3000 mg/L. The current Qinf/Qras ratio of 0.6 will be used. If a carbon limitation is observed then methanol will be added. The internal recycle flow will be limited to 75MGD (3 x influent flow). Lastly, the model will be run under diurnal flow conditions.

Task 3: HPO Scenario - Nutrient Removal with MBBR

With an upgraded aeration system (DO can be maintained at selected concentration) and conversion to an MBBR process, the HPO plant model will be run to see if it can treat 25 MGD to a total nitrogen (TN) concentration of less than 8 mgN/L. A 2 million gallon two CSTR in series anoxic basin filled with biofilm chip will be added directly upstream of the existing hybrid tank. The plant model will use Biochip with a specific surface area of 1200 m2/m3. The calibrated gas exchange will be implemented and there will be no inhibition due to pH. The following target DO concentrations will be maintained: Tank 1: 25 mg/L, Tank 2: 15 mg/L, Tank 3: 6 mg/L. The RAS flow will be zero. If a carbon limitation is observed then methanol will be added. The internal recycle flow will be limited to 75MGD (3 x influent flow). Lastly, the model will be run under diurnal flow conditions.

Task 4: BNRAS Scenario – 0.5 MGD Centrate Addition

With the design aeration system (a total installed airflow of 28,000 cfm), the BNRAS plant model will be run to see if it can treat 12.5 MGD of raw flow and 0.5 MGD of centrate flow with a methanol feed to the anoxic basin. The model will be run under diurnal flow conditions.

Roger Road WWTP

Task 1: Biofilter Effluent Scenario - Nutrient Removal with MBBR – 41 MGD

With an upgraded aeration system (DO can be maintained at selected concentration) and conversion to an MBBR process, the RRWWTP model will be run to see if it can treat 41 MGD to a total nitrogen (TN) concentration of less than 8 mgN/L. The plant model will use Biochip with a specific surface area of 1200 m2/m3. The following target DO concentrations will be maintained: Tank 1: 0 mg/L, Tank 2: 4 mg/L, Tank 3: 4 mg/L, Tank 4: 4 mg/L (i.e. ¼ of the existing tank volume will be anoxic). The sludge blanket height will be maintained at ~ 1 ft. The RAS flow will be zero. If a carbon limitation is observed then methanol will be added. Lastly, the model will be run under diurnal flow conditions.

Task 2: Biofilter Effluent Scenario - Nutrient Removal with MBBR – 50 MGD

With an upgraded aeration system (DO can be maintained at selected concentration) and conversion to an MBBR process, the RRWWTP model will be run to see if it can treat 50 MGD to a total nitrogen (TN) concentration of less than 8 mgN/L with a post-denitrification filter. The plant model will use Biochip with a specific surface area of 1200 m2/m3. The following target DO concentrations will be maintained: Tank 1: 0 mg/L, Tank 2: 4 mg/L, Tank 3: 4 mg/L, Tank 4: 4 mg/L (i.e. ¼ of the existing tank volume will be anoxic). The sludge blanket height will be maintained at ~ 1 ft. The RAS flow will be zero. If a carbon limitation is observed then methanol will be added. Lastly, the model will be run under diurnal flow conditions.

Task 3: No Biofilter Scenario - Nutrient Removal with MBBR – 41 MGD

With an upgraded aeration system (DO can be maintained at selected concentration) and conversion to an MBBR process, the RRWWTP model will be run bypassing the flow from the primary tanks directly to the MBBR to see if the plant can treat 41 MGD to a total nitrogen (TN) concentration of less than 8 mgN/L. The plant model will use Biochip with a specific surface area of 1200 m2/m3. The following target DO concentrations will be maintained: Tank 1: 0 mg/L, Tank 2: 4 mg/L, Tank 3: 4 mg/L, Tank 4: 4 mg/L (i.e. ¼ of the existing tank volume will be anoxic). The sludge blanket height will be maintained at ~ 1 ft. The RAS flow will be zero. If a carbon limitation is observed then methanol will be added. Lastly, the model will be run under diurnal flow conditions.

Task 4: No Biofilter Scenario - Nutrient Removal with MBBR – 50 MGD

With an upgraded aeration system (DO can be maintained at selected concentration) and conversion to an MBBR process, the RRWWTP model will be run bypassing the flow from the primary tanks directly to the MBBR to see if the plant can treat 50 MGD to a total nitrogen (TN) concentration of less than 8 mgN/L with a post-denitrification filter.. The plant model will use Biochip with a specific surface area of 1200 m2/m3. The following target DO concentrations will be maintained: Tank 1: 0 mg/L, Tank 2: 4 mg/L, Tank 3: 4 mg/L, Tank 4: 4 mg/L (i.e. ¼ of the existing tank volume will be anoxic). The sludge blanket height will be maintained at ~ 1 ft.

The RAS flow will be zero. If a carbon limitation is observed then methanol will be added. Lastly, the model will be run under diurnal flow conditions.

The objective of this memorandum is to convey the results of the requested scenario simulations to Pima County and is not intended as a recommendation of any particular course of action at the Ina Road WWTP. It is important to note that this study does not take into account any limitations imposed by the existing structures at the plant nor does it take into account any hydraulic limitations which may exist at increased plant flow rates.

2. REVIEW OF INA ROAD WWTP PLANT MODEL DESCRIPTION

The following sections detail the HPO and the BNRAS model set-up.

2.1. Model Set-Up

The plant layout was constructed from the following process units:

a) **Influent**: For the HPO primary influent, a COD/TSS based influent model was implemented with the major data inputs being COD, TSS and TKN. For the BNRAS primary influent, a COD based influent model was implemented with the major data inputs being COD and TKN. A third influent object was included in the layout to simulate centrate addition to the BNRAS facility. A BOD based model was used for the centrate. A forth influent object was included to simulate methanol addition to the BNRAS facility for specific scenarios where carbon was limited.

b) **Primary Clarifiers:** For the HPO plant, the four (4) primary clarifiers were combined into one single unit with an equivalent surface area. For the BNRAS plant, the two (2) primary clarifiers were combined into one single unit with an equivalent surface area. The clarifiers were modeled with the one dimensional settler model that uses the double exponential settling equation.

c) **HPO**: The HPO tank was modeled as a single, plug flow unit consisting of three (3) completely mixed tanks-in-series. The mathematical model used to simulate the biological conversions in the activated sludge process was ASM2d. ASM2d was implemented to provide the option to evaluate phosphorous removal.

d) **BNRAS**: The BNRAS was modeled as a single, plug flow unit, consisting of eight (8) completely mixed tanks-in-series with an internal recycle flow connecting tank No.8 with tank No. 1. The mathematical model used to simulate the conversions in the activated sludge process was ASM2d, allowing for future phosphorous removal evaluation.

e) **Final Clarifiers:** For the HPO clarifiers, the four (4) secondary clarifiers were combined into one single unit with an equivalent surface area. For the BNRAS plant, the three (3) secondary clarifiers were combined into one single unit with an equivalent surface area. The clarifiers were modeled with the one dimensional settler model that uses the double exponential settling equation. This model is used to describe the vertical suspended solids profile from the sludge blanket to the weir under dynamic conditions.

2.2. Plant Raw Influent and Centrate Characteristics

The detailed profile used to model the Ina Road influent streams was based on the data obtained during an intensive sampling campaign in March 2003. Table 2.1 shows the average influent characteristics included in the model for both the HPO and BNRAS streams. The characteristics of the centrate have also been included.

Table 2.1 – Raw Influent and Centrate Characteristics – Averages for March 2003

Stream	Flow (MGD)	COD (mg/L)	$cBOD_5$ (mg/L)	TSS (mg/L)	VSS (mg/L)	TKN (mg/L)	NH_4-N (mg/L)
HPO Stream	25	600	300	270	220	57	37
BNRAS Stream	12.5	600	300	270	220	57	37
Centrate	0.5	3230	240	2350	1760	1740	1480

The stoichiometric ratios implemented in the raw influent models as well as the centrate are shown in Table 2.2.

Table 2.2 – Raw Influent and Centrate Stoichiometry

Stoichiomtetric ratio	HPO	BNRAS	Centrate
VSS/TSS	0.8	0.8	0.75
Soluble fraction of total COD	0.27	0.27	0.50
Inert fraction of soluble COD	0.33	0.33	0.85
COD content of VSS (XCOD/VSS)	1.9	1.9	1.6
BOD_5/BOD_{ult}	0.68	0.68	0.35

2.3. Ina Road WWTP Model Parameters

Table 2.3 summarizes the physical characteristics of the HPO model.

Table 2.3 – HPO Model Physical Parameters

Unit Object	Diameter (ft)	Total Surface Area (ft^2)	SWD (ft)	Total Volume (ft^3)	Gas Headspace Volume (ft^3)	SVI (mL/g)
Primary Clarifiers	-	34,560	8	-	-	-
Four trains	-	-	-	255,552	139,719	-
Final Clarifiers	115	41,548	14	-	-	150

Note: (-) in the table indicates that parameter is not required as model data entry.

Table 2.4 summarizes the physical characteristics of the BNRAS model.

Table 2.4 – BNRAS Model Primary Clarifiers

	Dimensions per Clarifier (ft)	Total Surface Area (ft^2)	SWD (ft)	Total Volume (gal)	Underflow Rate (gpm)	SVI (mL/g)
Primary Clarifiers	220 x 40	17,600	10	1,316,576	100	-
Anoxic: 4 trains with 4 stages	Each train: 112x28x21	-	-	263,424 (ft3)	-	-
Aerobic: 4 trains with 4 stages	Each train: 264x28x20	-	-	591,360(ft3)	-	-
Final Clarifiers	-	42,942	18	-	8,500 – 39,000	150

In addition to the information included in Tables 2.3 and 2.4 the following were also used in the model:

- BNRAS Train: Internal recycle pumps with an installed capacity of 4x13,000 gpm (1 standby). Operating range: 250-300% of AAF (AAF = 12.5 MGD, 31.25 – 37.5 MGD, average 275% = 34.4 MGD)
- BNRAS Train: The target MLSS concentration for the BNRAS train quoted in the CDM design tables was 3,000 mg/L.
- The maximum specific growth rate (μ_a) of the autotrophic group was 0.9 d^{-1} (@ 20°C) and the decay rate (b_a) was 0.17 d^{-1} (@ 20°C).
- BNRAS Aeration: The design tables provided by Pima County gave the diffuser distribution and blower capacity. The alpha and beta values used in the model were left at the defaults. The SOTE values were assumed to be the same as the target SOTE values shown in the US Filter Clean Water Oxygen Transfer Tests, August 2002. Table 2.5 shows the parameters used to model the aeration system of the BNRAS Train.

Table 2.5 – Ina Road BNRAS Train Aeration System Parameters

Parameter	Ina Road Model Values
α	0.6 - 0.8
β	0.95
θ	1.024
Total air flow installed (cfm)	28,000
Air flow distribution (% of total - stages 5 to 8)	48, 27, 17, 8
Specific oxygen transfer efficiency (% - stages 5 to 8)	31%, 31%, 29.5%, 29.5%

The HPO model set-up in this project did not consider the addition of liquid oxygen. The available oxygen feed was assumed to be provided by the PSA system only.

3. SIMULATION SCENARIOS AND RESULTS FOR THE INA ROAD WWTP PROCESS STREAM

3.1. Ina Road Tasks - Results

The following operational parameters, detailed in Table 3.1 were used.

Table 3.1 – Ina Operational Parameters

Scenario	Influent Flow (MGD)	Centrate Flow (MGD)	DO Aerobic Tanks (mg/L)	MLSS (mg/L)	WAS Flow (gpm)	RAS Flow (MGD)	Internal Recycle (MGD)	Methanol Flow (gpd)
Task 1	20	N/A	8,8,14	2150	200	12	N/A	N/A
Task 2	25	N/A	25,15,6	2920	220	15	75	3200
Task 3	25	N/A	25,15,6	140	220	0	75	3200
Task 4	12.5	0.5	N/A	3480	380	12.5	56.2	8000

Table 3.2 shows the average results for the final effluent.

Table 3.2 – Ina Final Effluent

Scenario	TSS (mg/L)	BOD_5 (mg/L)	$sBOD_5$ (mg/L)	COD (mg/L)	sCOD (mg/L)	TN (mg/L)	NH_4–N (mg/L)	Nitrate (mg/L)
Task 1	20	14	1	89	63	39	2	35
Task 2	26	12	1	93	63	12	0.5	10
Task 3	21	12	1	88	64	14	0.9	11
Task 4	7	7	3	64	55	12	0.4	10

For all tasks, WAS flow was manipulated to maintain a target MLSS concentration in the HPO/BNRAS tanks. Internal Recycle flow was manipulated to ensure that the DO levels in the anoxic tanks were minimized (i.e. ~ 0 mg/L). Methanol flow was manipulated to eliminate carbon limitations, while ensuring that the effluent soluble BOD did not exceed acceptable levels.

4. REVIEW OF THE ROGER ROAD WWTP PLANT MODEL DESCRIPTION

The following sections detail the Roger Road model set-up.

4.1. Model Set-Up

The plant layout was constructed from the following process units:

a) **Influent**: A BOD based influent model was implemented with the major data inputs being TSS, BOD and TKN. A second influent object with a BOD based model was included in the layout to simulate all return streams.

b) **Primary Clarifiers:** The six (6) primary clarifiers were simulated as three units, each with the equivalent surface area of two primary tanks. The clarifiers were modeled with the one dimensional settler model that uses the double exponential settling equation.

c) **Biofilters:** The two biofilters were simulated as one unit with the equivalent surface area. The biological model used was **Mantis**, modified to include diffusion in the biofilm.

d) **Aeration Tanks**: Each aeration train was modeled with a single, plug flow object, representing one (for AS 1-2) and four (for AS 3-6) completely mixed tanks-in-series. The bioreactor kinetics were modeled using the **Mantis** model, a modified version of ASM1. This kinetic model is capable of describing BOD-removal, nitrification and denitrification.

e) **Final Clarifiers:** The nine (9) secondary clarifiers were grouped into two units with an equivalent surface area. The clarifiers were modeled with the one dimensional settler model that uses the double exponential settling equation. This model is used to describe the suspended solids profile from the sludge blanket to the weir under dynamic conditions.

Figure 5.1 shows the plant layout in GPS-X. The following sections detail the physical and operational parameters used in the plant model for each of the unit processes.

4.2. Plant Raw Influent Characteristics

Table 5.1 shows the influent characteristics used in the model as determined by field measurements from January 2001 to March 2001. No recycle streams are included in these measurements.

Table 5.1 – Roger Road WWTP Model Influent Characteristics

COD (mg/L)	sCOD (mg/L)	BOD_5 (mg/L)	$sBOD_5$ (mg/L)	TSS (mg/L)	VSS (mg/L)	NH_4-N (mg/L)	TKN (mg/L)
585	261	231	115.5	228	180	25.7	39

From the data in Table 5.1, the following stoichiometric ratios were calculated (Table 5.2).

Table 5.2 – Raw Influent Stoichiometry

Parameter	Values in model - winter
VSS/TSS	0.79
Ammonia/TKN	0.66
Soluble substrate/BOD_{ult}	0.50
XCOD/VSS	1.80
BOD_5/BOD_{ult}	0.50

4.3. Roger Road WWTP Model Parameters

Table 5.3 summarizes the physical characteristics of the Roger Road model.

Table 5.3 – Roger Road WWTP Model Physical Parameters

Unit Process	Diameter /Unit (ft)	Total Surface Area (ft^2)	SWD (ft)	Total Volume (gal)
Primary Clarifiers 5-8	105	34,620	8	-
Primary Clarifiers 9-10	120	22,608	12	-
Biofilters	165	42,744	26	-
Aeration tanks 1, 2 (2 single stage basins)	-	264x41	15	151,000 x 2
Aeration tanks 3-6 (4 two-pass basins)	-	115x25	16.3	94,000 x 4
Final Clarifiers 1, 2	100	15,700	9	-
Final Clarifiers 3, 4	105	17,310	8	-
Final Clarifiers 5, 6	105	17,310	11	-
Final Clarifiers 7, 8, 9	105	25,965	12	-

In addition to the information included in Tables 5.2 and 5.3 the following were also used in the model:

- The raw flow split between the two sets of primary clarifiers was assumed to be 33.4% to PSTs 9-10 and 66.6% to PSTs 5-8.
- A 50% - 50% flow split between aeration trains 1-2 and 3-6 was assumed.
- The maximum specific growth rate (μ_a) of the autotrophic group was 0.9 d^{-1} (@ 20°C) and the decay rate (b_a) was 0.17 d^{-1} (@ 20°C).
- Aeration tanks 1 and 2 send flow to final clarifiers 1 to 4 and aeration tanks 3 to 6 send flow to final clarifiers 5 to 9.

Table 5.4 shows the values used in the model for the aeration system. No design information was available for the parameters included in Table 5.4.

Table 5.4 – Aeration System Parameters

Parameter	Roger Road Model Values
α	0.6-0.8
β	0.95
θ	1.024
DO Levels (mg/L – stages 1-4)	0,4,4,4

5. SIMULATION SCENARIOS AND RESULTS FOR THE ROGER ROAD WWTP

5.1. Roger Road Tasks - Results

The following operational parameters, detailed in Table 5.1 were used.

Table 5.1 – Roger Operational Parameters

Scenario	Influent Flow (MGD)	MLSS (mg/L)	DO Tanks 1-4 (mg/L)	WAS Flow (MGD)	RAS Flow (MGD)	Internal Recycle (MGD)	Methanol Flow (gpd)
Task 1	41	140	0,4,4,4	1.8	0	20	8500
Task 2	50	140	0,4,4,4	2.1	0	20	6600
Task 3	41	120	0,4,4,4	1.8	0	5	1100
Task 4	50	130	0,4,4,4	2.1	0	5	800

Table 5.2 shows the results for the final effluent.

Table 5.2 – Roger Final Effluent

Scenario	TSS (mg/L)	BOD_5 (mg/L)	$sBOD_5$ (mg/L)	COD (mg/L)	sCOD (mg/L)	TN (mg/L)	NH_4–N (mg/L)	Nitrate (mg/L)
Task 1	15	13	5	58	37	12	0.5	7
Task 2	17	17	7	63	41	12	0.7	6
Task 3	15	13	6	60	40	13	0.6	8
Task 4	16	16	8	65	43	13	0.7	7

For all tasks, Internal Recycle flow was manipulated to ensure that the DO levels in the anoxic tanks were minimized (i.e. ~ 0 mg/L). Methanol flow was manipulated to eliminate carbon limitations, while ensuring that the effluent soluble BOD did not exceed acceptable levels.

Appendix G Water Management Legal and Regulatory Issues

WATER MANAGEMENT LEGAL AND REGULATORY ISSUES

Southern Arizona Water Rights Settlement Act:

Southern Arizona Water Rights Settlement Act (SAWRSA) of 1982 impacts treated effluent. Under this Act, the Tohono O'odham Indian Tribe has entitlement to 28,200 acre-feet AF per year of water of adequate quality for agricultural use. The actual source of this water is as yet undetermined, but the U.S. Secretary of the Interior has an agreement with the City of Tucson whereby the Secretary is to receive 28,200 (AF) MGD of treated effluent.

Groundwater Management Act (GMA)

To address long-term groundwater overdraft problems occurring in many areas of the State of Arizona, the Arizona Groundwater Management Act was passed by the State in 1980 which established four active management areas (AMA), including the Tucson AMA. It was recognized by the State Legislature that the international issues of the southern portion of the Upper Santa Cruz Valley Sub Basin were tremendously different than those issues facing the metropolitan Tucson area, and in 1994, the Santa Cruz AMA was carved out of the southern portion of Tucson AMA.

The objectives of the Groundwater Management Code are:

1. To control severe groundwater depletion.
2. To provide the means for allocating Arizona's limited groundwater resources.
3. To augment Arizona's groundwater reserves through supply development.

The primary goal for three of the AMAs, including the Tucson AMA, is the attainment of "safe yield by 2025". The Groundwater Code defines safe yield as "to achieve and thereafter maintain a long-term balance between the annual amount of groundwater withdrawn in an AMA and the annual amount of natural and artificial groundwater recharge in the AMA" A.R.S. § 45-561 (12). The realization of this goal was set to be achieved incrementally using five management periods. The Tucson AMA is currently in the Third Management Plan (TMP) for the period of 2002 to 2010.

Third Management Plan (TMP)

The Arizona Department of Water Resource's (ADWR) strategy for the TMP is:

- Continuing equitable water conservation requirements for all groundwater users.

- Increasing financial assistance, technical assistance and increased public education efforts on new water conservation methods, augmentation, recharge and monitoring efforts.
- Identifying areas of critical groundwater level decline, rapidly increasing decline, extremely limited availability, potential land subsidence and poor quality groundwater.
- Identifying existing and projected overdraft conditions and identifying potential changes in ADWR strategy to achieve safe yield.
- Improving monitoring, updating ADWR's hydrologic groundwater models and expanding available databases; changes yearly, and is based on Tucson Water's operation and maintenance costs.
- Increasing the use of available renewable supplies while decreasing the dependency on groundwater resources.
- Encourage efforts of coordination between the agencies affecting water policy and providing assistance to local and regional water planning efforts.

ADWR projects that the Tucson AMA will not achieve safe yield by 2025 without considerably more effort in water conservation measures and the full utilization of renewable water supplies.

Assured Water Supply (AWS)

The AWS program was initiated in 1973 as a consumer protection act requiring developers to obtain a determination from the State of Arizona regarding the availability of water to subdivided lots prior to the marketing of these lots. Upon passage of the 1980 Groundwater Management Act and the creation of the Active Management Areas (AMA), prohibiting the sale of subdivided lots without the availability of sufficient water of adequate quality for one hundred years strengthened AWS rules in the AMAs. The current AWS program rules became effective February 7, 1995 and further strengthened the program by requiring that the Management Plan criteria be met, or in other words, requiring the use of renewable resources.

The current AWS rules have tremendous implications to cities, towns, private water companies, and developers/landowners located within the Tucson AMA. In order to sell or lease subdivided lands within the Tucson AMA, a demonstration of an assured water supply must be made prior to the approval of the final plat and issuance of a public report from the Arizona Department of Real Estate. (A subdivision is defined as six or more parcels with at least one parcel having an area less than 36 acres.) ADWR makes the determination of whether an AWS exists. If an AWS does not exist, the land may not be subdivided. Those areas without an AWS would eventually be forced to stop urban development.

There are two methods to achieving an Assured Water Supply, a Designation of Assured Water Supply (DAWS) or a Certificate of Assured Water Supply (CAWS). Cities, towns, and private water companies may choose to obtain a DAWS if they have sufficient renewable water resources to meet anticipated demand of their service area. A developer of a subdivision located within the water service area of a city, town, or private water company with a DAWS is not required to obtain a CAWS. If a city, town, or private water company does not obtain a DAWS, the developer/landowner/subdivider must apply for a CAWS to continue with the planned land development. In both cases the applicant is required to have a water service agreement with the water provider that has the water service area right in which the proposed development is located and, for a certificate, must demonstrate that their subdivision has sufficient renewable water sources to meet demand for 100 years.

The AWS program is a significant commitment by Arizona to protect its groundwater resources. The AWS program is expected to cause water service providers to shift from groundwater to renewable resources, such as surface water and effluent. An applicant for an assured water supply must prove five conditions to ADWR's satisfaction. These are:

1. Physical Availability of a 100-year Water Supply

The physical availability criterion requires the applicant to show that it has enough water resources to meet projected (current and committed) demands for 100-years. For cities, towns, and private water companies the assured water supply demand is determined by using their current water demand and the estimated build-out demand from undeveloped subdivided lands within their service area. For applicants of a certificate of assured water supply, the projected demand is the estimated build-out water demand of their subdivision over a 100-year period. Water supplies must be shown to be legally and continuously available.

If groundwater is used as a supply, ADWR will analyze whether its use will cause the depth-to-static water level (measured from the surface of the earth) to exceed the 1,000 feet after 100 years of pumping. This is a serious concern for water providers located in the Tucson AMA. The amount of groundwater available to Tucson area water providers for purposes of demonstrating an assured water supply is limited.

2. Water Quality

Applicants for an AWS must prove to ADWR that its supplies will meet federal and state water quality standards for the proposed use. It is expected that surface water processed at water treatment plants will meet the water quality requirement. Depending on the prevailing contamination levels of the aquifer underlying the Tucson AMA, groundwater, recovered effluent and recovered surface water credits may eventually require treatment in order to pass the water quality requirement.

3. Consistency with the Management Plan

Tucson AMA cities, towns and private water companies seeking or maintaining a DAWS must be in compliance with ADWR's water conservation regulations, including lost and unaccounted for water as described in the Tucson AMA Third Management Plan. Developers, sub-dividers, and landowners seeking a CAWS whose water use may likely cause a water provider to violate its conservation requirement will still be allowed to obtain a CAWS. In this instance, the water provider will be warned of potential compliance problems resulting from providing water service to the new certificate holder.

4. Consistency with the Management Goal

ADWR does allow applicants for an AWS to use a limited allocation of mined groundwater in proving physical availability and consistency with the management goal. The amount of mined groundwater allowed for each applicant is calculated using a formula prescribed in AWS rules and is also constrained by the physical availability criteria.

For those that receive a groundwater allocation, the allocation may be "banked" for use during any time within the 100-year assured water supply period.

In the counties eligible for CAP water, the Central Arizona Groundwater Replenishment District (CAGRD) was created to help water providers and developers achieve the Management Goal of using renewable supplies. The CAGRD works by "replenishing" groundwater pumped by member lands or member service areas. Member lands are those subdivisions enrolled into the CAGRD

at the time a land developer is applying for a CAWS. A Member Service Area is a water provider that has enrolled its entire service area into the CAGRD.

5. Financial Capability

Cities and towns seeking DAWS must demonstrate that financing is available in their respective five-year capital improvement plans for major system improvements, such as storage or treatment facilities. If the platting authority (e.g., county, city, or town) has adequate bonding requirements to insure the installation of the necessary facilities, an applicant for a certificate may not be required by ADWR to provide evidence of financial capability. Private water companies can use the State of Arizona Corporation Commission approval as evidence of financial capability.

Options for Obtaining an Assured Water Supply

A city, town or private water company will have to decide two key points: first, does the water provider have sufficient amounts of renewable water resources; and second, does the water provider have adequate financial resources to demonstrate financial capability? Table 1 provides a summary of the options.

In Case 1, where the water provider has sufficient renewable water resources and can demonstrate financial capability, the DAWS option would be advisable because it simplifies the AWS documentation process and it is more supportive of the AMA's groundwater management goals. A provider may get designated based on groundwater availability and membership in the CAGRD, if groundwater is available.

In Case 2, where the water provider lacks sufficient renewable water resources, but can demonstrate financial capability, the water provider has the following three choices. The water provider could attempt to:

1. Acquire the water resources needed and apply for a DAWS
2. Join the Central Arizona Groundwater Replenishment District (CAGRD) and apply for a DAWS, or
3. Place the burden of securing additional water resources on the developer. If the water provider chooses the latter, the developer may attempt to acquire the water resources needed for their development. If successful, the developer could pledge the resource to the water provider, and the water provider would apply to ADWR for a DAWS. If the developer is not successful in acquiring additional water resources, the developer may apply to ADWR for a CAWs, upon enrollment of the property in the CAGRD, providing sufficient groundwater is available.

In Case 3, where the water provider has sufficient renewable water resources, but is not able to demonstrate financial capability, the water provider may want to explore the possibility of placing the burden of paying the construction of water-related infrastructure on the developer through development fees.

In Case 4, where the water provider lacks the needed renewable water resources and is not able to demonstrate financial capability, all of the aforementioned options need to be explored.

Assured Water Supply, Recharge and CAGRD Issues Relating to Aquifer Draw-down

ADWR has questioned whether the 1,000-foot physical availability criterion is adequate to prevent permanent irreversible damage to the aquifer due to land subsidence. ADWR has identified two critical groundwater decline management areas in the Tucson area, the City of Tucson's Central Wellfield and the area of metal mine pumping in the Green Valley/Sahuarita area. Additionally,

evidence of land subsidence, fissuring and aquifer compaction has been observed in the northern Avra Valley. Subsidence monitoring will continue in the Tucson AMA to improve the understanding of the extent and degree of subsidence.

In developing a water resources strategy for the Tucson AMA, there are three key issues that need to be understood: first, ADWR's groundwater model projects severe decline and dewatering in the Tucson AMA aquifer, unless renewable water resources are more widely used; second, the CAGRD does not guarantee that a member will be granted an assured water supply. The water provider is still subject to the 1,000 feet depth-to-static water level physical availability limitations of the aquifer on which they rely. Third, new wells used to pump groundwater or recover stored water credits are subject to ADWR's rules regarding drawdown of the aquifer. Currently, recovery wells are subject to a 4-feet per year drawdown limit, unless the well is within the area of impact of a recharge facility. Table 6.x.x presents the applicability of ADWR's AWS, recharge and CAGRD requirements to various types of water produced from wells.

Table 6.x.x AWS, Recharge and CAGRD Rules Related to Aquifer Drawdown

Requirement	Providers that Have AWS Designation (with or without CAGRD)
1,000 Ft. Drawdown	
Incidental recharge	Yes, subject to 1,000 ft. drawdown
Groundwater account	Yes, subject to 1,000 ft. drawdown
Recovery of credits inside hydro-impact area	No, not subject to 1,000 ft. drawdown
Recovery of credits outside hydro-impact area	Yes, subject to 1,000 ft. drawdown
Pump water to be replenished by GRD	Yes, subject to 1,000 ft. drawdown
4 Ft. Per Year or More Draw-Down	
Incidental recharge	No, not subject to the 4 ft. per year drawdown
Groundwater account	No, not subject to the 4 ft. per year drawdown
Recovery of credits inside hydro-impact area	No, not subject to the 4 ft. per year drawdown
Recovery of credits outside hydro-impact area	Yes, subject to the 4 ft. per year drawdown
Pump water to be replenished by CAGRD	No, not subject to the 4 ft. per year drawdown

Each water provider seeking a DAWS must show that it will be in compliance with these requirements. Similarly, if Tucson AMA water providers plan to store and/or recover CAP water from the aquifer, they must also comply with the assured water supply and recharge requirements.

Table 6.x.x Assured Water Supply Options

	Case #1	Case #2	Case #3	Case #4
Water Resources	Yes	No	Yes	No
Financial Capability	Yes	Yes	No	No
Options	Seek DAWS or join the CAGRD and seek digestion	Join CAGRD and Seek DAWS or make developer obtain water resources or join CAGRD and obtain CAWs	Make developer pay for water related infrastructure and seek DAWS	See cases #2 and #3

1995 Water Consumer Protection Act (WPCA)

In total, the Tucson AMA is sub-contracted for 215,333 AF of Central Arizona Project (CAP) water, with the largest sub-contractor being the City of Tucson/Tucson Water. Tucson Water is the largest water provider in the Tucson AMA serving over 75% of the population within the Tucson AMA. The direct delivery of CAP, the largest renewable water resource in the Tucson AMA, is currently not available to residents in City of Tucson because of the 1995 Water Consumer Protection Act (WPCA). In 1992, Tucson Water began the direct delivery of treated CAP water. This was discontinued in 1993 because of "brown water" problems. The brown water problem was attributed to the loosening of corrosion materials in older infrastructure throughout the water distribution system because of the chemical differences in the CAP. In addition to prohibiting the direct use of CAP, the 1995 WPCA requires that CAP water be used solely for sale, exchanged or recharged and to replace groundwater used by agriculture, industry and landscape irrigation. The WPCA also does not allow the direct injection of CAP water into the aquifer, further limiting the areas where water may be recharged.

Although recharge of CAP is helping the overall water balance in the Tucson AMA, the restrictions of the WPCA force recharge to occur outside the areas with severe water level declines. Additional factors that limit recharge in areas of severe decline are the cost of land, geology, existing contamination sites and potential sources of contamination.

Appendix H Regulations for Production of Class A and Class B Biosolids

REGULATIONS FOR PRODUCTION OF CLASS A AND CLASS B BIOSOLIDS

The federal Clean Water Act Part 503 regulations identify two classes of pathogen reduction:

Class A

Class A biosolids undergo a "Process to Further Reduce Pathogens (PFRP)." Pathogens are reduced to a level similar to the native soil and environment. Class A biosolids products can be used on home lawns and gardens, parks and golf courses, and other places where public contact is likely. Class A biosolids products include composted biosolids, lime pasteurized biosolids, and fertilizer pellets. Class A biosolids products are sometimes ingredients in soil amendments, potting soils, and slow-release fertilizers.

Class B

Class B biosolids undergo a "Process to Significantly Reduce Pathogens (PSRP)." This means that while pathogens are significantly reduced to levels, which are often below, those found in animal manures, additional best management practices ("BMPs") are required at the site where they are used. In New England, Class B biosolids are used in bulk as fertilizers in agriculture and forestry and to reclaim barren lands. Site permits are required for Class B biosolids use.

Currently both Roger Road WWTP and Ina Road WPCF wastewater treatment facilities produce biosolids with Class B pathogen reduction. Land application of Class B biosolids requires extensive monitoring, reporting, and record keeping. There are restrictions on the crop harvesting, animal grazing, and public contact when Class B biosolids are used on farmland. Moreover, there is a growing public perceptions of concern associated with the use of Class B biosolids throughout the United States. These factors may ultimately diminished the agricultural community's enthusiasm in accepting biosolids as a soil amendment.

Summary of Class A and Class B Pathogen Reduction Requirements

Class A: In addition to meeting the requirements in one of the six alternatives listed below, fecal coliform or Salmonella sp. bacteria levels must meet specific density requirements at the time of biosolids use or disposal or when prepared for sale or give away.

Alternative 1: Thermally treated biosolids - Biosolids must be processed through one of the four time-temperature regimes (described in 40CFR503).

Alternative 2: Biosolids treated in a high pH-high temperature process - Biosolids must meet specific pH, temperature, and air-drying requirements.

Alternative 3: Biosolids treated in other processes - Demonstrate that the process can reduce enteric viruses and viable helminth ova, and maintain operating conditions used in the demonstration after pathogen reduction.

Alternative 4: Biosolids treated in unknown processes - Biosolids must be tested for pathogens - Salmonella sp. or fecal coliform bacteria, enteric viruses, and viable helminth ova - at the time the biosolids are used, or disposed, or in certain situations, prepared for use or disposal.

Alternative 5: Biosolids treated in a PFRP - Biosolids must be treated in one of the Processes to Further Reduce Pathogens (PFRP).

Alternative 6: Biosolids treated in a process equivalent to PFRP - Biosolids must be treated in a process equivalent to one of the PFRPs, as determined by the permitting authority.

The following requirements must be met for all the above Class A pathogen alternatives. Either:

- The density of fecal coliform in the biosolids must be less than 1,000 most probable number (MPN) per gram total solids (dry-weight basis).

OR

- The density of Salmonella sp. bacteria in the biosolids must be less than 3 MPN per 4 grams of total solids (dry-weight basis).

The following are the processes to "further reduce pathogens (PFRP)" to produce Class A Biosolids listed in Appendix B of 40CFR503:

Class B: The requirements in one of the three alternatives below must be met.

Alternative 1: Monitoring of indicator organisms - Test for fecal coliform density as an indicator for all pathogens at the time of biosolids use or disposal.

Alternative 2: Use of PFRP - Biosolids are treated in one of the Processes to Significantly Reduce Pathogens (PSRP).

Alternative 3: Use of processes equivalent to PSRP - Biosolids are treated in a process equivalent to one of the PSRPs, as determined by the permitting authority.

1. Composting - Using either the within-vessal composting method or the static aerated pile composting method, the temperature of the biosolids is maintained at 55 degrees C or higher for three days. Using the windrow composting method, the temperature of the biosolids is maintained at 55 degrees C or higher for 15 days or longer. During the period when the compost is maintained at 55 degrees C or higher, the windrow is turned a minimum of five times.

2. Heat Drying - Biosolids are dried by direct contact with hot gases to reduce the moisture content of the biosolids to 10 percent or lower. Either the temperature of the biosolids particles exceeds 80 degrees C or the wet bulb temperature of the gas in contact with the biosolids as the biosolids leave the dryer exceeds 80 degrees C.

3. Heat Treatment - Liquid biosolids are heated to a temperature of 180 degrees C or higher for 30 minutes.

4. Thermophilic Aeorbic Digestion - Liquid biosolids are agitated with air or oxygen to maintain aerobic conditions, and mean cell residence time of biosolids is 10 days at 55 degrees C to 60 degrees C.

5. Beta Ray Irradiation - Biosolids are irradicated with beta rays from an accelerator at dosages of a least 1.0 megarad at room temperature (ca. 20 degrees C).

6. Gamma Ray Irradiation - Biosolids are irradiated with gamma rays from an accelerator at dosages of at least 1.0 megarad at room temperature (ca. 20 degrees C).

7. Pasteurization - The temperature of biosolids is maintained at 70 degrees C or higher for 30 minutes or longer.

Appendix I Capitalization of Infrastructure Growth, Replacement and Regulatory Compliance

Infrastructure rehabilitation is an ongoing capital expense necessary to maintain the operational integrity of the system as components reach, or exceed, their useful operational life. As Pima County is still in a growth mode and build out is not presently foreseen in the next twenty years, capital expenses for expansion of both the conveyance and treatment systems will continue to be ongoing. At this point in time the three most costly components are: upgrading the Roger and Ina facilities to include denitrification of all effluent, upgrading biosolids treatment at all facilities, and implementing CMOM practices in the operations of the conveyance system.

All projects in excess of $100K are eligible to be capitalized and have their completed costs added to the value of PCWWM facilities in service. The addition of new facilities to meet regulatory issues is easily determined as additions to the value of the plant in service. Likewise, major facilities and conveyance rehabilitation/replacement are easily identified as increasing the value of the plant in service. What is more difficult to quantify are the smaller projects individually less than $100,000 that replace segments or components of the system, increasing the life expectancy of the components replaced.

If PCWWM were a private utility, it would be in PCWWM's best interest to capitalize as much improvement work as possible because it would add to the book value of the utility. It also has long-term tax benefits as capital assists are depreciated while expensing projects provide for a one-time tax deduction and show no improvement to the utility's book value.

With the advent of GASB-34 (Government Accounting Standards Board – Statement No. 34), public utilities are encouraged to track assets more like private utilities. It is in PCWWM's best interest to maintain or increase its book value as a reflection of PCWWM's commitment to maintain the infrastructure. Additionally, with the constant pressure to contain O&M costs there is an incentive to capitalize replacement/rehabilitation work when possible, and much of this work could be done with bond funding verses limited available SDF cash.

One example of this type of maximization of capital improvements of small individual projects would be the replacement of deteriorated manholes. For example, each manhole on a section of the conveyance system may average $15,000 each to replace. If done individually, the projects would most likely be expensed. However, if there are 40 manholes requiring replacement the combined work could be completed as follows:

- Establish a $600,000 project to replace these manholes.
- Each replaced manhole increases the useful life over the old manhole it replaces.
- The project meets PCWWM capitalization guidelines.
- The remaining value of the old manhole can be identified and removed from the facilities in service, say $50,000 net.
- The new value can be added to the facilities in service with an overall increase of $550,000.

Similar examples can be demonstrated for the pipes and facilities within the treatment plants.