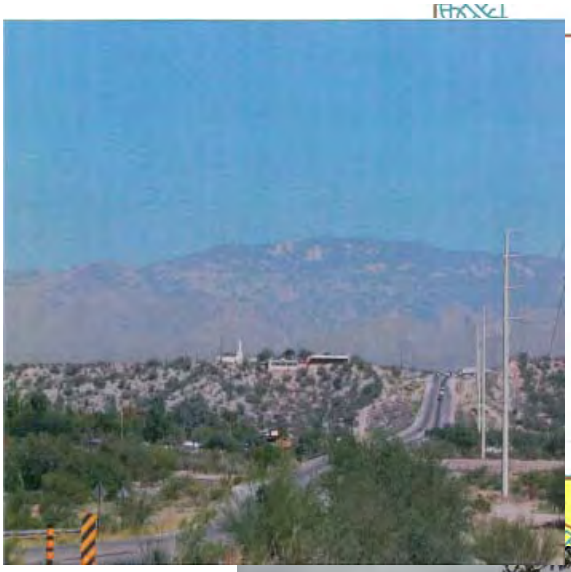
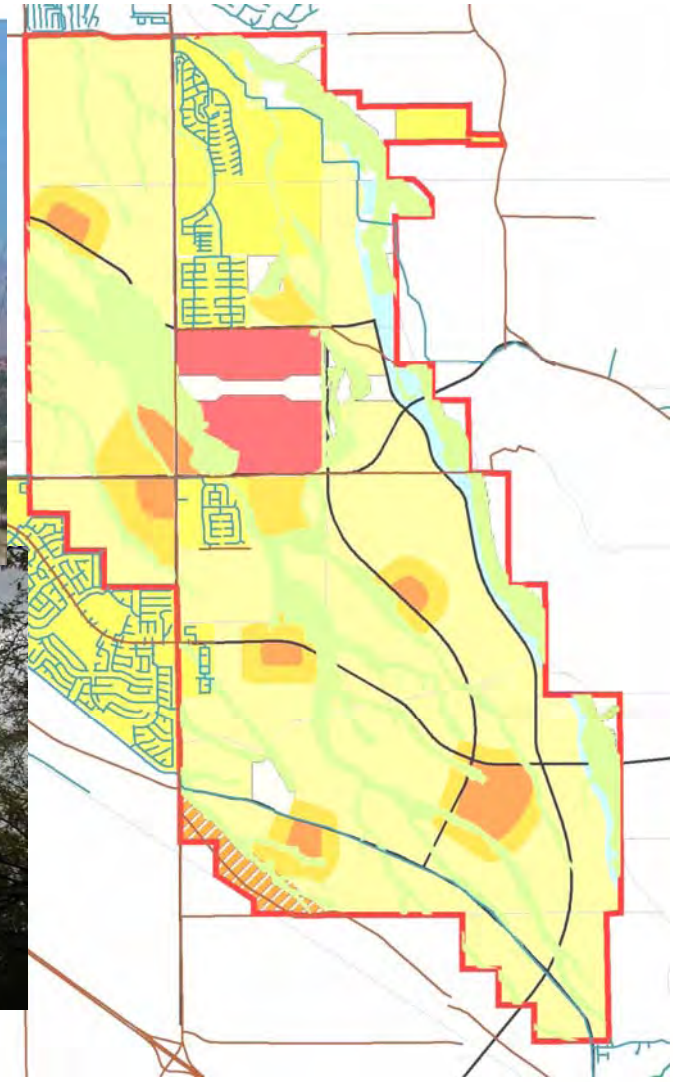
PIMA COUNTY
REGIONAL WASTEWATER
RECLAMATION DEPARTMENT

HOUGHTON AREA MASTER PLAN (HAMP)
WASTEWATER CONCEPTUAL PLAN

February 2008





MALCOLM PIRNIE

1094-114

Registered Professional Engineer (Sanitary)
CERTIFICATE NO. 27864
JAMES W. DETTMER
Date Signed 02-19-2007
ARIZONA, U.S.A.

Houghton Area Master Plan (HAMP) Wastewater Conceptual Plan

Final Report

Pima County Regional Wastewater Reclamation Department
201 North Stone Avenue, 8th Floor
Tucson, Arizona 85701

February 2008

MALCOLM PIRNIE, INC.

One South Church Avenue
Suite 1120
Tucson, Arizona 85701-1654

1094-114

TABLE OF CONTENTS

Page

1.0 INTRODUCTION 1-1
1.1 Description of Planning area 1-1
1.1.1 HAMP Planning Area 1-1
1.1.2 Wastewater Planning Area 1-2
1.2 Background 1-2
1.2.1 Pima Association of Governments – Transportation Analysis Zones 1-3
1.2.2 City of Tucson Houghton Area Master Plan 1-3
1.2.3 Arizona State Land Department Land Planning 1-4
1.2.4 2006 Metropolitan Area Facility Plan Update 1-5
1.2.5 Tucson Water Reclaimed Water System Master Plan 1-6
1.3 Purpose and Objectives 1-6
1.3.1 City of Tucson HAMP 1-7
1.3.2 Regional Wastewater Planning 1-7
1.3.3 Water and Reclaimed Water Planning 1-7
1.4 Report Organization 1-8

2.0 POPULATION AND FLOW PROJECTIONS 2-1
2.1 Population Model and Assumptions 2-1
2.2 Wastewater Flow Assumptions and Projections 2-1
2.3 Reclaimed Water Demand Projections 2-3

3.0 WASTEWATER CONVEYANCE AND TREATMENT SCENARIOS 3-1
3.1 Existing Interceptor Capacities 3-1
3.2 Wastewater Flow and Collection 3-2
3.3 Wastewater Treatment 3-4
3.3.1 Wastewater Treatment Location 3-4
3.3.2 Facility Sizing 3-5

4.0 SCENARIO SCREENING 4-1
4.1 Institutional and Regulatory Issues 4-1
4.2 Conceptual Conveyance and Treatment Facility Layouts 4-2
4.3 Identification of Treatment Facility Sites 4-3
4.4 Alternatives for Effluent Use 4-4
4.5 Screening of Scenarios 4-5

TABLE OF CONTENTS (Continued)

Page

5.0 COST EVALUATION OF SCREENED SCENARIOS 5-1
5.1 Implementation Cost Opinions 5-1
5.1.1 Basis of Cost Opinion 5-1
5.1.2 Unit Cost Development 5-1
5.1.3 Conveyance Cost Opinion 5-2
5.1.4 Treatment Cost Opinion 5-3
5.2 Cost Analysis 5-4
5.3 Implementation Schedule (Flow-Based) 5-6

6.0 COMPARISON OF SCENARIOS 6-1
6.1 COMPARISON MATRIX 6-1
6.1.1 Conveyance Scenarios (1A and 1B) 6-1
6.1.2 Treatment Scenarios (2A, 2B, 3A, and 3B) 6-1

7.0 CONCLUSIONS AND RECOMMENDATIONS 7-1
7.1 Conclusions 7-1
7.2 Recommendations 7-2

TABLE OF CONTENTS (Continued)

Page

LIST OF TABLES

Table No.	Description	Page
2-1	Projected ADWF vs. Facility Plan Projections and Metered Data (mgd)	2-2
2-2	Reclaimed Water Demand Around the HAMP Planning Area	2-4
3-1	Existing Southeast Interceptor Diameters and Capacity	3-1
3-2	Existing Pantano Interceptor Diameters and Capacity	3-2
3-3	SEI Alternative Flows	3-3
3-4	PTI Alternative Flows	3-3
3-5	Scenario Treatment Capacities	3-6
4-1	Treatment Facility Footprint Requirements	4-3
4-2	Non-Cost Evaluation	4-5
4-3	Non-Cost Evaluation – Extended	4-6
5-1	Unit Costs for Trunk Sewer Collection Pipelines and Manholes for Wastewater Conceptual Plan	5-2
5-2	Sewer and Manhole Cost Opinion for Wastewater Conveyance Scenarios	5-3
5-3	Summary of Capital and O&M Cost Summary of Wastewater Alternatives	5-5
6-1	Comparison of HAMP Wastewater Management Alternatives	6-2

LIST OF FIGURES

Figure No.	Description	Following Page
1-1	Tucson Area Map	1-1
1-2	Existing Development Areas	1-2
1-3	Wastewater Drainage Basins	1-5
1-4	Reclaimed Water Infrastructure	1-6
2-1	Summary of Population Projections	2-1
3-1	Interceptor System and Manhole Locations	3-1
3-2	SEI Wastewater Flow Alternative Drainage Basins	3-2

TABLE OF CONTENTS (Continued)

		Page
3-3	PTI Wastewater Flow Alternative Drainage Basins	3-3
4-1	Potential Sewer Capacity Deficiencies	4-2
4-2	HAMP Trunk Sewers	4-2
4-3	Scenario 2B Drainage Basin Configuration	4-2
4-4	Recommended Treatment Plant Sites	4-3
5-1	Implementation Schedule – Scenario 1A	5-6
5-2	Implementation Schedule – Scenario 2A	5-6
5-3	Implementation Schedule – Scenario 2B	5-6

LIST OF APPENDICES

Appendix	Description	Page
A	Technical Memorandum 1 - May 18, 2006: Technical Memorandum for Population Projections, Wastewater Flow Projections, and Water Demand Projections for the Houghton Area Master Plan (HAMP) Project Site	A-1
B	Technical Memorandum 2 - July 13, 2006: Technical Memorandum for Wastewater Treatment Scenarios for the Houghton Area Master Plan (HAMP) Project Site	B-1
C	Technical Memorandum 3 -August 25, 2006: Technical Memorandum of Wastewater Treatment and Conveyance Evaluation for the Houghton Area Master Plan (HAMP) Project Site	C-1

1.0 INTRODUCTION

Malcolm Pirnie, Inc. (Malcolm Pirnie) was retained concurrently by Tucson Water and the Pima County Regional Wastewater Reclamation Department (PCRWRD) to conduct coordinated master planning studies of water and wastewater infrastructure requirements for anticipated development of the Houghton Area Master Plan (HAMP) planning area. A majority of the land within the HAMP planning area is State Trust Land currently managed by the Arizona State Land Department (ASLD). The ASLD is considering selling portions of this land for development and has been engaged in master planning activities.

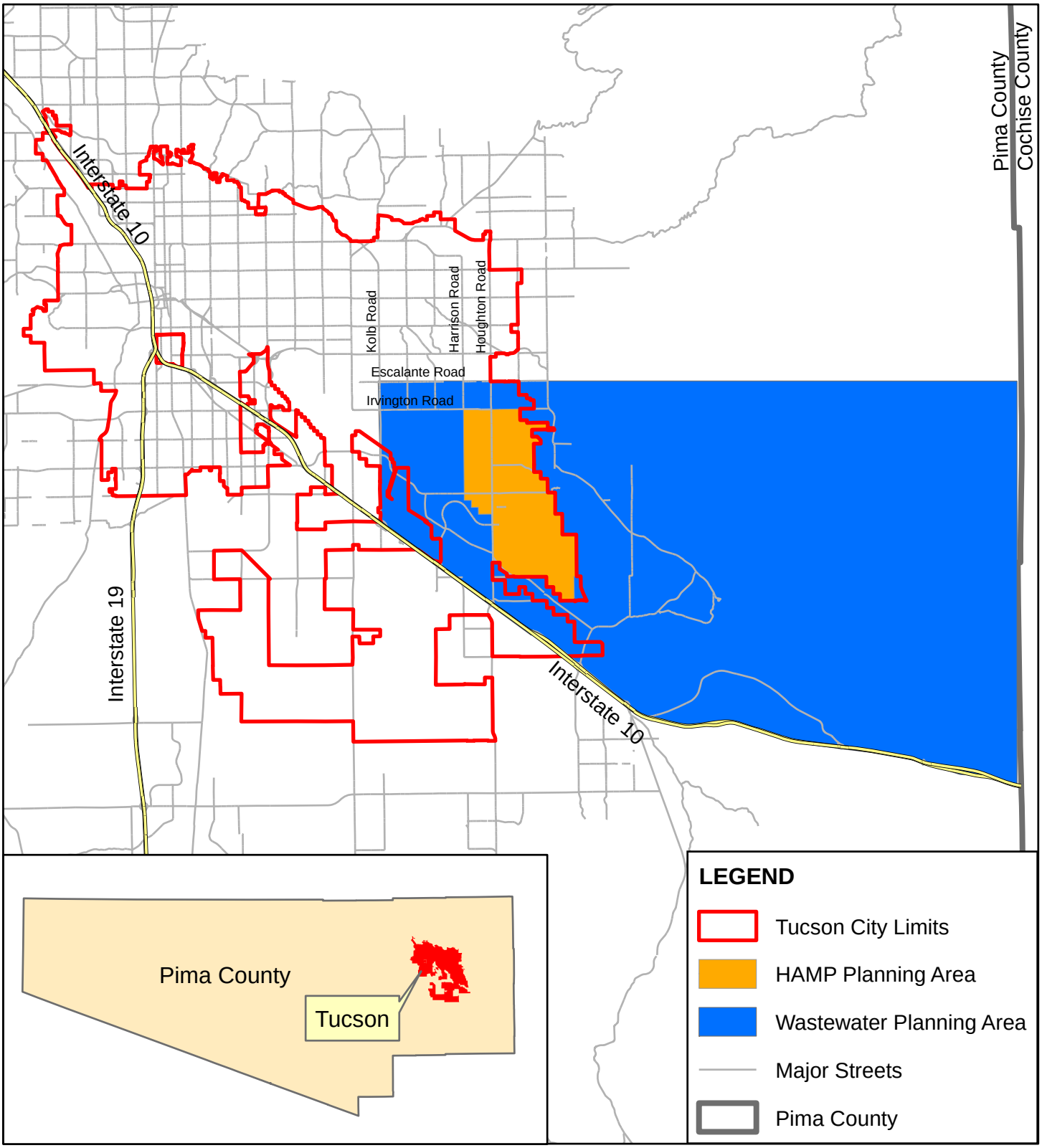
Tucson Water and PCRWRD have mutually agreed to use the same population and development planning assumptions for the HAMP planning area to complete their respective master plan studies. Recommendations for infrastructure development, therefore, are consistent with current facility planning for both utilities. The purpose of this report is to present the conceptual study results and recommendations for wastewater infrastructure requirements in the HAMP planning area. A second report will be prepared with study results and recommendations for potable water and reclaimed water facilities.

1.1 DESCRIPTION OF PLANNING AREA

The HAMP planning area is located in the southeastern portion of Tucson along Houghton Road north of Interstate Highway 10 (I-10) as illustrated in Figure 1-1. Water planning activities for this project were limited to the HAMP planning area, while wastewater conceptual planning was extended to a much larger area surrounding the HAMP boundary. The Wastewater planning area, illustrated in Figure 1-1, includes HAMP and upgradient areas that contribute wastewater flow to HAMP.

1.1.1 HAMP Planning Area

The HAMP planning area was defined in the City of Tucson HAMP as the southeast portion of Tucson bounded on the north by Irvington Road, the west by Harrison Road, the southwest by the Rita Ranch development, and the south and east by the Tucson city limits. The planning area encompasses approximately 10,800 acres with



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TUCSON AREA MAP

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FIGURE 1-1

approximately 7,740 acres belonging to the ASLD. Detailed discussion of the City of Tucson HAMP report is presented below. The HAMP planning area was the focus for this development planning, because this area represents one of the largest contiguous portions of undeveloped land within the Tucson city limits.

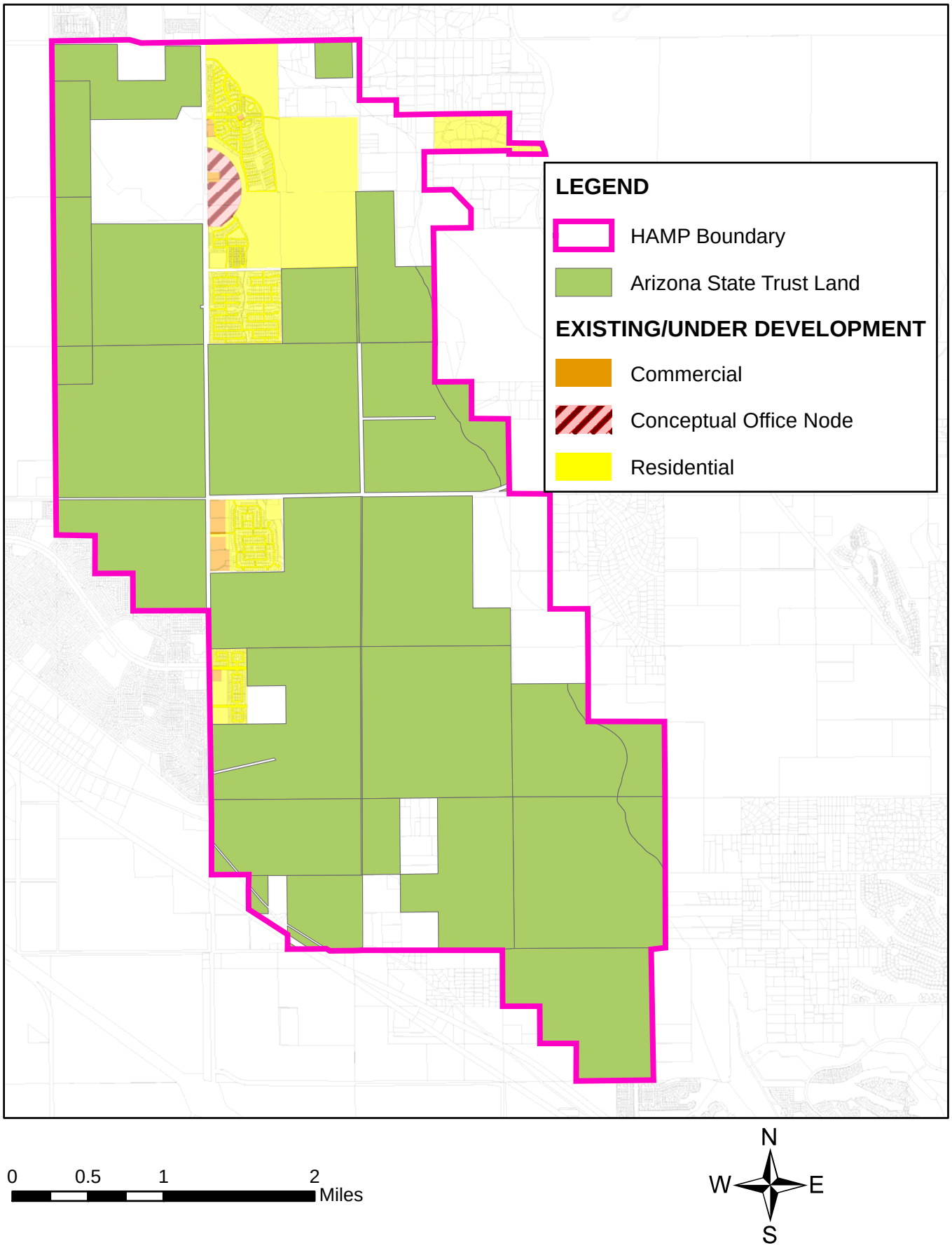
1.1.2 Wastewater Planning Area

The Wastewater planning area is bounded by Escalante Road to the north, Kolb Road to the west, I-10 to the south, and the Pima/Cochise County line to the east. The larger Wastewater planning area is generally higher in elevation than the HAMP planning area and, therefore, contributes wastewater flow through the HAMP planning area from sewered portions of the larger Wastewater planning area. The sewered populations, which are within the Wastewater planning area and upgradient from HAMP, are outside of the Tucson Water service area. These sewered populations are only customers of PCRWRD; however, they must be considered in this master planning effort, since their wastewater flows will impact planning decisions within the HAMP planning area.

The wastewater master plan recommendations presented in this report account for wastewater flows generated within the HAMP planning area and from upgradient areas. In sewered areas of the planning area, no usage of septic tanks is assumed. Septic tank use is expected in unsewered portions of the HAMP planning area and the larger Wastewater planning area and projected wastewater flow have been adjusted accordingly.

1.2 BACKGROUND

Approximately three-fourths of the land area within the HAMP boundaries is currently managed by the ASLD as State Trust Land as illustrated in Figure 1-2. The ASLD is actively investigating phased sales of land holdings within the HAMP planning area, which has focused attention on preparing coordinated master planning efforts for this area. Several studies have previously been prepared that relate to the master planning efforts for HAMP. The following paragraphs describe previous studies affecting planning in the HAMP area.



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EXISTING DEVELOPMENT AREAS

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FIGURE 1-2

1.2.1 Pima Association of Governments – Transportation Analysis Zones

The Pima Association of Governments (PAG) prepares population estimates and projections for Pima County and its incorporated jurisdictions for transportation and urban development planning. The PAG Regional Council established a local Population Planning Committee that assigns population estimates using socioeconomic data and analysis for 846 transportation analysis zones (TAZs) across Pima County and into small portions of neighboring Pinal and Cochise Counties. The PAG TAZ estimates are based on population data for the year 2000, and population projections are estimated for the year 2030. PAG TAZ data has been accepted by all participating parties as the basis for generating population estimates, water demand projections, and wastewater flow projections for the HAMP planning area and the surrounding Wastewater planning area.

1.2.2 City of Tucson Houghton Area Master Plan

The Houghton Area Master Plan was prepared by the City of Tucson Department of Urban Planning and Design as a model for planning the development of distinct growth areas within the City of Tucson consistent with the State's Growing Smarter and Growing Smarter Plus Acts and the City's General Plan. The document was adopted by the Tucson Mayor and Council on June 7, 2005. The City developed the plan in cooperation with the State of Arizona, Pima County, the Sonoran Institute, and a Citizen Review Committee, and incorporated a plan for future land use called the "Desert Village Model". The Desert Village Model combines high, medium, and low density residential land uses with commercial development in localized village and town centers. HAMP was developed by adhering to six guidance elements:

- Land Use
- Circulation and Mobility
- Environmental and Cultural Resources
- Public Services, Utilities, and Facilities
- Cost of Service
- Implementation

Limited residential development has previously been established within the HAMP planning area as illustrated in Figure 1-2. Significant tracts of State Land are anticipated to be sold and developed in accordance with plans set forth in the HAMP, while owners of smaller existing parcels are also encouraged to ensure compatibility with HAMP. The City of Tucson HAMP included the possibility of a water reclamation plant in or near the HAMP area. Although the City's HAMP identified a conceptual facility site near Harrison Road and Irvington Road, this concept was not fully developed, and additional planning would be required to optimally site the facility. Reclaimed water treatment and usage is considered in more detail in this wastewater master plan study.

1.2.3 Arizona State Land Department Land Planning

The ASLD is responsible for Arizona State Trust Land, which was deeded to Arizona in 1912 when Arizona was granted statehood. Sales of Trust Land benefit Arizona public institutions, primarily state schools. The ASLD initiated planning efforts to maximize return for their beneficiaries. In June 2006, URS, Inc. prepared a draft Phased Disposition Scenario Report for ASLD that described major infrastructure needs for the development of the HAMP planning area in a manner consistent with the City's plan. The draft report addressed phased development requirements for water, wastewater, drainage, and transportation infrastructure.

The URS master plan report indicated that the HAMP planning area would have a build-out population of approximately 85,000, which is consistent with the City's HAMP report. In addition, the peak day demand for potable water was estimated by URS at approximately 21 million gallons per day (mgd) based on a residential use rate of 110 gallons per capita per day (gpcd) and commercial use of 52 gpcd. Wastewater flow projections were based on 85 gpcd for residential use and 1,000 gallons per acre for commercial use. An estimate of 10.5 mgd for wastewater flow from the HAMP planning area was projected.

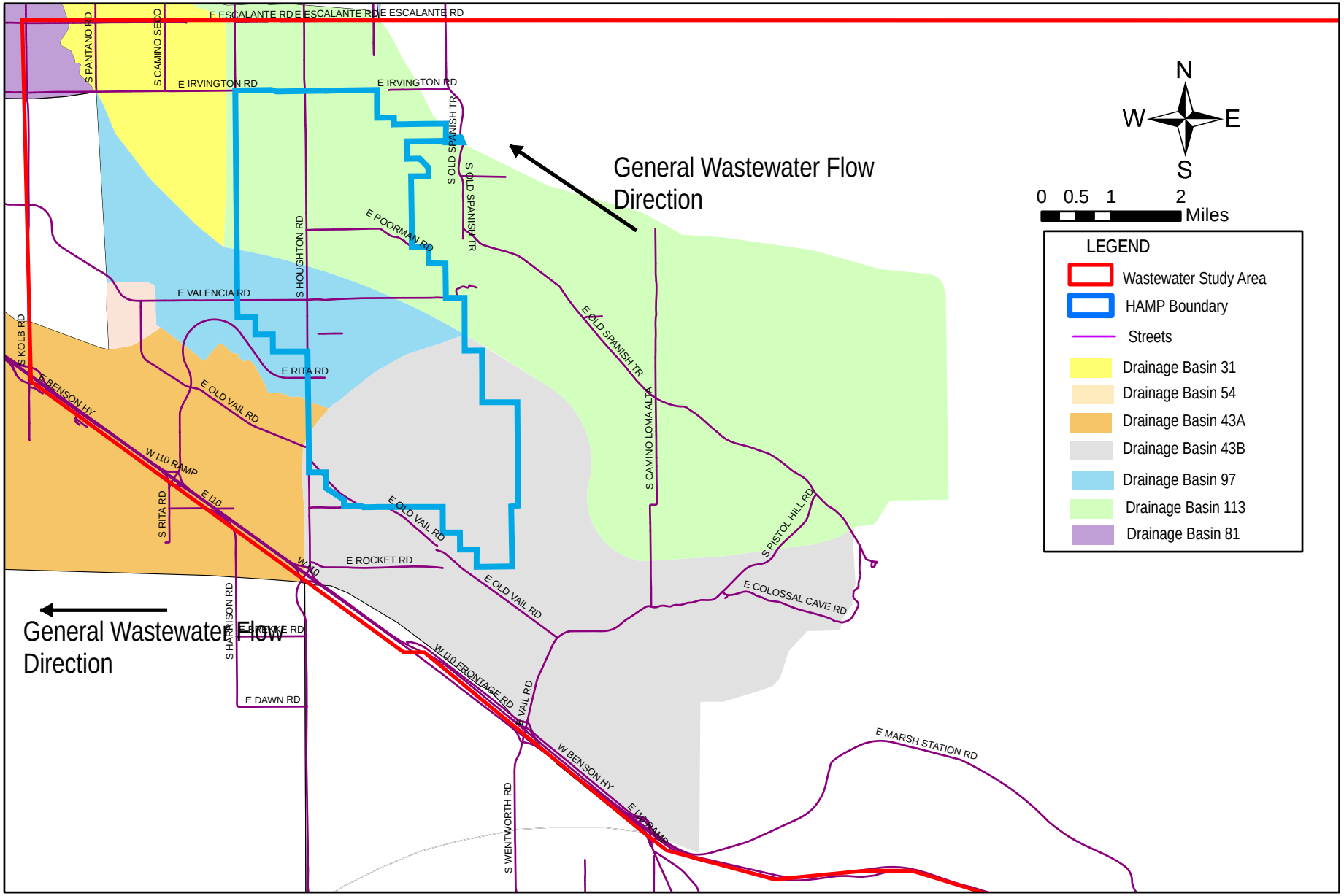
The URS report presented several scenarios for the development of the HAMP planning area. All projections for water and wastewater facility requirements were made without consideration for population influences and/or infrastructure requirements outside the HAMP planning area boundaries.

1.2.4 2006 Metropolitan Area Facility Plan Update

PCRWRD recently prepared an update to the Metropolitan Area Facility Plan. The resulting 2006 Metropolitan Area Facility Plan Update (Facility Plan Update) covers wastewater planning for the Tucson metropolitan area for the period 2006 to 2026. The goal of the Facility Plan Update was to guide continuing development of the metropolitan area and regional wastewater conveyance and treatment systems. The plan addressed issues associated with the condition of existing facilities, future conveyance and treatment needs, regulatory requirements, water resource management, asset management, and funding.

The wastewater flows from the vicinity of the HAMP planning area are collected within five drainage basins (43A, 43B, 54, 97, and 113) that were identified in the Facility Plan Update and are illustrated in Figure 1-3. These wastewater flows are conveyed to the Roger Road Wastewater Treatment Plant (WWTP) for treatment through two major sewer lines, the Southeast Interceptor (SEI) and the Pantano Interceptor (PTI). The Facility Plan Update identified capacity deficiencies in both the SEI and PTI between the Roger Road WWTP and the HAMP planning area. The Facility Plan Update attributes capacity deficiencies in down-gradient interceptor segments for both sewer lines to population growth projected in HAMP and areas around Vail. Recommendations in the Facility Plan Update include evaluating increasing capacity in the SEI around the City of South Tucson and east of Wilmot Road as well as increasing capacity in the PTI at the Harrison Road siphon at the Pantano Wash, along the Pantano Wash to Golf Links Road, and between along the Pantano between Speedway Boulevard and Kolb Road.

The Facility Plan Update also recommended evaluation of the need for a water reclamation facility to serve the far southeast area of metropolitan Tucson and conceptualized the facility as a sub-regional treatment facility funded by a Community Facility District. The potential facility would be built to coincide with existing interceptors reaching capacity and would likely have a phased implementation. As previously suggested in the City of Tucson HAMP, the Facility Plan Update included a potential location for a HAMP facility near the intersection of Harrison Road and Irvington Road.



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WASTEWATER DRAINAGE BASINS

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FIGURE 1-3

1.2.5 Tucson Water Reclaimed Water System Master Plan

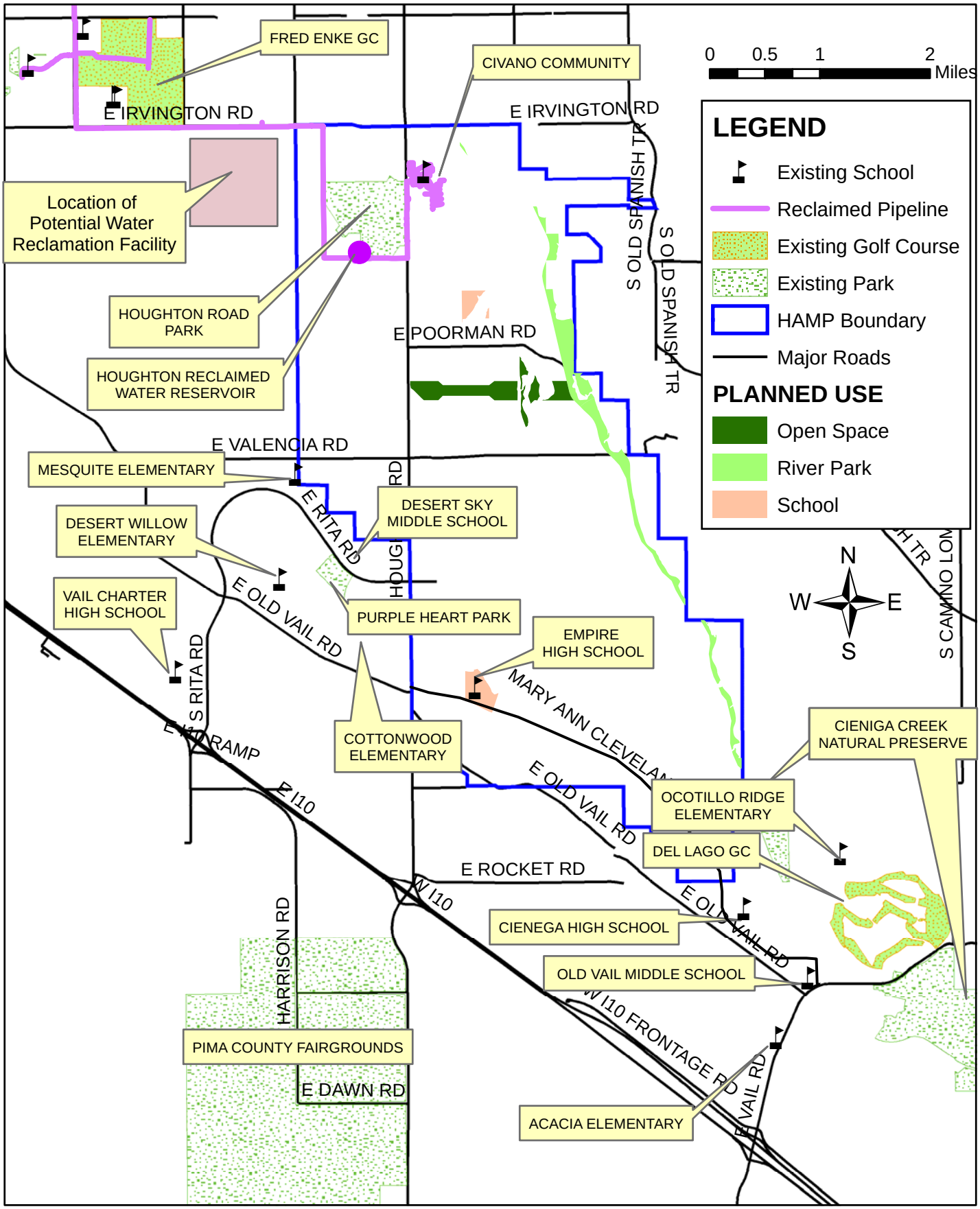
Tucson Water prepared a Reclaimed Water System Master Plan in 1999 to provide planning for expansion of the reclaimed water distribution system based on existing infrastructure and a market study of potential reclaimed water users in the Tucson Water service area. The existing Reclaimed Water System currently serves the Civano community in the northern portion of HAMP from a 4.5 million-gallon reservoir located near Houghton Road, approximately one mile south of Irvington Road, as illustrated in Figure 1-4.

Principal reclaimed water customers include large turf irrigation facilities including golf courses, schools, and parks. The Reclaimed Water System Master Plan used a GIS-based approach to evaluate these potential demands. The HAMP planning area is projected to include a variety of potential reclaimed water users, and the areas surrounding HAMP include existing irrigation demands that could potentially be served from the reclaimed water system, including the Del Lago Golf Course, Cienega High School, Vail Middle School, and elementary schools and parks in the vicinity of Vail and Rita Ranch as illustrated in Figure 1-4.

1.3 PURPOSE AND OBJECTIVES

The purpose of this report is to provide recommendations for wastewater conveyance and treatment development in the HAMP planning area and the Wastewater planning area consistent with the existing utility infrastructure and planned expansions of the regional wastewater, potable water, and reclaimed water systems. The objectives of this report include:

- Develop population and flow projections
- Characterize existing infrastructure capacities
- Develop wastewater conveyance and treatment alternatives
- Identify applicable institutional and regulatory issues
- Screen alternatives based on non-cost criteria
- Evaluate costs for feasible alternatives



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RECLAIMED WATER INFRASTRUCTURE AND POTENTIAL RECLAIMED WATER USE SITES

FIGURE 1-4

- Present conclusions and recommendations for HAMP wastewater management

The conceptual wastewater plan for HAMP and the surrounding Wastewater planning area has been prepared to be consistent with previous planning efforts for the HAMP planning area. A summary of the conformance with previous efforts is presented below.

1.3.1 City of Tucson HAMP

Transportation Analysis Zone (TAZ) data from the Pima Association of Governments (PAG) was used as the basis for population projections. These population figures have been adopted for planning purposes by PAG, ASLD, PCRWRD, Tucson Water, and the City of Tucson Development Services for planning efforts in the HAMP planning area. To the extent possible, major trunk sewers were located along planned transportation corridors to allow for consistency with other major construction efforts. This location of trunk sewers had the added benefit of placing major sewers directly adjacent to the planned population centers of the HAMP.

1.3.2 Regional Wastewater Planning

As mentioned previously, the Facility Plan Update envisioned a potential HAMP water reclamation facility to serve HAMP and the surrounding area. Information on existing interceptor capacities from the Facility Plan Update was used in this study for consistency in wastewater conveyance planning. Drainage basins, peaking factors, and per capita wastewater flow rates are also consistent with the Facility Plan Update. An ongoing regional study called the Regional Optimization Master Plan (ROMP) will integrate the findings of this report into the larger regional wastewater treatment planning effort.

1.3.3 Water and Reclaimed Water Planning

The HAMP wastewater treatment alternatives are closely related to objectives for reclaimed water use in the planning area. This joint effort has been undertaken by PCRWRD and Tucson Water for reclaimed water planning in and around the HAMP area due to the close relationship of reclaimed water and wastewater treatment. A concurrent

planning effort by Tucson Water has focused on the potable and reclaimed water needs of the HAMP area. Population projections have been coordinated based upon TAZ data, and reclaimed water coordination was undertaken in development of wastewater treatment and conveyance alternatives. System-wide reclaimed water supply has been evaluated as part of the HAMP reclaimed water planning.

1.4 REPORT ORGANIZATION

The study has been developed as a series of three technical memoranda: *Population and Flow Projections, Development of Wastewater Treatment Scenarios, and Screening of Wastewater Treatment Scenarios*. Each of the technical memoranda has been summarized, and all are included in appendices. This report is organized into the following sections:

Section 1 – Introduction. The introduction provides an overview of the report background, objectives, and organization.

Section 2 – Population and Flow Projections. Section 2 provides an overview of the population model used to estimate current and future populations within the HAMP planning area and the surrounding Wastewater planning area. This section also provides a description of TAZ data, the assumptions used to determine water demand, wastewater flow projections, and reclaimed water demand projections in HAMP. The technical memorandum that provides the backup information for Section 2 is presented in Appendix A.

Section 3 – Wastewater Conveyance and Treatment Scenarios. Section 3 provides a summary of the wastewater flow projections for individual drainage basins within the planning area, the development of conveyance scenarios, and the development of treatment alternatives. Each scenario is defined based on the location of wastewater treatment and the portions of the drainage basins directed to either the SEI or PTI interceptors. A comparison of existing wastewater flow capacities and projected flow rates was used to develop alternatives that would maximize the use of existing infrastructure. The technical memorandum supporting the development of conveyance and treatment scenarios is presented in Appendix B.

Section 4 – Scenario Screening. Section 4 provides a summary of wastewater conveyance and treatment scenario screening using non-cost criteria. This section provides conceptual layouts of treatment system footprints, regulatory requirements, and screening criteria. Each scenario was scored for each criterion, and the total scores were summed and compared. The three highest ranked scenarios were carried forward for cost development. The technical memorandum supporting the scenario screening is presented in Appendix C.

Section 5 – Cost Evaluation of Screened Scenarios. Section 5 provides an overview of the estimated costs of the screened scenarios.

Section 6 – Comparison of Scenarios. Section 6 presents a comparison of the advantages and disadvantages of each of the screened scenarios selected in Section 5.

Section 7 – Conclusions and Recommendations. Section 6 provides a summary of the conceptual wastewater plan conclusions and recommendations.

2.0 POPULATION AND FLOW PROJECTIONS

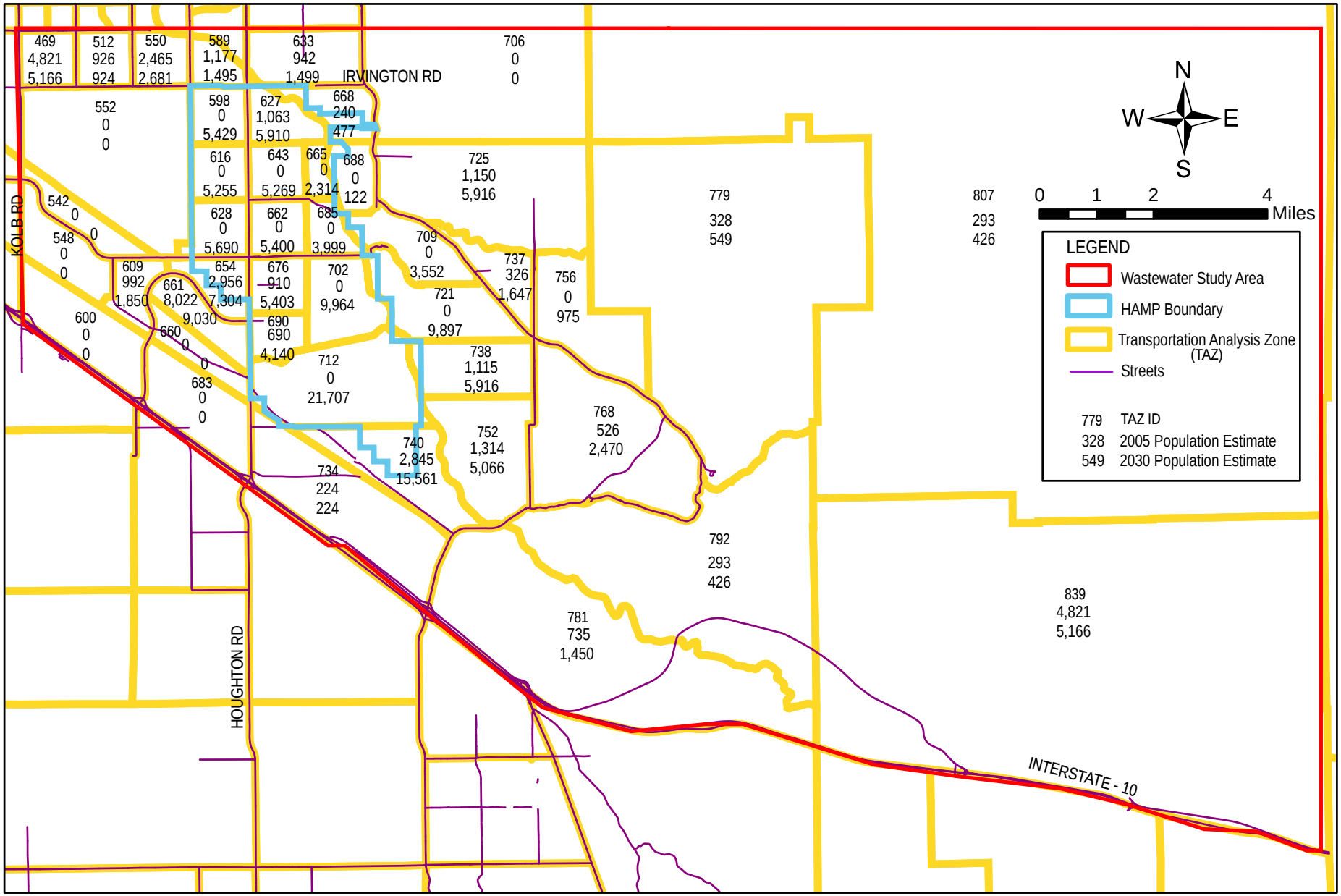
Population, water demand, and wastewater flow projections for the HAMP planning area and the Wastewater planning area were developed and documented in Technical Memorandum No. 1 include in Appendix A of this report. A summary of this technical memorandum is presented below.

2.1 POPULATION MODEL AND ASSUMPTIONS

The population projections were modeled using available TAZ population projection data for the year 2030. The TAZ 2030 population projections were assumed to be representative of the "buildout" population for the HAMP planning area and the Wastewater planning area. Estimates for 2005 populations were made by assuming linear increases in population for each TAZ from the published 2000 data to the 2030 projections. Figure 2-1 illustrates the population distributions for 2005 and 2030 across the HAMP planning area and the Wastewater planning area. Population was redistributed within the study area based on evidence of development as seen in aerial photography. Using this model, the buildout population projection for the HAMP planning area was 87,748, while the entire Wastewater planning area was projected to have a population of 164,786.

2.2 WASTEWATER FLOW ASSUMPTIONS AND PROJECTIONS

Average dry weather flow (ADWF) projections for the Wastewater planning area were developed using the per capita flow factor developed in the Facility Plan Update of 85 gpcd, and peak dry weather flow (PDWF) was calculated from projected ADWF based on the peaking factor algorithm used in the Facility Plan Update that estimates peaking characteristics based on system configuration and flow distribution. Areas projected to be on septic tank service were not included in the wastewater flow projections. The projected ADWF for the Wastewater planning area in 2005 totaled approximately 2.7 mgd and the 2005 PDWF totaled 4.6 mgd. Approximately 700,000 gallons per day of the 2005 total wastewater flow was generated in Drainage



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SUMMARY OF POPULATION PROJECTIONS

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FIGURE 2-1

Basins 31 and 81, which are down gradient of the PTI in the Wastewater planning area. As a result, only approximately 2 mgd of the 2005 wastewater flow from the planning area exited the drainage basins through either the SEI or the PTI interceptors. The Wastewater planning area is projected to have an ADWF of 11.9 mgd and a PDWF of 18.1 mgd at buildout (excluding basins 31 and 81 as described previously).

Current flow projections were compared to available metering data to show a meaningful correlation with flow projections and validate the population and wastewater flow projection models. The results of this comparison are presented below:

Table 2-1
Projected ADWF vs. Facility Plan Projections and Metered Data (mgd)

Basin ID	2005 ADWF	Facility Plan Projection	Metered Flow (high)[1]	Metered Flow (low)[1]
43B	0.40	0.40	0.41	0.32
54 & 97	0.74	0.68	0.76	0.58
113	0.53	0.73	0.60	0.46

Note:
1. Metered flow readings from the wastewater collection pipelines are based on measurements of depth of wastewater flow. The flow depth is converted into a volume using the Manning formula and assumed range of the Manning roughness constant (n) between 0.010 and 0.013. The high metered flow rate corresponds to an n = 0.010. Low metered flow rate is based on n = 0.013.

This comparison of the modeled 2005 ADWF flows for specific drainage basins correspond closely to the metered flow rates at the exit points to the above-referenced drainage basins. The 2005 ADWF projections, therefore, are representative of current wastewater flow rates for TAZs within the Wastewater planning area.

As previously stated, the 2030 TAZ data have been accepted by participating planning parties as buildout population data for the HAMP and Wastewater planning areas, while the 2005 population estimates represent current population. As a result, growth of population and wastewater flow rates can be modeled without reference to dates. There is considerable uncertainty associated with the timing of development in the HAMP planning area, and by focusing wastewater planning on flow rates rather than dates; uncertainty associated with the development progression for HAMP can be

managed. Wastewater Conveyance and Treatment Scenarios, therefore, were evaluated based on flow-based triggers rather than time-based triggers (Section 4).

2.3 RECLAIMED WATER DEMAND PROJECTIONS

Similar to the wastewater flow projections, water demand projections are based on the population modeled for the HAMP planning area. The buildout water demand projection was approximately 14 million gallons per day (mgd) based on an average demand of 163 gpcd for residential and commercial/industrial water use. For planning purposes, Tucson Water assumes a reclaimed water demand of approximately 8 percent of total water demand based on system-wide historical reclaimed water usage, which would result in a HAMP area reclaimed water demand of 1.2 mgd at buildout.

The HAMP planning area represents a small portion of the Tucson Water service area and reclaimed water usage may be different than the system-wide average. As a result, the validity of this assumption regarding reclaimed water demand could vary if the mix of development varies from the rest of Tucson Water's water service area..

To augment the projected reclaimed water demand for the HAMP area, known potential reclaimed water users were identified in the vicinity of but outside of the HAMP planning area including the Del Lago Golf Course near Vail, several schools near Vail (Vail Elementary School, Vail Middle School, and Cienega High School), and schools and parks in the Rita Ranch development on the southwest corner of the HAMP boundary. Table 2-2 presents a summary of existing and projected future reclaimed water demands in and around the HAMP planning area.

Table 2-2 Reclaimed Water Demand Around the HAMP Planning Area			
Existing Users	**Estimated Irrigation Demand (AF/Ac)**	**Estimated Irrigated Acreage**	**Estimated Reclaimed Demand (mgd)**
Golf Course (Del Lago)	4.0	395	1.4
Schools (Vail and Rita Ranch)	3.4	97	0.3
Parks	3.2	127	0.4
Subtotal Existing Demand			**2.1**
Future Users	**Estimated Irrigation Demand (AF/Ac)**	**Estimated Irrigated Acreage**	**Estimated Reclaimed Demand (mgd)**
Golf Course (Research Park)	4.0	114	0.4
Future Schools	3.4	30	0.1
Future Parks	3.2	168	0.4
Subtotal Future Demand			**0.9**

Reclaimed water demand around the HAMP planning area could range from 2.1 mgd to 3.0 mgd. Since reclaimed water demand is principally used for turf and landscape irrigation, demand for reclaimed water will not be consistent year-round. Combined with the estimated reclaimed water demand within HAMP of 1.2 mgd, the total reclaimed water demand for a system in the HAMP area could range from 3.3 mgd to 4.2 mgd.

3.0 WASTEWATER CONVEYANCE AND TREATMENT SCENARIOS

Wastewater conveyance and treatment scenarios were developed for the Wastewater planning area based on two alternatives for drainage basin layouts and three configurations for wastewater treatment. Existing infrastructure was evaluated in relation to the population and flow projections previously described in Section 2.0. Detailed descriptions of the development and assumptions for each of the wastewater conveyance and treatment scenarios are presented in Technical Memorandum No. 2, which is included in this report as Appendix B.

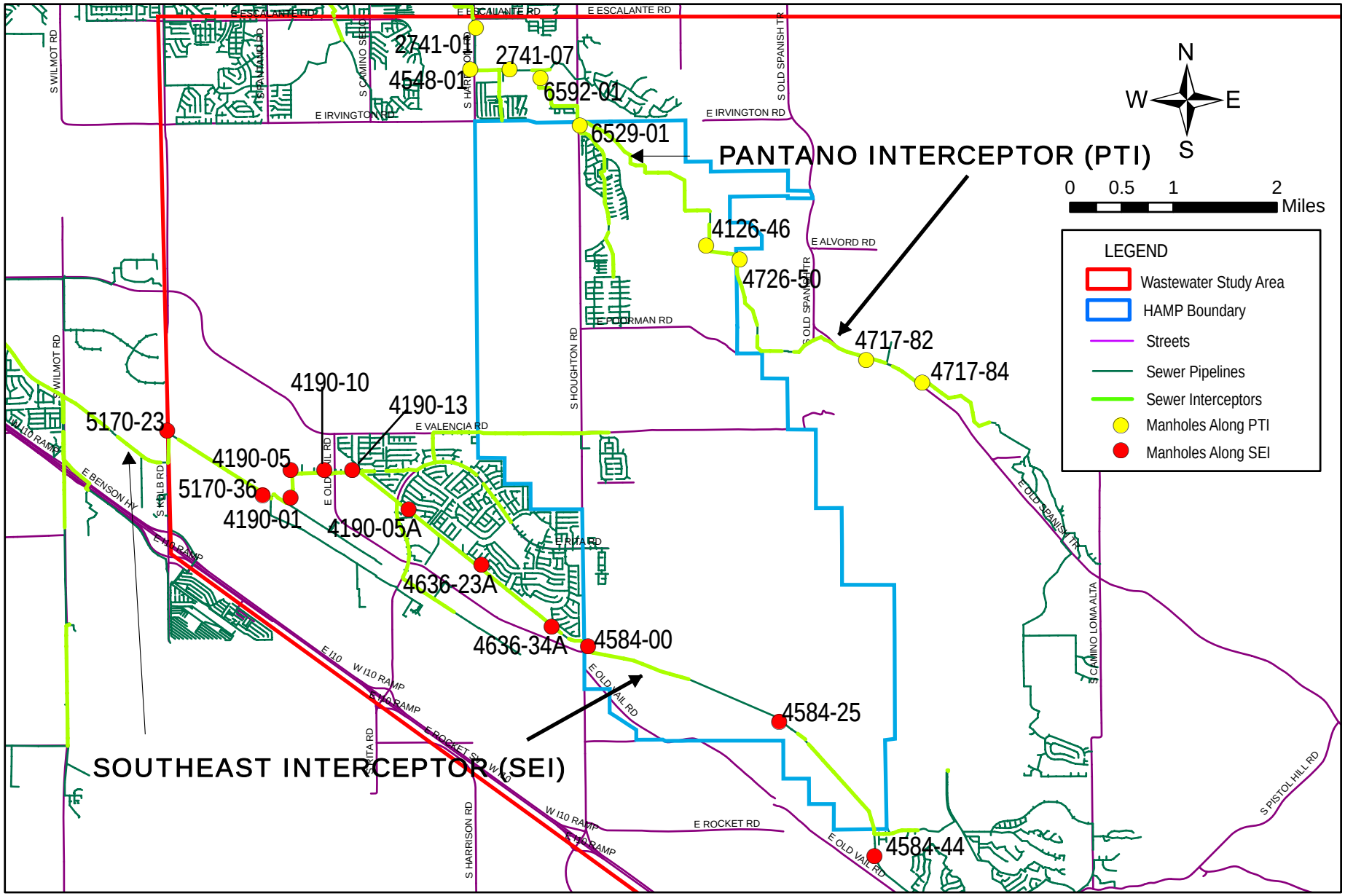
3.1 EXISTING INTERCEPTOR CAPACITIES

The existing interceptors in the Wastewater planning area were evaluated based on information in the Facility Plan Update. The Southeast Interceptor (SEI) and Pantano Interceptor (PTI) convey wastewater from the planning area to the Roger Road WWTP. Summaries of existing interceptor sizes and full pipe capacities at selected manhole locations (Figure 3-1) are presented for the SEI in Table 3-1 and for the PTI in Table 3-2.

Table 3-1
Existing Southeast Interceptor Diameters and Capacity

Down-gradient Manhole	Pipe Diameter (inches)	Full Pipe Capacity (mgd)
4584-44	15	4.03
4584-25	15	4.30
4584-00	18	4.90
4636-34A[1]	18	5.43
4636-23A	18	6.13
4190-05A	18	6.30
4190-13	24	13.96
4190-10[2]	30	21.10
4190-05	36	18.49
4190-01	48	16.12
5170-36	30	14.65
5170-23[3]	24	11.82

Notes:
1 – Exit Point of Drainage Basin 43B.
2 – Exit Point of Drainage Basins 43A, 43B, 54, and 97.
3 – Exit Point of Wastewater planning area.



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INTERCEPTOR SYSTEM AND MANHOLE LOCATIONS

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FIGURE 3-1

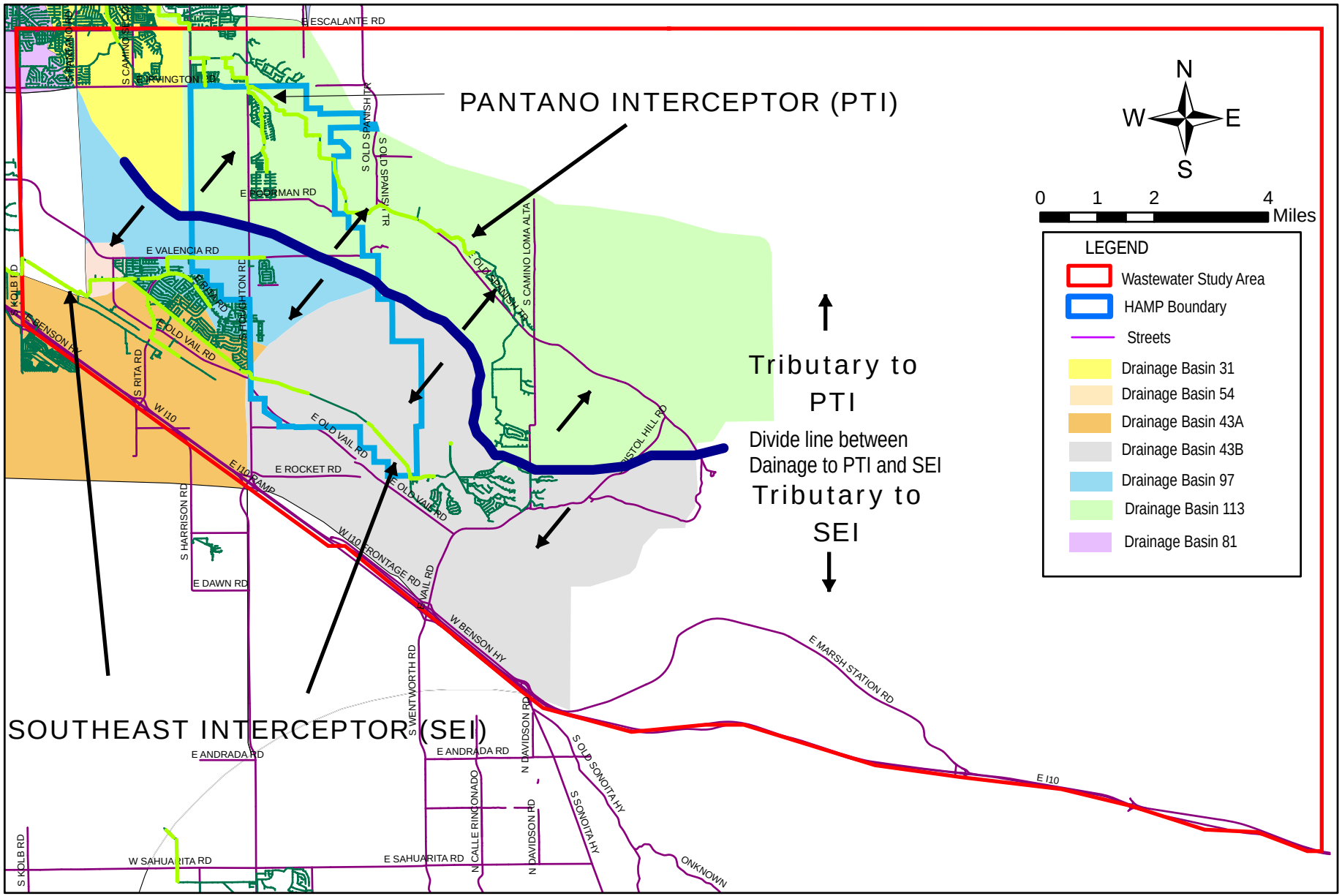
Table 3-2 Existing Pantano Interceptor Diameters and Capacity		
Down-gradient Manhole	**Pipe Diameter (inches)**	**Full Pipe Capacity (mgd)**
4717-84	15	3.02
4717-82	15	2.11
4726-50	18	4.04
4126-46	20	4.85
6592-16	21	5.41
6592-01	20 & 21	5.57
2741-07	18	2.93
4548-01	18	4.39
2741-01[1]	12	1.68

Notes:
1 – Exit Point of Drainage Basin 113 and Wastewater planning area.

The SEI full-pipe capacity at the exit point of the Wastewater planning area is 11.8 mgd, while the full-pipe capacity of the PTI at the exit point of the Wastewater planning area is only 1.68 mgd at the siphon across the Pantano Wash at Harrison Road.

3.2 WASTEWATER FLOW AND COLLECTION

Due to the relatively flat topography of the Wastewater planning area, different options are available for conveyance of wastewater flows to either the SEI or the PTI. The first option uses the basin drainage pattern developed in the Facility Plan Update under which wastewater flows generated in Basins 43A, 43B, 54, and 97 flow to the SEI and wastewater generated in Basin 113 flows to the PTI as shown in Figure 3-2 and presented in Table 3-3. This conveyance option maximizes flow towards the SEI and, therefore, was referred to as the SEI Alternative.



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SEI WASTEWATER FLOW ALTERNATIVE DRAINAGE BASINS

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FIGURE 3-2

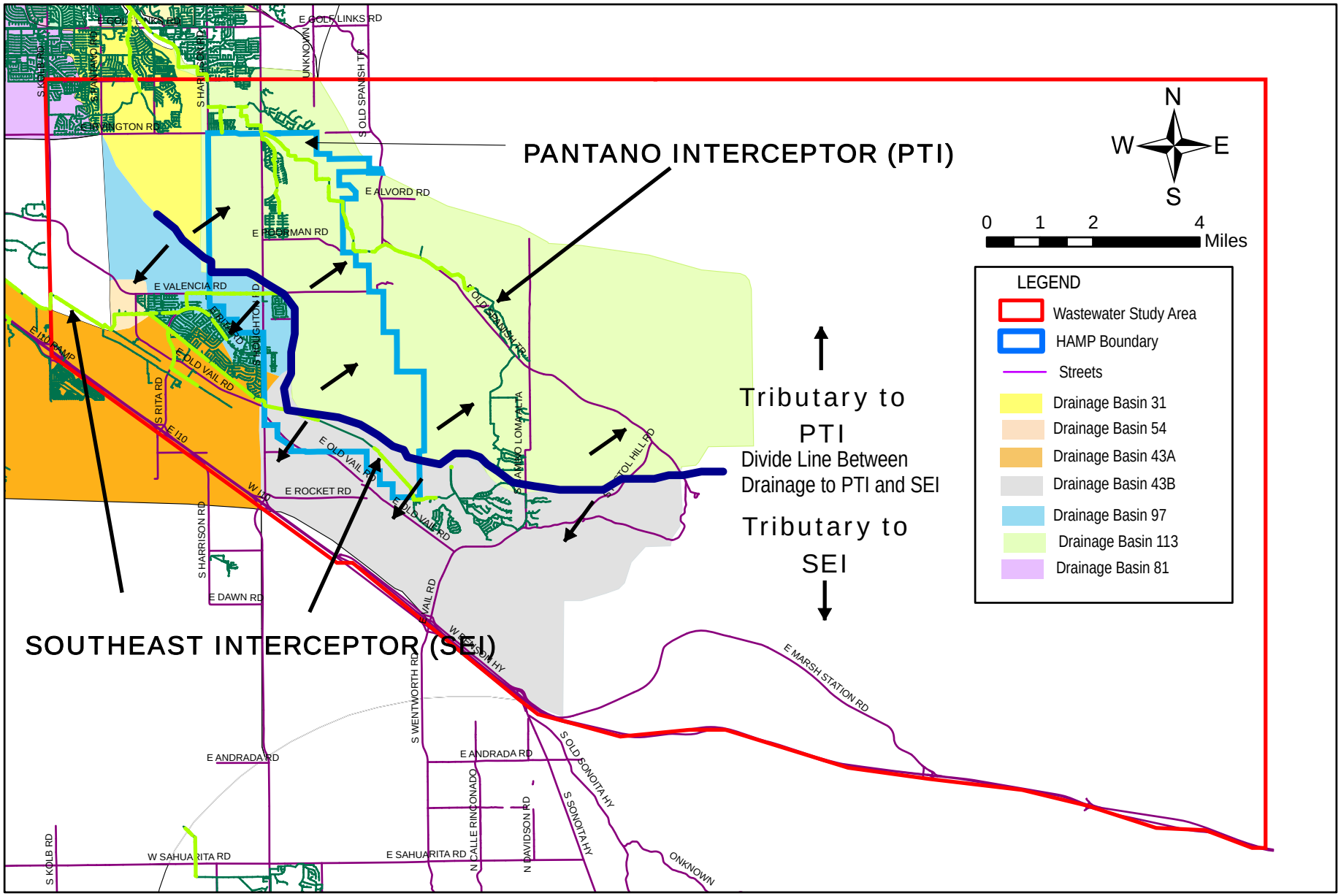
Table 3-3 SEI Alternative Flows			
Drainage Basin	**ADWF (mgd)**	**Peaking Factor**	**PDWF (mgd)**
Wastewater Flows to the Southeast Interceptor (SEI)			
43A	0.46	1.96	0.91
43B	4.18	1.63	6.79
54	0.02	2.64	0.04
97	2.67	1.68	4.49
SEI Total	7.3	1.57	11.5
Wastewater Flows to the Pantano Interceptor (PTI)			
113	4.6	1.62	7.4
PTI Total	4.6	1.62	7.4

Notes:
ADWF – Average Dry Weather Flow
PDWF – Peak Dry Weather Flow

A second conveyance option was developed that modifies the basin boundary lines to maximize flow to the PTI. The modified basin boundaries are shown in Figure 3-3 and the buildout flows are presented in Table 3-4. This was referred to as the PTI Alternative.

Table 3-4 PTI Alternative Flows			
Drainage Basin	**ADWF (mgd)**	**Peaking Factor**	**PDWF (mgd)**
Wastewater Flows to the Southeast Interceptor (SEI)			
43A	0.46	1.96	0.91
43B[1]	2.30	1.70	3.92
54	0.02	2.64	0.04
97[1]	1.57	1.75	2.75
SEI Total	4.4	1.62	7.1
Wastewater Flows to the Pantano Interceptor (PTI)			
113[2]	7.6	1.56	11.8
PTI Total	7.6	1.56	11.8

Note:
1. Basins 43B and 97 are reduced in area and subsequent wastewater flow compared to the SEI Alternative.
2. Basin 113 has increased area and subsequent wastewater flow compared to the SEI Alternative.



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PTI WASTEWATER FLOW ALTERNATIVE DRAINAGE BASINS

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FIGURE 3-3

The projected PDWF for the SEI under the SEI Alternative is approximately 11.5 mgd. As previously stated, the full-pipe capacity of the SEI at the planning area exit point is approximately 11.8 mgd. PCRWRD typically sizes interceptors for 85 percent of full pipe flow during PDWF. As a result under the SEI Alternative, the capacity of the SEI was projected to be insufficient to convey buildout wastewater flow rates. Segments of the SEI within the planning area also have insufficient capacity to convey wastewater flow under the SEI Alternative. These results were consistent with the findings of PCRWRD reported in the Facility Plan Update. Under the PTI Alternative (Table 3-4; Figure 3-3), the SEI would have sufficient capacity to convey projected buildout wastewater flows.

The buildout PDWF for the PTI under the SEI Alternative was projected to be 7.4 mgd and 11.8 mgd under the PTI Alternative. Based on the existing full-pipe capacity of the PTI at the planning area exit point of 1.68 mgd, both conveyance alternatives would require increases in capacity of the PTI at the Harrison Road siphon and several down-stream segments.

3.3 WASTEWATER TREATMENT

Three wastewater treatment alternatives were developed, and each was combined with the two conveyance alternatives to provide six wastewater treatment scenarios. This section presents descriptions of the HAMP treatment alternatives and scenarios.

3.3.1 Wastewater Treatment Location

The concepts behind each of the wastewater treatment alternatives are described below:

- **Treatment Alternative 1 - Roger Road WWTP**

  The first treatment alternative involves conveyance of all wastewater flows from the Wastewater planning area through existing interceptor alignments to the Roger Road WWTP. Downstream interceptors would be upgraded in accordance with the Facility Plan Update. This concept is also consistent with planning concepts being developed by PCRWRD's Regional

Optimization Master Plan (ROMP), which is evaluating regional conveyance and treatment alternatives for the metropolitan wastewater treatment system.

- **Treatment Alternative 2 - HAMP Reclamation Facility**

  The second treatment alternative includes constructing a HAMP reclamation facility sized to eliminate the need to upgrade interceptors within the Wastewater planning area. Although some relief will be realized for interceptors downstream of the planning area, this scenario cannot collect and dispose of enough wastewater flow to alleviate all downstream capacity deficiencies, and this alternative will require some conveyance system improvements downstream of the Wastewater planning area.

- **Treatment Alternative 3 - Reclaimed Water Demand**

  The third wastewater treatment alternative includes matching the treatment capacity in the HAMP planning area to the preliminary estimates of projected reclaimed water demand for the HAMP planning area. The treatment capacity under this alternative would include constructing more HAMP treatment capacity than the first alternative but less than the second.

3.3.2 Facility Sizing

A total of six combined conveyance and treatment scenarios were developed and an alpha-numeric designation, that includes a number to identify the treatment alternative followed by a letter, to identify the conveyance alternative. Treatment alternatives were numbered 1, 2, and 3 according to the alternatives presented above. Conveyance alternatives were designated by A for the SEI conveyance alternative and B for the PTI conveyance alternative. A summary of HAMP treatment facility sizing based on these six scenarios is presented in Table 3-5.

Table 3-5 Scenario Treatment Capacities	
Scenario	**Required HAMP Treatment Facility Capacity (mgd)**
1A	N/A
1B	N/A
2A	2.5 (PTI)
2B	5.0
3A	1.2
3B	1.2

4.0 SCENARIO SCREENING

Conceptual conveyance and treatment facilities, which were developed for each of the six scenarios and described in Section 3.0, served as the basis for conceptual wastewater treatment facility layouts including necessary setbacks for facility footprints. Initial evaluations of facility sites were also performed as part of the conceptual scenario development. Institutional and regulatory issues were outlined to aid in evaluation of the six scenarios. Non-cost screening criteria were developed for an initial screening of scenarios, and these criteria were used to rank the scenarios. Technical Memorandum No. 3 dated August 25, 2006, was prepared summarizing the conceptual layouts of facilities, regulatory issues, and screening of alternatives. The technical memorandum is presented in Appendix C.

4.1 INSTITUTIONAL AND REGULATORY ISSUES

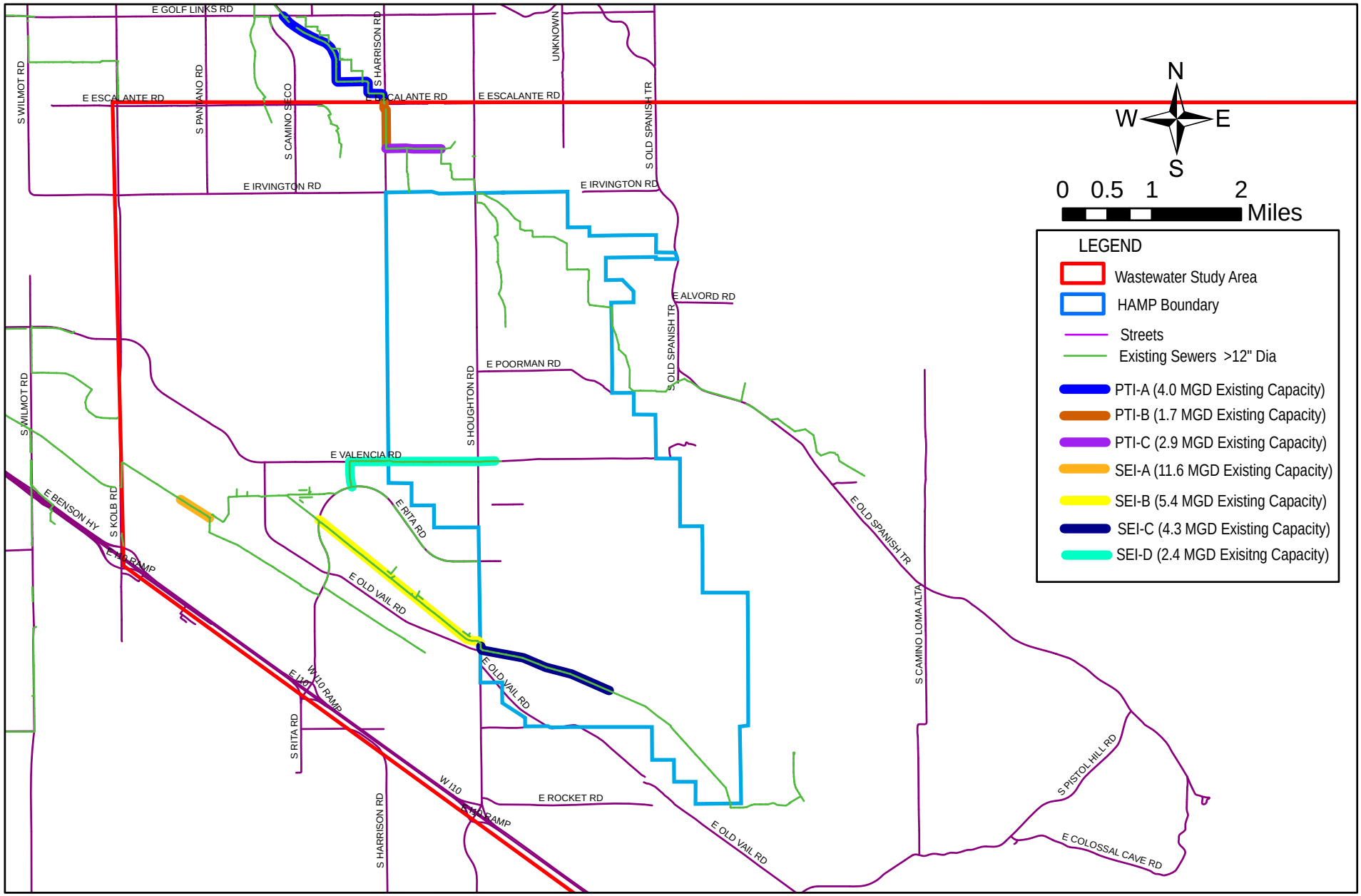
Several regulatory issues will impact decisions in the Wastewater planning area. Under Arizona regulations, setback requirements for treatment facilities include a minimum of 350 feet for facilities with full noise, odor, and aesthetic controls and at least 1,000 feet for other facilities. Federal Aviation Administration (FAA) rules dictate distances between open water facilities and airports because of the potential for fowl-aircraft collisions. This was an initial concern for facility siting, but all preferred sites are outside of the distance from Davis-Monthan Air Force Base prescribed by the FAA. Other permits that may be required for a new HAMP treatment facility include an Aquifer Protection Permit (APP), an Arizona Pollutant Discharge Elimination System (AZPDES) permit, and permits for compliance with Sections 402 and 404 of the Federal Clean Water Act (CWA). Should a wastewater treatment plant be constructed as part of wastewater management in the HAMP planning area, a 208 permit demonstrating consistency with the Clean Water Act Section 208 regional planning would be required. Biosolids regulations are also discussed in the technical memorandum presented in Appendix C.

4.2 CONCEPTUAL CONVEYANCE AND TREATMENT FACILITY LAYOUTS

Wastewater flow projections developed previously in Sections 2.0 and 3.0, were used to identify areas of existing sewers that may require augmentation under various treatment scenarios (see Figure 4-1). Conceptual trunk sewer routes in the HAMP area were also developed based on the two conveyance concepts described in Section 3.2 and Appendix B. Proposed conceptual alignments for the HAMP trunk sewers are presented in Figure 4-2. The conceptual alignments include two trunk sewer lines: HAMP 1 and HAMP 2. The two lines were necessary to allow for collection of all wastewater flows within the HAMP area by gravity. A modified trunk sewer alignment was required for Scenario 2B to maximize wastewater flow to the preferred treatment site at the Poorman Gunnery Range adjacent to the northwest corner of the HAMP area using a siphon rather than a lift station (see Figure 4-3).

Layouts were developed for the treatment facility sizes identified in Table 3-5. Illustrations of facility layouts are presented in Appendix C in Figures 11 through 16. Candidate sites identified for the two larger HAMP treatment facilities (Scenarios 2A and 2B) were generally larger than available sites in the vicinities of the smaller facilities (Scenarios 3A and 3B). Therefore, the larger facilities were conceptually developed as oxidation ditch facilities, to coincide with PCRWRD's larger outlying facilities. The smaller reclaimed water facilities (Scenarios 3A and 3B) were conceptually developed as membrane bioreactor (MBR) plants similar to the Randolph Park Water Reclamation Facility to take advantage of the smaller footprint offered by MBR facilities when compared to equivalent capacity oxidation ditches, allowing them to fit on the available candidate treatment sites.

Flow-based implementation schedules identifying the relative timing of capital improvements were developed for each scenario. The flow-based implementation schedules are illustrated in Figures 4 through 6 (Scenarios 1A, 1B, and 2B, respectively) and Figures 8 through 10 (Scenarios 2B, 3A, and 3B) of Appendix C. For each major construction element, implementation triggers for wastewater flows were identified for design (based on 75% of existing full-pipe flow capacity) and final construction (based



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POTENTIAL SEWER CAPACITY DEFICIENCIES

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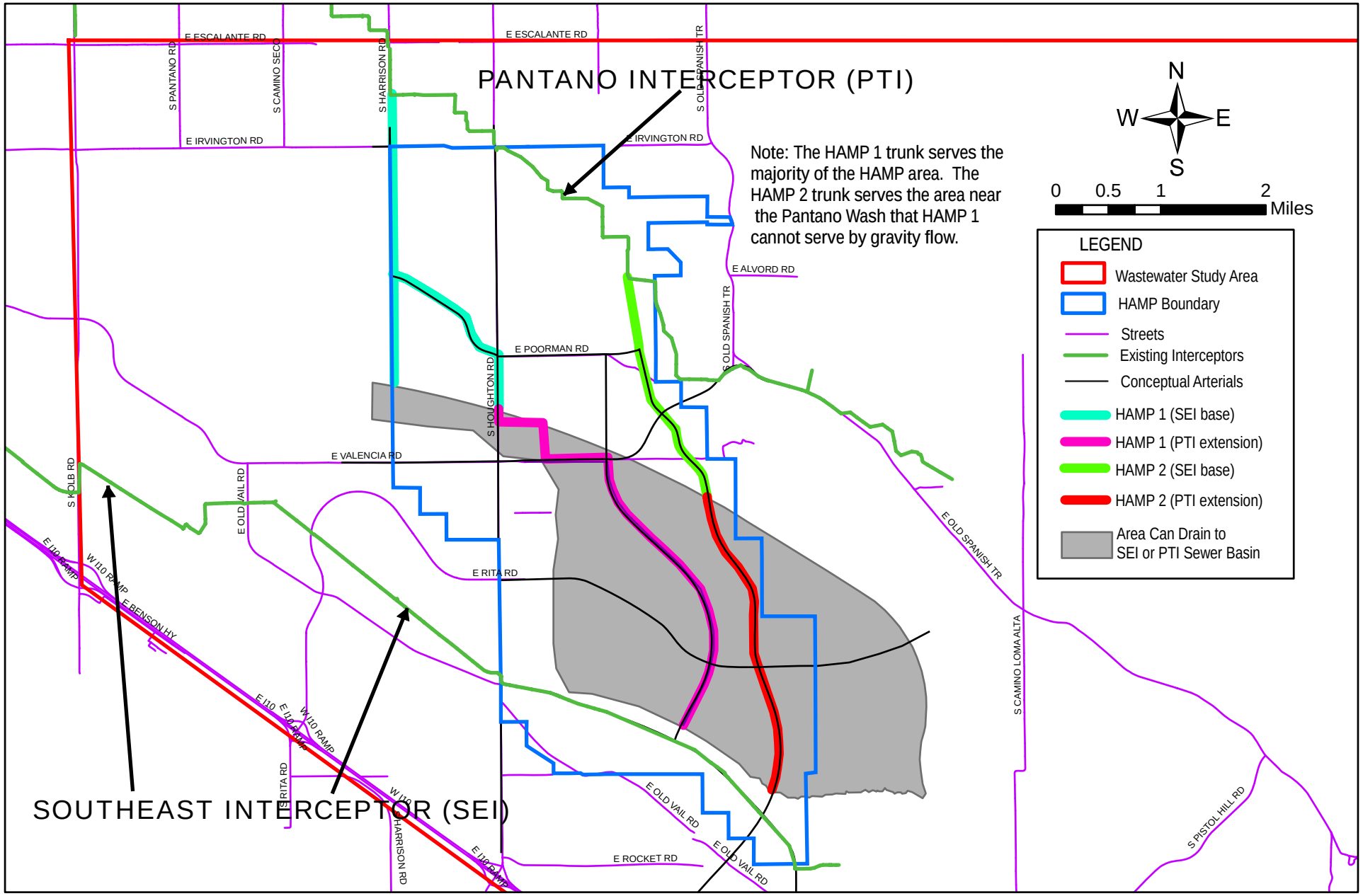
FIGURE 4-1



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ALTERNATIVE HAMP TRUNK SEWERS

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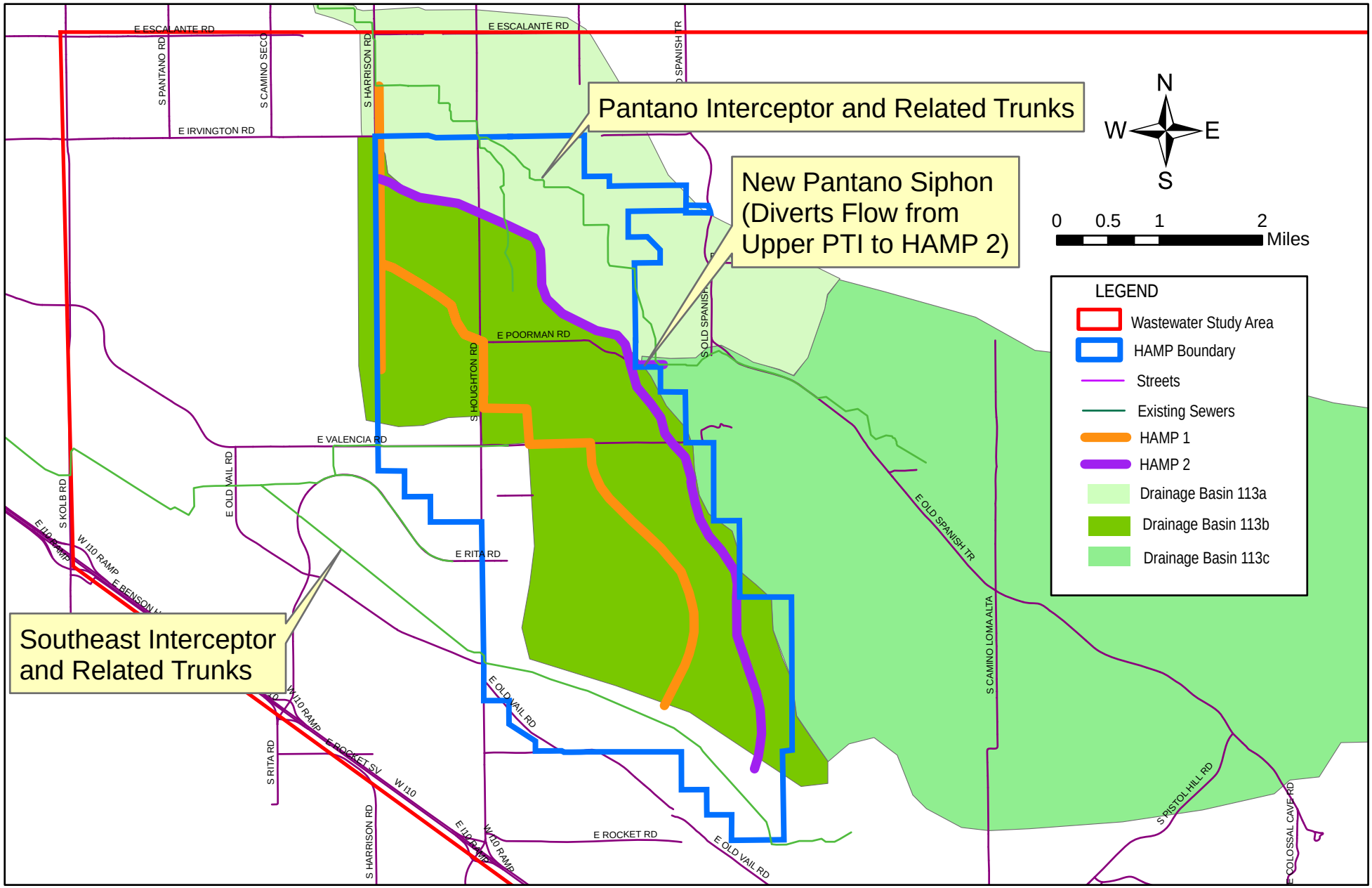
FIGURE 4-2



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SCENARIO 2B DRAINAGE BASIN CONFIGURATION AND CONVEYANCE ALTERNATIVES

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FIGURE 4-3

on 100% of existing full-pipe flow capacity). These implementation schedules assisted in differentiation of scenarios for the non-cost evaluation.

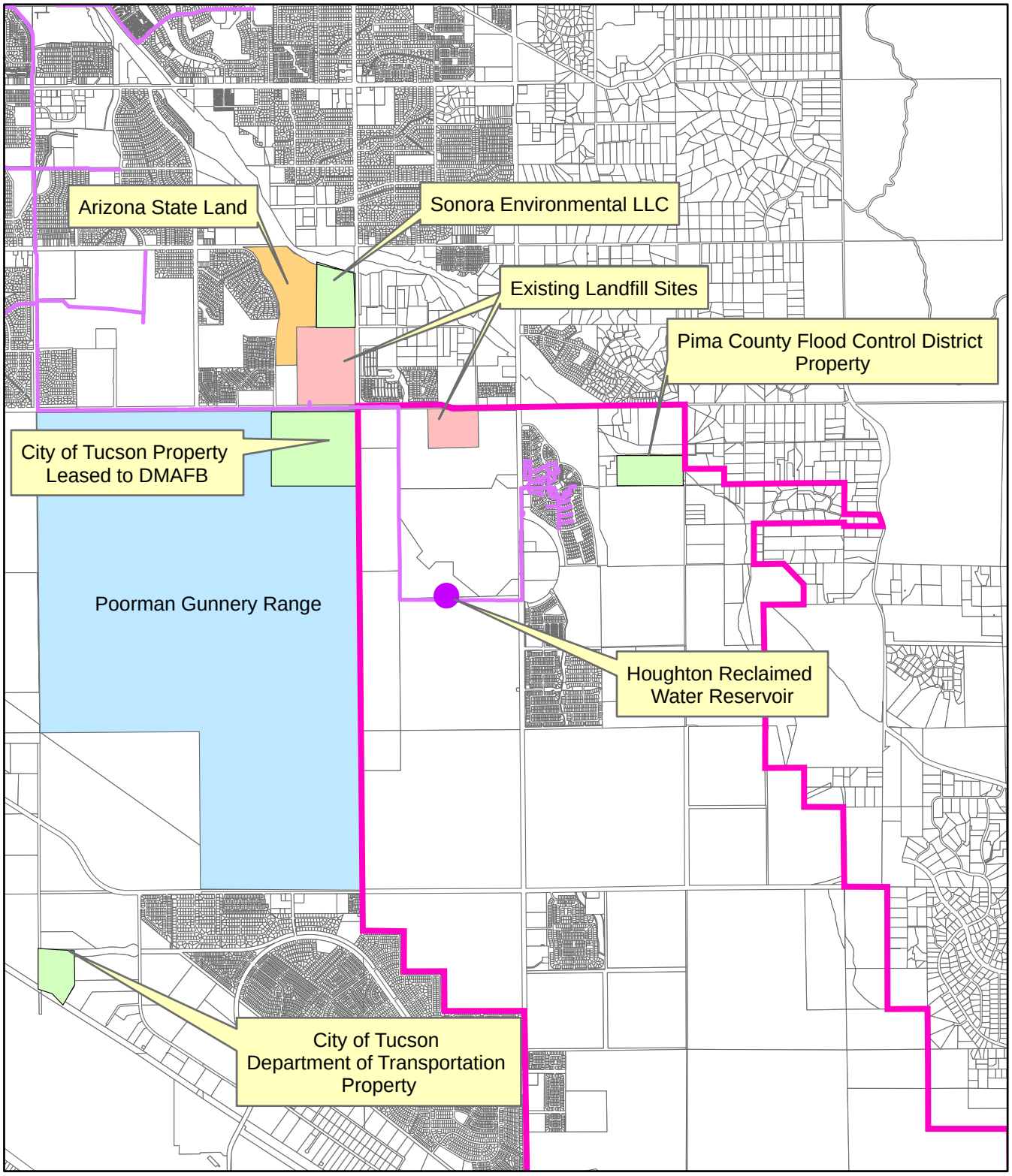
4.3 IDENTIFICATION OF TREATMENT FACILITY SITES

Candidate treatment facility sites were identified based on proximity to existing or future sewer infrastructure and minimum site acreage as presented in Table 4-1.

Table 4-1
Treatment Facility Footprint Requirements

Scenario	Required Treatment Facility Capacity (mgd)	Approximate Site Area with Odor, Noise and, Aesthetic Controls (Acres)	Approximate Site Area without Odor, Noise, and Aesthetic Controls (Acres)
1A	N/A	N/A	N/A
1B	N/A	N/A	N/A
2A	N/A	24	120
2A	2.5 (PTI)	33	140
2B	5.0	39	152
3A	1.2	24	120
3B	1.2	24	120

Initial selection of candidate sites was limited to parcels owned by either Pima County or the City of Tucson. A site for Scenario 2B was identified at the northeast corner of the Poorman Gunnery Range (the same site identified in the City of Tucson HAMP and later in the Facility Plan Update), which is owned by the City of Tucson. A site was identified for Scenarios 2A and 3A on Pima County Flood Control District Property along the Pantano Wash. Another candidate site was identified for Scenarios 2A, 2B, and 3A at the Sonora Environmental LLC site, which is privately owned. All sites are identified on Figure 4-4. The Sonora Environmental site would require acquisition of State Trust Land to the west for required setbacks. A parcel of land owned by the City of Tucson Department of Transportation property was identified for Scenario 3B, which is the only scenario with a treatment facility located near the SEI.



LEGEND

- HAMP STUDY AREA BOUNDARY
- RECOMMENDED WASTEWATER TREATMENT LOCATIONS
- EXISTING RECLAIMED WATER DISTRIBUTION SYSTEM

0 0.5 1 2 Miles

N W E S

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RECOMMENDED TREATMENT PLANT SITES

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FIGURE 4-4

4.4 ALTERNATIVES FOR EFFLUENT USE

Effluent use options for the HAMP treatment facility scenarios included potential reclaimed water use in and around the HAMP planning area, delivery to the existing Tucson Water reclaimed water system via the Houghton Reservoir, on-site basin recharge, and surface discharge to the Pantano Wash. The reclaimed water demand in and around the HAMP planning area would be primarily for turf and landscape irrigation. As a result, decreased demand during winter months would require an additional use/disposal option. Delivery of treated wastewater effluent from a HAMP treatment facility to the Tucson Water reclaimed system at the Houghton Reservoir would provide a year-round delivery point if the reclaimed water distribution system can transport the flow from the reservoir to reclaimed customers or to the Sweetwater Underground Storage and Recovery (US&R) Facility (located near the Roger Road WWTP) during low demand periods. Initial hydraulic modeling of the Tucson Water reclaimed water distribution system indicated that effluent from a 5 mgd treatment facility in the HAMP planning area could be conveyed to Sweetwater in the existing system. The Houghton Reservoir is at an elevation approximately 600 feet higher than Tucson Water's production facilities near the Roger Road WWTP, and reclaimed water pumping costs could be reduced if reclaimed water is introduced to the system at the Houghton Reservoir.

Reclaimed water use varies seasonally. Large demands are generally seen during summer months, and demand drops significantly during winter months. Tucson Water currently uses the Sweetwater US&R to store effluent during low demand periods. Currently, the reclaimed water system accepts up to 3 mgd from PCRWRD's Randolph Park WRF, which is sent to the Sweetwater US&R when system demand is low. The Sweetwater US&R, however, does not have sufficient capacity to accept an additional 5 mgd from a HAMP facility, and additional capacity would need to be added or construction of alternative facilities for effluent management would be required to accept the additional HAMP flows during low-demand periods.

Recharge for underground storage and recovery was also considered for effluent disposal, and could prove to be a viable option, but would require further hydrogeological

investigation to prove their viability. Discharge to the Pantano Wash was considered for the PTI alternatives; however, surface discharge was determined to only be advisable as a secondary (emergency) disposal option. Both surface water discharge to the Pantano and delivery to the Tucson Water reclaimed water system may require an AZPDES permit, and additional discussions with the Arizona Department of Environmental Quality (ADEQ) would be required to determine the need for an AZPDES permit.

4.5 SCREENING OF SCENARIOS

The six wastewater conveyance and treatment scenarios were evaluated based on non-cost selection criteria, discussed in detail in Technical Memorandum No. 3, presented in Appendix C. Each criterion was assigned a relative weighting factor as an indication of its importance. The weighting factors were developed based on input from PCRWRD and Tucson Water staff. The scenarios were ranked (Table 4-2) with a higher ranking indicating a scenario was more desirable. The rankings and weighting factors were then used to calculate a composite score in Table 4-3.

Table 4-2
Non-Cost Evaluation

	Scenario						
Non-Cost Selection Criteria	**1A**	**1B**	**2A**	**2B**	**3A**	**3B**	**% Weight**
Maximize Use of Existing Infrastructure	5	2	5	3	4	2	10%
Maximize Use of Gravity Flow Systems	1	1	5	6	4	4	10%
Minimize the Quantity of Treatment Facilities and Permitting	6	6	3	4	1	1	25%
Maximize Water Resource	1	1	5	6	4	4	10%
Gain Public Acceptance	5	6	1	4	3	2	15%
Minimize Sensitivity to Development Assumptions	6	3	4	1	5	2	5%
Implement in a Logical Sequence	5	4	2	1	5	4	10%
Minimize Construction Impact	3	6	2	5	1	4	15%
						SUM	100%

Table 4-3 Non-Cost Evaluation - Extended						
	Scenarios - Extended					
Non-Cost Selection Criteria	**1A**	**1B**	**2A**	**2B**	**3A**	**3B**
Maximize Use of Existing Infrastructure	0.5	0.2	0.5	0.3	0.2	0.4
Maximize Use of Gravity Flow Systems	0.1	0.1	0.5	0.6	0.4	0.4
Minimize the Quantity of Treatment Facilities and Permitting	1.5	1.5	0.75	1	0.25	0.25
Maximize Water Resource	0.1	0.1	0.5	0.6	0.4	0.4
Gain Public Acceptance	0.75	0.9	0.15	0.6	0.3	0.45
Minimize Sensitivity to Development Assumptions	0.3	0.15	0.2	0.05	0.1	0.25
Implement in a Logical Sequence	0.5	0.4	0.2	0.1	0.4	0.5
Minimize Construction Impact	0.45	0.9	0.3	0.75	0.6	0.15
SUM	***4.20***	***4.25***	3.10	***4.00***	2.65	2.80

The scenarios having a combined score of 4 or higher were selected for further evaluation. Scenarios with flows conveyed to the SEI generally scored lower than alternatives with conveyance maximized to the PTI. The facility sized for reclaimed water demand in the HAMP planning area (1.2 mgd) also scored low, because these scenarios still required all the upgrades for wastewater conveyance to the Roger Road WWTP as well as infrastructure for the treatment system.

Non-cost criteria also included evaluation of flexibility for each Scenario. Based on these qualitative evaluations of flexibility, Scenario 1B provides the most latitude for wastewater management in the HAMP planning area. Scenario 1B collects all of the wastewater directed to the PTI by gravity through the Harrison Road siphon. An alternative treatment site has been identified at this location (Sonoran Environmental, LLC). This site could be used to construct a treatment facility or, alternatively, a lift station that could convey wastewater to the treatment site identified on the Poorman Gunnery Range.

Additional flexibility would be realized through the upgrade of the Harrison Road siphon along the PTI. The current capacity of the siphon is 1.68 mgd, and its capacity would require an increase in the near future. The expansion of the Harrison Road siphon could be conducted in phases to an ultimate capacity of approximately 12 mgd. The

12 mgd capacity would be sufficient to convey the maximum buildout flow for the PTI under Scenario 1B. The phased construction should be made in 4 mgd increments since the minimum buildout capacity for the PTI was estimated at approximately 4.6 mgd.

5.0 COST EVALUATION OF SCREENED SCENARIOS

Conceptual opinions of probable construction costs were developed for the three preferred scenarios screened previously in Section 4.0. Scenario 1A was developed to maximize wastewater flow to the SEI and involved treatment of all wastewater at the Roger Road WWTP. Scenario 1B also involves treatment at the Roger Road WWTP, but with conveyance to the PTI maximized. Scenario 2B called for a conveyance layout similar to Scenario 1B, but with modifications to allow gravity flow to the preferred treatment site at the Poorman Gunnery Range. Under buildout conditions for Scenario 2B, approximately 7.4 mgd (ADWF) of wastewater flow would be conveyed to the Roger Road WWTP for treatment.

5.1 IMPLEMENTATION COST OPINIONS

5.1.1 Basis of Cost Opinion

The conceptual opinions of probable capital and operation and maintenance (O&M) costs were developed using vendor and contractor quotations, previous project data, and from RS Means cost estimating guides. All conceptual cost data presented in this report represent October 2006 dollars, corresponding to a 20 Cities Average Engineering News Record Construction Cost Index (ENR CCI) of 7,883.

The level of accuracy for the cost opinions correspond to a Class 4 Estimate as defined by the Association for Advancement of Cost Engineering (AACE) International. This level of engineering cost estimating is generally made with limited information, and it is appropriate for planning study evaluations conducted at the level of detail herein. Cost opinions prepared at this level of engineering are generally considered to have an accuracy range of +50/-30 percent. Present worth costs were calculated based on an annual interest rate of 4 percent over a 20-year operation period.

5.1.2 Unit Cost Development

Conceptual sewer construction unit costs were developed based on data collected from recent projects completed between 2000 and 2005. Unit costs for conveyance systems include the cost of pipe using vitrified clay for diameters from 8 to 27 inches and

reinforced concrete pipe for 30 inches and greater, excavation and backfill, manholes spaced an average of 500 feet, contractor overhead and profit of 20 percent, and assumed average easement acquisition of 50 percent. An overview of installed unit costs for different diameter pipelines and estimated lengths is presented in Table 5-1.

Table 5-1

Unit Costs for Trunk Sewer Collection Pipelines and Manholes for Wastewater Conceptual Plan

Pipe Size	Cost per Linear Foot <15 ft Deep
8	$77
10	$86
12	$94
15	$113
18	$130
21	$149
24	$167
27	$185
30	$203
33	$221
36	$238

5.1.3 Conveyance Cost Opinion

Conceptual conveyance system cost opinions were developed for comparison purposes based on estimated sewer diameters and lengths. A spreadsheet model was developed to estimate sizes of sewer trunk pipelines and interceptors based on projected flows and sump elevations at specific manholes. The cost opinions do not include “local” collection networks that were considered to be equivalent for all scenarios. Total cost opinions included a 25 percent factor for engineering, design, and administration of construction, as well as a 30 percent contingency on the combined subtotal of construction and engineering costs. The conceptual cost opinions for the conveyance alternatives are summarized in Table 5-2.

Table 5-2

Sewer and Manhole Cost Opinion for Wastewater Conveyance Scenarios

Pipe Diameter (inches)	Cost/ft	Scenario 1A Length (ft)	Scenario 1A Cost	Scenario 1B Length (ft)	Scenario 1B Cost	Scenario 2B Length (ft)	Scenario 2B Cost
8	$77	21,900	$1,680,000	23,500	$1,800,000	23,500	$1,800,000
10	$86	11,000	$950,000	0	$0	0	$0
12	$94	9,600	$910,000	12,200	$1,150,000	0	$0
15	$113	9,200	$1,040,000		$0	6,200	$700,000
18	$130	14,900	$1,940,000	28,700	$3,740,000	33,400	$4,350,000
21	$149	24,000	$3,570,000	10,300	$1,530,000	24,300	$3,620,000
24	$167	2,800	$470,000	9,200	$1,530,000	0	$0
27	$185	0	$0	0	$0	2,600	$480,000
30	$203	2,000	$410,000	2,800	$570,000	2,800	$570,000
Subtotal			$10,970,000		$10,320,000		$11,520,000
Engineering and Administration (25%)			$2,742,500		$2,580,000		$2,880,000
Contingency (30%)			$4,113,750		$3,870,000		$4,320,000
Total Cost			$17,826,250		$16,770,000		$18,720,000

5.1.4 Treatment Cost Opinion

A conceptual level cost opinion was also developed for the HAMP WWTF associated with Scenario 2B. Recent wastewater treatment plant construction projects completed in Southern Arizona between 2000 and 2003 were used as the basis for developing a cost per gallon per day of treatment capacity. Treatment costs were based on plants capable of producing A+ effluent and include costs for treatment and handling of biosolids. All costs were adjusted to current rates as described in Section 5.1.1. An average constructed cost of $10 per gallon of daily wastewater treatment capacity was identified for plants employing conventional treatment processes such as oxidation ditch treatment facilities. Constructed costs for advanced treatment technologies, such as membrane bioreactors, can be expected to vary between $12 to $15 per gallon. Engineering, design, and construction administration costs for the wastewater treatment facility, assumed to be 25 percent of construction costs, provides an estimated range of $12.50 to $19 per gallon of wastewater treatment capacity. The total conceptual cost

opinion for the treatment facility includes a 30 percent contingency of the combined construction and engineering costs.

Based on a range of $10 to $15 per gallon of average day treatment capacity, the constructed cost of the Scenario 2B facility is projected to be between $50 million and $75 million including biosolids treatment facilities. Using the assumptions for engineering, design, and construction administration, the total project costs for the facility would be between $62.5 million and $95 million. Adding a 30 percent contingency, the total cost for the HAMP treatment facility including biosolids would be between $81.3 million and $123.5 million.

Annual O&M costs were estimated based on existing costs for the Green Valley WWTP and the Randolph Park WRF, which were provided by PCRWRD, and operating data from other similar treatment systems in Southern Arizona. Annual O&M costs are expected to be approximately $1 million per year. The present worth of $1 million of annual O&M costs is $13.6 million based on twenty years of operation and an annual interest rate of 4 percent.

5.2 COST ANALYSIS

The conveyance cost opinions identify Scenario 1B (PTI Alternative, Roger Road WWTP) as the least cost alternative for collection of wastewater flows developed within the Wastewater planning area. The cost opinion for Scenario 1A (SEI Alternative, Roger Road WWTP) is approximately 10 percent higher than Scenario 1B. The higher cost is associated with upgrades to the SEI interceptor along its entire length within the Wastewater planning area due to the wastewater flow from HAMP under Scenario 1A. Under both Scenarios 1A and 1B, the PTI requires upgrades near its exit point from the planning area. As a result of maximizing wastewater flow from the HAMP area to the PTI, cost savings were apparent due to relief of wastewater flow rates to the SEI.

The highest cost conveyance alternative was for Scenario 2B (PTI Alternative, HAMP WWTF). Scenario 2B costs were approximately 20 percent higher than Scenario 1B. The difference in cost between the two scenarios was attributable to the need for construction of a siphon at the Pantano Wash near the Poorman Road alignment in the

central portion of the HAMP planning area. These elements are necessary for Scenario 2B to ensure that adequate wastewater flow is delivered to the City-owned property on the Poorman Gunnery Range without requiring a lift station. Development of Scenario 1B could still proceed leaving open the opportunity for treatment by either constructing a lift station near the Harrison Road siphon or considering an alternative treatment location such as the Sonoran Environmental property and/or State Trust land near the Pantano Wash at Harrison Road.

The only alternative including treatment of wastewater in the HAMP planning area is Scenario 2B. The total capital cost for the 5.0 mgd treatment facility was estimated to be between $81.3 million and $123.5 million. When the O&M present worth of $13.6 million is added, the resulting total present worth is between $95 million and $137 million. Both Scenarios 1A and 1B would require treatment capacity at the Roger Road WWTP, which will also carry an O&M cost. Evaluation of system-wide costs were outside the scope of this study; however based on economy of scale, regional large-scale treatment would likely result in lower overall capital and O&M costs when compared to a new, smaller regional treatment facility. A summary of projected capital, O&M, and present worth costs for wastewater alternatives 1A, 1B, and 2B are presented in Table 5-3.

TABLE 5-3

CAPITAL AND O&M COST SUMMARY OF WASTEWATER ALTERNATIVES

Scenario	Capital Costs ($ Million)		Annual O&M Costs/Present Worth ($ Million)	Total Present Worth[1] ($ Million)
	Conveyance	Treatment		
1A	17.8	-	-	17.8
1B	16.8	-	-	16.8
2B	18.7	81.3 – 123.5	1.0/13.6	113.6 – 155.8

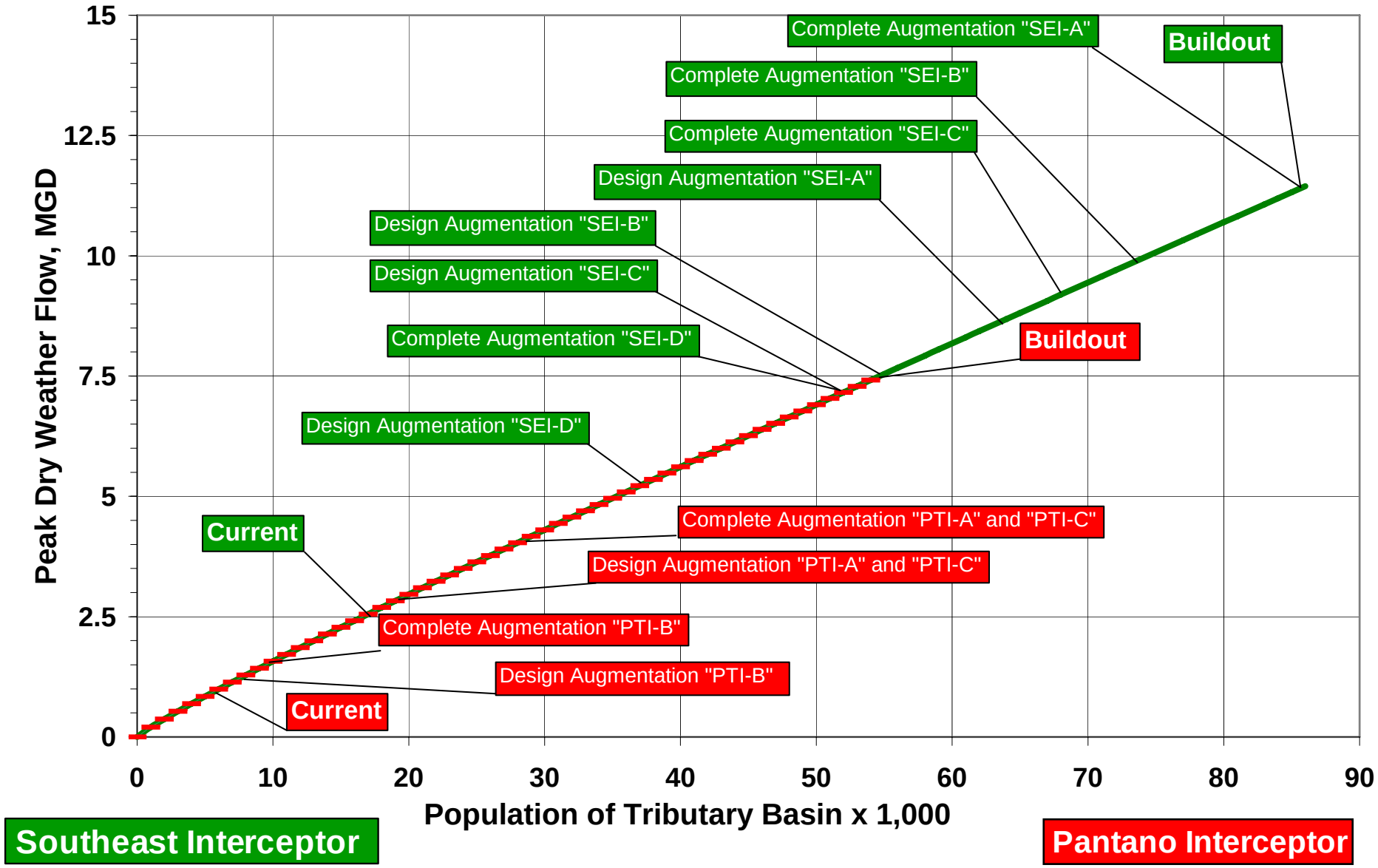
1. Present worth is based on a lifecycle of 20 years and an annual percentage rate of 4 percent

Overall, cost and non-cost evaluations of wastewater treatment in the HAMP planning area indicate that treatment should only be considered if sufficient capacity can

be treated and disposed of to remove the need for upgrading interceptor (conveyance) capacities. Based on the results of this study, the threshold capacity of a treatment facility in the HAMP area should be approximately 5.0 mgd to avoid conveyance capacity improvements. A treatment facility in the HAMP area could serve as a production source for the Tucson Water reclaimed water distribution system. This approach could have mutual benefits for both utilities. Delivery of wastewater effluent to the reclaimed system would provide a beneficial use to the community. Additionally, source water to the reclaimed system from the HAMP area would reduce pumping and O&M costs to the existing reclaimed water system. However, due to the peaking characteristics of the reclaimed water system, existing seasonal storage facilities would require expansion to accommodate the HAMP WWTF flows year round. Capital costs associated with either expanding the Sweetwater US&R or constructing additional storage and recovery facilities are not included in this evaluation. These additional capital expenditures would also need to be considered in the decision to construct a reclaimed facility in the HAMP planning area. Additional outside considerations for a HAMP WWTF may be present that were not included in this analysis. Preliminary evaluations of a HAMP WWTF conducted in the Regional Optimization Master Plan (ROMP), which is currently being developed by PCRWRD, have indicated that wastewater treatment and reclamation can occur more cost effectively to the community as a whole at the Roger Road WWTP site than at a HAMP area treatment facility.

5.3 IMPLEMENTATION SCHEDULE (FLOW-BASED)

The population-based implementation schedules for all scenarios were developed and presented in Technical Memorandum No. 3, which is included in Appendix C of this report. A population-based approach was developed to provide tangible trigger points rather than target dates, which are susceptible to deviations from the PAG population projects. To provide a basis for CIP planning, the resulting implementation schedules for the screened scenarios are presented in Figures 5-1, 5-2, and 5-3 for scenarios 1A, 1B, and 2B, respectively.



MALCOLM PIRNIE
INDEPENDENT ENVIRONMENTAL ENGINEERS, SCIENTISTS AND CONSULTANTS

PIMA COUNTY REGIONAL WASTEWATER RECLAMATION DEPARTMENT

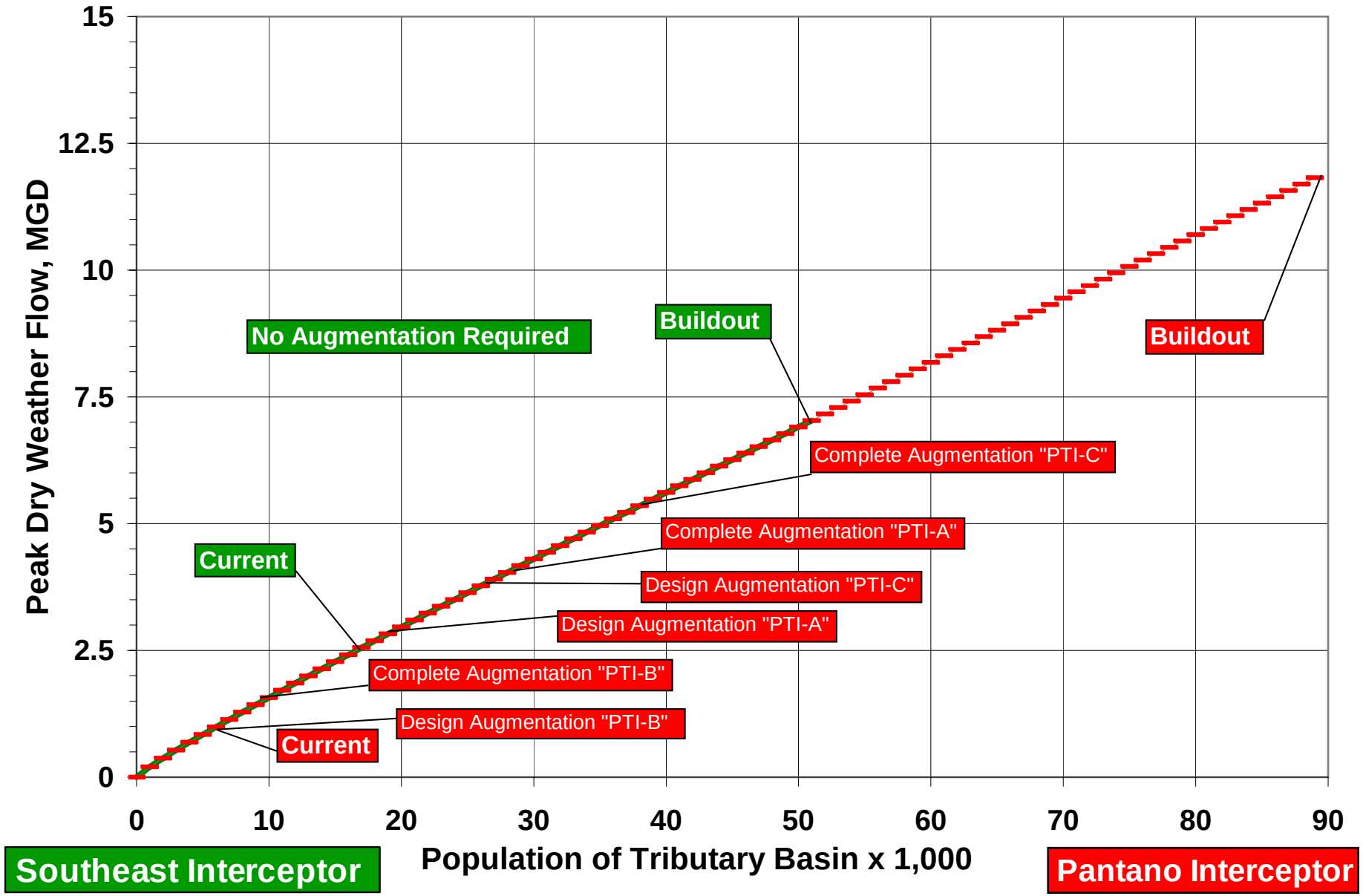
HOUGHTON AREA MASTER PLAN

PIMA CO CONTRACT NO. 25-03-M-137732-0306

IMPLEMENTATION SCHEDULE SCENARIO 1A

MALCOLM PIRNIE INC.

FIGURE 5-1



MALCOLM PIRNIE

INDEPENDENT ENVIRONMENTAL ENGINEERS, SCIENTISTS AND CONSULTANTS

PIMA COUNTY REGIONAL WASTEWATER RECLAMATION DEPARTMENT

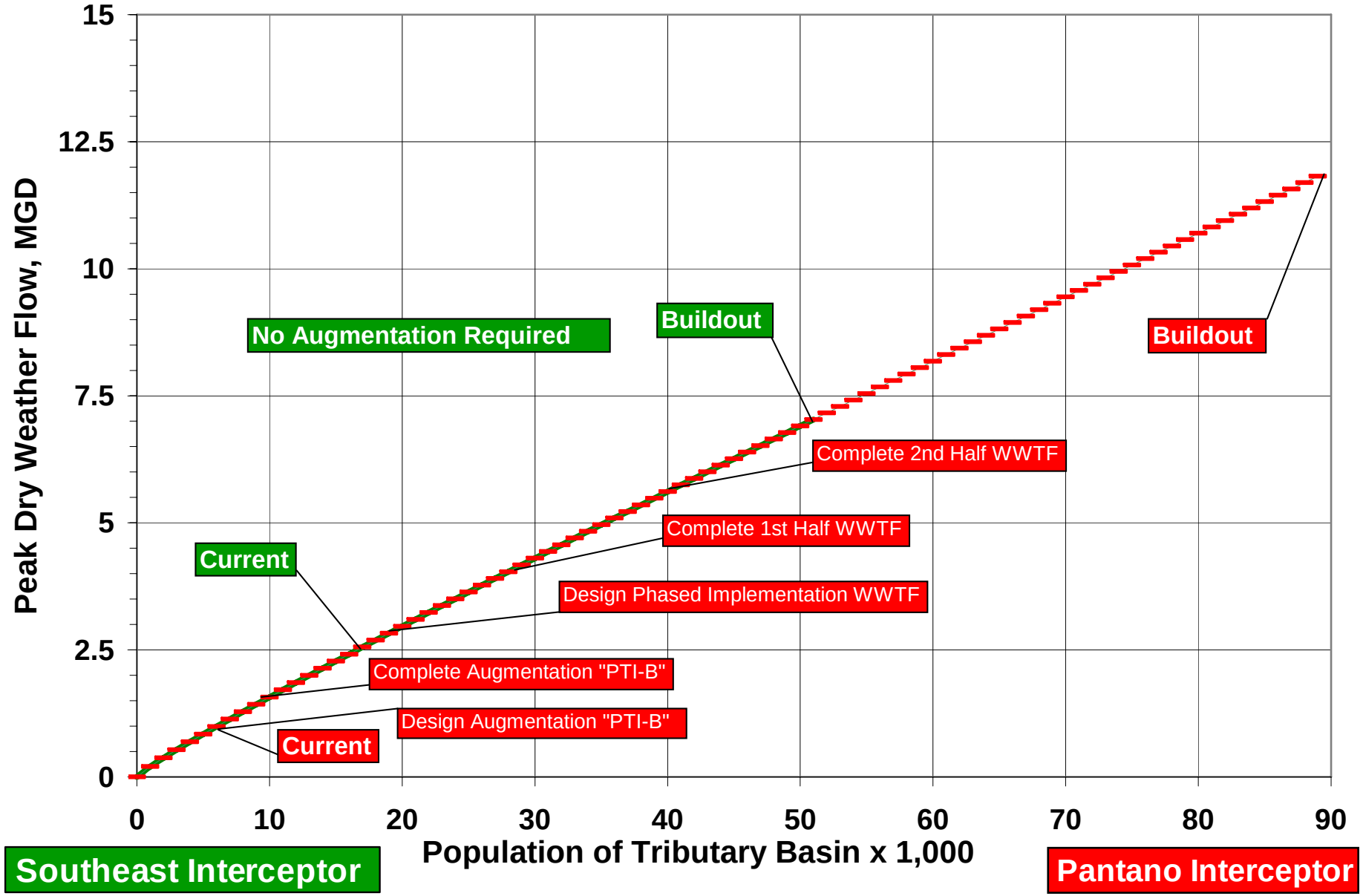
HOUGHTON AREA MASTER PLAN

PIMA CO CONTRACT NO. 25-03-M-137732-0306

IMPLEMENTATION SCHEDULE
SCENARIO 1B

MALCOLM PIRNIE INC.

FIGURE 5-2



MALCOLM PIRNIE
INDEPENDENT ENVIRONMENTAL ENGINEERS, SCIENTISTS AND CONSULTANTS

PIMA COUNTY REGIONAL WASTEWATER RECLAMATION DEPARTMENT

HOUGHTON AREA MASTER PLAN

PIMA CO CONTRACT NO. 25-03-M-137732-0306

IMPLEMENTATION SCHEDULE
SCENARIO 2B

MALCOLM PIRNIE INC.

FIGURE 5-3

6.0 COMPARISON OF SCENARIOS

The Wastewater planning scenarios were qualitatively compared to highlight the advantages and disadvantages resulting from the scenario screening and cost analyses presented in Sections 4.0 and 5.0. This section presents the results of that qualitative comparison.

6.1 COMPARISON MATRIX

A comparison matrix was developed that presents the conveyance and treatment characteristics of each scenario and lists the associated advantages and disadvantages of the scenarios. The comparison matrix is shown in Table 6-1. A discussion of the comparison is presented below:

6.1.1 Conveyance Scenarios (1A and 1B)

In general, the conveyance alternatives represented the lowest cost alternatives for both initial construction and O&M costs. Because they do not include the construction of additional treatment facilities and rely on the existing Roger Road WWTP for treatment, the permitting requirements are much less rigorous than for the scenarios that rely on additional treatment.

6.1.2 Treatment Scenarios (2A, 2B, 3A, and 3B)

The treatment scenarios provide the benefit of generating reclaimed water at an elevation that is approximately 600 feet higher than the existing Tucson Water reclaimed water production facilities. There are several challenges in integrating a HAMP-area based treatment facility with the reclaimed water system including:

- Balancing the economics of planning, designing, constructing, and operating a new treatment facility with the potential energy savings to the reclaimed water system operation.
- Identifying, planning, designing, and constructing improvements to Tucson Water's reclaimed water system to accept up to an additional 5 mgd of reclaimed water on a continual basis.

Table 6-1
Comparison of HAMP Wastewater Management Alternatives

Scenario	Primary Conveyance	Treatment Location	Advantages	Disadvantages
1A	Southeast Interceptor	Roger Road WWTP	- Maximizes Use of Existing Infrastructure - Minimizes Permitting Requirements - Second Lowest Construction Cost - Lowest O&M Cost	
1B	Pantano Interceptor	Roger Road WWTP	- Maximizes Use of Existing Infrastructure - Minimizes Permitting Requirements - Lowest Construction Cost - Provides Flexibility to Add HAMP-area Treatment in the Future.	
2A	Southeast Interceptor	HAMP (2.5 MGD) PCRFCD Property (Figure 4-4)	- Potential Source for Reclaimed Water at Favorable Elevation	- Treatment Location is Remote from Existing Reclaimed System - Treatment Facility in Populated Area - Seasonal Effluent Management - Rigorous Permitting Requirements - Third Lowest non-cost Evaluation Score
2B	Pantano Interceptor	HAMP (5.0 MGD) Poorman Gunnery Range (Figure 4-4)	- Potential Source for Reclaimed Water at Favorable Elevation	- Treatment Facility in Populated Area - Seasonal Effluent Management - Highest Construction Cost - Highest O&M Cost
3A	Southeast Interceptor	HAMP (1.2 MGD) PCRFCD Property (Figure 4-4)	- Potential Source for Reclaimed Water at a Favorable Elevation	- Treatment Facility in Populated Area - Treatment Location is Remote from Existing Reclaimed System - Seasonal Effluent Management - Lowest Non-cost Evaluation Score
3B	Pantano Interceptor	HAMP (1.2 MGD) City of Tucson DOT Property (Figure 4-4)	- Potential Source for Reclaimed Water at a Favorable Elevation	- Treatment Facility in Populated Area - Treatment Location is Remote from Existing Reclaimed System - Seasonal Effluent Management - Second Lowest Non-cost Evaluation Score

- Effluent management that accommodates the severe seasonal reclaimed water demand peaks inherent to irrigation needs.
- Contingency planning for periods when the reclaimed water system may not be able to accept delivery of reclaimed water.
- Identification of sites in proximity to existing reclaimed water system infrastructure.

Three of the four treatment scenarios did not survive the initial screening applied in Section 4.0, primarily due to the remote locations with respect to existing reclaimed system infrastructure. The remaining scenario (Scenario 2B) displayed the highest capital and O&M costs of the three remaining scenarios. The site identified for this facility is located at the northeast corner of the Poorman Gunnery Range, near the intersection of Irvington Road and Harrison Road, and is directly adjacent to a major reclaimed water pipeline.

Each of the treatment alternatives would place a new wastewater treatment facility within areas that are either currently populated or current planning shows to be developed for residential use during the planning period of this study.

7.0 CONCLUSIONS AND RECOMMENDATIONS

7.1 CONCLUSIONS

1. The HAMP planning area has a projected buildout population of approximately 88,000 based on PAG TAZ population data, resulting in a buildout average daily wastewater flow (ADWF) of 7.7 million gallons per day (mgd). The buildout population is similar to planning information developed by URS Engineering for the Arizona State Land Department.

2. The Wastewater planning area has a projected buildout population of approximately 165,000 based on PAG TAZ data resulting in a buildout ADWF of 12.7 mgd.

3. Due to the relatively flat topography of the southern portion of the HAMP planning area, new wastewater infrastructure can be constructed to direct wastewater flows by gravity to either the Southeast Interceptor (SEI) or the Pantano Interceptor (PTI). The buildout average daily wastewater flow of the affected area is approximately 4.2 mgd.

4. Of the six wastewater conveyance and treatment scenarios evaluated, the least cost alternative is based on maximizing wastewater flows within the HAMP planning area to the PTI and conveying them to the Roger Road WWTP for treatment. Wastewater treatment in the HAMP area, while more costly, could potentially provide up to 5 mgd of reclaimed water to the Tucson Water reclaimed water system at the highest elevation in the system. This could provide an opportunity for cost sharing in a HAMP treatment facility with Tucson Water.

5. Much of the wastewater infrastructure in the HAMP area is common to both the PTI conveyance alternative and the construction of a HAMP treatment facility. The common treatment elements provide PCRWRD with the opportunity to construct the infrastructure in a manner that can accommodate either a conveyance or treatment alternative and allows for deferring the commitment to either alternative.

6. PCRWRD is currently developing a Regional Optimization Master Plan (ROMP) that will present a regional plan for wastewater treatment, management, and reuse in the Tucson metropolitan area. The ROMP is considering a comprehensive plan for wastewater management, and the results of this HAMP Wastewater Conceptual Study will be considered as part of this regional study.

7.2 RECOMMENDATIONS

1. Continue communications with the Arizona State Land Department (ASLD) and monitoring development in the HAMP planning area. Because most of the land in the HAMP area is Arizona state trust land, residential development in the area will most significantly be triggered by the schedule by which the ASLD plans to make the land available for auction. By continuing to monitor the rate at which development occurs, PCRWRD can proactively prepare infrastructure to accommodate growth in the HAMP area.

2. Develop a capital improvement program in the HAMP area that is consistent with Scenario 1B (PTI conveyance scenario). Of the six scenarios evaluated, Scenario 1B offers the lowest capital costs, takes maximum advantage of existing infrastructure, and provides the most flexibility to accommodate future planning modifications.

3. Continue joint planning discussions with Tucson Water regarding reclaimed water use in the HAMP planning area. Continued cooperation between Pima County and the City of Tucson is essential to providing comprehensive water, wastewater, and reclaimed water planning that meets future needs in the HAMP area at overall costs that are beneficial to the rate payers of both utilities.

Appendix A

Technical Memorandum 1
May 18, 2006

Technical Memorandum for Population Projections, Wastewater Flow Projections, and Water Demand Projections for the Houghton Area Master Plan (HAMP) Project Site

MALCOLM PIRNIE
INDEPENDENT ENVIRONMENTAL ENGINEERS, SCIENTISTS AND CONSULTANTS

Malcolm Pirnie, Inc.
One South Church Avenue
Suite 1120
Tucson, AZ 85701-1654
T: 520.629.9982
F: 520-620-6476
www.pirnie.com

May 18, 2006

Charles H. Matthewson
Project Manager
Pima County Wastewater Management Department
201 N. Stone Avenue, 8th Floor
Tucson, Arizona 85701

Richard S. Williamson, P.E., R.L.S.
Engineering Manager
Planning and Engineering Division
Tucson Water
310 W. Alameda
Tucson, Arizona 85701

Re: Technical Memorandum for Population Projections, Wastewater Flow Projections, and Water Demand Projections for the Houghton Area Master Plan (HAMP) Project Site

Pima County Contract # 25-03-M-137732-0306
City of Tucson Contract # 05909:4

Dear Mr. Matthewson and Mr. Williamson:

The purpose of this technical memorandum is to present the results of Malcolm Pirnie's population, wastewater flow, and water demand projections for the Houghton Area Master Plan (HAMP) for the wastewater planning area and the potable water and reclaimed water planning area. This technical memorandum is being prepared in response to decisions made during the May 10, 2006 Interim Project Status Meeting. The memorandum is divided into the following sections:

1.0 HAMP Population Model and Assumptions
2.0 Wastewater Flow Assumptions and Projections
3.0 Water Demand Assumptions and Projections

1.0 HAMP Population Model and Assumptions

Population projections were prepared for the potable water and reclaimed water planning area, which is coincident with the HAMP planning area, and the Wastewater planning area of which HAMP is a large portion. The Wastewater planning area is bounded by Escalante Road to the north, Kolb Road to the west, Interstate Highway 10 (I-10) to the south, and the Pima/Cochise County line to the east. The larger Wastewater planning area allows for the master planning of

the HAMP area while paying attention to upstream wastewater producers. The population projections for the two planning areas are based on projections for Traffic Analysis Zones (TAZs) published by the Pima Association of Governments (PAG) using the following assumptions:

a Buildout population is based on 2030 TAZ population data.

b Population is distributed evenly across the TAZ for TAZs with similar landuse presented in the City of Tucson Master Plan. If a TAZ is only partially within the planning area, the corresponding population within the planning area is proportional to the percentage of the TAZ area within the planning area.

c Development in individual TAZs will not begin at the same time. TAZs, which have current development start accumulating population in 2005; TAZs that currently have plans for development projects begin accumulating population in 2010; and TAZs without current plans for development will begin accumulating population in 2015.

d Starting population for each TAZ is equal to the 2005 PAG projections.

e Population growth within a TAZ is linear from start date to 2030.

Table 1 in Attachment A of this technical memorandum presents the summary of population projections for the Wastewater planning area, while Table 2 presents population for just the HAMP planning area. The buildout population projection for the HAMP planning area in 2030 using this model is 87,748, while the entire Wastewater planning area is projected to have 164,786 in 2030.

Distribution of population across the Wastewater planning area in 2005 and 2030 is illustrated in Figure 1 of Attachment B. Figure 2 provides a similar illustration of the HAMP planning area. The HAMP planning area covers approximately 17 square miles. With a buildout population of 87,748 people, the HAMP planning area would have approximately 5,200 people per square mile. Figure 3 provides an illustration of the County parcel map for the Rita Ranch development immediately southwest of the HAMP planning area. Based on 2005 projections of the TAZ data for the three TAZs included in the Rita Ranch development, approximately 11,000 people live in the two square-mile development. The housing density presented in the Rita Ranch development equates approximately to 5,500 people per square-mile. Most of the 2030 population projections for TAZs within the HAMP planning area are estimated at a similar density as seen at Rita Ranch, or often higher.

Unlike the uniform development at Rita Ranch, the development concept for HAMP uses the village and town center concept. The City's Houghton Area Master Plan (Department of Urban Planning and Design, Resolution 20101, June 7, 2005) provides some guidance on proposed population densities within the village and town center development concepts. The town and

village centers are proposed to support a development density of 16 residential units per acre (RAC). The area surrounding the town and village centers are proposed to support medium density residential development at 8 RAC, and surrounding low density residential development at 4 RAC. The 2030 PAG TAZ projections evenly spread the 87,748 across the entire HAMP planning area; however, there should be no limitations for future development within the HAMP planning area due to TAZ population projections. It should be noted that the Rita Ranch development depicted in Figure 3 is approximately 4 to 5 RAC depending upon assumptions of the number of people per household (2.3 and 2.7) and PAG population data for TAZs 609, 654, and 661.

2.0 Wastewater Flow Assumptions and Projections

The Wastewater planning area comprises an area much larger than the HAMP planning area due to the impact on wastewater flows from drainage basins located upstream from the HAMP planning area. The Wastewater planning area was divided into seven individual drainage basins (Basins 31, 32, 43A, 43B, 54, 97, and 113) as used in the Pima County Wastewater Department Facility Plan Update (March 2006). The HAMP planning area includes portions of three of these basins (Basins 34B, 97, and 113). Wastewater average dry weather flow (ADWF) projections were made by multiplying population by 85 gallons per capita per day (gpcd) based on combined residential and commercial wastewater flows, which is consistant with the Facility Plan Update. Table 3 provides a summary of the projected ADWF for the Wastewater planning area from 2005 through 2030 in five-year increments. The initial ADWF projection for the Wastewater planning area totaled approximately 2.7 million gallons per day (MGD) with approximately 0.6 MGD going to the Pantano Interceptor and approximately 2.1 MGD going to the Southeast Interceptor. Figures 4 and 5 provide visual illustrations of ADWF volumes across the Wastewater planning area in 2005 and 2030, respectively.

Peak dry weather flows (PDWF) were calculated using the peaking factor algorithm presented in the 2006 Facility Plan Update. This algorithm provides declining peaking factors with increasing population. With regard to PDWF estimates, total upstream population is calculated before the peaking factor algorithm is applied. Thus, the same interceptor will have different peaking factors at different points along its alignment. Based on total population in 2030, a peak wastewater flow of 18.1 MGD is projected for the wastewater study area. Figure 6 provides an illustration of the Pantano and Southeast Interceptors, as well as PDWF projections for 2005, 2015, and 2030 under the current drainage basin concept. At buildout, approximately 7.5 MGD is directed to the Pantano Interceptor and 11.5 MDG is directed to the Southeast Interceptor (note that these flows total more than the total area flow of 18.1 MGD because the peaking factors are calculated independently). An alternative wastewater drainage approach would be to divert wastewater flows from the central and south portions of the HAMP planning area, away from the Southeast Interceptor and into the Pantano Interceptor. This diversion is feasible due to the flat nature of the topography in this portion of HAMP. Figure 7 provides the interceptors and PDWFs for this alternative, suggesting up to approximately 11.8 MGD can be directed to the Pantano Interceptor, if desired.

The population and ADWF wastewater models were checked against wastewater generation rates and metered data for existing manholes in the County's sewer system. The results of this comparison are presented below:

Projected ADWF vs. Facility Plan Projections and Metered Data (MGD)

Basin ID	2005 ADWF	Facility Plan Projection	Metered Flow (high)[1]	Metered Flow (low)[1]
43B	0.4	0.4	0.41	0.32
54 & 97	0.74	0.68	0.76	0.58
113	0.53	0.73	0.6	0.46

Note:

1. Metered flow readings from the wastewater collection pipelines are based on measurements of depth of wastewater flow. The flow depth is converted into a volume using the Manning formula and assumed range of the Manning roughness constant (n) between 0.010 and 0.013. The high metered flow rate corresponds to an n = 0.010. Low metered flow rate is based on n = 0.013.

The projected ADWF rates are based on 85 gpcd, which are assumed to be conservative and match closely to the high metered flow rates reported by the County. As a result, the population model and wastewater flow projections are also assumed to be a reasonable representation of developing wastewater flows in the project area.

3.0 Water Demand Assumptions and Projections

Similar to the wastewater flow projections, water demand projections area based on the population model presented for the HAMP planning area presented in Table 2. Water demand projections were developed by multiplying population numbers for individual TAZs by an average day potable water demand of 163 gpcd for both residential and commercial/industrial water demand. Table 4 provides a summary for projected water demand in the HAMP planning area from 2005 through 2030 in five-year increments. At buildout, the average day demand is projected to be approximately 14 MGD. A peaking factor of 1.8 is applied to determine the 2030 peak day demand of approximately 26 MGD. Finally, an additional peaking factor of 1.75 is applied to the peak day demand to estimate the peak hour demand of approximately 45 MGD. Figure 8 provides an illustration of estimated water demand across the HAMP planning area for 2005 and 2030. In general, water demand is evenly spread across the entire site.

Malcolm Pirnie is pleased to submit this interim report, if you have any questions or comments concerning the information presented in this letter, please call me at 629-8265 or Glenn Hoeger at 629-8282.

Very truly yours,

MALCOLM PIRNIE, INC.

James W. Dettmer, P.E., BCEE
Associate

gch

Attachments

1094-114
1830-080

c:	Ed Curley,	Pima County Wastewater Management Department
	Steve Munsell,	Pima County Wastewater Management Department
	Richard Williamson,	Tucson Water
	David Nelson,	Tucson Water
	Karen Dotson,	Tucson Water
	Tom Victory,	Tucson Water
	Dean Trammel,	Tucson Water
	Glenn Hoeger,	Malcolm Pirnie
	George Maseeh,	Malcolm Pirnie

TABLES

Table 1

Population Projections for the Wastewater Study Area

TAZ	Population Projections					
	2005	2010	2015	2020	2025	2030
469	4,821	4,890	4,959	5,028	5,097	5,166
512	926	926	925	925	924	924
542	0	0	0	0	0	0
548	0	0	0	0	0	0
550	2,465	2,508	2,551	2,594	2,637	2,681
552	0	0	0	0	0	0
586	1,177	1,241	1,305	1,369	1,433	1,495
589	1,018	1,049	1,080	1,111	1,142	1,175
598	0	1,086	2,172	3,258	4,344	5,429
600	0	0	0	0	0	0
609	992	1,164	1,336	1,508	1,680	1,850
616	0	1,051	2,102	3,153	4,204	5,255
627	1,063	2,032	3,001	3,970	4,939	5,910
628	0	1,138	2,276	3,414	4,552	5,690
633	942	1,053	1,164	1,275	1,386	1,499
643	0	1,054	2,108	3,162	4,216	5,269
654	2,956	4,043	5,130	6,217	7,304	7,304
660	0	0	0	0	0	0
661	8,022	8,224	8,426	8,628	8,830	9,030
662	0	1,080	1,944	2,808	3,672	5,400
665	0	463	926	1,389	1,851	2,314
668	240	287	334	381	428	477
676	910	1,809	2,708	3,607	4,506	5,403
683	0	0	0	0	0	0
685	0	0	668	1,778	2,888	3,999
688	0	0	33	63	92	122
690	690	1,380	2,070	2,760	3,450	4,141
702	0	0	1,993	4,650	7,307	9,964
706	0	0	0	0	0	0
709	0	0	814	1,727	2,640	3,552
712	0	0	3,628	9,654	15,680	21,707
721	0	1,995	3,971	5,947	7,923	9,897
725	1,150	2,103	3,056	4,009	4,962	5,916
734	224	224	224	224	224	224
737	326	590	854	1,118	1,382	1,647
738	1,115	1,794	2,473	3,152	3,831	4,512
740	2,845	5,388	7,931	10,474	13,017	15,561
752	1,314	2,064	2,814	3,564	4,314	5,066
756	0	0	239	484	729	975
768	526	915	1,304	1,693	2,082	2,470
779	328	372	416	460	504	549
781	735	878	1,021	1,164	1,307	1,450
792	0	330	332	334	336	337
807	0	0	0	0	0	0
839	293	320	347	374	401	426
Total	35,078	53,451	78,635	107,425	136,215	164,786

Table 2

Population Projections for HAMP Study Area

TAZ	Population Projections					
	2005	2010	2015	2020	2025	2030
598	0	1,086	2,172	3,258	4,344	5,429
616	0	1,051	2,102	3,153	4,204	5,255
627	1,063	1,871	2,679	3,487	4,295	5,910
628	0	1,138	2,276	3,414	4,552	5,690
643	0	1,054	2,108	3,162	4,216	5,269
654	0	1,087	1,902	2,717	3,532	4,348
662	0	1,080	1,944	2,808	3,672	5,400
665	0	463	926	1,389	1,852	2,314
668	240	272	304	336	368	429
676	910	1,659	2,408	3,157	3,906	5,403
685	0	0	668	1,778	2,889	3,999
688	0	0	0	0	0	0
690	690	1,265	1,840	2,415	2,990	4,141
702	0	0	1,993	4,650	7,307	9,964
712	0	1,995	6,923	11,851	16,779	21,707
740	0	0	302	1,031	1,760	2,490
Totals	2,903	14,021	30,547	48,606	66,666	87,748

Table 3

Average Dry Weather Flow (ADWF) Wastewater Study Area (gpd)[1]

TAZ	Percent of TAZ in Basin[2]	Percent on Septic[3]	2005	2010	2015	2020	2025	2030
Drainage Basin 113								
586	100%	5%	95,043	100,211	105,379	110,547	115,715	120,681
589	100%	5%	82,204	84,707	87,210	89,713	92,217	94,881
598	100%	0%	0	92,310	184,620	276,930	369,240	461,465
616	100%	0%	0	89,335	178,670	268,005	357,340	446,675
627	100%	0%	90,355	172,720	255,085	337,450	419,815	502,350
628	20%	0%	0	19,346	38,692	58,038	77,384	96,730
633	100%	40%	48,042	53,703	59,364	65,025	70,686	76,449
643	100%	0%	0	89,590	179,180	268,770	358,360	447,865
662	70%	0%	0	64,260	115,668	167,076	218,484	321,300
665	100%	0%	0	39,355	78,689	118,023	157,356	196,690
668	100%	0%	20,400	24,395	28,390	32,385	36,380	40,545
685	100%	0%	0	0	56,780	151,130	245,480	339,915
688	100%	0%	0	0	2,805	5,327	7,848	10,370
709	100%	40%	0	0	41,514	88,077	134,640	181,152
721	80%	50%	0	67,830	135,014	202,198	269,382	336,498
725	100%	10%	87,975	160,880	233,784	306,689	379,593	452,574
737	100%	50%	13,855	25,075	36,295	47,515	58,735	69,998
738	50%	20%	37,910	60,996	84,082	107,168	130,254	153,408
752	30%	10%	30,156	47,369	64,581	81,794	99,006	116,265
756	100%	50%	0	0	10,158	20,570	30,983	41,438
768	70%	30%	21,908	38,110	54,312	70,513	86,715	102,876
779	100%	100%	0	0	0	0	0	0
Total			**527,847**	**1,230,191**	**2,030,271**	**2,872,942**	**3,715,613**	**4,610,123**
Drainage Basin 43B								
690	45%	0%	26,393	52,785	79,178	105,570	131,963	158,393
702	50%	0%	0	0	84,703	197,625	310,548	423,470
712	100%	0%	0	0	308,380	820,590	1,332,800	1,845,095
721	20%	100%	0	0	0	0	0	0
734	100%	100%	0	0	0	0	0	0
738	50%	100%	0	0	0	0	0	0
740	100%	0%	241,825	457,980	674,135	890,290	1,106,445	1,322,685
752	70%	10%	70,365	110,527	150,690	190,852	231,015	271,284
768	30%	50%	6,707	11,666	16,626	21,586	26,546	31,493
781	100%	10%	56,228	67,167	78,107	89,046	99,986	110,925
792	100%	50%	0	14,025	14,110	14,195	14,280	14,323
Total			**401,516**	**714,150**	**1,405,927**	**2,329,754**	**3,253,581**	**4,177,668**
Drainage Basin 97								
552	60%	100%	0	0	0	0	0	0
609	40%	0%	33,728	39,576	45,424	51,272	57,120	62,900
628	80%	0%	0	77,384	154,768	232,152	309,536	386,920
654	100%	0%	251,260	343,655	436,050	528,445	620,840	620,840
661	50%	0%	340,935	349,520	358,105	366,690	375,275	383,775
662	30%	0%	0	27,540	49,572	71,604	93,636	137,700
676	100%	0%	77,350	153,765	230,180	306,595	383,010	459,255
690	55%	0%	32,258	64,515	96,773	129,030	161,288	193,592
702	50%	0%	0	0	84,703	197,625	310,548	423,470
Total			**735,531**	**1,055,955**	**1,455,574**	**1,883,413**	**2,311,252**	**2,668,452**
Drainage Basin 43A								
548	100%	20%	0	0	0	0	0	0
600	100%	0%	0	0	0	0	0	0
609	50%	0%	42,160	49,470	56,780	64,090	71,400	78,625
660	100%	100%	0	0	0	0	0	0
661	50%	0%	340,935	349,520	358,105	366,690	375,275	383,775
683	100%	50%	0	0	0	0	0	0
Total			**383,095**	**398,990**	**414,885**	**430,780**	**446,675**	**462,400**
Drainage Basin 54								
609	10%	0%	8,432	9,894	11,356	12,818	14,280	15,725
Total			**8,432**	**9,894**	**11,356**	**12,818**	**14,280**	**15,725**
Drainage Basin 31								
512	100%	0%	86,530	89,165	91,800	94,435	97,070	99,875
550	100%	0%	209,525	213,180	216,835	220,490	224,145	227,885
552	40%	100%	0	0	0	0	0	0
Total			**296,055**	**302,345**	**308,635**	**314,925**	**321,215**	**327,760**
Drainage Basin 81								
469	100%	0%	409,785	415,650	421,515	427,380	433,245	439,110
Total			**409,785**	**415,650**	**421,515**	**427,380**	**433,245**	**439,110**
			2,762,261	**4,127,175**	**6,048,163**	**8,272,012**	**10,495,861**	**12,701,238**

Notes:

1. ADWF based on 85 gallons per capita per day.
2. Straight area weighted percentage of the portion of the TAZ within the Wastewater Study Area.
3. Estimate based on areas that do not currently have sewer service and are unlikely to be sewered because of low population density, topography, and proximity to existing interceptors.

Table 4

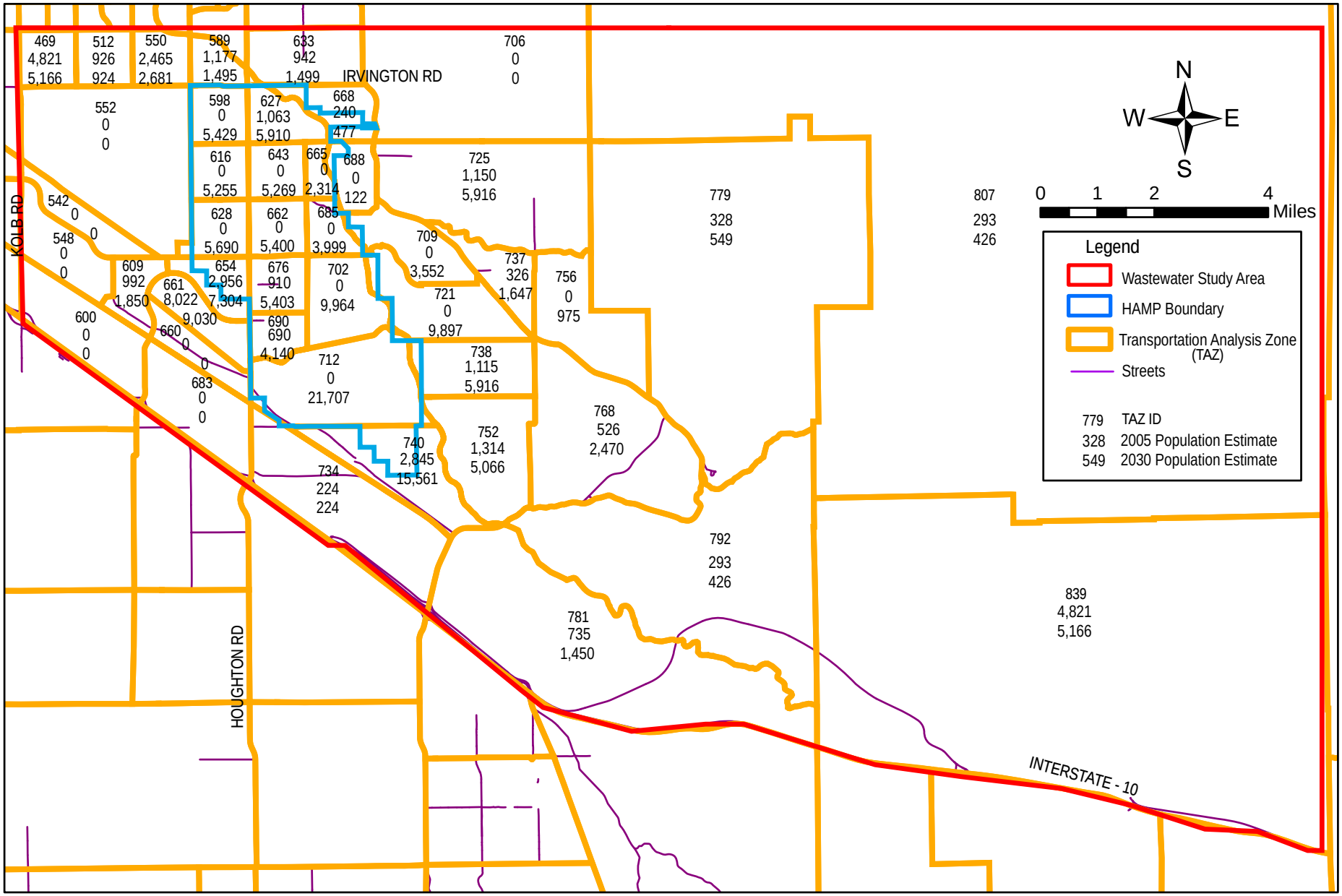
Water Demand Projections (gpm)

TAZ	Average Day Water Demand Projections[1]					
	2005	2010	2015	2020	2025	2030
598	0	123	246	369	492	615
616	0	119	238	357	476	595
627	120	212	303	395	486	669
628	0	129	258	386	515	644
643	0	119	239	358	477	596
654	0	123	215	308	400	492
662	0	122	220	318	416	611
665	0	52	105	157	210	262
668	27	31	34	38	42	49
676	103	188	273	357	442	612
685	0	0	76	201	327	453
688	0	0	0	0	0	0
690	78	143	208	273	338	469
702	0	0	226	526	827	1,128
712	0	226	784	1,341	1,899	2,457
740	0	0	34	117	199	282
Totals (gpm)	329	1,587	3,458	5,502	7,546	9,933
Totals (MGD)	0.5	2.3	5.0	7.9	11	14
Peak Day Water Demand Projections[2]						
598	0	221	443	664	885	1,106
616	0	214	428	642	857	1,071
627	217	381	546	710	875	1,204
628	0	232	464	696	927	1,159
643	0	215	430	644	859	1,074
654	0	221	388	554	720	886
662	0	220	396	572	748	1,100
665	0	94	189	283	377	471
668	49	55	62	68	75	87
676	185	338	491	643	796	1,101
685	0	0	136	362	589	815
688	0	0	0	0	0	0
690	141	258	375	492	609	844
702	0	0	406	947	1,489	2,030
712	0	406	1,411	2,415	3,419	4,423
740	0	0	62	210	359	507
Totals (gpm)	591	2,857	6,224	9,904	13,583	17,879
Totals (MGD)	0.9	4.1	9.0	14	20	26
Peak Hour Water Demand Projections[3]						
598	0	387	774	1,162	1,549	1,936
616	0	375	749	1,124	1,499	1,874
627	379	667	955	1,243	1,531	2,107
628	0	406	812	1,217	1,623	2,029
643	0	376	752	1,127	1,503	1,879
654	0	388	678	969	1,259	1,550
662	0	385	693	1,001	1,309	1,925
665	0	165	330	495	660	825
668	86	97	108	120	131	153
676	324	592	859	1,126	1,393	1,927
685	0	0	238	634	1,030	1,426
688	0	0	0	0	0	0
690	246	451	656	861	1,066	1,477
702	0	0	711	1,658	2,605	3,553
712	0	711	2,468	4,226	5,983	7,740
740	0	0	108	368	628	888
Totals (gpm)	1,035	4,999	10,892	17,331	23,770	31,288
Totals (MGD)	1.5	7.2	15.7	25	34	45

Notes:

1. Average day demand based on 163 gallons per capita per day for residential and commercial demands.
2. Peak day demand based on average day demand times 1.8 peaking factor.
3. Peak hour demand based on peak day demand times 1.75 peaking factor.

FIGURES



MALCOLM PIRNIE

INDEPENDENT ENVIRONMENTAL ENGINEERS, SCIENTISTS AND CONSULTANTS

PIMA COUNTY WASTEWATER MANAGEMENT DEPARTMENT

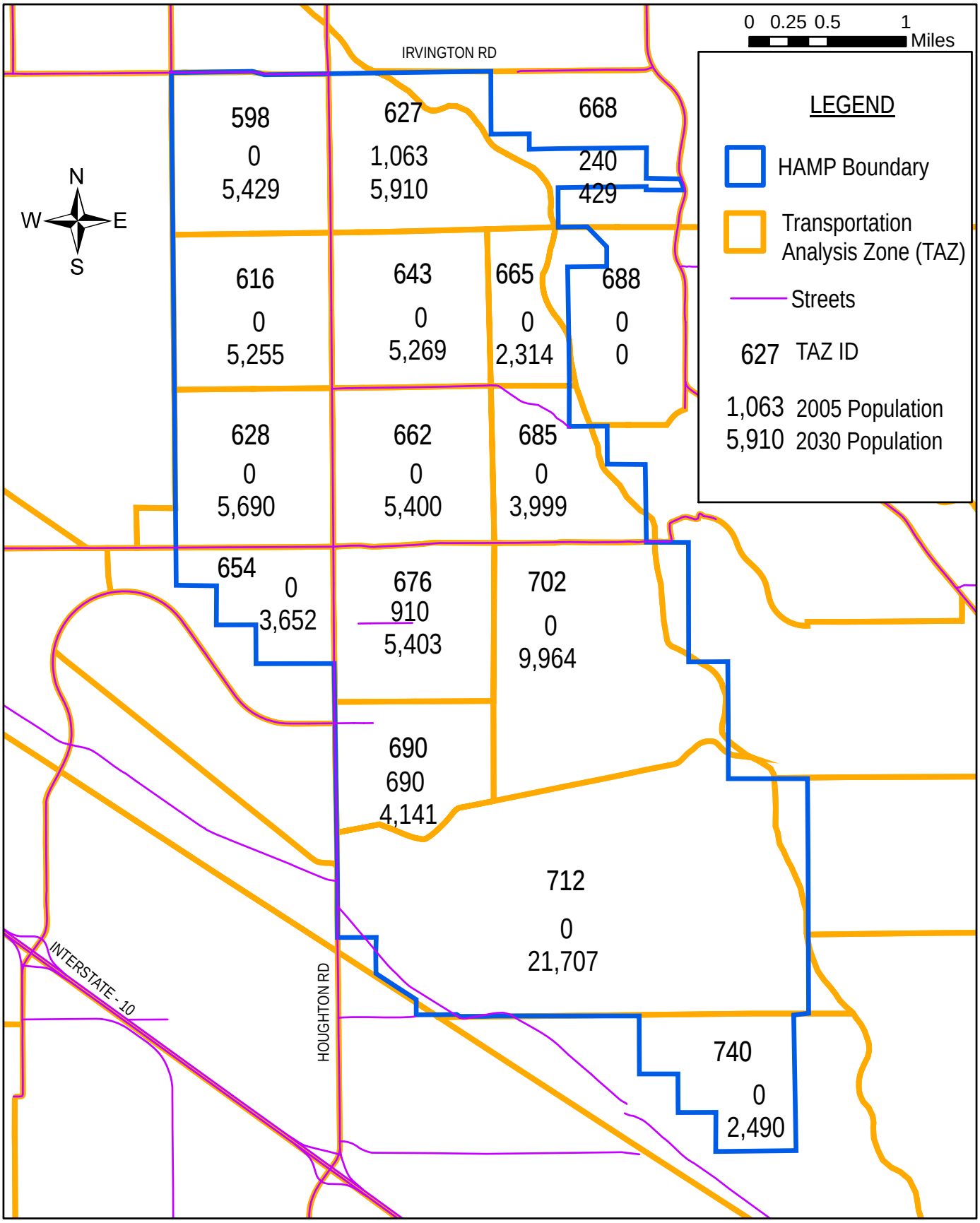
HOUGHTON AREA MASTER PLAN

PIMA CO CONTRACT NO. 25-03-M-137732-0306

SUMMARY OF POPULATION PROJECTIONS FOR THE PIMA COUNTY WASTEWATER STUDY AREA

MALCOLM PIRNIE, INC.

FIGURE 1



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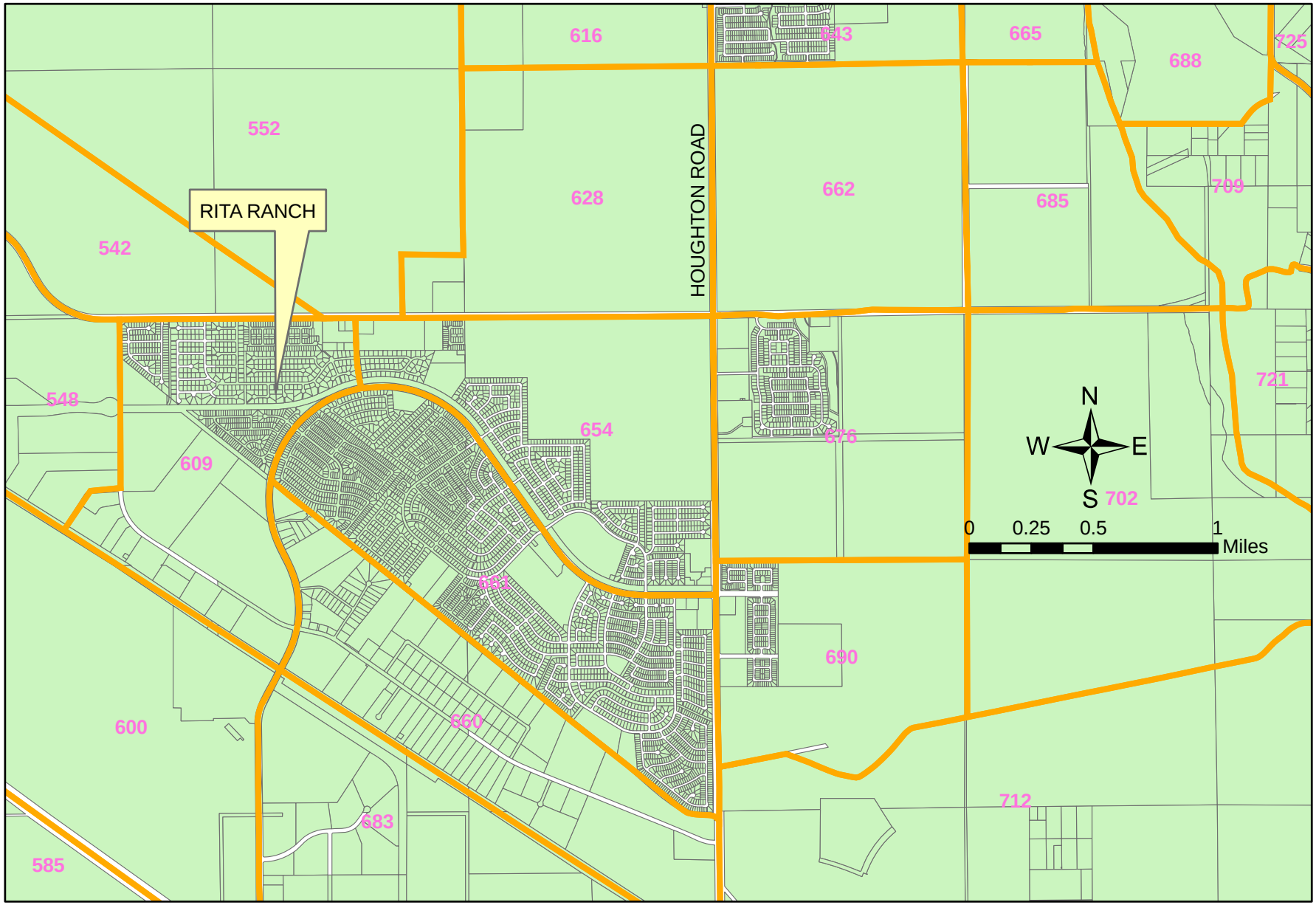
PIMA CO CONTRACT NO. 25-03-M-137732-0306

POPULATION PROJECTIONS WITHIN HAMP

MALCOLM PIRNIE, INC.

FIGURE 2



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PIMA COUNTY WASTEWATER MANAGEMENT DEPARTMENT

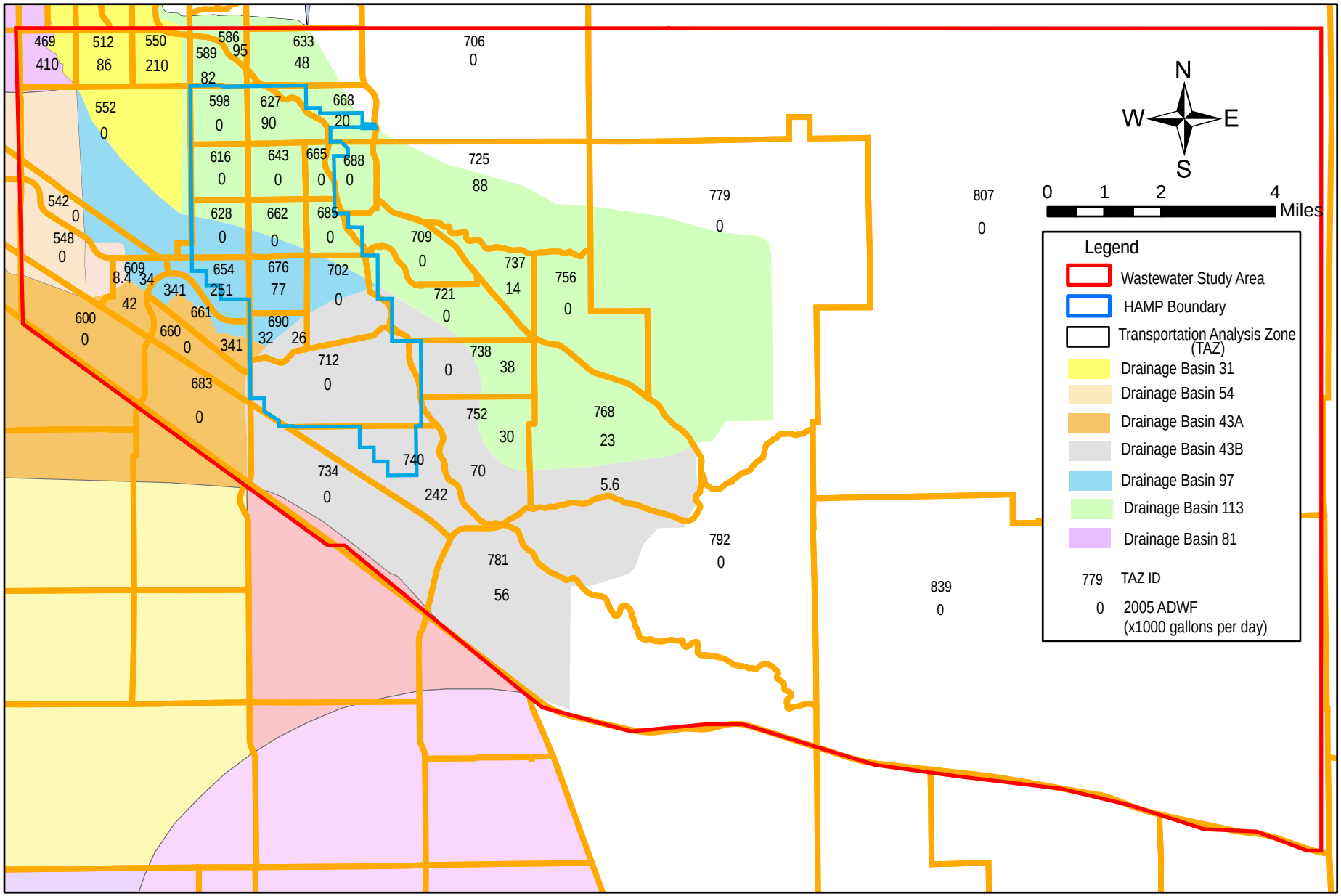
HOUGHTON AREA MASTER PLAN

PIMA CO CONTRACT NO. 25-03-M-137732-0306

RITA RANCH
PARCEL MAP

MALCOLM PIRNIE, INC.

FIGURE 3



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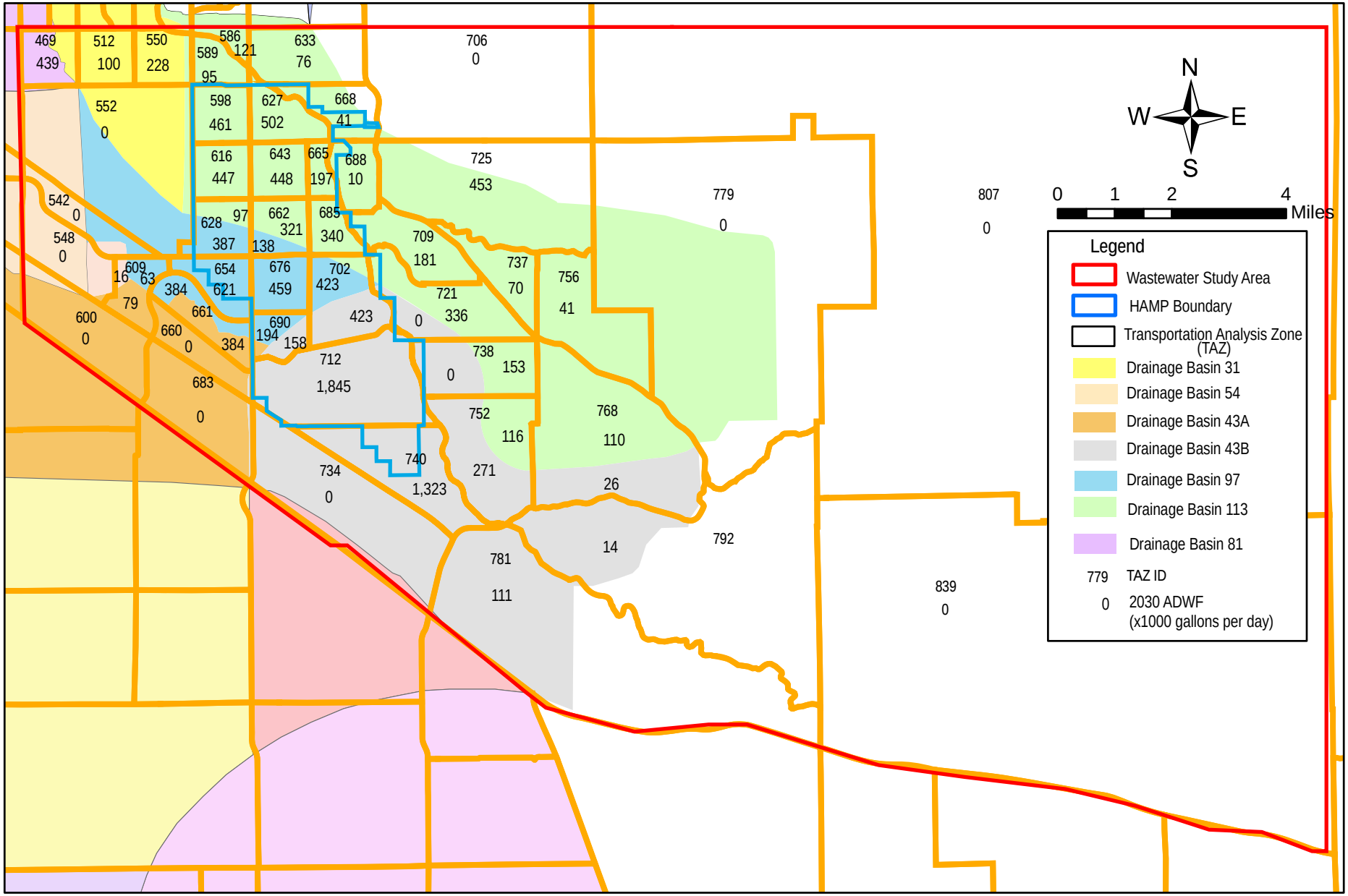
SUMMARY OF 2005 AVERAGE DRY WEATHER FLOW (ADWF)

MALCOLM PIRNIE, INC.

FIGURE 4



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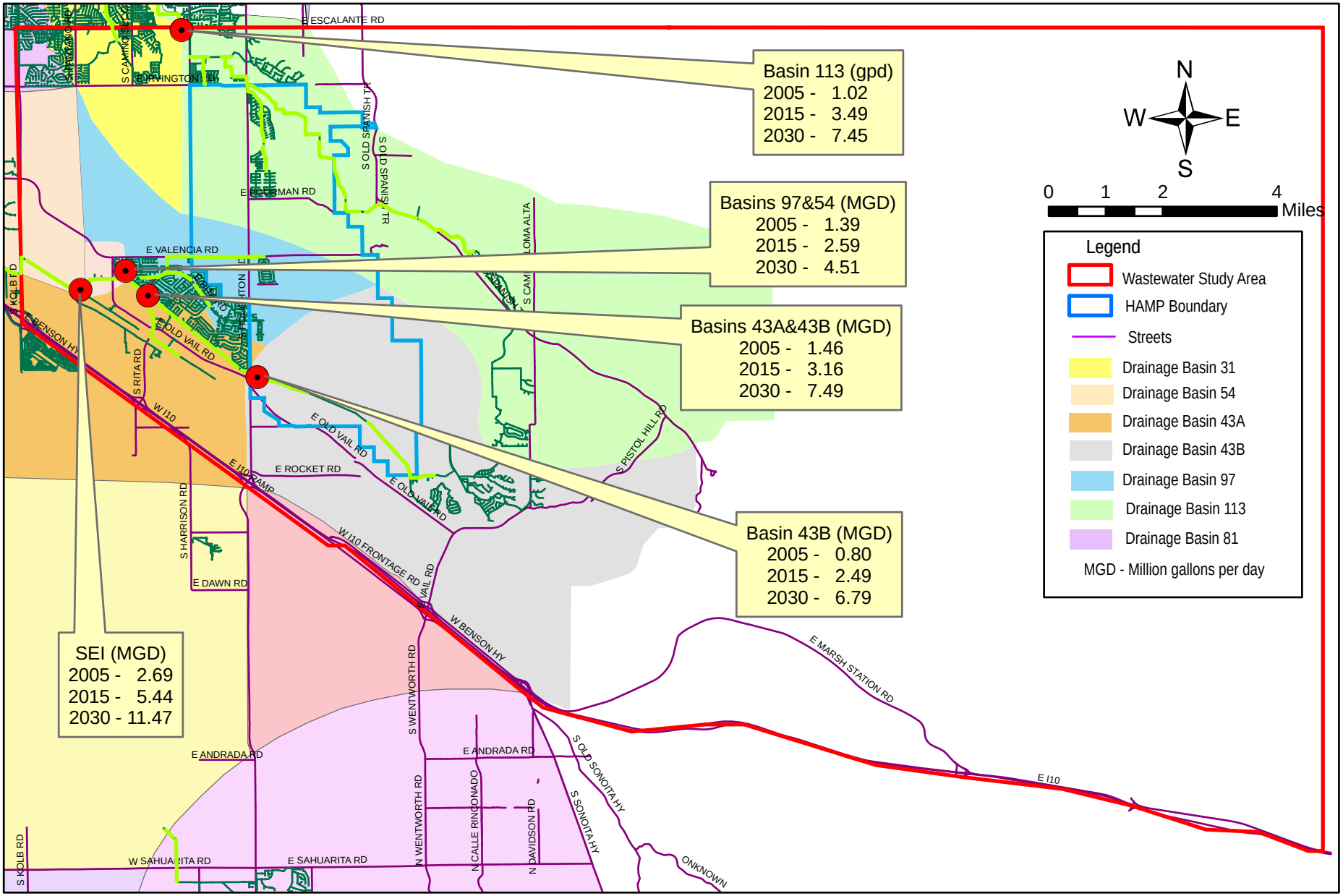
SUMMARY OF 2030 AVERAGE DRY WEATHER FLOW (ADWF)

MALCOLM PIRNIE, INC.

FIGURE 5



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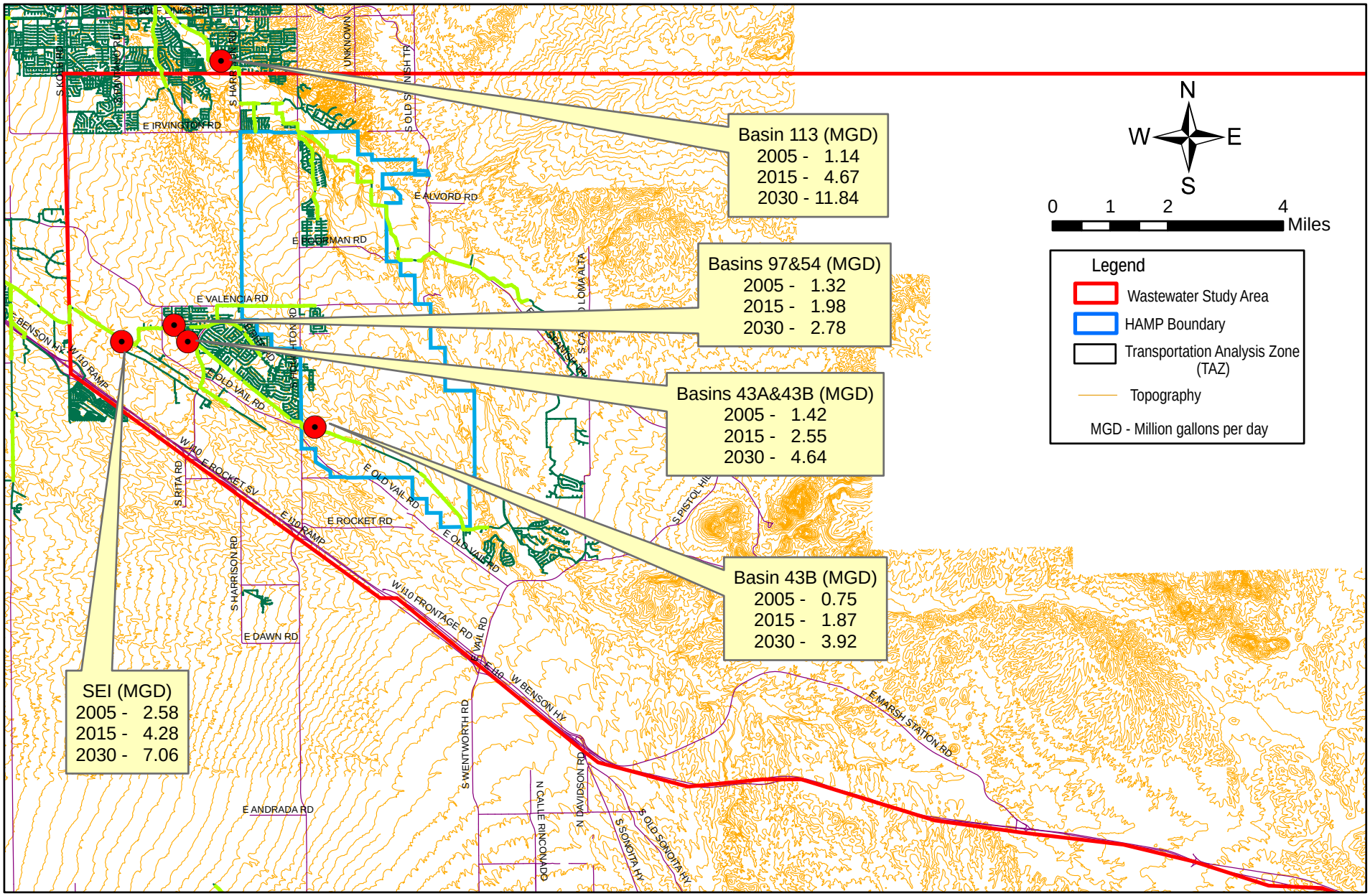
HOUGHTON AREA MASTER PLAN

PIMA CO CONTRACT NO. 25-03-M-137732-0306

SUMMARY OF PEAK DRY WEATHER FLOW (PDWF)

MALCOLM PIRNIE, INC.

FIGURE 6



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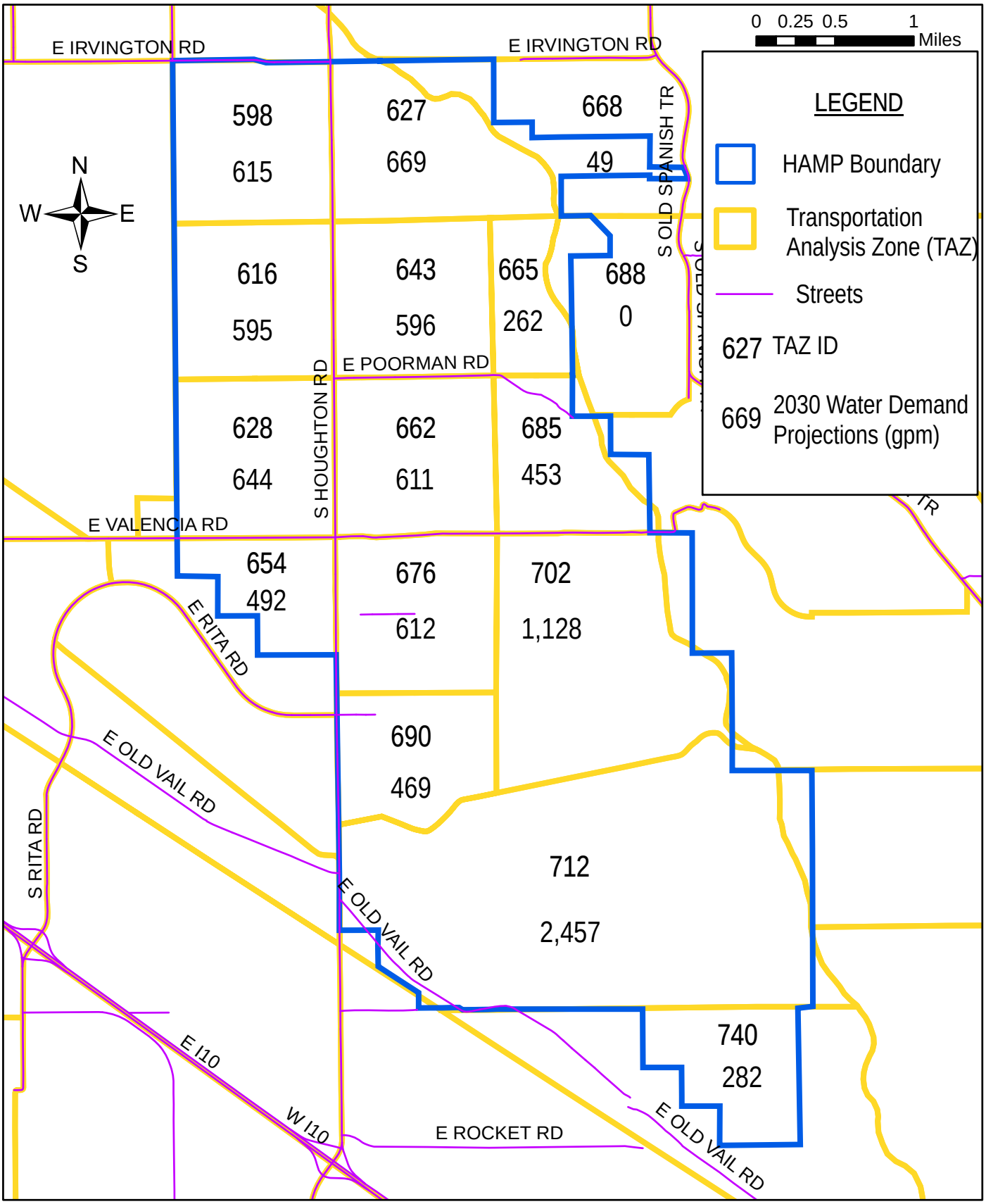
PIMA CO CONTRACT NO. 25-03-M-137732-0306

SUMMARY OF 2030 PEAK DRY WEATHER FLOW (PDWF) FACILITY PLAN DRAINAGE

MALCOLM PIRNIE, INC.

FIGURE 7



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PIMA CO CONTRACT NO. 25-03-M-137732-0306

2030 AVERAGE POTABLE DEMAND PROJECTIONS

MALCOLM PIRNIE, INC

FIGURE 8

Appendix B

Technical Memorandum 2
July 13, 2006

Technical Memorandum for Wastewater Treatment Scenarios for the Houghton Area Master Plan (HAMP) Project Site

MALCOLM PIRNIE
INDEPENDENT ENVIRONMENTAL ENGINEERS, SCIENTISTS AND CONSULTANTS

Malcolm Pirnie, Inc.
One South Church Avenue
Suite 1120
Tucson, AZ 85701-1654
T: 520.629.9982
F: 520-620-6476
www.pirnie.com

July 13, 2006

Charles H. Matthewson, Project Manager
Pima County Wastewater Management Department
201 N. Stone Avenue, 8th Floor
Tucson, Arizona 85701

Re: **Technical Memorandum for Wastewater Treatment Scenarios for the Houghton Area Master Plan (HAMP) Project Site**

Pima County Contract # 25-03-M-137732-0306
City of Tucson Contract # 05909:4

Dear Mr. Matthewson:

The purpose of this memorandum is to document the wastewater treatment scenarios for the Houghton Area Master Plan (HAMP) and surrounding Wastewater Study Area. As discussed in our project status meeting dated June 12, 2006, wastewater treatment scenarios have been developed related to population growth and flow projections for the HAMP study area, as well as the available flow capacities within the Southeast Interceptor (SEI) and the Pantano Interceptor (PTI) as presented in the March 2006 Metropolitan Area Facility Plan Update. Three alternative scenarios were developed to manage wastewater in the HAMP Wastewater Study Area:

1. Direct all wastewater flow from the study area to the Roger Road Wastewater Treatment Plant without local treatment in the HAMP study area and construct improvements to sections of the SEI and PTI to alleviate capacity restrictions.
2. Treat sufficient volumes of wastewater in the HAMP Wastewater Study Area to alleviate the projected SEI and PTI flow capacity deficiencies.
3. Size a wastewater treatment facility based on projected reclaimed water demand and construct improvements to sections of the SEI and PTI.

Each of these scenarios include alternative evaluations of maximizing wastewater flow to the PTI or, inversely, maximizing wastewater flow to the SEI. This memorandum is organized into the following sections:

Section 1 – Summary of Interceptor Sizing and Flow Capacities
Section 2 – Summary of Population Projections, ADWF and PDWF

Section 3 – Wastewater Treatment Scenarios
Section 4 – Summary and Conclusions

1.0 SUMMARY OF INTERCEPTOR SIZE AND CAPACITIES

Interceptor sizing and full-pipe capacities for the SEI and PTI were obtained from Figure 4.2.1 – *Interceptor System with Approximate Full Pipe Capacities* of the March 2006 Metropolitan Area Facility Plan Update. Figure 1 provides an illustration of the interceptors and manhole locations for the HAMP Wastewater Study Area. Interceptor sizes and full pipe capacities are as follows:

Southeast Interceptor (SEI)

Down-gradient Manhole	Pipe Diameter (inches)	Full Pipe Capacity (MGD)
4584-44	15	4.03
4584-25	15	4.30
4584-00	18	4.90
4636-34A[1]	18	5.43
4636-23A	18	6.13
4190-05A	18	6.30
4190-13	24	13.96
4190-10[2]	30	21.10
4190-05	36	18.49
4190-01	48	16.12
5170-36	30	14.65
5170-23[3]	24	11.82

Notes:
1 – Exit Point of Drainage Basin 43B.
2 – Exit Point of Drainage Basins 43A, 43B, 54, and 97.
3 – Exit Point of Study Area.

Pantano Interceptor (PTI)

Down-gradient Manhole	Pipe Diameter (inches)	Full Pipe Capacity (MGD)
4717-84	15	3.02
4717-82	15	2.11
4726-50	18	4.04
4126-46	20	4.85
6592-16	21	5.41
6592-01	20 & 21	5.57
2741-07	18	2.93
4548-01	18	4.39
2741-01[1]	12	1.68

Notes:
1 – Exit Point of Drainage Basin 113 and Study Area.

The SEI within the HAMP Wastewater Study Area is characterized as having full pipe capacity ranging from approximately 4 million gallons per day (MGD) in the vicinity of Vail to 21 MGD at the junction point with the Rita Ranch interceptor draining basins 54 and 97. The SEI full pipe capacity at the exit point of the study area is approximately 12 MGD.

The PTI upgradient of the HAMP boundary ranges in diameter from 15 to 21 inches with corresponding full pipe capacities of 2.11 MGD near Rocking K and 5.41 MGD at Houghton Road and Irvington. The 12-inch interceptor at Harrison and the Pantano Wash represents a constriction with a 1.68 MGD full pipe capacity. The PTI full pipe capacity at the exit of the study area is approximately 4 MGD.

2.0 SUMMARY OF POPULATION PROJECTIONS, ADWF, AND PDWF

A summary of the population and wastewater flow projects is presented in the first technical memorandum for the HAMP project dated May 18, 2006. Based on the population model developed from the Pima Association of Governments (PAG) Traffic Analysis Zones (TAZs) for 2030, the population for the HAMP Wastewater Study Area is projected to be 164,786. Not all of the population is projected to be connected to the sewer system in 2030, with an estimated 15,360 people still using on-site septic systems at that time. As a result, the total sewered population for the HAMP Wastewater Study Area is 149,426, of which 87,748 people are projected to live within the HAMP boundaries.

Wastewater flow projections presented in this technical memorandum are based on the 85 gallons per day per person (gpdp) as presented in the 2006 Metropolitan Facility Plan Update. Recent meter data for wastewater flows from areas dominated by recently constructed residential developments indicate that 65 gpdp may be more accurate of actual wastewater generation rates. Should the 65 gpdp be indicative of wastewater

generation in the HAMP Wastewater Study Area, wastewater flow rates would be reduced by approximately 24 percent compared to the rates presented in this memorandum.

As stated in the previous technical memorandum, most of the HAMP project area can have wastewater directed to either the SEI or the PTI by gravity due to the relatively flat topography of the site. Two wastewater flow alternatives, therefore, have been developed.

Wastewater Flow Alternative 1 – SEI Alternative

The first wastewater drainage alternative for the HAMP project area is based on the drainage basins presented in the March 2006 Metropolitan Area Facility Plan Update. This wastewater flow alternative is called the SEI Alternative, because most of the wastewater flow is directed to the Southeast Interceptor. Figure 2 provides an illustration of the drainage basins and the boundaries of HAMP and the HAMP Wastewater Study Area. As illustrated in Figure 2, wastewater flows from Drainage Basins 43A, 43B, 54, and 97 would be directed to the SEI. The wastewater flow from Drainage Basin 113 would be directed to the PTI. The table below summarizes the projected wastewater flow rates in 2030 for the drainage basins as presented in Figure 2. The flow rates presented include average dry weather flow (ADWF) and peak dry weather flow (PDWF). The ADWF data is principally used for sizing treatment facilities, while the PDWF is used to size conveyance systems. Peaking factors are calculated using the algorithm from the 2006 Facility Plan Update, which provides lower peaking factor estimates for larger upstream populations.

Wastewater Flow Summary for SEI Alternative

Drainage Basin	ADWF (MGD)	Peaking Factor	PDWF (MGD)
Wastewater Flows to the Southeast Interceptor (SEI)			
43A	0.46	1.96	0.91
43B	4.18	1.63	6.79
54	0.02	2.64	0.04
97	2.67	1.68	4.49
SEI Total	7.3	1.57	11.5
Wastewater Flows to the Pantano Interceptor (PTI)			
113	4.6	1.62	7.4
PTI Total	4.6	1.62	7.4

Notes:
ADWF – Average Dry Weather Flow
PDWF – Peak Dry Weather Flow
MGD – million gallons per day
Peaking Factors calculated based upon 2006 Facility Plan algorithm

Wastewater Flow Alternative 2 – PTI Alternative

The second wastewater flow alternative evaluated was developed to maximize wastewater flow from the HAMP area to the PTI. Because the topography across the HAMP area is generally flat, wastewater flows from significant portions of Drainage Basins 43B and 97 can be directed to the PTI rather than the SEI as depicted in the drainage basin outlines presented in the Facility Plan Update. Figure 3 provides an illustration of the revised drainage basin boundaries with increased area for Drainage Basin 113 and corresponding reductions in the area of Drainage Basins 43B and 97. Based on the revised drainage basin outlines, the ADWF to the PTI has increased by 3 MGD from 4.6 MGD in the SEI Alternative to 7.6 MGD in the PTI Alternative. The peak flow rates being directed to the PTI have correspondingly increased from 7.4 MGD under the SEI Alternative to 11.8 MGD under the PTI Alternative. ADWF and PDWF flows for each drainage basin and both interceptors under the PTI Alternative are summarized in the table below.

Wastewater Flow Summary for PTI Alternative

Drainage Basin	ADWF (MGD)	Peaking Factor	PDWF (MGD)
Wastewater Flows to the Southeast Interceptor (SEI)			
43A	0.46	1.96	0.91
43B[1]	2.30	1.70	3.92
54	0.02	2.64	0.04
97[1]	1.57	1.75	2.75
SEI Total	4.4	1.62	7.1
Wastewater Flows to the Pantano Interceptor (PTI)			
113[2]	7.6	1.56	11.8
PTI Total	7.6	1.56	11.8

Note:
1. Basins 43B and 97 are reduced in area and subsequent wastewater flow compared to the SEI Alternative.
2. Basin 113 has increased area and subsequent wastewater flow compared to the SEI Alternative.

The values for ADWF and PDWF presented for the SEI Alternative and the PTI Alternative represent the flow rates at each interceptor at the point where the interceptors leaves the study area at 2030 PAG population projections. These flow rates were used to evaluate the wastewater conveyance and treatment scenarios presented in the next section.

WASTEWATER TREATMENT SCENARIOS

Three wastewater treatment scenarios have been developed as part of the project status meeting held on Monday, June 12, 2006:

Scenario 1 – Roger Road WWTP
Scenario 2 – HAMP Skimming Plant
Scenario 3 – Reclaimed Water Demand

Each of the three alternatives is discussed separately below. In discussions for all three scenarios, wastewater flows for treatment facility sizing is based on ADWF. The treatment plants would be designed with sufficient on-site storage capacity to meet daily peaking requirements. The wastewater interceptors, however, must be sized to meet all potential flow rates. For discussions of wastewater interceptors, therefore, PDWF is used to base capacities and sizing.

Scenario 1 - Roger Road WWTP

Under Scenario 1, all of the wastewater generated in the HAMP Wastewater Study Area would be conveyed northwest to the Roger Road Wastewater Treatment Plant (WWTP). HAMP area and downstream interceptor pipelines are assumed to be upgraded with sufficient capacity to convey all wastewater flows from the study area to the Roger Road WWTP as shown in Section 4.2 of the 2006 Metropolitan Facility Plan Update. Using the two wastewater flow alternatives (SEI Alternative and PTI Alternative) previously described, Scenario 1 has two approaches to achieve the goal of conveying the PDWF of approximately 18 MGD (ADWF = 12 MGD) from the HAMP Wastewater Study Area to the Roger Road WWTP:

Scenario 1a (SEI Alternative) – Upgrades would likely be required along portions of the SEI upstream of manhole 4190-05A to accommodate PDWF from the HAMP Wastewater Study Area. An additional 4.6 MGD PDWF from the remaining portion of Drainage Basin 43A will be directed to the SEI; however, this portion of the drainage basin is located outside the HAMP Wastewater Study Area boundary. Under this alternative, the capacity of the PTI would also need to be increased from approximately 4 MGD to 7.4 MGD.

Scenario 1b (PTI Alternative) – Upgrading the PTI capacity from approximately 4 MGD to 11.8 MGD. Under this alternative, the SEI capacity would not require upgrading. Even the addition of approximately 4.6 MGD PDWF from the portion of Drainage Basin 43A from outside the study area would barely exceed the minimum capacity along the SEI of approximately 12 MGD.

Scenario 2 – HAMP Skimming Plant

Scenario 2 assumes that wastewater treatment plant(s) will be constructed to treat wastewater flows that are in excess of existing interceptor capacity. Scenario 2 also has options associated with the two wastewater flow alternatives.

Scenario 2a (SEI Alternative) – The SEI Alternative has 11.5 MGD (PDWF) of wastewater flow directed to the Southeast Interceptor from the study area. The SEI has capacity deficiencies in the upstream portion of the Wastewater Study Area that are not conducive to capacity upgrades by local wastewater treatment. Upgrades to the SEI within the Wastewater Study Area will be required regardless of the location or capacity of a

potential treatment facility. The peak wastewater flow rate under this scenario is very close the full-pipe capacity of the drainage basin, and construction of a second plant, therefore, is not considered as a part of this scenario. Alternatively, 7.4 MGD (PDWF) of wastewater flow is directed to the PTI. The capacity along this pipeline within the study area is approximately 4 MGD. A treatment plant with a capacity of approximately 2.5 MGD (ADWF) would be included along the PTI under this alternative.

Scenario 2b (PTI Alternative) – The PTI Alternative has approximately 11.8 MGD of wastewater flow directed to the PTI and approximately 7.1 MGD directed to the SEI. No treatment facility would be recommended at SEI since sewer augmentation is not required, but a 5 MGD (ADWF) treatment plant would be recommended to remove the need to increase the capacity of the PTI.

Scenario 3 – Reclaimed Water Demand

Scenario 3 is based on sizing a HAMP wastewater treatment facility to meet projected reclaimed water demands in the developing HAMP project area. Two alternatives have been developed:

Scenario 3a – Sizing a reclaimed facility to match projected 1.2 MGD reclaimed water demand in the HAMP project area along the SEI. The reclaimed water demand is based on eight percent of the 2030 total water demand for the HAMP project area. The SEI has a current capacity of approximately 12 MGD and under the 2030 PDWF for the SEI is approximately 11.5 MGD under the SEI Alternative for wastewater flow. SEI augmentation would depend on where the reclaimed facility could be sited on the SEI. The capacity of the PTI, under this scenario, would require its capacity increased from approximately 4 MGD to 7.4 MGD.

Scenario 3b – Sizing a reclaimed water treatment facility to match the reclaimed water demand of the HAMP project area in 2030 of 1.2 MGD. The reclaimed plant would be located along the PTI. The wastewater flow alternative for this scenario would be the PTI Alternative, which would direct a PDWF of 11.8 MGD to the PTI. The projected PDWF to the SEI under this alternative would be 7.1 MGD. The existing 4 MGD capacity of the PTI would need to be increased to 9.4 MGD to have sufficient capacity to convey peak flows past the reclaimed plant to the Roger Road WWTP.

4.0 SUMMARY AND CONCLUSIONS

The three wastewater treatment scenarios provide a range of approaches to treating wastewater flows from the HAMP study area. The first approach (Scenario 1) is to use the existing Roger Road WWTP to treat wastewater from the HAMP study area. This approach will minimize the cost associated with treatment plant construction in the HAMP area; however, will require increasing the capacity of the SEI and/or PTI depending upon the selected wastewater flow alternative. Under the SEI Alternative

(Scenario 1a), the capacity of the SEI within the HAMP Wastewater Study Area is 12 MGD, which is slightly over the projected PDWF of 11.5 MGD. As a result, the existing interceptor pipeline would likely be sufficient to handle wastewater flows under this scenario, but upstream capacity upgrades are likely. The PTI would require an increase in capacity from its current 4 MGD to approximately 7.4 MGD. Under the PTI Alternative (Scenario 1b), the SEI would not require any additional investment to meet 2030 PDWF projections. The PTI, however, would require its capacity to be increased from 4 MGD to 11.8 MGD. Most of the future wastewater flow would come from within the HAMP boundaries in areas where there are no current interceptors. As a result, much of the future capacity can be designed into the future wastewater collection system for HAMP alleviating the need for additional capacity along the PTI within Drainage Basin 113.

The second approach for wastewater management at HAMP (Scenario 2) is to construct skimming plants in the HAMP Wastewater Study Area sized to treat wastewater flows above the capacity of the current interceptors. Similar to the first scenario, Scenario 2 has been developed for both the SEI and the PTI Alternatives. Under the SEI Alternative (Scenario 2a), treatment would be required along the PTI, although the WWTP would only be 2.5 MGD. The PTI Alternative, however, would require a 5 MGD treatment plant.

Finally, the third approach (Scenario 3) is to construct one treatment facility in the HAMP area sized to meet projected reclaimed water demand. The plant could be located along either the SEI or PTI. Scenario 3a would place a 1.2 MGD reclaimed plant along the SEI, which could alleviate upstream capacity deficiencies depending on site availability. The PTI would need its capacity increased from 4 MGD to 7.4 MGD under this scenario. As previously stated, the increased capacity for the PTI can be largely accommodated through development of unsewered areas within the HAMP boundaries, which must have capital investment regardless of the decision to construct a treatment plant. Scenario 3b would have a 1.2 MGD reclaimed water plant along the PTI; however, this alternative would still require increasing the capacity of the PTI from 4 MGD to 9.4 MGD.

The table below presents a summary of the interceptor capacity and treatment plant capacity under each of the six scenarios.

Treatment Scenario Summary

Scenario	Interceptor	Existing Minimum Interceptor Capacity (MGD)	Proposed Interceptor Capacity (MGD)[1]	Proposed Treatment Plant Capacity (MGD)[2]
Scenario 1a	SEI	12	up	na
	PTI	4	7.4	na
Scenario 1b	SEI	12	nc	na
	PTI	4	11.8	na
Scenario 2a	SEI	12	up	na
	PTI	4	nc	2.5
Scenario 2b	SEI	12	nc	na
	PTI	4	nc	5.0
Scenario 3a	SEI	12	up	1.2
	PTI	4	7.4	na
Scenario 3b	SEI	12	nc	na
	PTI	4	9.4	1.2

Notes:
1. Proposed interceptor capacity based on PDWF.
2. Proposed Wastewater Treatment capacity based on ADWF.

up – Upstream capacity upgrades required under, but nominal capacity is sufficient under this scenario.
nc – No change in interceptor capacity required under this scenario.
na – No treatment plant along the specified interceptor required under this scenario.

These capacities will be used to develop conceptual layouts of facilities, non-economic requirements, and cost analyses for wastewater management in the HAMP Wastewater Study Area.

Malcolm Pirnie is pleased to submit this interim technical memorandum, if you have any questions or comments concerning the information presented in this letter, please call me at 629-8265 or Glenn Hoeger at 629-8282.

Very truly yours,

MALCOLM PIRNIE, INC.

James W. Dettmer, P.E., BCEE
Associate

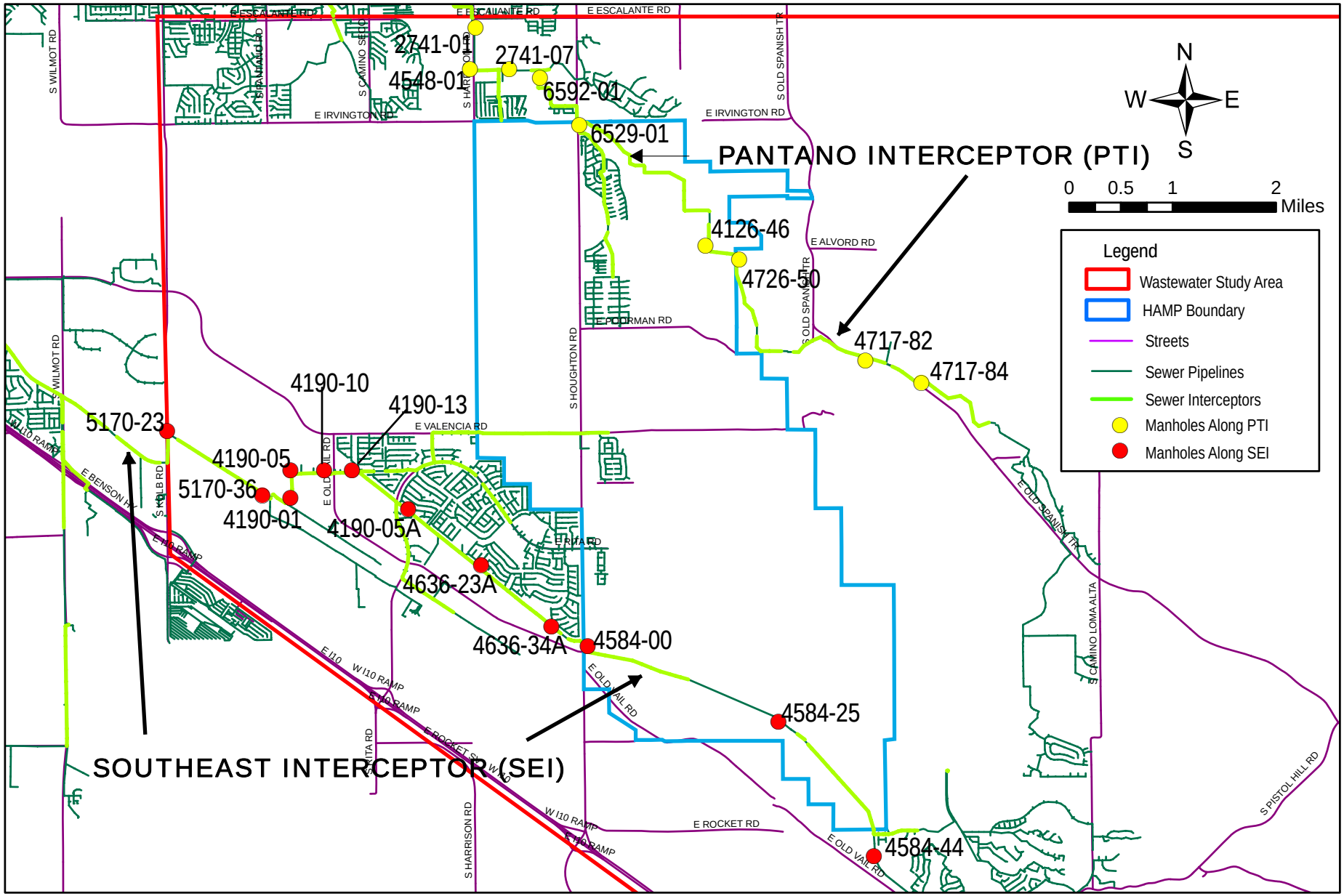
gch

Enclosures

1094-114

c:	Ed Curley,	Pima County Wastewater Management Department
	Steve Munsell,	Pima County Wastewater Management Department
	David Nelson,	Tucson Water
	Dean Trammel,	Tucson Water
	Richard Williamson,	Tucson Water
	Glenn Hoeger,	Malcolm Pirnie
	George Maseeh,	Malcolm Pirnie

FIGURES



MALCOLM PIRNIE

INDEPENDENT ENVIRONMENTAL ENGINEERS, SCIENTISTS AND CONSULTANTS

PIMA COUNTY WASTEWATER MANAGEMENT DEPARTMENT

HOUGHTON AREA MASTER PLAN

PIMA CO CONTRACT NO. 25-03-M-137732-0306

INTERCEPTOR SYSTEM AND MANHOLE LOCATIONS

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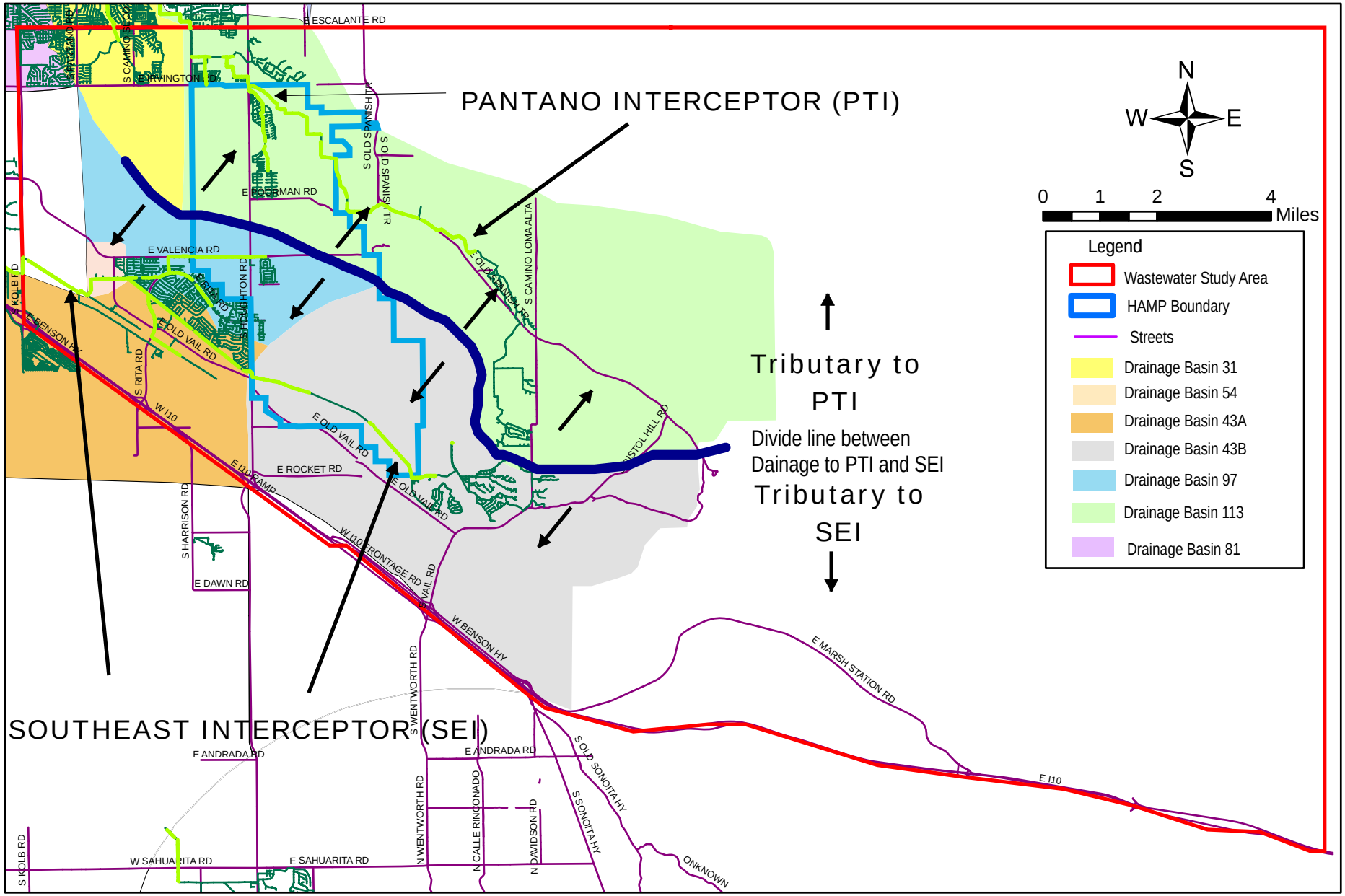
FIGURE 1



MALCOLM PIRNIE

INDEPENDENT ENVIRONMENTAL ENGINEERS, SCIENTISTS AND CONSULTANTS

PIMA COUNTY WASTEWATER MANAGEMENT DEPARTMENT

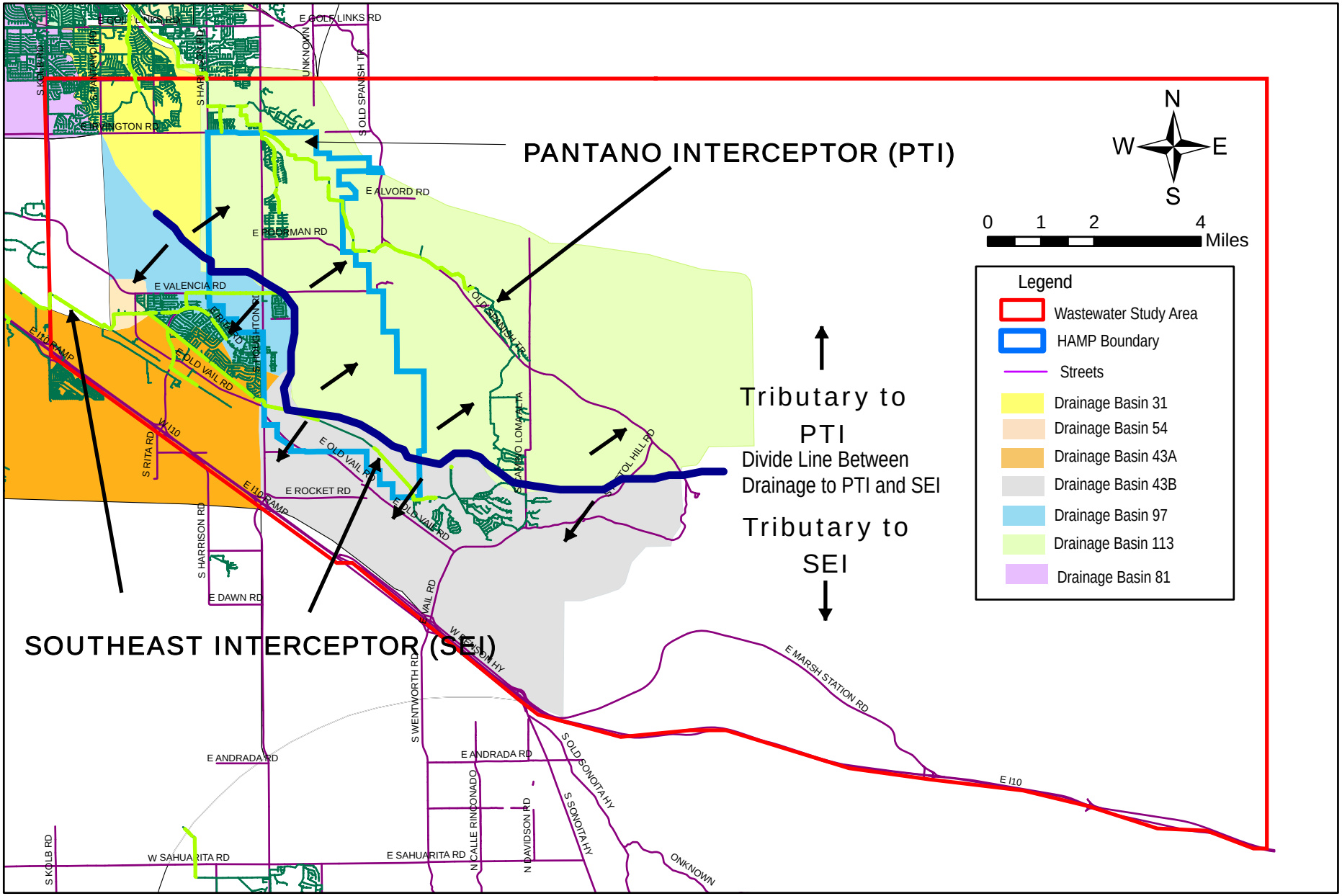
HOUGHTON AREA MASTER PLAN

PIMA CO CONTRACT NO. 25-03-M-137732-0306

SEI WASTEWATER FLOW ALTERNATIVE DRAINAGE BASINS

MALCOLM PIRNIE, INC.

FIGURE 2



MALCOLM PIRNIE

INDEPENDENT ENVIRONMENTAL ENGINEERS, SCIENTISTS AND CONSULTANTS

PIMA COUNTY WASTEWATER MANAGEMENT DEPARTMENT

HOUGHTON AREA MASTER PLAN

PIMA CO CONTRACT NO. 25-03-M-137732-0306

PTI WASTEWATER FLOW ALTERNATIVE DRAINAGE BASINS

MALCOLM PIRNIE, INC.

FIGURE 3

Appendix C

Technical Memorandum 3
August 25, 2006

Technical Memorandum of Wastewater Treatment and Conveyance Evaluation for the Houghton Area Master Plan (HAMP) Project Site

MALCOLM PIRNIE
INDEPENDENT ENVIRONMENTAL ENGINEERS, SCIENTISTS AND CONSULTANTS

Malcolm Pirnie, Inc.
One South Church Avenue
Suite 1120
Tucson, AZ 85701-1654
T: 520.629.9982
F: 520-620-6476
www.pirnie.com

August 25, 2006

Charles H. Matthewson, Project Manager
Pima County Wastewater Management Department
201 N. Stone Avenue, 8th Floor
Tucson, Arizona 85701

Re: **Technical Memorandum of Wastewater Treatment and Conveyance Evaluation for the Houghton Area Master Plan (HAMP) Project Site**

Pima County Contract # 25-03-M-137732-0306
City of Tucson Contract # 05909:4

Dear Mr. Matthewson:

The purpose of this technical memorandum is to further develop the wastewater conveyance and treatment scenarios for the Houghton Area Master Plan (HAMP) and surrounding Wastewater study area served by the Pima County Wastewater Treatment Department (PCWMD) and to eliminate less feasible scenarios based on non-cost criteria.

Preliminary non-cost screening criteria are described herein, which will complement the upcoming cost evaluation that will be presented in a final report. Non-cost criteria relate to current infrastructure, public acceptance, regulatory requirements, sustainability, and future operations.

This technical memorandum presents a summary of treatment and conveyance concepts and introduces flow-based implementation triggers for various scenarios. Different combinations of treatment and conveyance have been identified to handle wastewater flows from the study area. Wastewater treatment scenarios in the HAMP area vary from zero to 5.0 million gallons per day (MGD) with all excess flows that are not treated in a HAMP treatment facility being conveyed to the Roger Road Wastewater Treatment Plant (WWTP).

Regulations governing the operation of HAMP treatment plants are described herein. Regulations identified include siting, construction, operation, and permitting.

This memorandum is organized into the following sections:
Section 1.0 – Non-Cost Screening Criteria
Section 2.0 – Summary of Wastewater Treatment and Conveyance Concepts and Flow-based Implementation Schedules
Section 3.0 – Regulatory Issues
Section 4.0 – Conceptual Wastewater Treatment Facility Site Layouts

Section 5.0 – Potential Treatment Facility Sites
Section 6.0 – Wastewater Reuse/Discharge Alternatives
Section 7.0 – Summary and Conclusions

1.0 NON-COST SCREENING CRITERIA

Non-cost screening criteria were developed that combine technical, operational, and institutional considerations. These criteria will be used to screen infeasible or undesirable scenarios. Scenarios remaining after the screening process will be further evaluated, and conceptual-level cost opinions for capital and operation and maintenance will be developed for comparison purposes. Non-cost criteria will complement comparative costs in the final evaluation. The following are the non-cost criteria:

1.1 Maximize Use of Existing Infrastructure

The use of existing infrastructure reduces consumption of materials and maximizes PCWMD's current capital investment. Existing infrastructure in the HAMP area is limited to interceptors along the periphery and collection systems in already developed areas. The proximity to existing reclaimed water mains will also be considered in the appropriate scenarios.

1.2 Maximize Use of Gravity Flow Systems

This criterion has two aspects. The principal component is maximizing gravity operations (minimizing pumping requirements) for the sewer collection system. Secondary consideration will be given to the production of reclaimed water at locations that are near the portions of the reclaimed water system that are pressurized by the Houghton Reservoir high water elevation.

1.3 Minimize the Quantity of Treatment Facilities and Permitting

Consolidation of treatment facilities is considered to promote operational streamlining and to minimize future operations and maintenance costs. Permitting requirements are also consolidated when the quantity of treatment facilities is minimized.

1.4 Maximize Water Resource

Scenarios will be judged by how they improve overall water resource sustainability for the Tucson metropolitan area.

1.5 Gain Public Acceptance

PCWMD desires to be a good neighbor. This means that the issue of public acceptance is not merely meeting the "minimum" of regulatory compliance. Wastewater treatment plant sites that would be in close proximity to residential neighborhoods are less desirable.

1.6 Minimize Sensitivity to Development Assumptions

Certain scenarios will be more adversely affected by inaccurate population projections than others. This criterion will give credit to scenarios that are least impacted by inaccuracies in population projections.

1.7 Implement in a Logical Sequence

A scenario must be practical to design and construct before population growth exceeds the capacity of the existing infrastructure.

1.8 Minimize Construction Impact

Construction will be necessary under all scenarios. Scenarios that consolidate the geographical area of construction are desired to minimize widespread construction disturbances.

2.0 SUMMARY OF WASTEWATER TREATMENT AND CONVEYANCE CONCEPTS AND FLOW-BASED IMPLEMENTATION SCHEDULES

Three wastewater treatment options were previously developed: treatment at the Roger Road Wastewater Treatment Plant, construction of wastewater treatment facilities to serve the HAMP wastewater study area to mitigate deficiencies in the existing conveyance system, and construction of wastewater treatment capacity to meet projected reclaimed water demand for the HAMP area. The relatively flat topography of the southern portion of the HAMP area allows for gravity flow to either the Southeast Interceptor (SEI) or the Pantano Interceptor (PTI) (see Figure 2). Therefore, each treatment option includes two scenarios that are based on whether wastewater generated in this area is diverted to the SEI or PTI. Under Scenario A, the HAMP area conveyance system would be constructed to maximize the portion of flow that can be conveyed by gravity to the SEI. Under Scenario B, conveyance system construction is proposed to maximize the amount of flow that can be conveyed by gravity to the PTI. Scenarios, therefore, were designated with a number corresponding to a treatment option (1 for Roger Road, 2 for HAMP, and 3 for reclaimed) and a letter (A for SEI and B for PTI) indicating the conveyance option.

The following figures (all figures will be attached at the end) will be referred to in the discussions of scenarios to illustrate scenario components.

- Figure 1 shows existing sewer segments that may be deficient and will require augmentation under different scenarios.
- Figure 2 illustrates proposed alignments for HAMP trunk sewers, and the related characteristics of the trunk sewers are presented in Table 1. The HAMP 1 trunk line generally diverts flow to the western portion of the HAMP area toward the Harrison Road alignment, and the HAMP 2 trunk conveys flow to the central portion of the HAMP area.
- Figure 3 shows potential treatment facility sites, which are also described in Section 5.0.
- Individual figures have been developed for each scenario that depict flow-based implementation schedules associated with the scenarios. The schedules are based on total tributary population as identified in technical memoranda 1 and 2. Design of individual components is scheduled to commence when flow reaches 75% of existing capacity.

TABLE 1: ESTIMATED TRUNK SEWER MAXIMUM CAPACITIES

	1A	1B	2A	2B	3A	3B	
HAMP I	2.47	7.33	2.47	6.55	7.33	2.47	MGD
HAMP II	3.78	4.50	3.78	4.65	4.50	3.78	MGD

For all scenarios, wastewater flows used for treatment facility sizing are based on average dry weather flow (ADWF) and interceptor sizing is based on conveying peak dry weather flow (PDWF). Wastewater treatment plant acreage requirements and layouts will be discussed in more detail in Section 3.0.

2.1 Scenario 1A – Divert HAMP flows to SEI with no HAMP Treatment Facility

Principal Features:

- No HAMP treatment facility
- Smaller HAMP trunk sewers
- Significant sewer augmentation

The majority of HAMP flow would be conveyed to the Roger Road WWTP by the SEI. Augmentation will be necessary for all areas of the SEI and PTI identified in Figure 1. HAMP trunk sewers would be relatively small with implementation following the schedule identified in Figure 4.

2.2 Scenario 1B – Divert HAMP Flows to PTI with no HAMP Treatment Facility

Principal Features:

- No HAMP treatment facility
- Larger HAMP trunk sewers
- All capacity augmentation occurs in PTI (no construction on SEI)

Under this scenario, the PTI capacity requires augmentation in all PTI areas shown on Figure 1 (PTI-A, PTI-B, and PTI-C), but the existing SEI capacity in the HAMP wastewater study area is sufficient to convey projected flows. The HAMP trunk sewers would require extension and increased diameter to convey additional flow from the "SEI or PTI Sewer Basin" (gray area) in Figure 2. Implementation is summarized in Figure 5.

2.3 Scenario 2A – Divert Flows to SEI with New Treatment Facility

Principal Features:

- 2.5 MGD HAMP Treatment Facility
- Smaller HAMP trunk sewers
- Fully utilizes SEI

SEI augmentation and HAMP trunk sewers would be the same as described in Scenario 1A. PTI augmentation is necessary at PTI-B but is avoided at PTI-A and PTI-C because a 2.5 MGD treatment facility would divert flow from the SEI. The facility could be located on property owned by the Pima County Flood Control District (PCFCD) (see Figure 3). Use of this potential

treatment facility location is discussed in more detail in Section 5.0. Figure 6 illustrates th implementation schedule for Scenario 2A. Note that treatment facility design would need to be designed at relatively low flows to avoid augmentation at PTI-A and PTI-C.

2.4 Scenario 2B – Flows to PTI with New Treatment Facility

Principal Features:

- 5.0 MGD HAMP Treatment Facility
- Larger HAMP trunk sewers
- Minimal sewer augmentation

Interceptor augmentation under this scenario would only be required at PTI-B. The City of Tucson owns a parcel of property, which is currently leased to the Davis-Monthan Air Force Base (DMAFB) that could potentially be used to locate the 5.0 MGD treatment facility. This site is discussed in further detail in Section 5.0. HAMP trunk sewers will be longer than for Scenario 2A. The HAMP 2 alignment would need to be modified and would include a new siphon on the PTI to facilitate gravity flow to the proposed treatment site without constructing lift stations. Portions of the modified HAMP 2 trunk sewer will require relatively deep construction to accommodate the topography. Figure 7 illustrates the modified HAMP 2 trunk sewer and siphon as well as modifications to Drainage Basin 113 required to support this alternative. Flows from sub-basin 113a would flow only to the PTI while flows from sub-basins 113b and 113c would flow to the treatment facility. Treatment facility design would begin at the same flow as Scenario 2A, but the drainage basin in which that population could develop also includes the gray area of Figure 2. Figure 8 presents the design and construction schedule developed for Scenario 2B.

2.5 Scenario 3A – SEI Reclaimed Plant

Principal Features:

- 1.2 MGD HAMP treatment facility
- Smaller HAMP trunk sewers
- Significant sewer augmentation

A treatment facility would be sized to match the reclaimed water demand of the HAMP project area of 1.2 MGD at buildout. Reclaimed water demand projections are discussed further in Section 6.0. This scenario is the same as 1A except that a treatment facility would be sited on the SEI at the City of Tucson Department of Transportation property. Augmentation would be required at all identified areas except SEI-A. The existing reclaimed water distribution system is not in close proximity to this site and would require a major extension to connect the reclaimed plant (see Figure 3). The projected implementation schedule for Scenario 3A is presented in Figure 9.

2.6 Scenario 3B – PTI Reclaimed Plant

Principal Features:

- 1.2 MGD HAMP treatment facility
- Larger HAMP trunk sewers
- Augmentation consolidated onto PTI (no augmentation of the SEI)

The PCFCD property is proposed for this treatment plant site, which would allow for a reasonable connection distance to the existing reclaimed water distribution system as shown in Figure 3. Sewer augmentation would be essentially equal to Scenario 1B, but with slightly smaller capacity requirements for the augmentation. The scenario 3B implementation schedule is shown in Figure 10.

2.7 HAMP Trunk Sewer Summary

Table 2 gives more detailed information on the proposed HAMP trunk sewer alignments, which are shown in Figure 2.

TABLE 2: ESTIMATED TRUNK SEWER CHARACTERISTICS

	1A	1B	2A	2B	3A	3B	
HAMP I							
Max Capacity	2.47	7.33	2.47	6.55	2.47	7.33	MGD
Max Diameter	15	24	15	24	15	24	Inches
Length	46,000	53,000	46,000	53,000	46,000	53,000	Feet
HAMP II							
Max Capacity	3.78	4.50	3.78	4.65	3.78	4.50	MGD
Max Diameter	18	18	18	21	18	18	Inches
Length	10,000	28,000	10,000	37,000	10,000	28,000	Feet

3.0 REGULATORY ISSUES

Arizona Administrative Code Title 18, Chapter 9 (AAC R18-9) governs wastewater conveyance and treatment in the state of Arizona. This code is interpreted and administered by the Arizona Department of Environmental Quality (ADEQ). Federal regulations may also apply.

3.1 Setback Requirements

For WWTPs with a capacity of 1.0 MGD or more, the wastewater regulations (AAC R18-9-B201.I) specify setback requirements of 350 feet for facilities with full noise, odor, and aesthetic controls and 1000 feet for other facilities. These setbacks represent the "minimum horizontal distance maintained between a feature of a discharging facility and a potential point of impact" (AAC R18-9-101.34). PCWMD must own or have long term agreements with the owners of properties used for compliance with the setback requirements.

3.2 Wildlife Attractant

The Federal Aviation Administration (FAA) Advisory Circular (AC 150/5200-33) was released in May 1997 and agreed to by the United States Air Force, United States Army, United States Fish and Wildlife Service, and the United States Environmental Protection Agency in a memorandum of agreement in July 2003. The advisory circular indicated that any wildlife attractant should have a minimum of 10,000 feet of space buffer to runways and aircraft parking areas for turbine-powered aircraft. A distance of five miles was also recommended for areas within the approach and departure airspace. Open water impoundments have the potential to attract birds, which can be a potential safety concern for aircraft during take-off and landing. Wastewater treatment or recharge facilities in the HAMP area could present a hazard due to the proximity of DMAFB. Preliminary discussions with DMAFB personnel indicate that sites associated with the PTI should

not be a problem; however, the PCFCD site near Rita Ranch would require further investigation because it may be within approach and departure airspace. If the site is determined to present a hazard to DMAFB, the hazard can be mitigated by covering open water sources. The FAA advisory lists groundwater recharge as a mitigation that will be considered for exemption to the separation distance recommendations. Therefore, groundwater recharge facilities may be exempt from covering requirements even if wastewater treatment facilities are required to have covers.

3.3 Aquifer Protection Permit

The State of Arizona has consolidated the wastewater treatment and reclaimed water programs into the Aquifer Protection Permit (APP) regulations. As a result, all wastewater conveyance and treatment facilities require an APP.

3.4 Sections 401/402/404 Clean Water Act

Sections 401, 402, and 404 of the Clean Water Act (CWA) provide regulations for the protection of "waters of the United States." Section 401 of the CWA is administered by ADEQ and regulates the quality of water discharged to a water of the U.S. An Arizona Pollutant Discharge Elimination System (AZPDES) permit is required to comply with Section 401. When PCWMD's Randolph Park WRF was constructed, ADEQ ruled that because the Tucson Water reclaimed water system serves the Kino Environmental Restoration Project (KERP), which has been constructed in jurisdictional water, the facility required an AZPDES permit. An AZPDES permit requirement is anticipated for any HAMP treatment facility that provides source water to the reclaimed water system.

Permitting is also necessary for complying with Section 402 of the CWA, which regulates stormwater discharges from industrial facilities and construction sites to jurisdictional waters of the U.S. Wastewater treatment facilities will require individual stormwater discharge permits for construction activities at the treatment plant site, and for operations of the facility once it is completed. The stormwater permitting program has been administered by ADEQ as part of the AZPDES program; however, recent court rulings may cause future permits to be administered by the U.S. Environmental Protection Agency under the National Pollution Discharge Elimination System program.

Finally, Section 404 of the CWA regulated all dredging and filling activities within the boundaries of a jurisdictional water of the U.S. Any construction activity that has the potential to disturb more than 0.1 acres within a waterway of the U.S., requires coverage under a Section 404 Permit administered by the United States Army Corps of Engineers. All of these permits complying with the CWA would be required for the siting of any new treatment facility.

3.5 Biosolids

Biosolids stabilization at a HAMP treatment facility could be included in the facility design. For a skimming plant, however, the typical alternative to on-site biosolids stabilization would be to discharge the unstabilized solids to the collection system. In the case of a HAMP facility, solids would be conveyanced to the Roger Road WWTP for further treatment. ADEQ has interpreted skimming treatment facilities as "preparers of biosolids," which essentially means that biosolids

must be treated to land application standards at the skimming facility. This interpretation has been appealed by the City of Tempe, but ADEQ's interpretation was upheld. Therefore, biosolids stabilization may be required at a HAMP treatment facility, which would add significant capital cost, land requirement, truck access, and operation and maintenance costs to the facility with marginal benefit.

4.0 CONCEPTUAL WASTEWATER TREATMENT FACILITY SITE LAYOUTS

Conceptual layouts were developed for two types of treatment plants: Scenarios 2A and 2B were based on the use of oxidation ditches with tertiary filtration, and Scenarios 3A and 3B are based on the use of membrane bioreactors (MBR). Acreage requirements represent estimates based on a typical plant configuration and identify minimum land requirements based on 350-foot and 1,000-foot buffer zones.

4.1 1.2 MGD MBR Treatment Facility (Scenarios 3A and 3B)

The smaller wastewater treatment options are associated with meeting reclaimed water demand in the HAMP area. Figure 11 shows a conceptual MBR facility that could be easily expanded to 2.5 MGD. Acreage requirements for a 1.2 MGD MBR facility, which are illustrated in Figure 12, which total 24 acres for a 350-foot setback and 120 acres for a 1000-foot setback. Treatment would include screening and grit removal followed by anoxic treatment and aeration basins. Final clarification would be replaced by membrane filtration, which allows for a smaller footprint than conventional treatment systems and higher mixed liquor volatile suspended solids concentrations. The site layout also includes facilities for flow equalization and solids treatment and handling. MBR treatment will produce Class A+ effluent, suitable for open access irrigation and use in the Tucson Water reclaimed water system.

4.2 2.5 MGD (Scenario 2A)

The 2.5 MGD treatment facility includes a biological nutrient removal oxidation ditch (BNROD) for BOD and nitrogen removal. The conceptual configuration of the facility is shown in Figure 13. PCWMD has constructed a BNROD facility at the Green Valley WWTF and is currently constructing similar conversions at the Avra Valley WWTF and the Marana WWTF. Approximately 33 acres and 140 acres would be required for the 350-foot and 1,000-foot setbacks as shown in Figure 14. The treatment train would include screening and grit removal followed by the oxidation ditch. Final clarification would be followed by tertiary filtration to produce a Class A+ effluent. This facility concept also includes influent equalization and solids treatment and handling.

4.3 5.0 MGD (Scenario 2B)

This treatment option is configured similarly to the above option but with larger treatment units as illustrated in Figure 15. Some economy of scale will be realized with acreage requirements of 39 acres and 152 acres for the 350-foot and 1,000-foot buffer zones as shown in Figure 16.

5.0 POTENTIAL TREATMENT FACILITY SITES

Availability of treatment plant sites will affect selection from both a cost and non-cost perspective. Initial land purchasing and topography related pumping differences have cost implications. Non-cost siting factors such as gaining public acceptance and constructing gravity flow systems will also impact final selection. Screening for preliminary siting locations in the HAMP area was conducted. The screening focused on identifying parcels that are already owned by either Pima County or the City of Tucson; however, some private- and State-owned parcels were also identified that could support a treatment facility. The screening criteria for candidate parcels were based on whether the sites were large enough to fit a facility on the parcel (including buffers), the relative ease of conveying flows to the sites, and ensuring that the sites were not located within a 100-year floodplain.

5.1 City of Tucson-owned Property

Figure 17 shows City-owned parcels located within the wastewater study area. There are several sites that could support a facility including Poorman Gunnery Range, which is leased to DMAFB, and the Harrison landfill.

5.2 Pima County-owned Property

Property owned by Pima County in the HAMP area is principally PCFCD holdings along the Pantano wash as shown in Figure 18. Many of these tracts are too linear to accommodate setback requirements and are located within a floodplain.

5.3 State/Private Property

Arizona State Trust Land is handled in this study as if it were private property because of the Arizona State Land Department's requirements to sell the land for a premium. Therefore, State/private property was considered only when it was in an ideal location for siting a WWTP within the context of the topography of the associated drainage basin.

5.4 Candidate Sites

Figure 3 shows the four potential wastewater treatment plant sites that have been identified to manage wastewater in the HAMP wastewater study area:

- A site west of Rita Ranch has been identified to potentially site a treatment facility on the SEI that could support Scenario 3B. The site is currently owned by the City of Tucson's Department of Transportation. The parcel is approximately 48 acres. Due to its size, this site cannot accommodate a 1,000-foot setback.
- The Pima County Flood Control District owns a parcel along the PTI on East Nebraska Road in the northeast portion of the HAMP area. This site could accommodate the 1.2 and 2.5 MGD PTI treatment alternatives (Scenarios 2A and 3A). The site is slightly less than 50 acres, which would be insufficient to accommodate the 1000 foot setback. A more detailed survey of the site would be necessary before final recommendations are made. Flood control measures would likely be necessary at this site.
- The second PTI treatment site is located in the northeast corner of the Poorman Gunnery Range, which is currently owned by Tucson Water and leased by DMAFB. This site could accommodate the larger 5.0 MGD PTI WWTP (Scenario 2B) and would allow for the

larger setbacks (1,000 feet). Gravity flow sufficient to run a plant this size will require deep excavation in some areas. Due to the historical use of this site as a military gunnery range, the site will need to be cleared for environmental and safety hazards by the U.S. Air Force before being released for use by PCWMD.

- A third possible PTI site is a parcel privately owned by Sonora Environmental LLC. This site is just upstream of the Harrison Road siphon and has topographic advantages. It has not been specifically associated with any scenario but represents an alternative for Scenarios 2A, 2B, and 3A. The area of this site is approximately 56 acres and would not support a 1,000-foot buffer zone.

6.0 WASTEWATER REUSE/DISCHARGE ALTERNATIVES

The disposition of effluent generated by a treatment facility can have a significant impact on each of the treatment scenarios. Alternatives for effluent discharge or reuse were identified for use in the evaluation of each of the treatment scenarios. This section presents a discussion of alternatives for effluent reuse or discharge available in the HAMP area.

6.1 Projected Reclaimed Water Demand in the HAMP Study Area

Reclaimed water demand projections are based on a system-wide factor, which was applied to the HAMP area. Tucson Water development standards apply a reclaimed water use factor of 8% of the total (potable plus reclaimed) water demand of 177 gallons per capita per day. The total water demand projections were based on a combined residential, commercial, and industrial usage factor of 163 gallons per capita per day. Using the projected HAMP area population of 87,748 at buildout, the HAMP area would have a reclaimed water demand of approximately 1.2 MGD. These demand projections were made without detailed development planning in the HAMP area, and actual development within the HAMP area could affect the accuracy of reclaimed water projections.

6.2 Potential Source for Existing Reclaimed System

The City of Tucson reclaimed water system Houghton Reservoir is located within the HAMP boundary area. The reservoir is located at the highest elevation within the system, and could theoretically provide reclaimed water throughout the system without additional pumping. Current reclaimed water sources include the Roger Road Filtration Plant, the Sweetwater Underground Storage and Recovery Project (Sweetwater), and the Randolph Park WRF.

Demand in the reclaimed water system exhibits significant seasonal variation and varies in response to precipitation. Demand can vary from less than 3 MGD to as much as 28 MGD during the course of a year. Currently, the system must accept 3 MGD from the Randolph Park WRF regardless of system demand with the excess discharged to existing recharge basins at the Sweetwater facility. If the reclaimed water system is used as a sole discharge option for a new treatment plant in the HAMP area, provisions will need to be made within the system to increase the amount of reclaimed water that can be discharged to the Sweetwater facility. Tucson Water estimates that they currently can send as much as 10 MGD to the Sweetwater facility and has plans to build additional recharge basins in the future.

6.3 On-site Recharge

On-site recharge is an attractive option for utilizing a portion of the land area required for setbacks (see Section 3.1). Tucson Water has previously investigated the feasibility of recharge in eastern Tucson, but specific studies have not been conducted near any of the proposed HAMP treatment sites. The previous investigations performed by Tucson Water were located approximately 1.5 miles east of Houghton Road just south of Poorman Road near the Pantano Wash. The previous study found that silt near the ground surface limited surface infiltration rates to approximately 0.6 feet per day; however, some individual test pit locations had much higher infiltration rates ranging from 2.5 feet per day to 12 feet per day. The high infiltration rates were not reproducible and were attributed to lateral spreading rather than vertical infiltration. The study did indicate that lower strata were more conductive than the shallow silts encountered near the wash. If the non-porous top layers are relatively shallow, poor surface infiltration rates could be mitigated by excavating to the depths of the more porous materials. A more detailed hydrogeological investigation would be required if effluent recharge is pursued in the HAMP area.

6.4 Discharge to Pantano Wash

Discharging effluent to the Pantano Wash is a consistent, readily available effluent disposal method. However, many problems would be associated with a surface discharge on the Pantano. Current designated uses of the Pantano Wash are: aquatic and wildlife (ephemeral) and partial body contact. The effluent discharge would be the only water in the Pantano Wash for most of the year, and a different ecosystem would likely develop due to the perennial flow. This ecosystem would be completely dependent upon the effluent, which would have the potential to commit PCWMD to operate the HAMP treatment facility for an indefinite period. A Pantano Wash discharge would also go directly through populated areas increasing the likelihood of human contact with the effluent. The discharge would also likely need to be located downstream of Harrison Road, which currently passes through the Pantano Wash without a bridge crossing.

7.0 SUMMARY AND CONCLUSIONS

Several scenarios for wastewater conveyance and treatment for the HAMP wastewater study area have been explored. A ranking based evaluation of alternatives with weighting for each criterion is presented in Table 2. The ranking is multiplied by the weighting factor to obtain the results presented in Table 3.

TABLE 3: NON-COST EVALUATION

Non-Cost Screening Criteria	Scenario 1A	1B	2A	2B	3A	3B	% Weight
Maximize Use of Existing Infrastructure	4	3	4	3	4	3	10%
Maximize Use of Gravity Flow Systems	1	1	5	6	4	4	10%
Minimize the Quantity of Treatment Facilities and Permitting	6	6	3	4	1	1	25%
Maximize Water Resource	1	1	5	6	4	4	10%
Gain Public Acceptance	5	6	1	4	3	2	15%
Minimize Sensitivity to Development Assumptions	6	3	4	1	5	2	5%
Implement in a Logical Sequence	5	4	2	1	5	4	10%
Minimize Construction Impact	3	6	2	5	1	4	15%
						SUM	100%

TABLE 4: NON-COST EVALUATION - EXTENDED

Non-Cost Screening Criteria	Scenarios - Extended 1A	1B	2A	2B	3A	3B
Maximize Use of Existing Infrastructure	0.40	0.30	0.40	0.30	0.30	0.40
Maximize Use of Gravity Flow Systems	0.10	0.10	0.50	0.60	0.40	0.40
Minimize the Quantity of Treatment Facilities and Permitting	1.50	1.50	0.75	1.00	0.25	0.25
Maximize Water Resource	0.10	0.10	0.50	0.60	0.40	0.40
Gain Public Acceptance	0.75	0.90	0.15	0.60	0.30	0.45
Minimize Sensitivity to Development Assumptions	0.30	0.15	0.20	0.05	0.10	0.25
Implement in a Logical Sequence	0.50	0.40	0.20	0.10	0.40	0.50
Minimize Construction Impact	0.45	0.90	0.30	0.75	0.60	0.15
SUM	***4.10***	***4.35***	3.00	***4.00***	2.75	2.80

Scenarios were ranked based on a score of 1, 2, 3, 4, 5, or 6. Tied scenarios were scored such that only whole numbers were used and the scores of each criterion summed to 21, which is the sum if no tied scores were given. A ranking of six (the highest) was considered the most desirable for the individual criteria. A weighting factor was assigned to each criteria based on the criteria's relative importance. The total extended score is the average for each scenario with the weighting factor taken into consideration. Scenarios with an extended score above the median (3.5) are considered as candidates for further evaluation. A short summary is provided for each scenario describing the individual high and low rankings.

<u>Scenario 1A</u>

This scenario for conveyance maximized to the SEI and treatment at Roger Road had an overall favorable ranking and will be evaluated further.

- High Rankings

    - Treatment is consolidated at Roger Road
    - High public acceptance ranking because no new WWTF site is required
    - Shorter HAMP trunks and no treatment facility sizing estimates minimize development assumption sensitivity
    - Favorable implementation schedule
- Middle Rankings
    - Full utilization of the existing SEI
    - Construction impacts would be spread across a large area
- Low Rankings
    - Although no lift stations were necessary, poor ranking on gravity flow systems because no reclaimed water is produced in the HAMP area
    - Does not promote reclaimed water use

<u>Scenario 1B</u>
Highest overall ranking was given to the scenario for maximum conveyance by the PTI and treatment at Roger Road. It will be evaluated further.

- High Rankings
    - Treatment is consolidated at Roger Road
    - High public acceptance ranking because no new WWTF site is required
    - Least construction impact because of consolidated sewer work and no HAMP treatment facility
- Middle Rankings
    - Does not fully use SEI but does reserve some SEI capacity for Southlands growth
    - Marginally sensitive to development assumptions because of longer HAMP trunk sewers
    - Favorable implementation schedule
- Low Rankings
    - Although no lift stations were necessary, poor ranking on gravity flow systems because no reclaimed water is produced in the HAMP area
    - Does not promote reclaimed water use

<u>Scenario 2A</u>
This scenario with flow maximized to the SEI and a 2.5 MGD treatment facility on Pima County Floodplain Management property received a lower than median overall ranking and will not be evaluated further.

- High Rankings
    - Reclaimed water provided at a higher elevation
    - 2.5 MGD of reclaimed water produced
- Middle Rankings
    - Full utilization of the existing SEI
    - Marginal treatment capacity for permitting effort
    - Shorter HAMP trunk sewers, but larger treatment facility gives moderate sensitivity to development assumption
- Low Rankings

- Lowest public acceptance ranking because it would be the larger of two proposed facilities near existing developments
- Unfavorable implantation schedule
- Many construction impact including sewer augmentation and treatment facility

Scenario 2B

This scenario was ranked third overall and will receive further evaluation. It involves maximizing flow to the PTI and a 5 MGD treatment facility on the Poorman Gunnery Range site.

- High Rankings
  - The highest use of gravity flow for the reclaimed water system
  - 5 MGD of reclaimed water produced
  - Sewer construction consolidated and non-intrusive facility construction site
- Middle Rankings
  - Does not fully use SEI but does reserve some SEI capacity for Southlands growth
  - Marginal treatment capacity for permitting effort
  - Favorable HAMP treatment facility site
- Low Rankings
  - Most sensitive to development assumptions
  - Most difficult implementation sequence, although collection system provides flexibility to postpone HAMP treatment facility decision

Scenario 3A

A scenario with a HAMP facility sized for reclaimed water demand while maximizing flow to the SEI will no longer be evaluated.

- High Rankings
  - The shorter HAMP trunk sewers and smaller treatment facility limited sensitivity to development assumptions
  - Favorable implementation sequence
- Middle Rankings
  - Full utilization of the existing SEI
  - Some use of gravity flow for reclaimed system
  - Marginally promotes reclaimed water use
  - Marginal public acceptance because of proximity to existing development
- Low Rankings
  - Minimal treatment capacity for permitting effort
  - Requires sewer augmentation and a treatment facility

Scenario 3B

A scenario with a HAMP facility sized for reclaimed water demand while maximizing flow to the PTI will no longer be evaluated.

- High Rankings
- Middle Rankings
  - Does not fully use SEI but does reserve some SEI capacity for Southlands growth
  - Some use of gravity flow for reclaimed system

  - Marginally promotes reclaimed water use
  - Marginal public acceptance because of proximity to existing development
  - Consolidated sewer construction but requires a small treatment facility
- Low Rankings
  - Minimal treatment capacity for permitting effort
  - Low public acceptance ranking because proximity to existing developments
  - Sensitive to development assumptions because of longer HAMP trunk sewers and treatment facility

Based on the evaluation of non-cost criteria for HAMP wastewater, Scenarios 1A, 1B, and 2B were identified for further evaluation and cost analysis.

Malcolm Pirnie is pleased to submit this interim technical memorandum, if you have any questions or comments concerning the information presented in this letter, please call me at 629-8265 or Glenn Hoeger at 629-8282.

Very truly yours,

MALCOLM PIRNIE, INC.

James W. Dettmer, P.E., BCEE
Associate

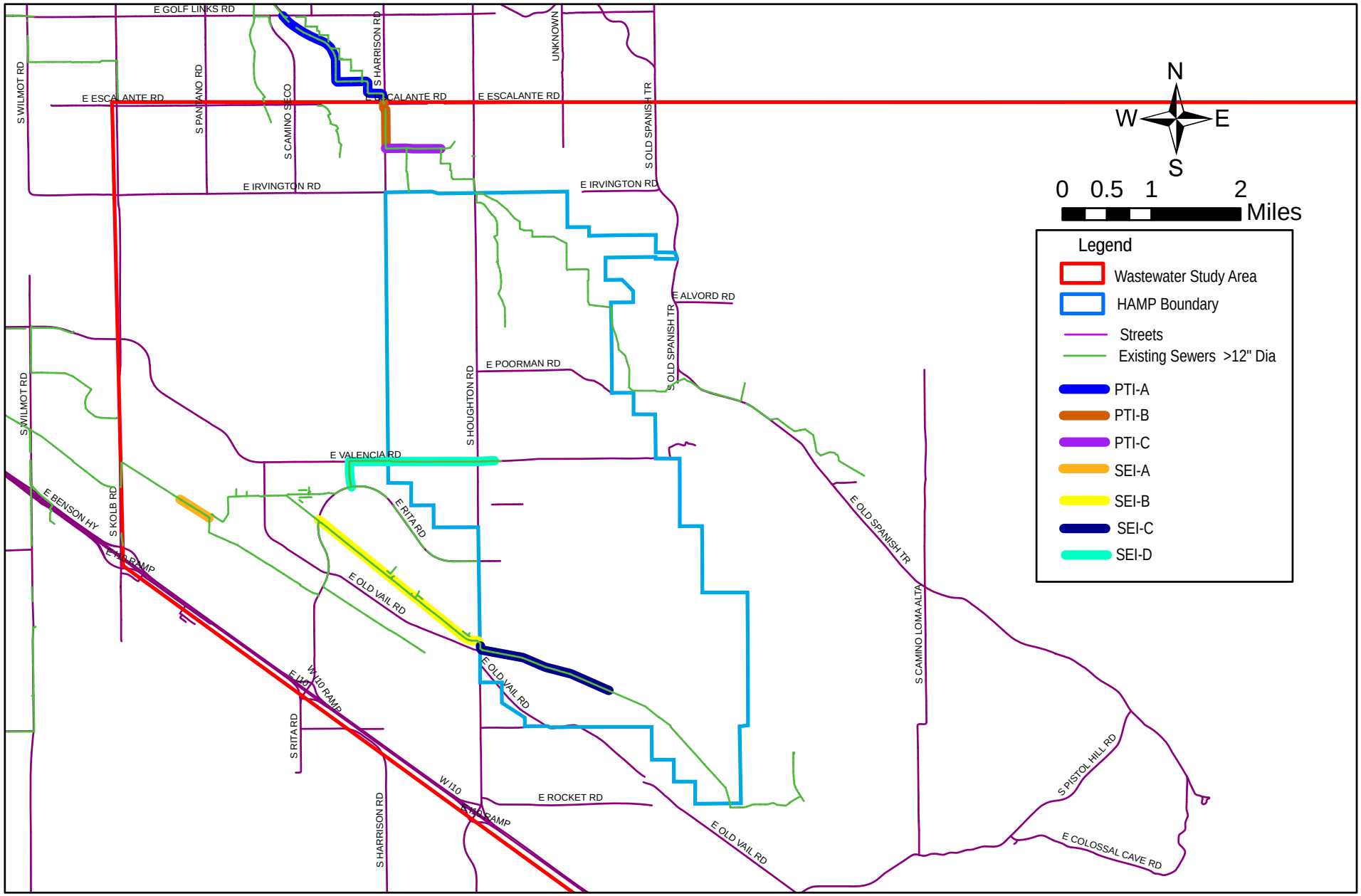
shs

Enclosures

1094-114

c:	Ed Curley,	PCWMD
	Steve Munsell,	PCWMD
	David Nelson,	Tucson Water
	Richard Williamson,	Tucson Water
	Glenn Hoeger,	Malcolm Pirnie
	Scott Schaefer,	Malcolm Pirnie
	George Maseeh,	Malcolm Pirnie

FIGURES



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POTENTIAL SEWER CAPACITY DEFICIENCIES

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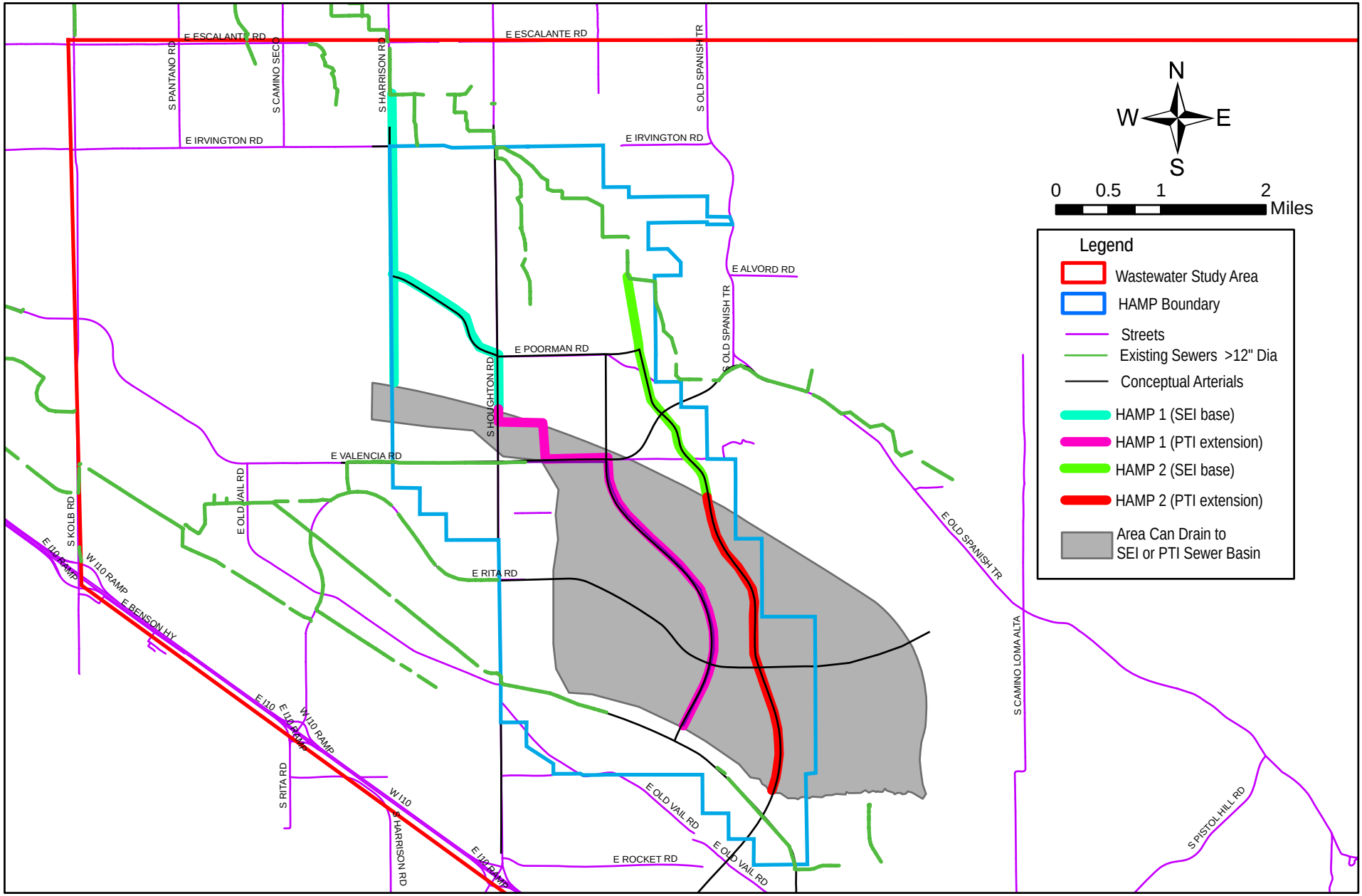
FIGURE 1



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HAMP TRUNK SEWERS

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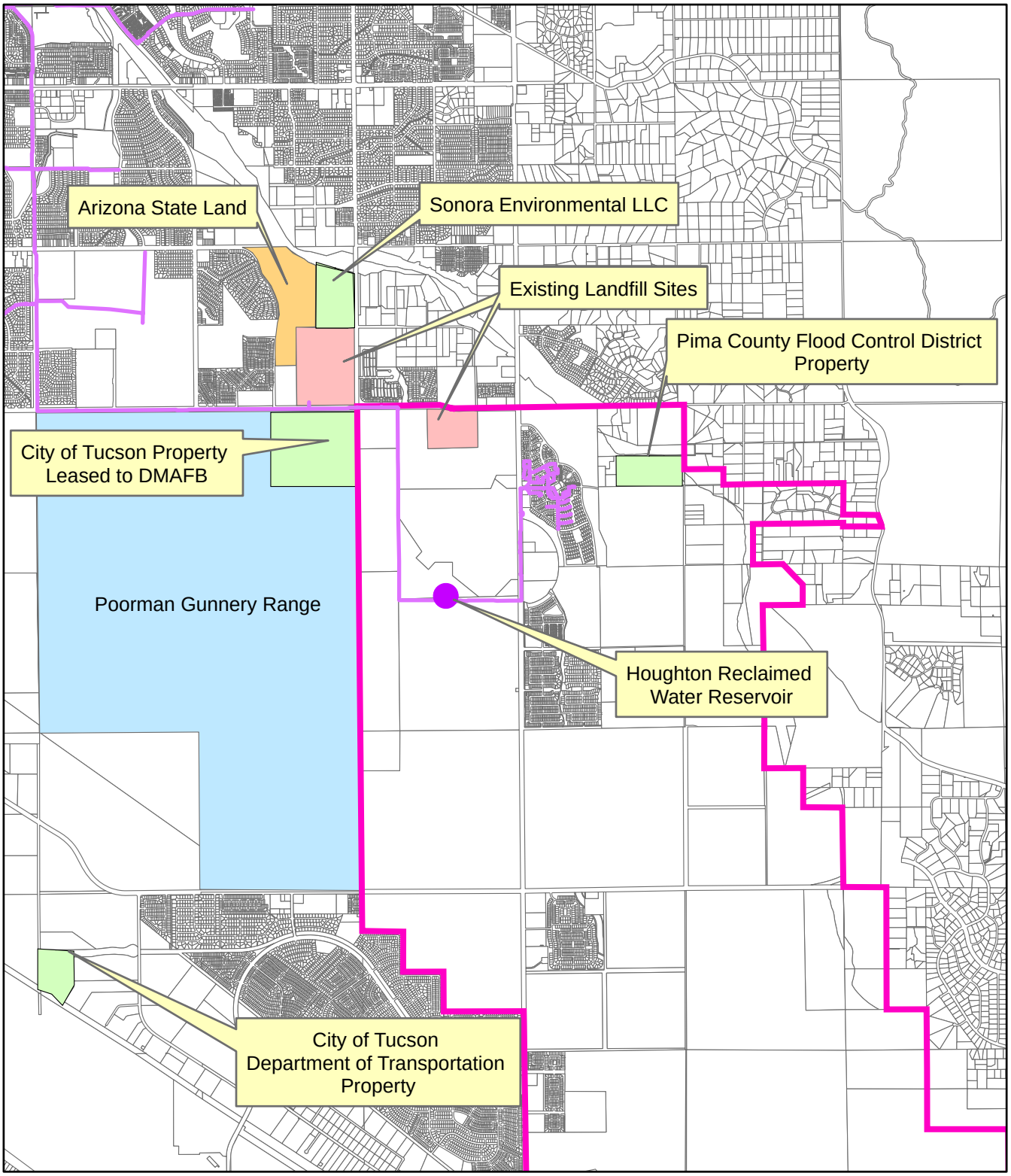
FIGURE 2



LEGEND

- HAMP STUDYA AREA BOUNDARY
- RECOMMENDED WASTEWATER TREATMENT LOCATIONS
- EXISTING RECLAIMED WATER DISTRIBUTION SYSTEM

0 0.5 1 2 Miles

N W E S

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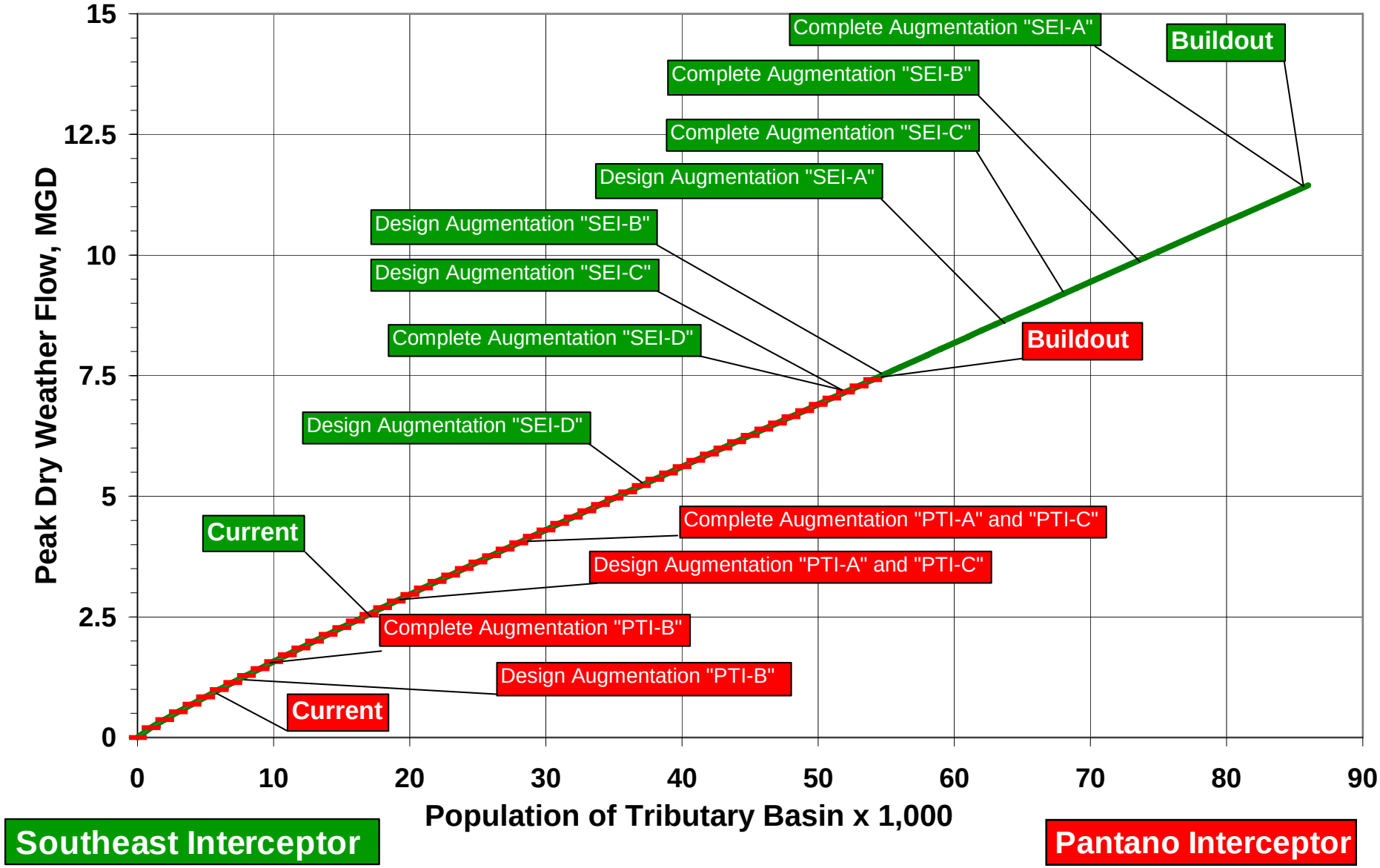
FIGURE 3

RECOMMENDED TREATMENT PLANT SITES



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Implementation Schedule
Scenario 1A

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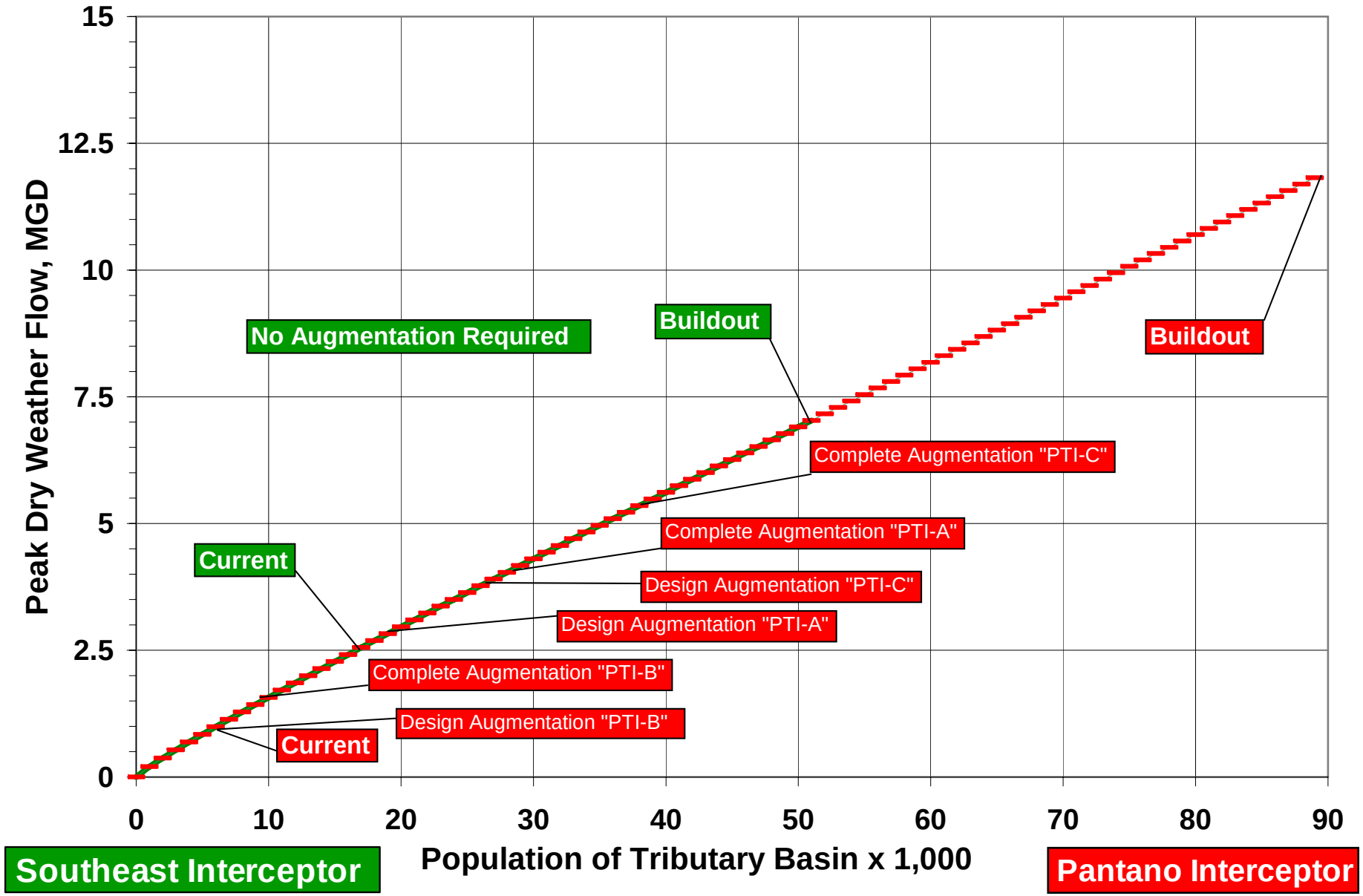
FIGURE 4



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Implementation Schedule
Scenario 1B

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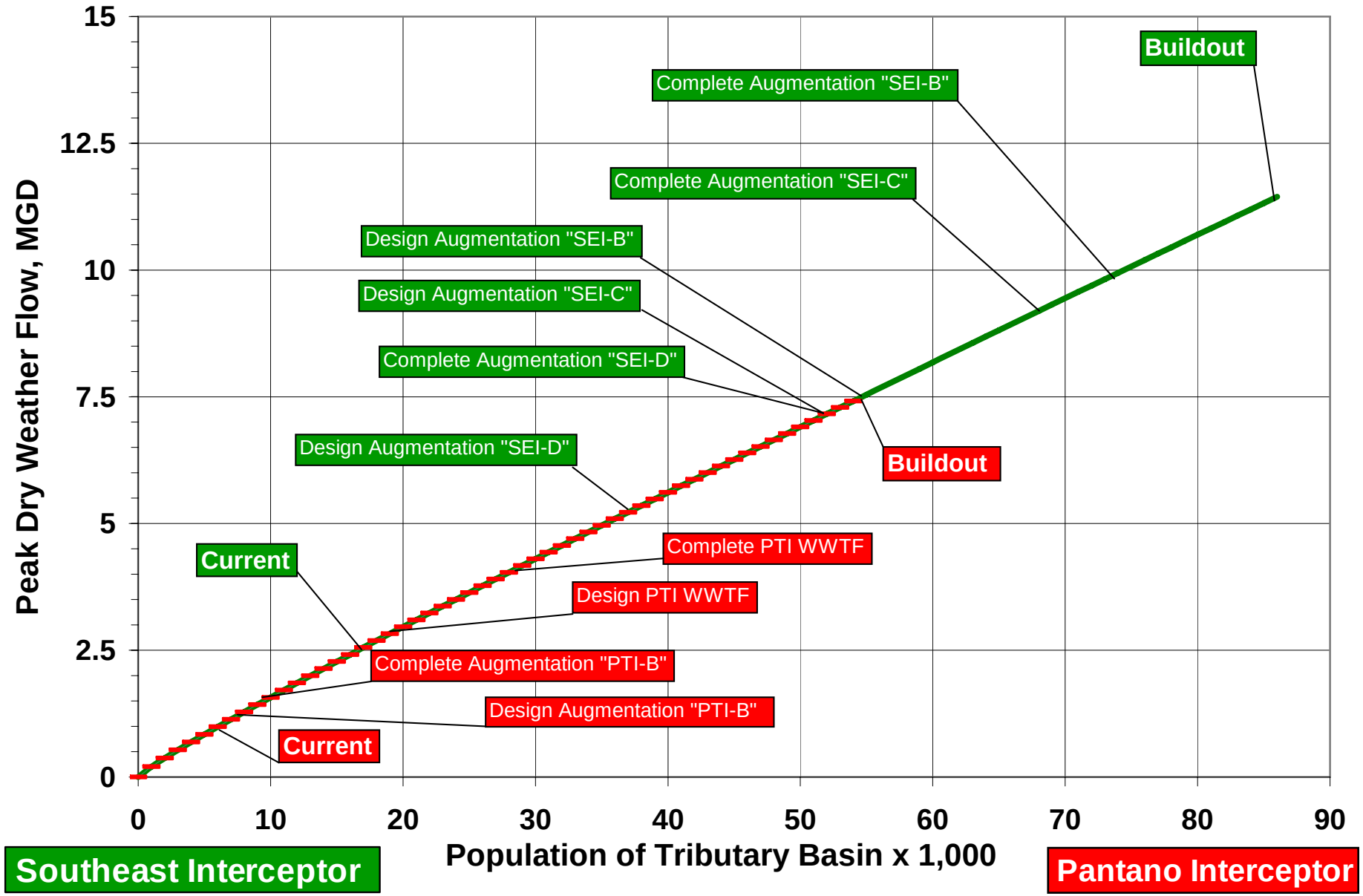
FIGURE 5



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Implementation Schedule
Scenario 2A

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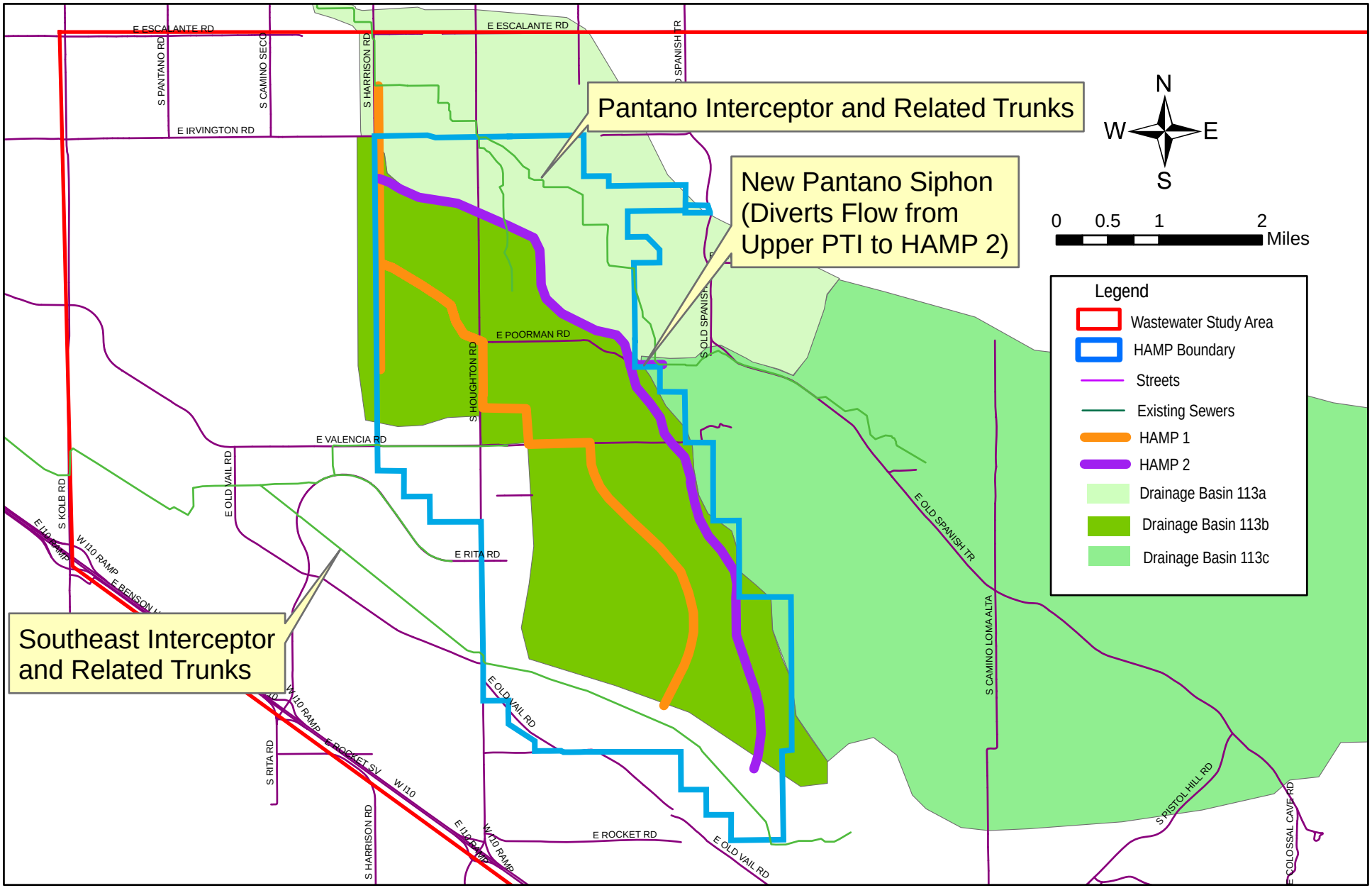
FIGURE 6



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SCENARIO 2B DRAINAGE BASIN CONFIGURATION

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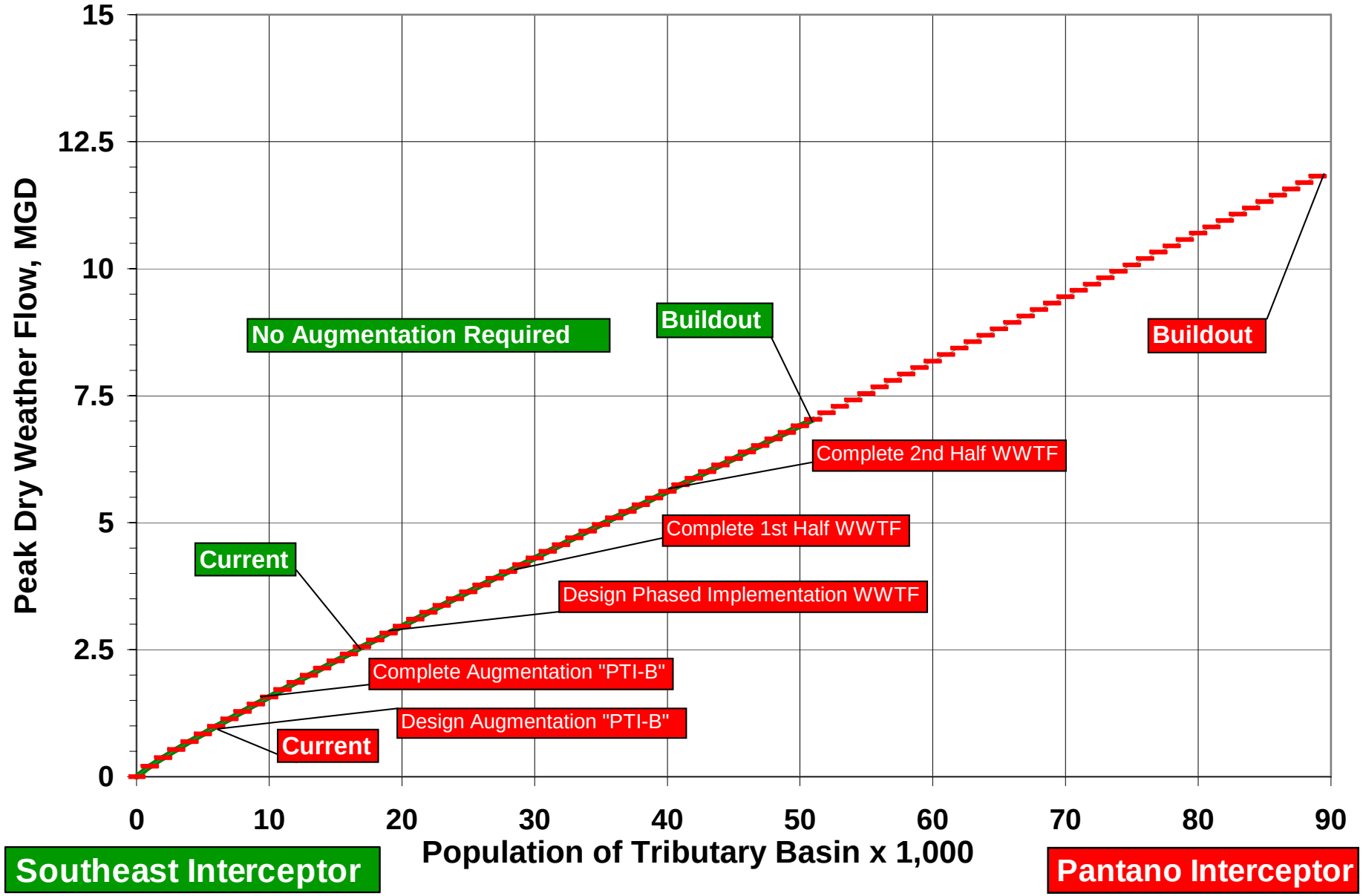
FIGURE 7



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Implementation Schedule
Scenario 2B

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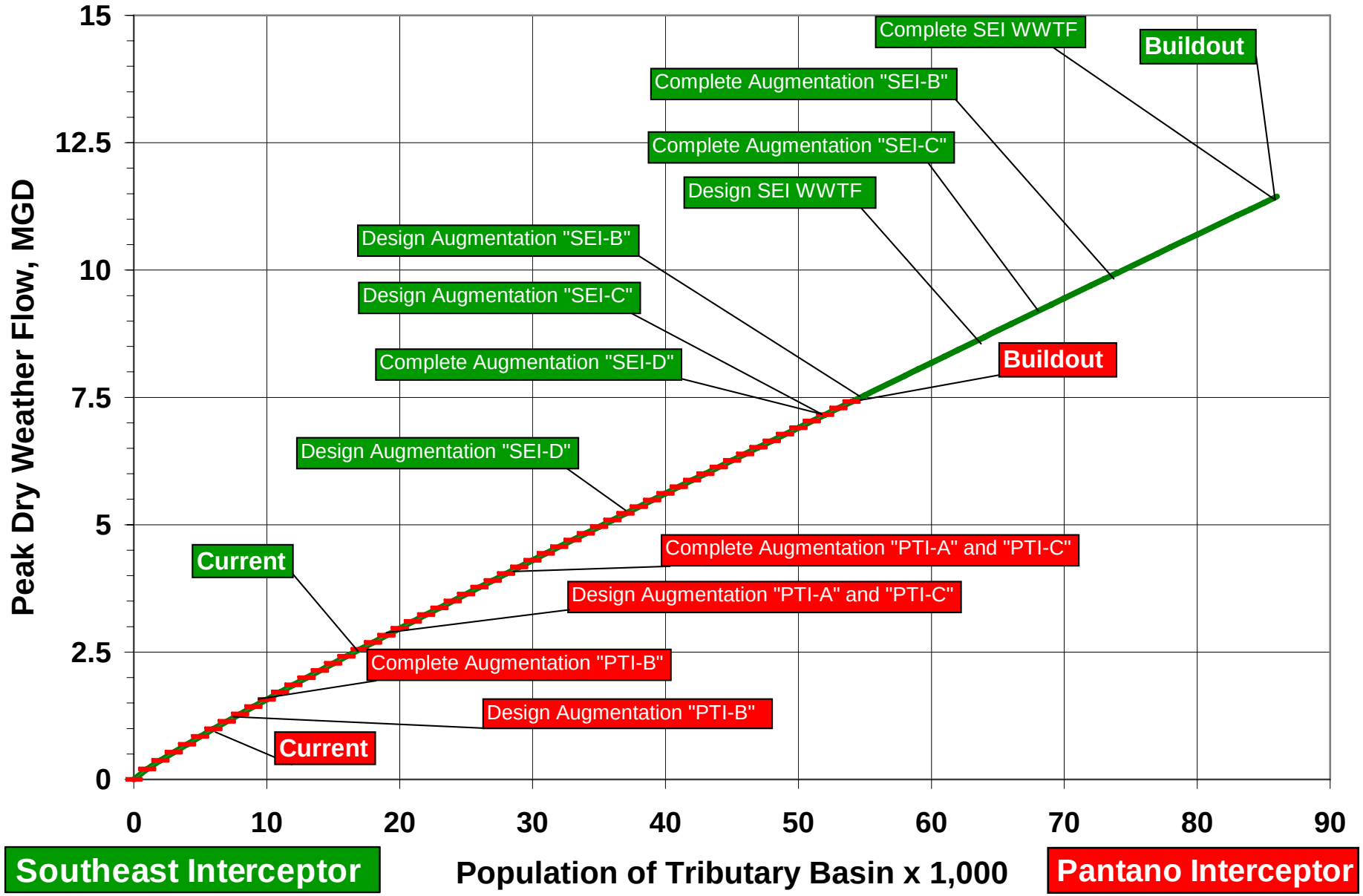
FIGURE 8



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Implementation Schedule
Scenario 3A

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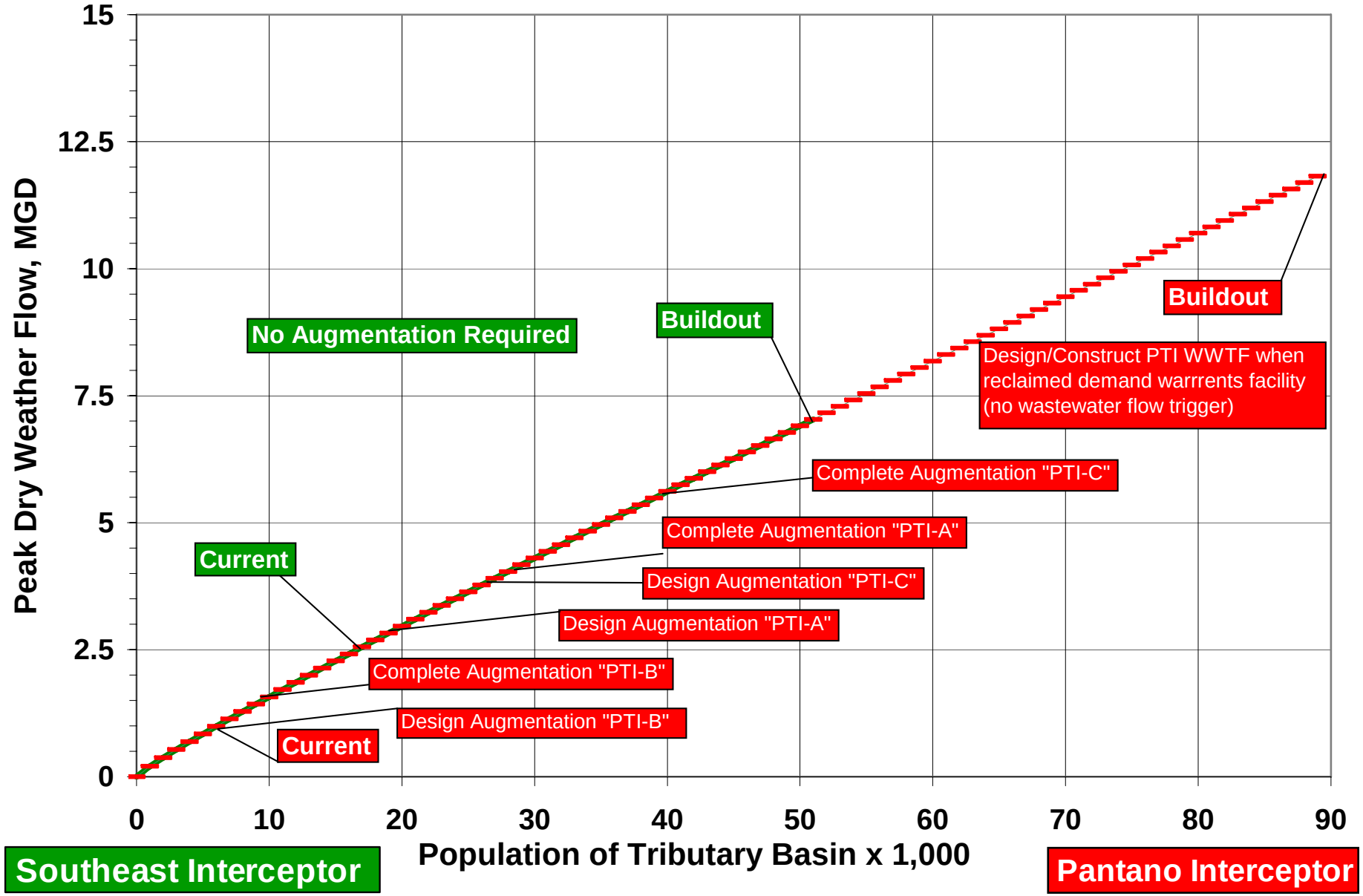
FIGURE 9



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Implementation Schedule
Scenario 3B

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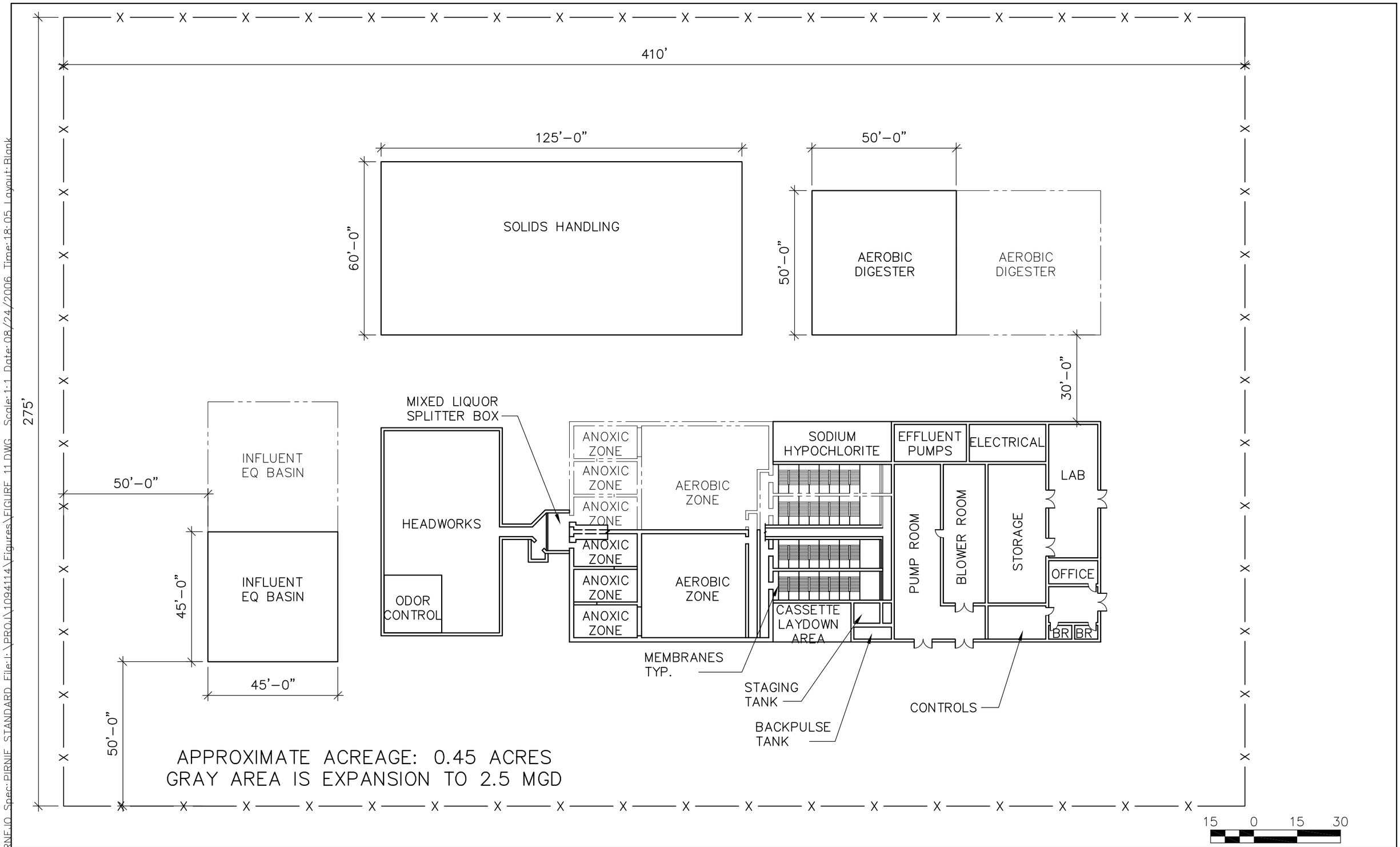
FIGURE 10



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PIMA CO CONTRACT NO. 25–03–M–137732–0306

SCENARIO 3:
1.2 MGD MEMBRANE BIOEACTOR PLANT

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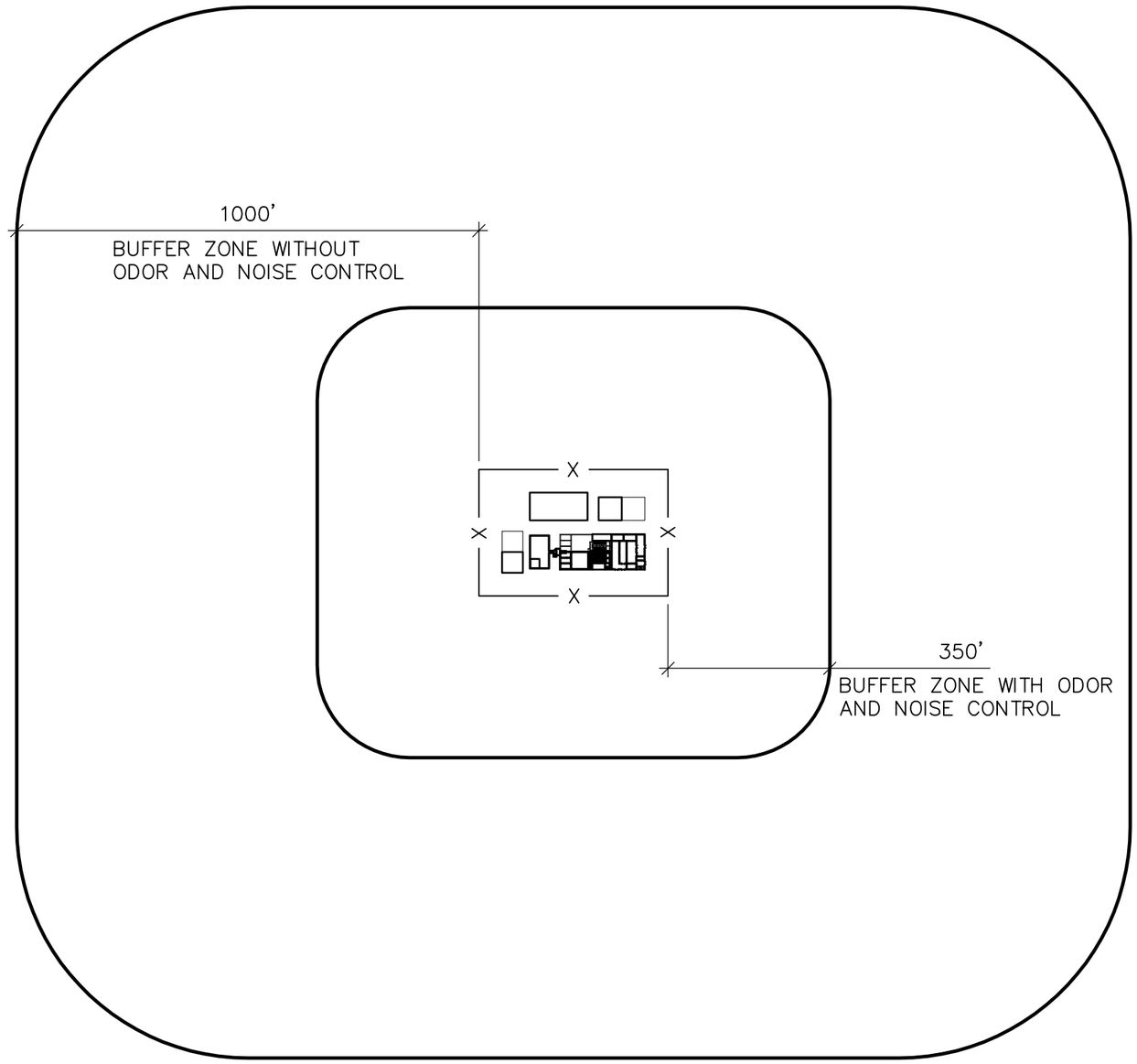
FIGURE 11

XREFS: IMAGES:K:\Symbols2000\Pirnie Standard\Gen\MPI Title Blocks\MPLOGOBK_Lockup_NoBleed.jpg
User:CORNELIO Spec:PIRNIE STANDARD File:I:\PROJ\1094114\Figures\FIGURE 11.DWG Scale:1:1 Date:08/24/2006 Time:18:05 Layout:Blank



PLANT ACREAGE:	2.5 ACRES
350' SETBACK:	24 ACRES
1000' SETBACK:	120 ACRES

150 0 150 300

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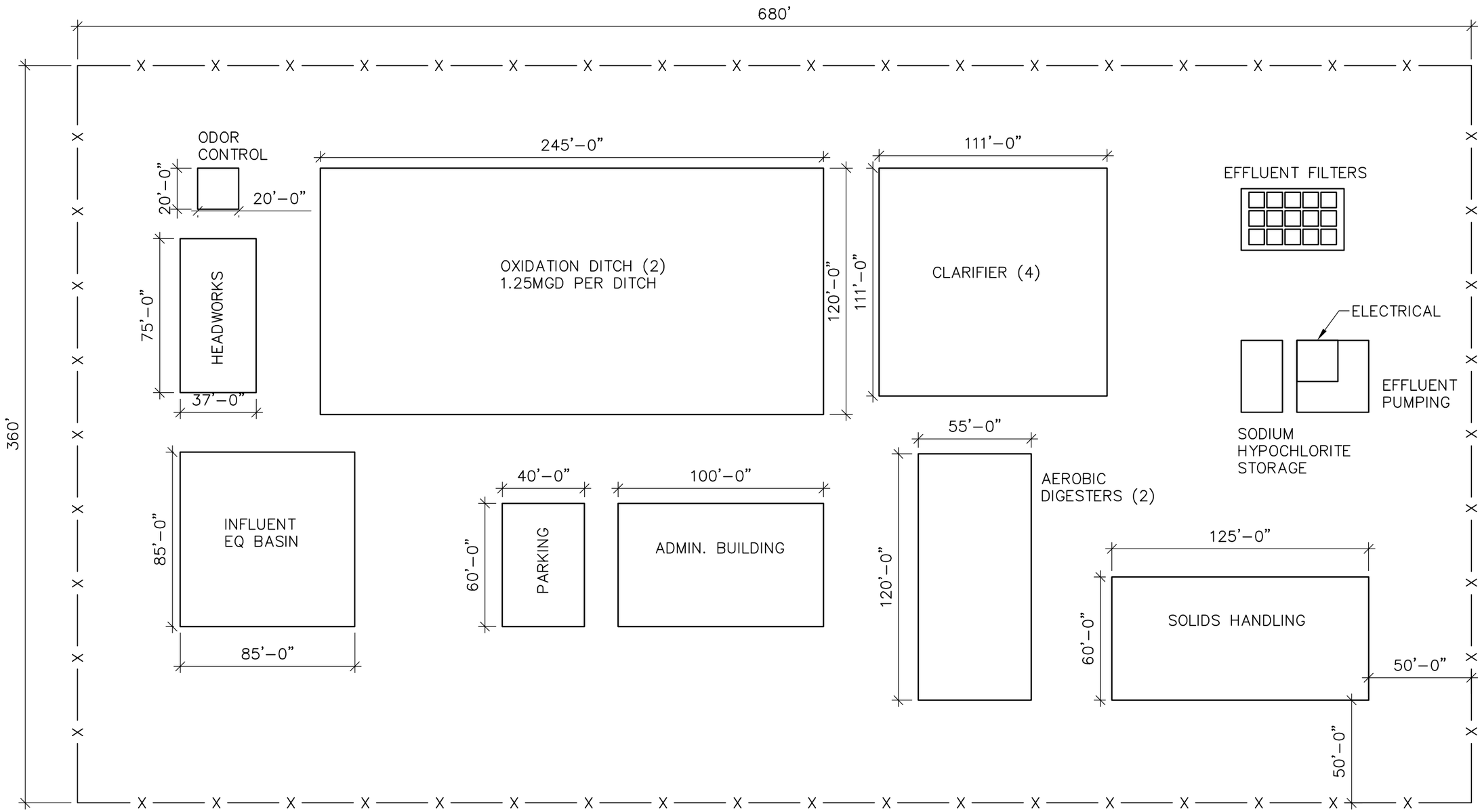
PIMA CO CONTRACT NO. 25-03-M-137732-0306

SCENARIO 3:
1.2 MGD MEMBRANE BIOEACTOR PLANT

MALCOLM PIRNIE, INC.

FIGURE 12

XREFS: IMAGES:K:\Symbols2000\Pirnie Standard\Gen\MPI Title Blocks\MPLOGOBK_Lockup_NoBleed.jpg
User:CORNEJO Spec:PIRNIE STANDARD File:I:\PROJ\1094114\Figures\FIGURE 12.DWG Scale:1:1 Date:08/24/2006 Time:18:07 Layout:Blank



APPROXIMATE ACREAGE: 5.6 ACRES

25 0 25 50

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PIMA COUNTY WASTEWATER MANAGEMENT

HOUGHTON AREA MASTER PLAN
PIMA CO CONTRACT NO. 25-03-M-137732-0306

SCENARIO 2A
2.5 MGD OXIDATION DITCH

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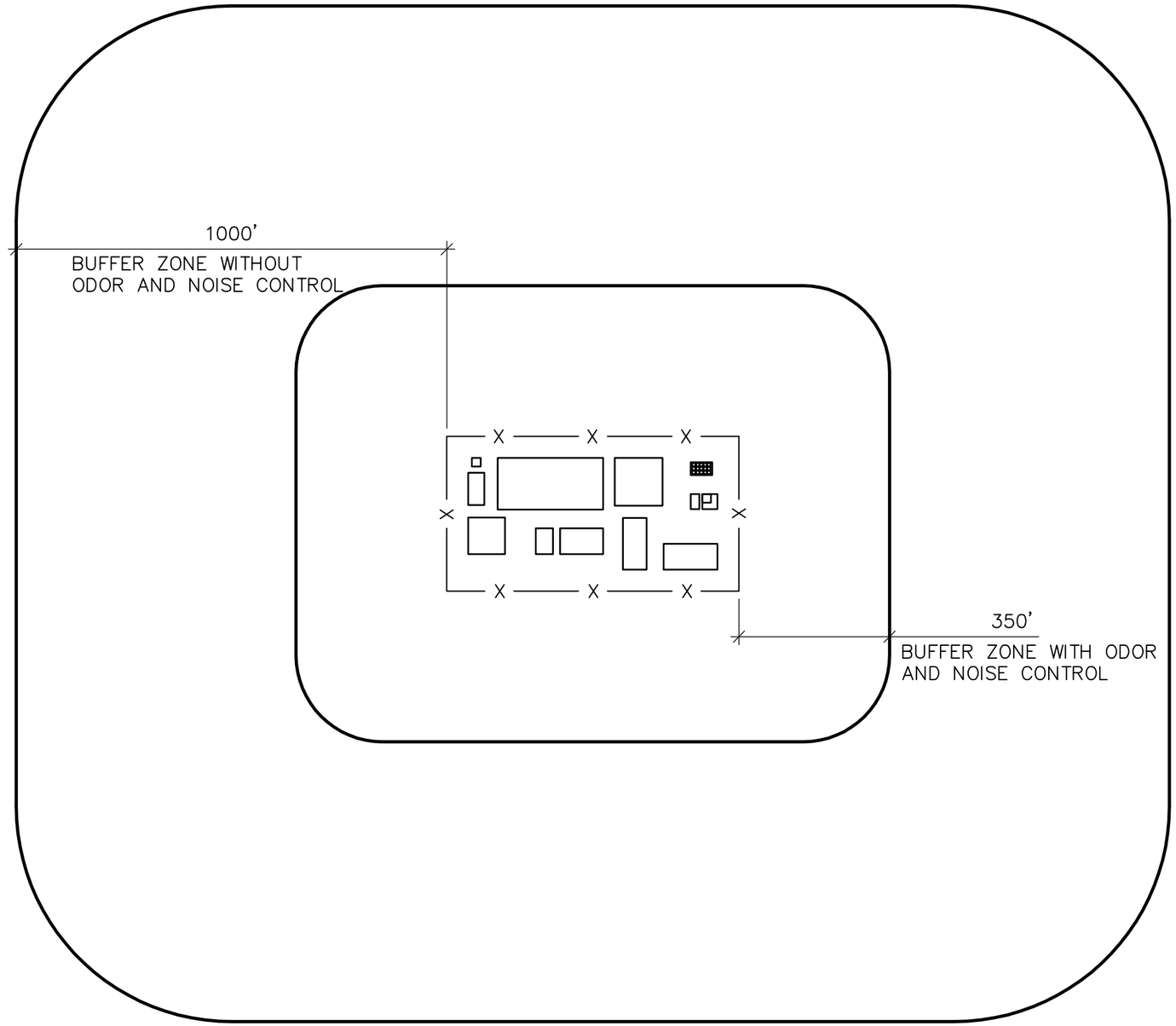
FIGURE 13

XREFS: IMAGES:K:\Symbols2000\Pirnie Standard\Gen\MPI Title Blocks\MPLOGOBK_Lockup_NoBleed.jpg
User:CORNEJO Spec:PIRNIE STANDARD File:I:\PROJ\1094114\Figures\FIGURE 13.DWG Scale:1:1 Date:08/24/2006 Time:18:07 Layout:Blank



PLANT ACREAGE:	5.6 ACRES
350' SETBACK:	32.7 ACRES
1000' SETBACK:	140 ACRES

150 0 150 300

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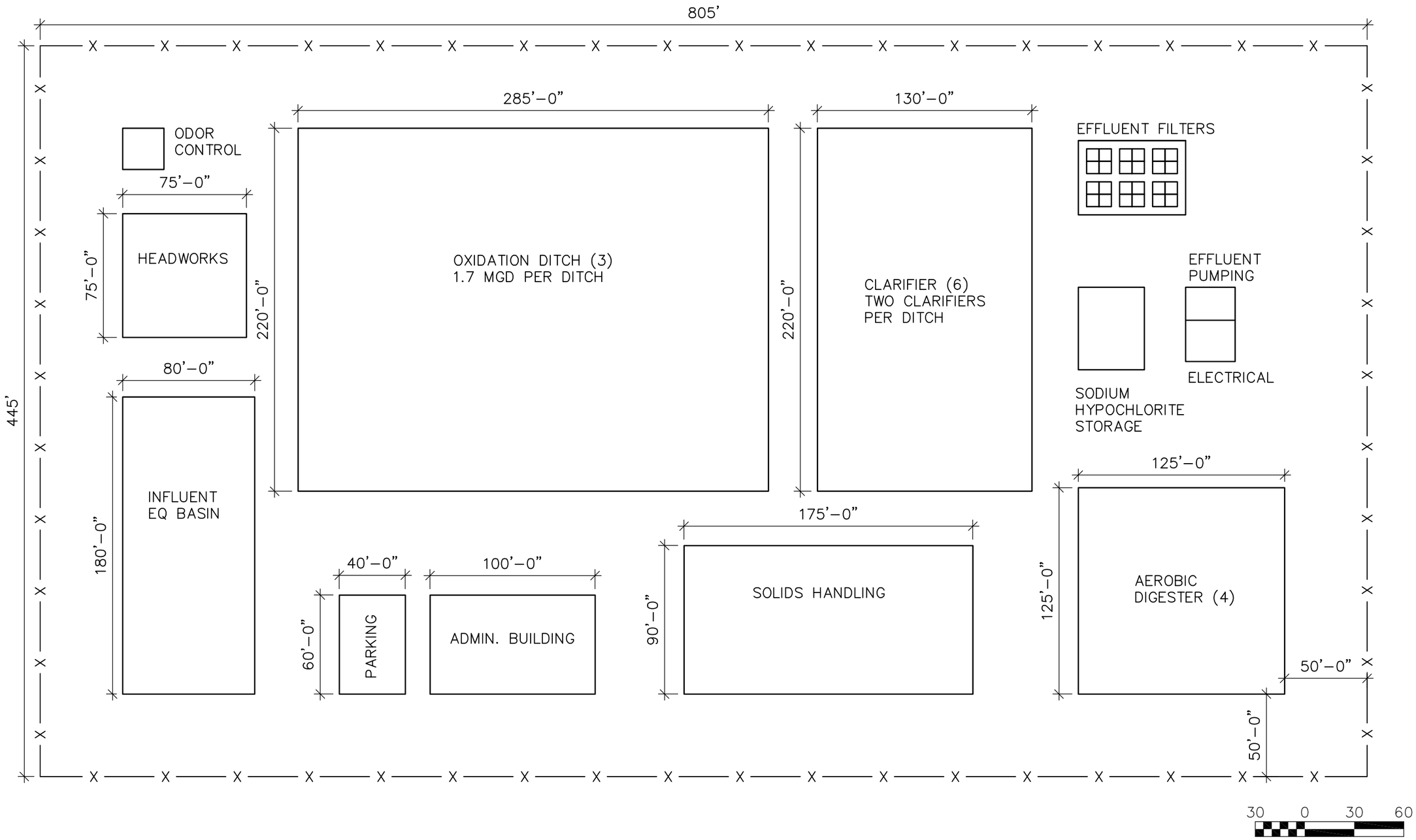
PIMA CO CONTRACT NO. 25-03-M-137732-0306

SCENARIO 2A
2.5 MGD OXIDATION DITCHES

MALCOLM PIRNIE, INC.

FIGURE 14

XREFS: IMAGES:K:\Symbols2000\Pirnie Standard\Gen\MPI Title Blocks\MPLOGOBK_Lockup_NoBleed.jpg
User:CORNEJO Spec:PIRNIE STANDARD File:I:\PROJ\1094114\Figures\FIGURE 14.DWG Scale:1:1 Date:08/24/2006 Time:18:06 Layout:Blank



APPROXIMATE ACREAGE: 8.2 ACRES

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PIMA COUNTY WASTEWATER MANAGEMENT

HOUGHTON AREA MASTER PLAN
PIMA CO CONTRACT NO. 25–03–M–137732–0306

SCENARIO 2B
5.0 MGD OXIDATION DITCHES

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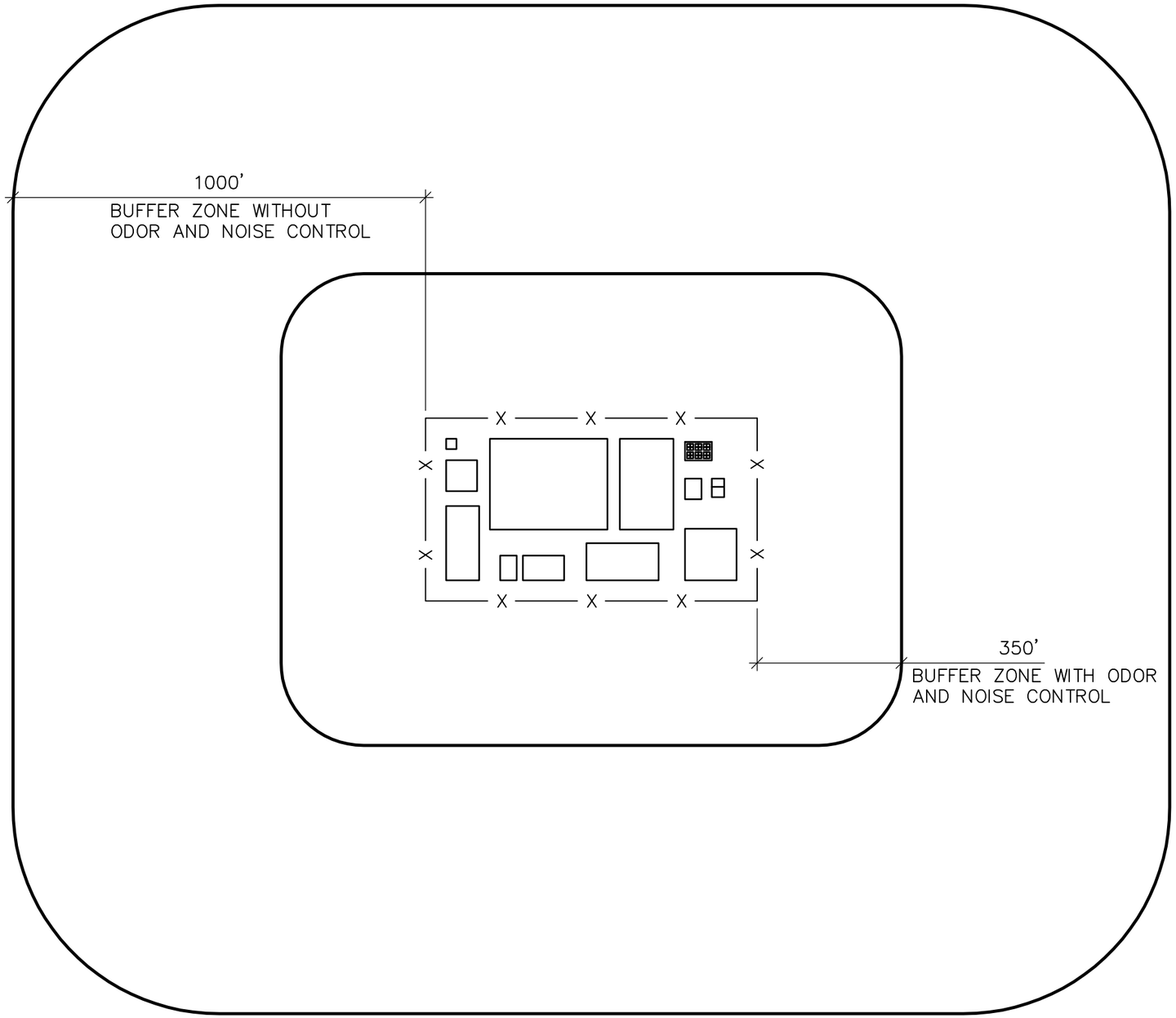
FIGURE 15

XREFS: IMAGES:K:\Symbols2000\Pirnie Standard\Gen\MPI Title Blocks\MPLOGOBK_Lockup_NoBleed.jpg
User:CORNEJO Spec:PIRNIE STANDARD File:I:\PROJ\1094114\Figures\FIGURE 15.DWG Scale:1:1 Date:08/24/2006 Time:18:06 Layout:Blank



PLANT ACREAGE:	8.2 ACRES
350' SETBACK:	38.7 ACRES
1000' SETBACK:	152 ACRES

150 0 150 300

MALCOLM PIRNIE

PIMA COUNTY WASTEWATER MANAGEMENT

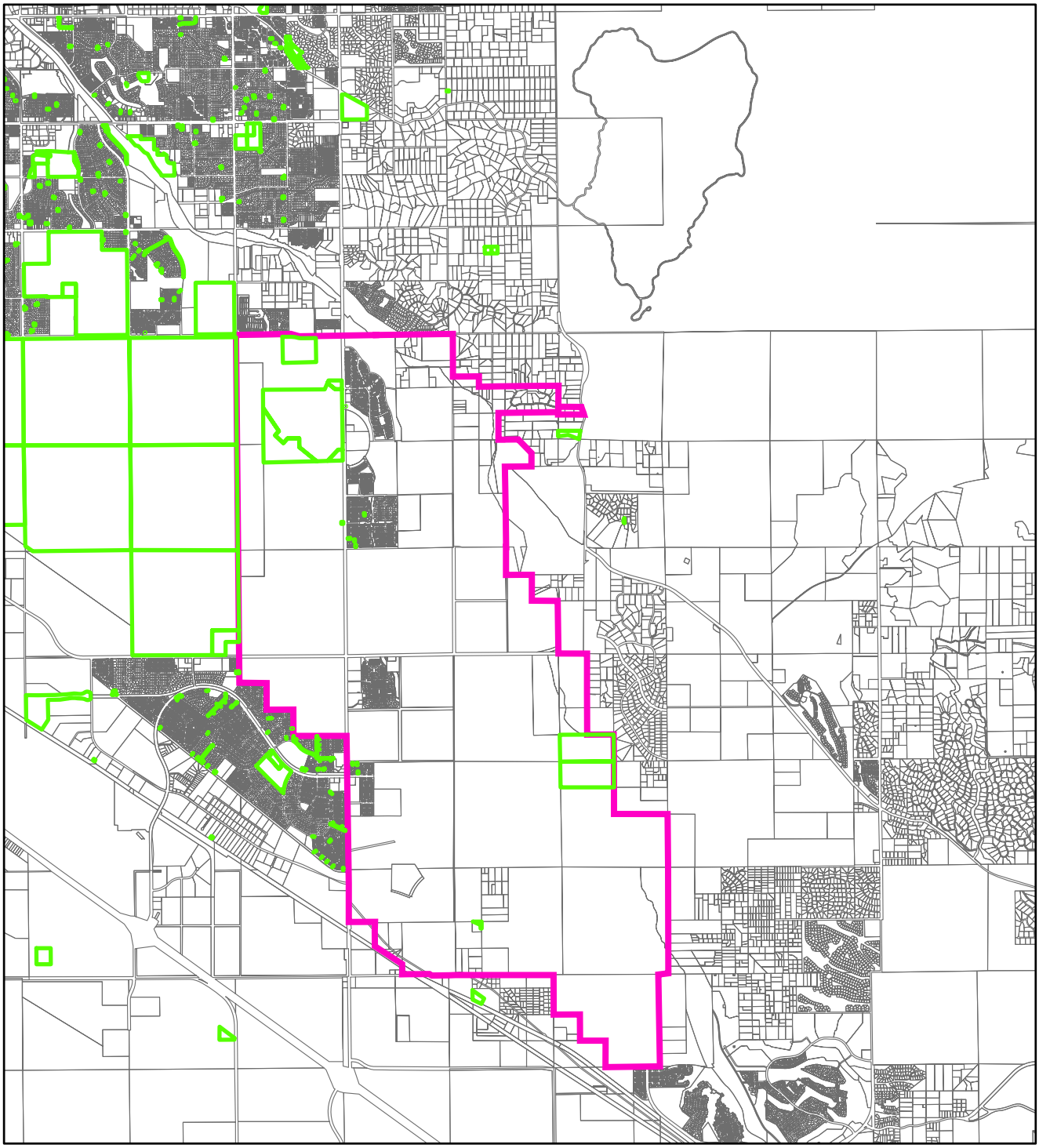
HOUGHTON AREA MASTER PLAN
PIMA CO CONTRACT NO. 25-03-M-137732-0306

SCENARIO 2B
5.0 MGD OXIDATION DITCHES

MALCOLM PIRNIE, INC.

FIGURE 16

XREFS: IMAGES:K:\Symbols2000\Pirnie Standard\Gen\MPI Title Blocks\MPLOGOBK_Lockup_NoBleed.jpg
User:CORNEJO Spec:PIRNIE STANDARD File:I:\PROJ\1094114\Figures\FIGURE 16.DWG Scale:1:1 Date:08/24/2006 Time:18:06 Layout:Blank



LEGEND

HAMP STUDY AREA BOUNDARY

CITY-OWNED PROPERTY BOUNDARIES

0 0.5 1 2 Miles

N W E S

MALCOLM PIRNIE

INDEPENDENT ENVIRONMENTAL ENGINEERS, SCIENTISTS AND CONSULTANTS

PIMA COUNTY WASTEWATER MANAGEMENT DEPARTMENT

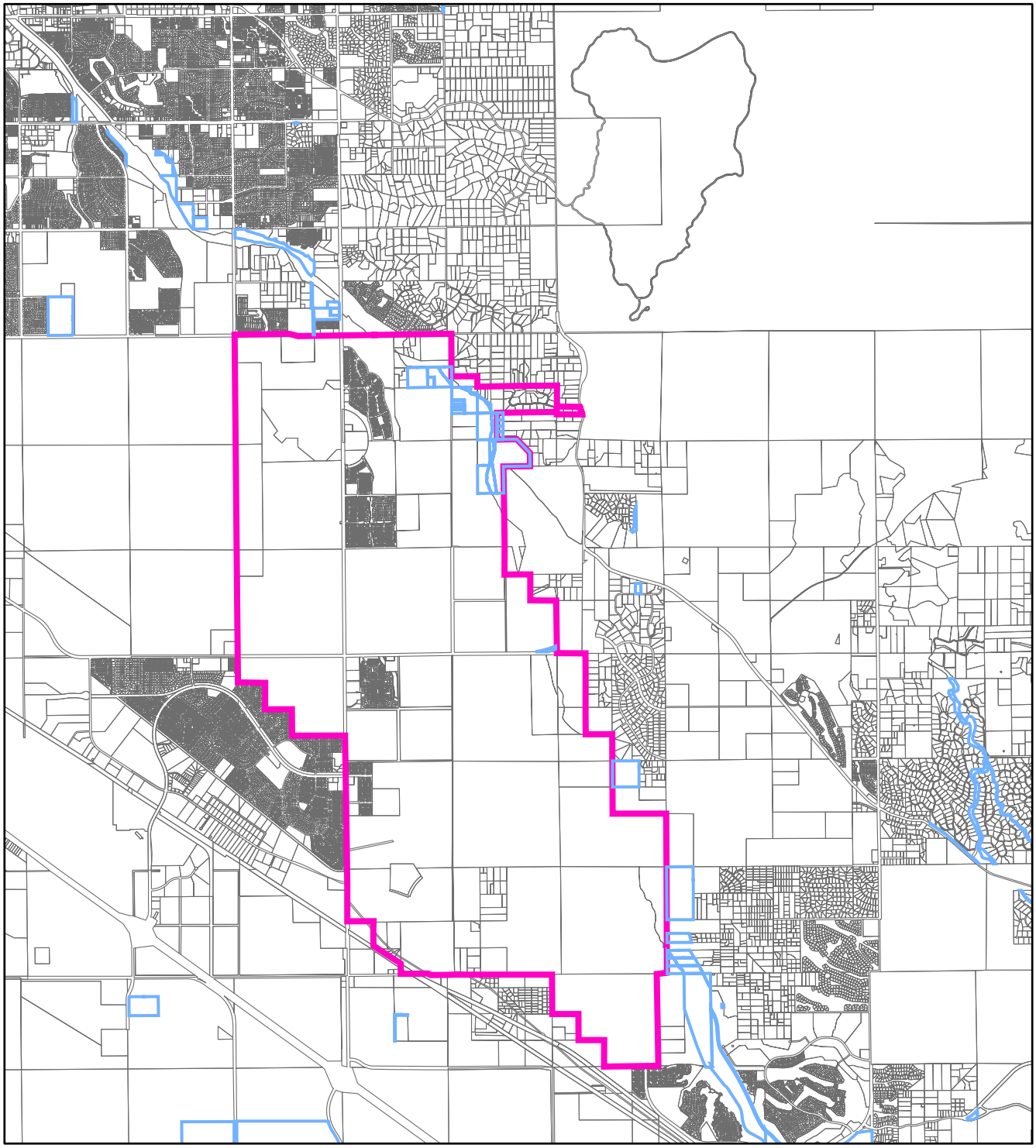
HOUGHTON AREA MASTER PLAN

PIMA CO CONTRACT NO. 25-03-M-137732-0306

CITY-OWNED PROPERTY

MALCOLM PIRNIE, INC.

FIGURE 17



LEGEND

HAMP STUDY AREA BOUNDARY

COUNTY-OWNED PROPERTY BOUNDARIES

0 0.5 1 2 Miles

N W E S

MALCOLM PIRNIE

INDEPENDENT ENVIRONMENTAL ENGINEERS, SCIENTISTS AND CONSULTANTS

PIMA COUNTY WASTEWATER MANAGEMENT DEPARTMENT

HOUGHTON AREA MASTER PLAN

PIMA CO CONTRACT NO. 25-03-M-137732-0306

MALCOLM PIRNIE, INC.

COUNTY-OWNED PROPERTY

FIGURE 18