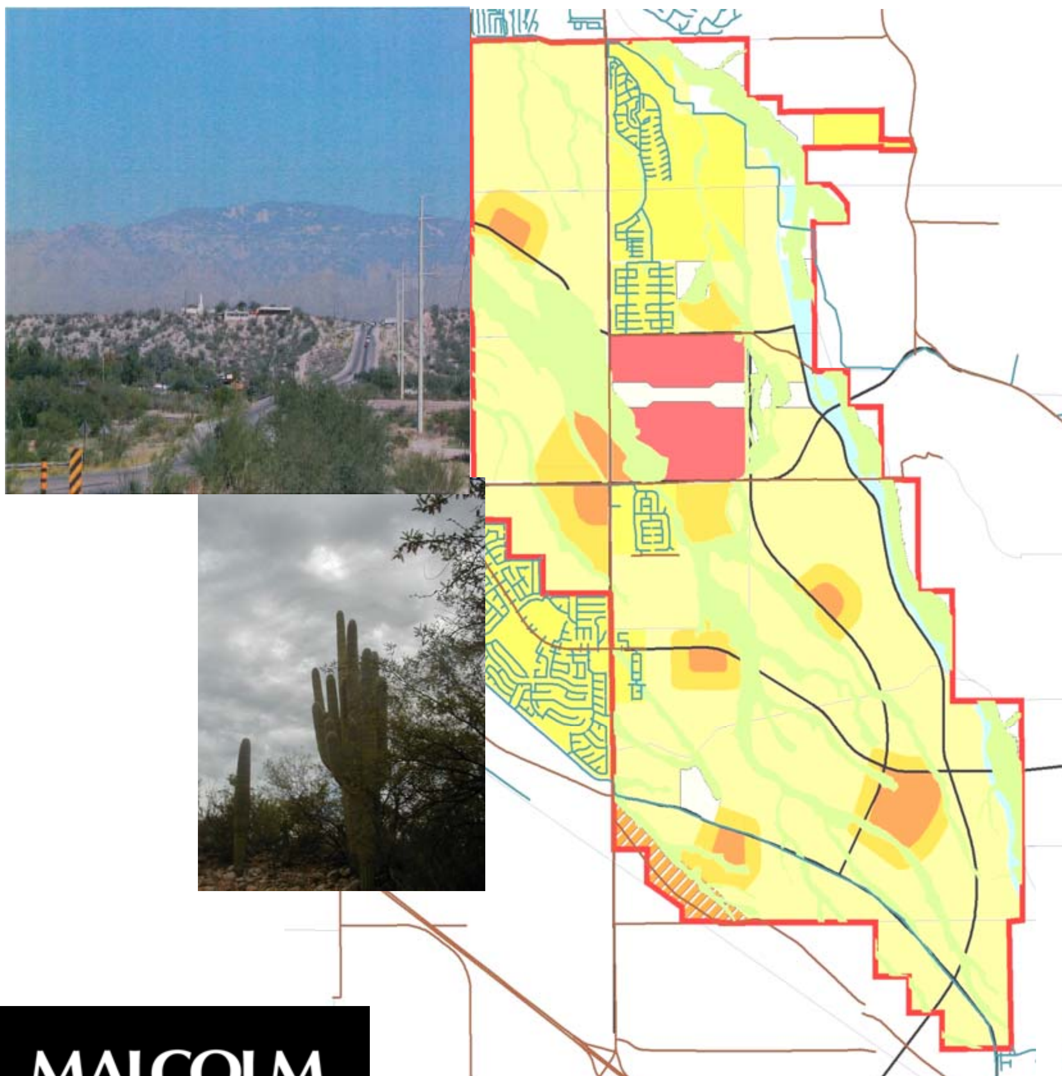
HOUGHTON AREA MASTER PLAN (HAMP)

POTABLE AND RECLAIMED WATER CONCEPTUAL PLAN

March 2008



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Houghton Area Master Plan (HAMP) Potable and Reclaimed Water Conceptual Plan

Final Report

Tucson Water
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Tucson, Arizona 85701

March 2008

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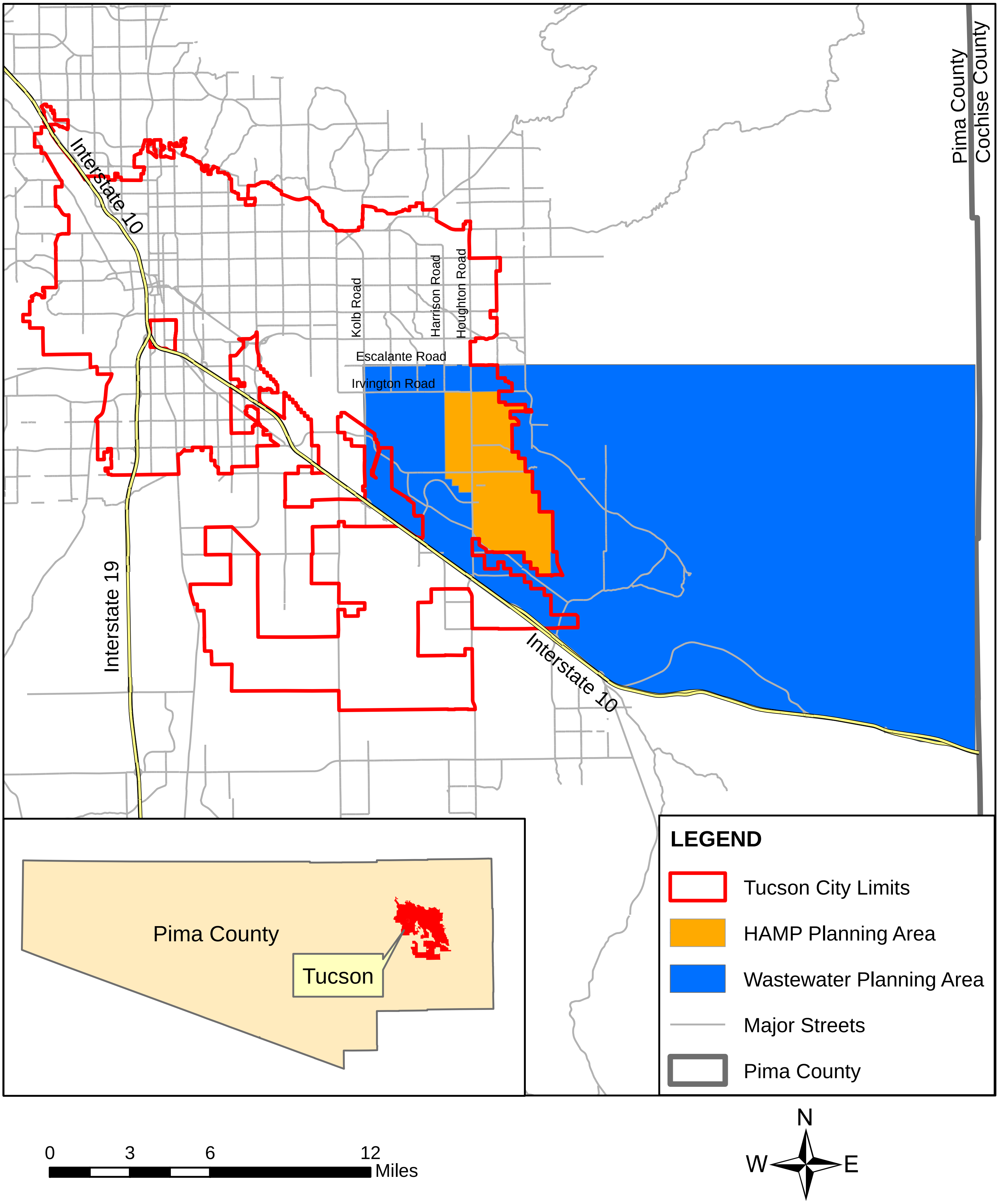
1.0 INTRODUCTION

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 potable water and reclaimed water infrastructure requirements in the HAMP planning area. A second report has already been prepared with study results and recommendations for wastewater facilities. The projected land use assumptions and population projections used in this potable and reclaimed water conceptual plan are consistent with PCRWRD's *HAMP Wastewater Conceptual Plan*.

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. Potable and reclaimed planning water planning activities conducted for this study were limited to the HAMP planning area, while wastewater conceptual planning was extended to a 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.



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TUCSON AREA MAP

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FIGURE 1-1

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 approximately 7,740 acres managed by the ASLD. Discussion of the City of Tucson HAMP report is presented in the following section (Background). 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.

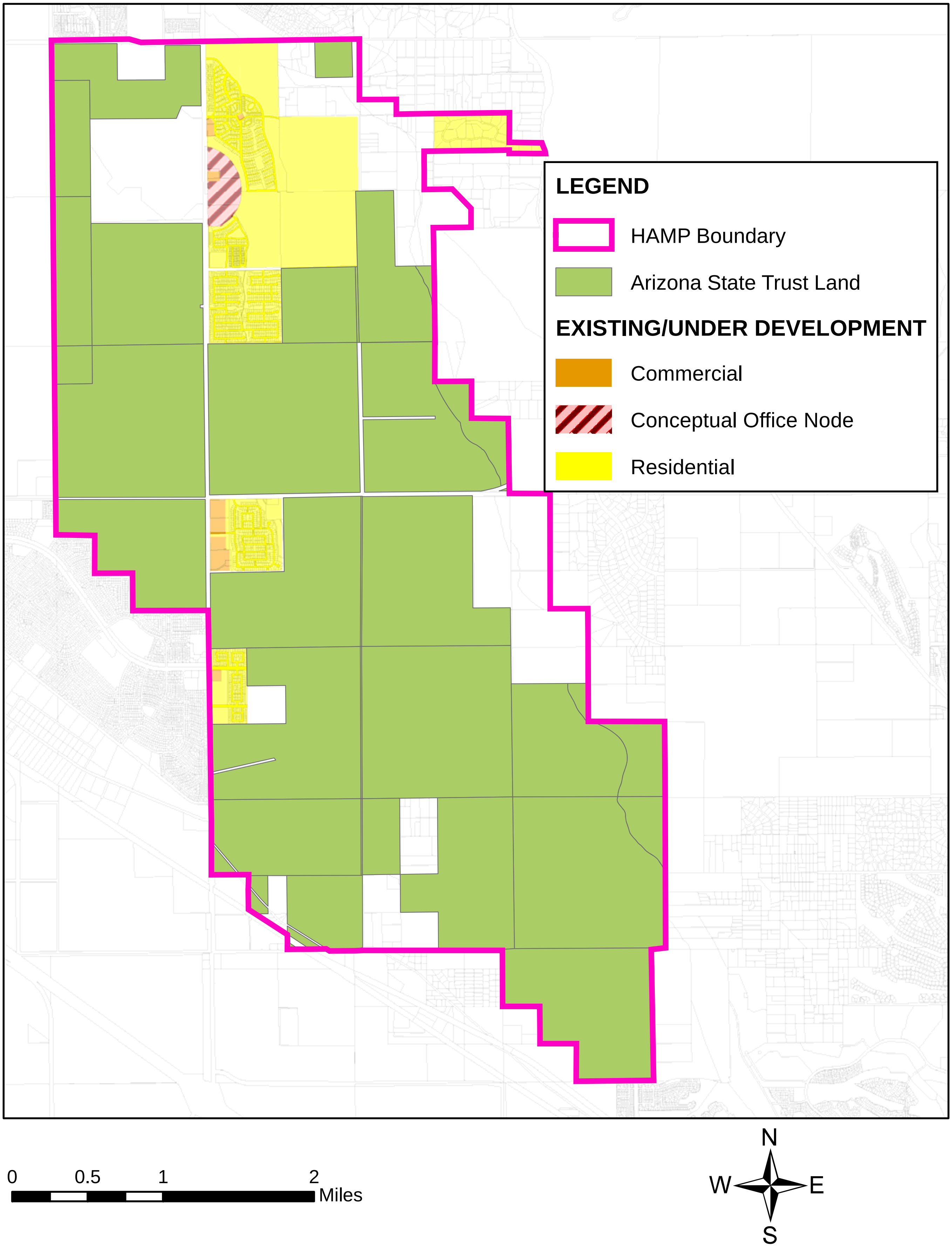
1.1.2 Related Wastewater Planning Area

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 area and, therefore, contributes wastewater flow through the HAMP 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 study area.

The Wastewater Conceptual Plan accounted 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 flows were 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



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EXISTING DEVELOPMENT AREAS

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FIGURE 1-2

this area. Several studies have previously been prepared that relate to the master planning efforts for HAMP.

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 Trust 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; however, this concept was not fully developed. Reclaimed water treatment was considered in the Wastewater Conceptual Plan and usage is considered in more detail in this 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 has initiated HAMP area 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 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 (note: Tucson Water and this report use a slightly higher composite estimate of 163 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 City of Tucson's Water Plan: 2000-2050

The City of Tucson initiated long range water resources planning to guide future decisions. This planning culminated in *Water Plan: 2000-2050*, which was adopted by the Tucson Mayor and Council on November 22, 2004. The plan offered ten recommendations for the future of which several could affect potable and reclaimed water in the developing HAMP area. These recommendations will be addressed further in Sections 4.0 and 5.0.

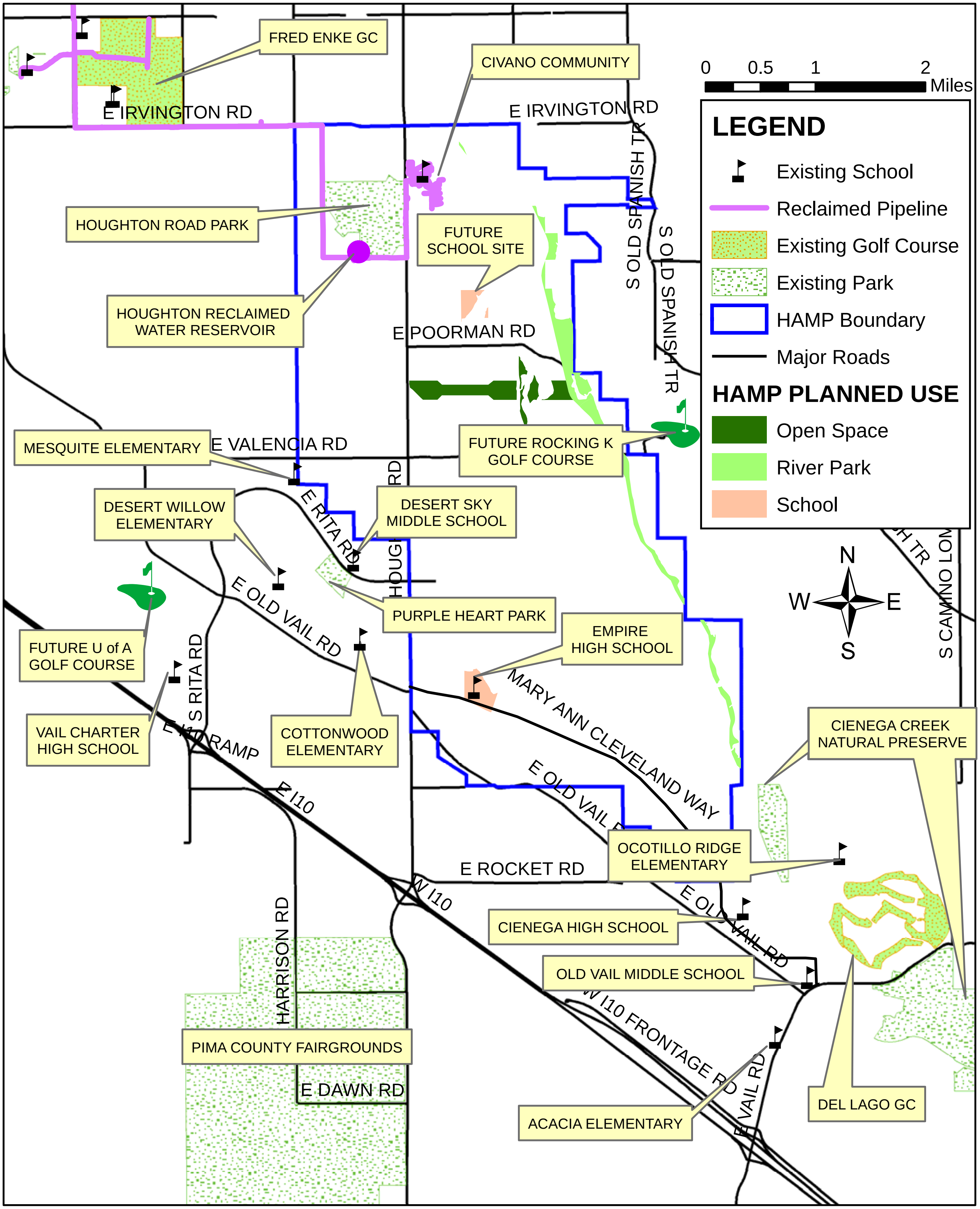
1.2.5 Tucson Water Reclaimed Water System Master Plan

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 1-3.

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 adjacent to HAMP also 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 1-3.

1.2.6 Tucson AMA Third Management Plan (2000-2010)

The Tucson Active Management Area (AMA) was established based on the 1980 Groundwater Management Act. It covers 3,866 square miles in Pima, Pinal, and Santa Cruz counties and is one of five AMAs in Arizona. The City of Tucson lies entirely within the Tucson AMA as shown in Figure 1-4. The Arizona Department of Water Resources is responsible for administration of the Groundwater Management Act and the Tucson AMA has a goal of reaching safe-yield by 2025. Currently, the *Tucson AMA*



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EXISTING RECLAIMED WATER INFRASTRUCTURE AND POTENTIAL REUSE SITES

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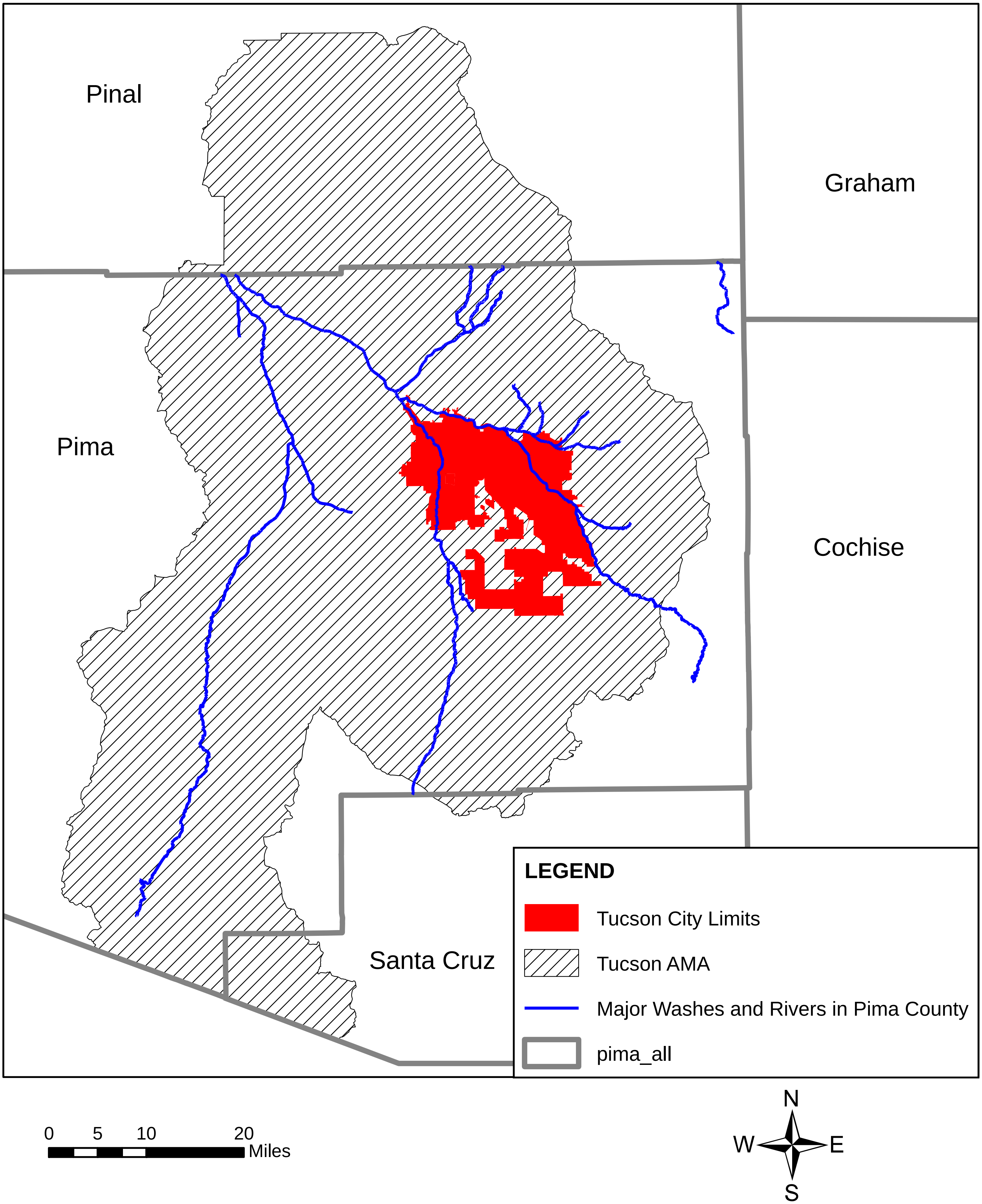
FIGURE 1-3



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TUCSON ACTIVE MANAGEMENT AREA

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FIGURE 1-4

Third Management Plan is the guiding document for managing water resources within the Tucson AMA.

1.2.7 PCRWRD 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 *Facility Plan Update* 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. The *Facility Plan Update* identified a potential location for a HAMP facility near the intersection of Harrison Road and Irvington Road.

1.2.8 Houghton Area Master Plan – Wastewater Conceptual Plan

The *Houghton Area Master Plan – Wastewater Conceptual Plan* (Wastewater Conceptual Plan) was developed in conjunction with this Potable and Reclaimed Water Conceptual Plan. The three technical memoranda that form the appendices and starting point of this report were also the appendices and starting point of the Wastewater Conceptual Plan. Population projections were consistent for both plans (PAG TAZ data). Recommendations from the Wastewater Conceptual Plan regarding a HAMP treatment facility and subsequent HAMP reclaimed water source will be integrated into this report. Options for use of effluent, which were briefly addressed in the Wastewater Conceptual Plan, will be developed further in this report.

1.3 PURPOSE AND OBJECTIVES

The purpose of this conceptual plan is to provide recommendations for potable and reclaimed water distribution infrastructure in the HAMP planning area consistent with the existing utility infrastructure and planned expansions in the current Capital Improvement Program (CIP). The objectives of this report include:

- Develop population and flow projections
- Characterize existing infrastructure capacities
- Develop potable water distribution alternatives
- Develop reclaimed water distribution alternatives
- Identify applicable institutional and regulatory issues
- Evaluate costs for feasible alternatives
- Present conclusions and recommendations for HAMP potable and reclaimed water management

The Conceptual Potable and Reclaimed Water Plan for HAMP 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) were 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, distribution mains were located along planned transportation corridors to allow for consistency with other major construction efforts. This location of distribution mains had the added benefit of placing distribution mains directly adjacent to the planned population centers of the HAMP.

1.3.2 Potable 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 Tucson Water and PCRWRD 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 PCRWRD has focused on the feasibility of wastewater treatment in 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.

1.3.3 Regional Wastewater Planning

As mentioned previously, the *Facility Plan Update* envisioned a potential HAMP water reclamation facility to serve the HAMP and surrounding area. PCRWRD is conducting an ongoing wastewater planning study called the Regional Optimization Master Plan (ROMP), which will integrate the findings of the Wastewater Conceptual Plan into the larger regional wastewater treatment planning effort.

1.4 REPORT ORGANIZATION

The portions of this study, developed in conjunction with PCRWRD, are based on a series of three technical memoranda: *Population and Flow Projections, Development of Wastewater Treatment Scenarios, and Screening of Wastewater Treatment Scenarios*. Each of these has been summarized, and all are included in appendices. This final report is organized in 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 population 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 – HAMP Wastewater Conceptual Plan. 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. The technical memorandum supporting the development of conveyance and treatment scenarios is presented in Appendix B.

Section 3 also provides a summary of wastewater conveyance and treatment scenario screening using non-cost criteria, as well as detailed layouts of treatment system footprints, regulatory requirements, and screening criteria. The technical memorandum supporting the scenario screening is presented in Appendix C.

Section 4 – Potable Water System. Section 4 begins with a discussion of the water resources available for the HAMP area. This section describes the existing potable infrastructure in the HAMP area and develops alternatives for new infrastructure.

Section 5 – Reclaimed Water System. Section 5 provides a summary of reclaimed water production facilities, development of reclaimed water demands, an evaluation of the community benefit from a HAMP treatment facility, and development of infrastructure alternatives. The alternatives from this section are evaluated in Section 6.

Section 6 – Cost Evaluation. Section 6 presents conceptual-level cost opinions for elements of infrastructure alternatives from the previous two sections.

Section 7 – Conclusions and Recommendations. Section 7 provides a summary of the master planning conclusions and recommendations.

2.0 POPULATION AND FLOW PROJECTIONS

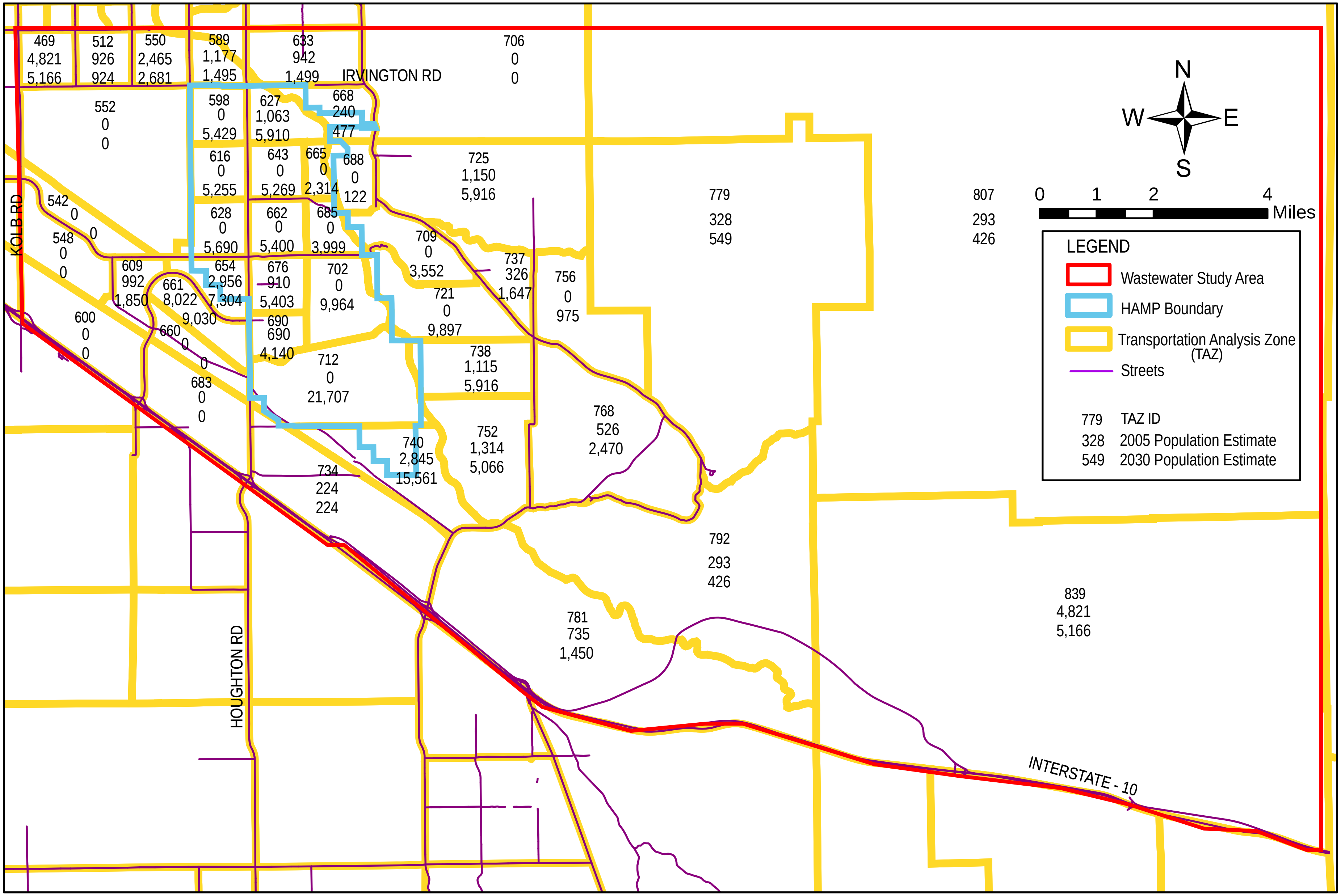
Population, water demand, and wastewater flow projections for the HAMP planning area and the Wastewater planning area were developed and documented in Technical Memorandum No. 1, included in this report as Appendix A. A summary of this technical memorandum is presented below.

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 totaled 87,748, while the entire Wastewater planning area was projected to have a buildout population of 164,786.

2.2 POTABLE WATER DEMAND PROJECTIONS

Potable water demand projections were based on the population modeled for the HAMP planning area. The buildout potable water demand was projected to be approximately 14 million gallons per day (mgd), based on an average demand of 163 gallons per capita per day (gpcd) for residential and commercial/industrial water use. Based on a peak day to average day demand factor of 1.8, approximately 26 mgd will be required for peak day demand in the HAMP area at buildout. With a peak hour to peak day peaking factor of 1.75, the peak hour demand for the area is projected to be about 45 mgd. Demands were projected in five year increments for each TAZ in the HAMP area and are presented in Table 4 of Appendix A.



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SUMMARY OF POPULATION PROJECTIONS

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FIGURE 2-1

2.3 RECLAIMED WATER DEMAND PROJECTIONS

Tucson Water assumes that reclaimed water demand is approximately eight 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. Reclaimed water demands adjacent to the HAMP area will be discussed further in Section 5.3.2.

3.0 HAMP WASTEWATER CONCEPTUAL PLAN

This section presents a summary of the *HAMP Wastewater Conceptual Plan* developed by PCRWRD as it relates to the reclaimed water system. 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. 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 in Appendix B. Conveyance and treatment scenarios were further developed in Technical Memorandum No. 3 and screened based on several criteria. Technical Memorandum No. 3 is included in Appendix C.

3.1 WASTEWATER CONVEYANCE AND TREATMENT SCENARIOS

In Technical Memorandum No. 2, three wastewater treatment alternatives were developed, and each was combined with the two conveyance alternatives to provide six wastewater treatment scenarios. The scenarios are described below, and the corresponding required HAMP treatment capacities are presented in Table 3-1 for each scenario.

Scenarios 1A & 1B - Roger Road WWTP. All wastewater from the Wastewater planning area would flow through existing downstream interceptors to the Roger Road WWTP for treatment. Downstream interceptors would be upgraded in accordance with the *PCRWRD 2006 Metropolitan Area Facility Plan Update (Facility Plan Update*). Under Scenario 1A, wastewater flow would be maximized to the Southeast Interceptor (SEI) with the remainder flowing to the Pantano Interceptor (PTI), and under Scenario 1B wastewater flow would be maximized to the PTI. This concept is also consistent with planning concepts being developed by PCRWRD's on-going ROMP, which is evaluating regional conveyance and treatment alternatives for the metropolitan wastewater treatment system.

Scenarios 2A & 2B- 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. Wastewater flow would be maximized to the SEI for Scenario 2A, and maximized to the PTI for Scenario 2B.

Scenarios 3A & 3B - 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. Wastewater flow would be maximized to the SEI for Scenario 3A, and maximized to the PTI for Scenario 3B.

TABLE 3-1

WASTEWATER SCENARIO TREATMENT CAPACITIES

Scenario	Required HAMP Treatment Facility Capacity (mgd)
1A	N/A
1B	N/A
2A	2.5
2B	5.0
3A	1.2
3B	1.2

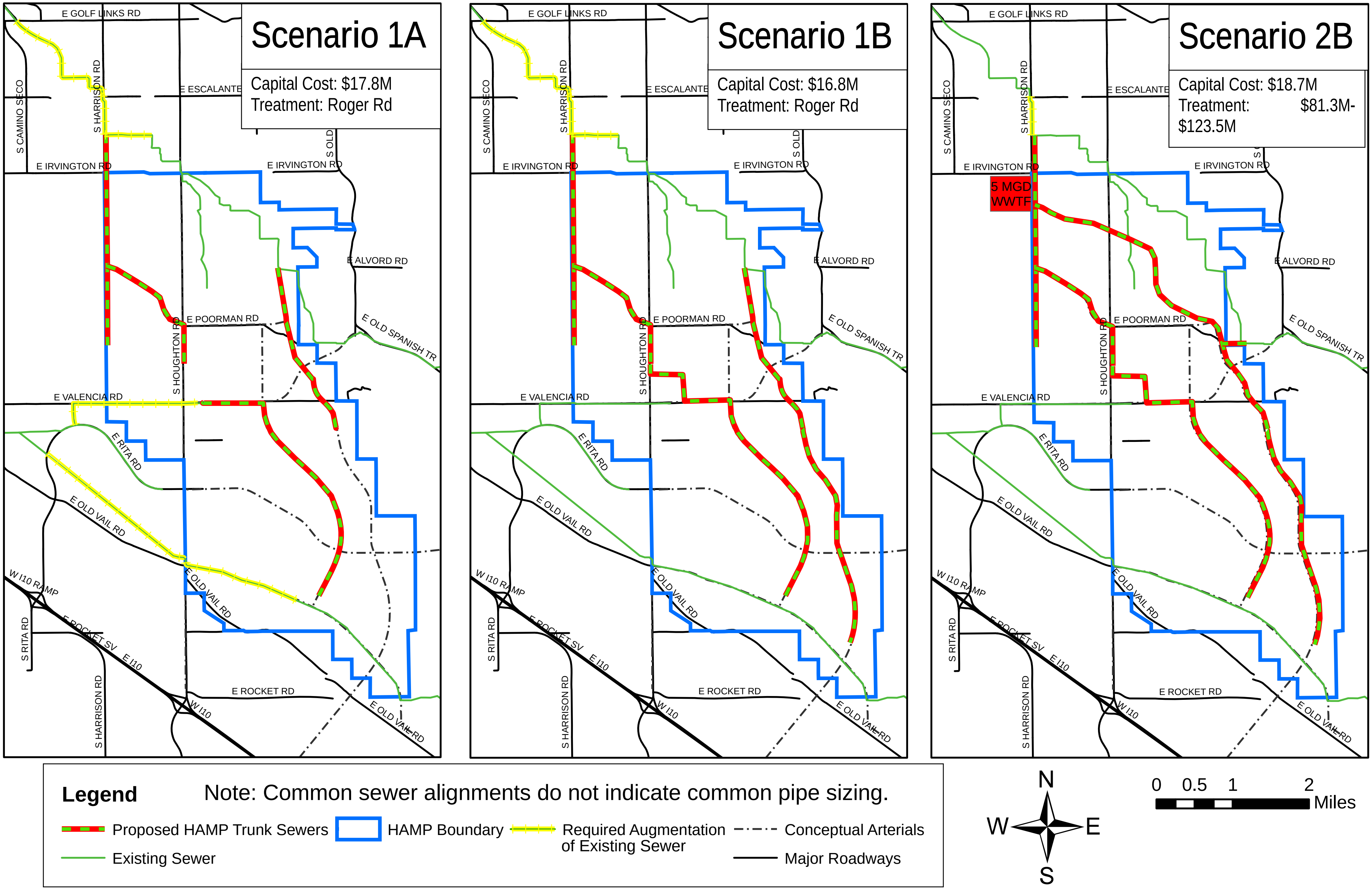
3.2 SCENARIO SCREENING

The wastewater conveyance and treatment scenarios identified in Technical Memorandum No. 2 were further developed and screened in Technical Memorandum No. 3, which is presented in Appendix C.

Conceptual conveyance and treatment facility layouts were developed for the treatment scenarios. The scenarios were ranked based on eight non-cost criteria, and Scenarios 1A, 1B, and 2B were selected for further evaluation. Figure 3-1 shows the proposed improvements and projected costs for the three remaining scenarios.

Effluent use options for Scenario 2B 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
- Surface discharge to the Pantano Wash



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HAMP Potable and Reclaimed Water Conceptual Plan

HAMP TRUNK SEWERS: SCENARIOS 1A, 1B, & 2B

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FIGURE 3-1

4.0 POTABLE WATER SYSTEM

This section describes potable water resources available to Tucson Water, existing potable water infrastructure, and alternatives developed for improvements to the potable infrastructure within the HAMP planning area. It also describes potable system improvements outside the HAMP planning area needed to support HAMP area development. This section also includes a recommended operation plan for transitioning to the future potable water system.

4.1 AVAILABLE WATER RESOURCES

The water resources for the HAMP planning area will be managed based on the City of Tucson's *Water Plan: 2000-2050.* Significant recommendations from the *Water Plan* that will affect the HAMP potable water system include:

- **Utilize Renewable Groundwater –** Tucson Water currently has the well capacity to pump more groundwater than the natural rate of recharge. As a result, new production wells in the HAMP area will be avoided if possible.
- **Fully Utilize Colorado River Water –** Tucson Water will aggressively pursue the ability to use its full Central Arizona Project (CAP) water allocation. As the HAMP area develops, CAP water from the Clearwater Program will be used to meet baseline demand in the HAMP area.
- **Acquire Additional Water Supplies –** The ASLD currently has a CAP allocation of 14,000 acre-feet within the Tucson Active Management Area (AMA). Several factors could lead to negotiations between Tucson Water and the ASLD for portions of this CAP allocation. Factors related to the HAMP area include:
  - Approximately 70 percent of the land in the HAMP study area is Arizona State Trust Land
  - ASLD has no infrastructure to transport CAP water to HAMP, and
  - Rules governing direct use of CAP water within the City of Tucson.

Approximately 11,500 acre-feet of water will be required at buildout for the lands currently managed by ASLD. Under Arizona Revised Statute (A.R.S. 37-106.01), the ASLD has the authority to transfer water rights "to any provider of permanent municipal water service."

- **Manage Water Demand –** New development in the HAMP area could offer an opportunity for Tucson Water to promote conservation measures with incentive programs.

4.1.1 Central Arizona Project (CAP) Water

Colorado River water comes to Tucson via the CAP aqueduct. CAP water is Tucson's principal renewable water resource, and the City of Tucson currently uses a 144,172 acre-feet per year of CAP allocation for planning purposes. CAP water is used by Tucson Water through the Clearwater Program. Under the Clearwater Program, Tucson Water recharges and recovers CAP water through the existing Central Avra Valley Storage and Recovery Project (CAVSARP). The future Southern Avra Valley Storage and Recovery Project (SAVSARP) will provide sufficient capacity for Tucson Water to recharge and recover its entire CAP allocation by 2012.

4.1.2 Groundwater

The *Water Plan: 2000-2050* estimated the sustainable rate of groundwater withdrawal in its service area to be 50,000 acre-feet of groundwater per year. Tucson Water is projected to exhaust its groundwater credits used for its designation of Assured Water Supply by 2035 if replenishment with a renewable source is not realized.

Tucson Water is currently evaluating its groundwater production wells on a system-wide basis to determine the most favorable locations for continued groundwater pumping. Groundwater could provide a portion of the water resource to the HAMP planning area through existing wells, but new wells are not planned to meet future HAMP area demands.

4.2 EXISTING INFRASTRUCTURE

Existing potable water infrastructure in the HAMP area is limited to a 24-inch water transmission pipeline along Houghton Road, the Houghton F-G Booster, the Old Vail G-Zone Reservoir, one F-Zone production well, and distribution infrastructure serving the existing Civano development as well as other small developments in the area. Additional infrastructure elements near the HAMP area that affect distribution include the Escalante F-Zone Reservoir, the Escalante F-G Booster, six G-Zone production wells, and distribution infrastructure in Rita Ranch. Figure 4-1 illustrates the locations of existing potable water infrastructure elements.

4.2.1 Pressure Zones

Tucson Water represents pressure zones with alpha designations (i.e., A, B, C, etc). Pressure zones at the same elevation can be discontinuous, and each of these discontinuous pressure zones is identified using an alpha-numeric designation after the pressure zone designation (i.e., G1, G2, GA, GF, etc). Each pressure zone represents 105 feet of elevation change so that customers within each pressure zone will receive water within the pressure range of 40 to 85 pounds per square inch. The north portion of the HAMP area lies in pressure zone F1. The middle portion lies in the G2-Zone, and the southern, highest portion is within pressure zone I2. A small portion of the GA-Zone, which is disconnected from G2, lies in the northeast portion of the HAMP area.

4.2.2 Production Wells

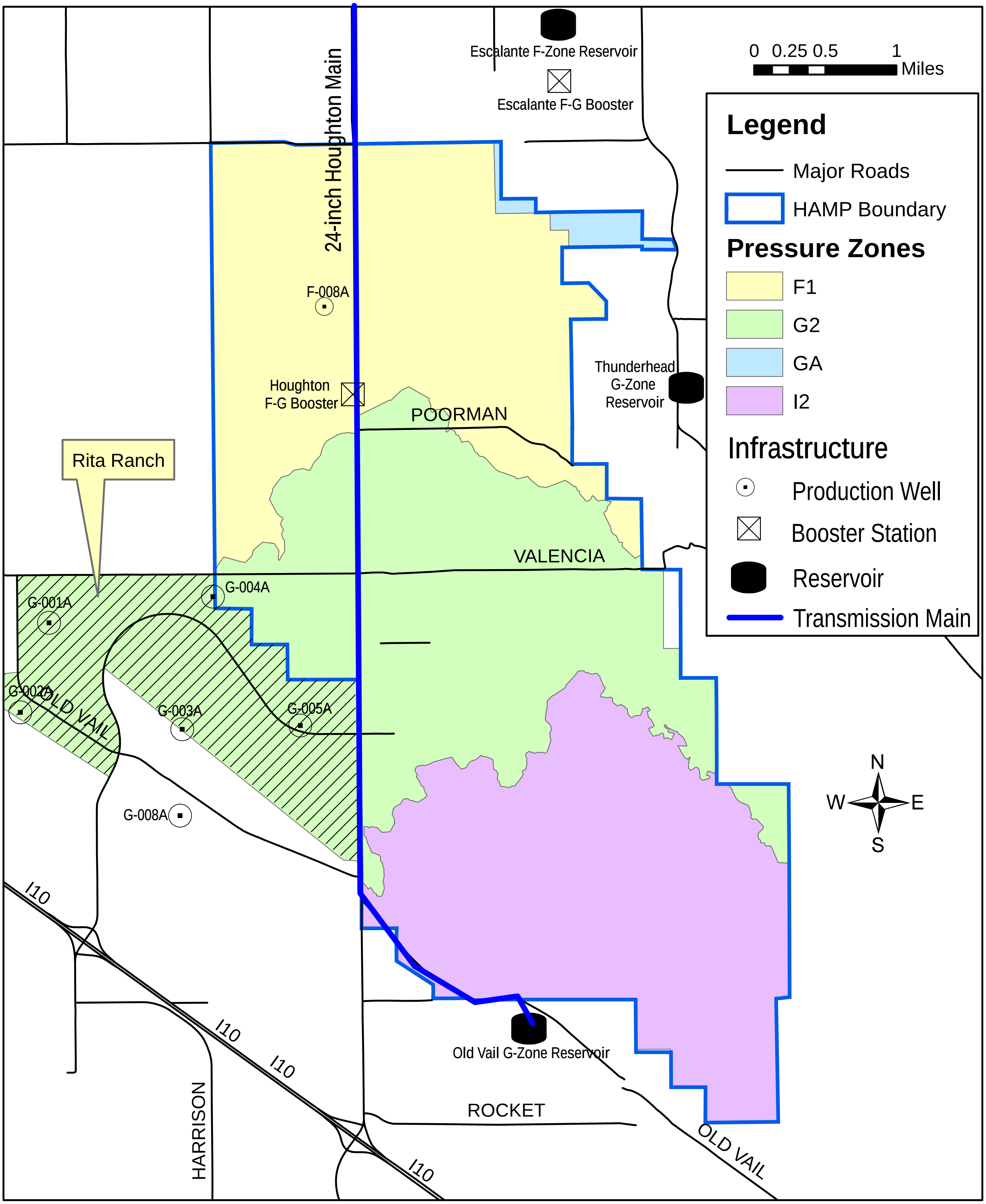
There is currently only one production well within the HAMP area, which is an F-Zone well located west of Houghton Road in the north portion of the HAMP area. Tucson Water has six G-Zone productions wells in the Rita Ranch area adjacent to the HAMP area on the southwest. There are G-Zone wells near Thunderhead Ranch to the east of the HAMP planning area, but they are not connected to the larger system.

4.2.3 Booster Stations

There is currently a booster station along Houghton Road, north of the intersection with Poorman Road, which lifts from F-Zone to the G2 portion of G-Zone. The Houghton F-G Booster has a capacity of 4.5 mgd. Another booster station (Escalante F-G Booster), which is outside of the HAMP area, lifts from Escalante F-Zone Reservoir to the GA pressure zone, of which HAMP encompasses a small portion. The Escalante F-G Booster has a capacity of 2.0 mgd.

4.2.4 Reservoirs

Several potable water reservoirs exist near the HAMP area. The “Old Vail G-Zone” reservoir currently provides storage capacity for Rita Ranch and existing developments in the HAMP area with a capacity of 0.2 million gallons. The “Escalante F-Zone” reservoir



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	EXISTING INFRASTRUCTURE	FIGURE 4-1

serves developments in the north HAMP area as well as areas to the north of the HAMP area with a capacity of 10 million gallons. The "Thunderhead G-Zone" reservoir serves a small section to the east of the HAMP area with a capacity of 40,000 gallons in the GF pressure zone, but is not connected to the larger system at this time.

The Rita Ranch G-Zone wells can also be considered to provide storage for the HAMP area in a volume equivalent to their single-day pumping capacity. The capacities of these wells will be discussed further in subsequent sections.

4.2.5 Transmission and Distribution System

A 24-inch main runs parallel to Houghton Road, which provides the main transmission supply to the existing distribution system in the HAMP area. The existing developments are served by loops off of this main, which currently terminates at the Old Vail G-Zone reservoir. The southern portion of the existing Houghton main also serves Rita Ranch. The existing HAMP distribution system does not have a second connection to the overall Tucson Water potable distribution system and, therefore, is not looped to provide redundant service to the study area.

4.3 DEVELOPMENT OF POTABLE SYSTEM ALTERNATIVES

Three potable water system alternatives were developed for delivering potable water to the HAMP planning area. The alternatives were selected based on their abilities to deliver water from existing and planned potable water system infrastructure based on the current Tucson Water Capital Improvement Program (CIP).

Tucson Water conducts hydraulic modeling using WaterCAD® software. Each of the infrastructure alternatives for the HAMP area has been prepared to facilitate their incorporation into Tucson Water's potable water system hydraulic model.

4.3.1 Criteria for Developing System Alternatives

Criteria common to all of the alternatives were developed for sizing system components associated with each of the three alternatives. The criteria included buildout water demand projections, system sizing and performance, and operating assumptions. The criteria are summarized in the following paragraphs.

4.3.1.1 Potable Water Demand

Projected potable water demands from Technical Memorandum No. 1 (Appendix A) were used as the basis for developing the HAMP infrastructure alternatives. The population projections from the TAZ data were assigned to the HAMP pressure zones based on geographic location. In cases where a TAZ was situated in more than one pressure zone, the percentage of the TAZ in each pressure zone was estimated and distributed accordingly. The estimated buildout populations for individual pressure zones are presented below:

- GA-Zone: 400
- F1-Zone: 28,000
- G2-Zone: 30,500
- I2-Zone: 28,800
- HAMP planning area total: 87,700

Because of its proximity to the HAMP area, the Rita Ranch area was also included in the HAMP water system planning with a projected buildout population of 13,800 within the G2-Zone.

Water demand projections were developed using Tucson Water's population-based water use criteria, which are summarized below:

- Average day demand: 163 gallons per capita per day.
- Peak day demand: 1.8 times average day demand.
- Peak hour demand: 1.75 times peak day demand.

Many of Tucson Water's system performance criteria are based on peak day demand. Table 4-1 shows the projected potable system peak day demand at buildout for each TAZ by pressure zone.

TABLE 4-1

HAMP PEAK DAY DEMAND ESTIMATES

BY PRESSURE ZONE AT BUILDOUT (mgd)

TAZ	GA	F1	G2	I2	SUM
HAMP Area					
598	0.0	1.6	0.0	0.0	1.6
616	0.0	1.5	0.0	0.0	1.5
627	0.0	1.7	0.0	0.0	1.7
628	0.0	0.8	0.8	0.0	1.7
643	0.0	1.3	0.2	0.0	1.5
654	0.0	0.0	1.3	0.0	1.3
662	0.0	0.2	1.4	0.0	1.6
665	0.0	0.7	0.0	0.0	0.7
668	0.1	0.0	0.0	0.0	0.1
676	0.0	0.0	1.6	0.0	1.6
685	0.0	0.4	0.8	0.0	1.2
688	0.0	0.0	0.0	0.0	0.0
690	0.0	0.0	0.7	0.5	1.2
702	0.0	0.0	2.0	0.9	2.9
712	0.0	0.0	0.0	6.4	6.4
740	0.0	0.0	0.0	0.7	0.7
Subtotal	0.1	8.2	9.0	8.5	25.7
Rita Ranch					
609	0.0	0.0	0.5	0.0	0.5
654	0.0	0.0	0.9	0.0	0.9
661	0.0	0.0	2.6	0.0	2.6
Subtotal	0.0	0.0	4.1	0.0	4.1
Total	0.1	8.2	13.0	8.5	29.8

4.3.1.2 System Performance Criteria

Tucson Water’s standard minimum water system performance criteria were used to provide preliminary sizing for distribution system components. Applicable performance criteria are summarized below:

- Pipelines:
  - Maximum velocity during peak hour: 5 feet per second (fps).
  - Maximum unit headloss during peak hour: 3 feet headloss per 1,000 feet of pipe.
  - Pipeline roughness coefficient, C = 120.
- Boosters: Peak hour (firm capacity).
- Reservoirs:
  - Central System: Peak day demand plus fireflow and emergency storage.
  - Isolated Systems: Two times peak day demand.

- Fireflow:
  - Residential: 1,500 gpm for two hours duration
  - Commercial: 4,000 gpm for four hours duration.
  - Emergency: Minimum of five percent of the peak day demand.

4.3.1.3 Other Planning Criteria

Other planning criteria specific to the HAMP area were developed to ensure consistency between the alternatives. Those criteria are summarized below:

- Tucson Water is currently planning infrastructure improvements to deliver water from the Hayden-Udall WTP to serve the area south of HAMP, including Santa Rita Bel Air (SRBA) and other potential demands in the Corona de Tucson area. HAMP alternatives may include increases in the planned sizing of this new infrastructure serving the southeast portion of the water service area. Existing development in SRBA is approximately seven miles south of Interstate 10 on Houghton Road.
- Additional HAMP water resources will be provided from existing and currently planned potable water infrastructure to ensure renewable water usage that is consistent with Tucson Water's long-range plan. Additional production wells will not be constructed to serve the HAMP area.
- Future transmission mains from the existing and planned potable system will enter the HAMP area from either the north, the south, or a combination of north and south.
- Incremental differences between peak day and peak hour demands will be provided from storage reservoirs.
- F-Zone and G-Zone will be served by high-water storage.
- Due to the relatively flat local topography, new I-Zone storage will be forebay storage from G-Zone elevation, which will be boosted to the I-Zone distribution system.
- The G-I booster capacity will be equal for all alternatives.
- All reservoirs will be sized to provide storage needed for the HAMP area. Existing and currently planned reservoirs located outside of the HAMP area will not include capacity for HAMP demands.
- Reservoir sizing will be equal for all alternatives.
- At buildout, wells will be used for emergency supply only.
- The delivery capacity of the existing 24-inch Houghton Main will be reserved for areas other than the HAMP area, and HAMP area demand may not impede delivery to other areas currently relying on the existing 24-inch Houghton Main.

4.3.1.4 Pipeline and Reservoir Sizes Based on Planning Criteria

Table 4-2 presents a summary of pipeline capacities by size using the criteria presented in Section 4.3.1.2. The pipeline capacities were incorporated into each of the three improvement alternatives.

TABLE 4-2

ESTIMATED TRANSMISSION MAIN CAPACITY

Pipe Diameter, inches	Velocity[1], feet/second	Calculated Headloss[1], feet/1,000 feet	Calculated Maximum Capacity, MGD
20	4.0	3.0	5.6
24	4.4	3.0	9.0
30	5.0	2.9	15.9
36	5.0	2.3	22.8
42	5.0	1.9	31.1
48	5.0	1.7	40.6
54	5.0	1.5	51.4
60	5.0	1.3	63.4
66	5.0	1.1	76.8
72	5.0	1.0	91.4
78	5.0	0.9	107.2
84	5.0	0.9	124.4

[1]Capacity estimated per Tucson Water Facility Sizing Standard 8-06.4.3.B. Velocity cannot exceed five feet per second, and headloss cannot exceed three feet per thousand feet for transmission mains over 16-inch diameter at C=120 for peak hour flows.

Table 4-3 presents a summary of reservoir sizes by pressure zone based on the sizing criteria presented in Section 4.3.1.2. The resulting reservoir sizes were incorporated into each of the three improvement alternatives.

TABLE 4-3

HAMP STORAGE REQUIREMENTS

Minimum Storage Components	Pressure Zone F1	G2	I2
Estimated Max Day Demand, MGD	8.2	13.0	8.5
Equalization Storage[1], MG	8.2	13.0	8.5
Fireflow Estimate[2], gpm	1,500	4,000	1,500
Duration[2], hrs	2	4	2
Fire Storage, MG	0.2	1.0	0.2
Emergency Storage[3], MG	0.4	0.7	0.4
Total Storage, MG	8.8	14.6	9.1

[1]Based on Tucson Water Facility Sizing Standard 8-06.5.2.B.

[2]Estimated per Tucson Water Facility Sizing Standard 8-06.3.2B. The "Town Center" area in zone-G2 was assumed to be similar to a downtown area for fireflow purposes.

[3]Based on Tucson Water Facility Sizing Standard 8-06.5.2.D.

As stated previously, the HAMP area is currently served by existing production wells and a 24-inch Houghton transmission main from the Escalante F-Zone Reservoir. Although the HAMP area is not technically an isolated system, based on the limited groundwater production capacity within HAMP coupled with the limited capacity to introduce water from the main distribution system, Tucson Water may treat HAMP as an isolated system until sufficient infrastructure is constructed to bring in additional supplies. In isolated systems, Tucson Water typically provides storage in excess of one peak day of supply (as much as two times peak day). As the area grows, it will be necessary to plan increases to storage capacity in the area to meet actual growth during interim years (prior to buildout). The storage capacity will also need to be planned to balance storage requirements with water quality concerns associated with water age.

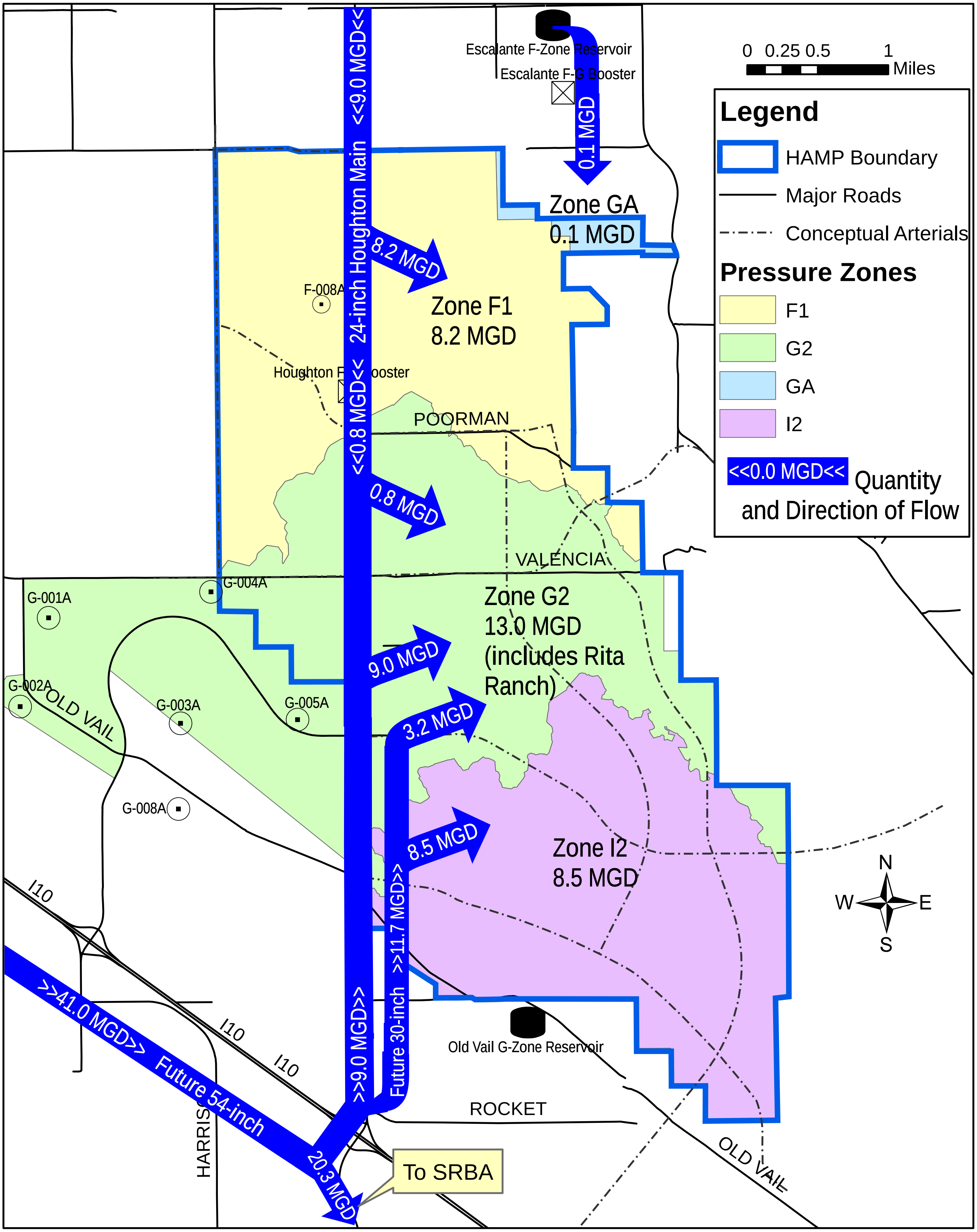
4.3.2 Potable System Alternative 1

Potable System Alternative 1 was developed such that new transmission main construction will be limited to the south portion of the HAMP area. The existing 24-inch Houghton main will deliver potable water to the HAMP area from both the north and south. A 54-inch transmission main would be required to meet future HAMP and Santa Rita Bel Air (SRBA) demands, and a future 30-inch transmission main would connect HAMP to the larger transmission main. The general transmission system for

Alternative 1 is illustrated in Figure 4-2. A schematic of the HAMP area showing Alternative 1 improvements to each of the affected pressure zones is included in Figure 4-3.

Transmission mains within the HAMP area were sized based on projected peak day demands. Under this alterative the 24-inch Houghton Main would supply 9.0 mgd at F-Zone pressure from the north, of which 8.2 mgd would be supplied to the F1-Zone and a future HAMP F-Zone reservoir will be required to meet peak hour demands. The remaining 0.8 mgd from the north would be supplied to the G-Zone using the existing Houghton F-G Booster. The Houghton Main would also supply 9.0 mgd from the south to the G2-Zone. A future 30-inch main from the south would supply the balance of projected demand for the G2-Zone (3.2 mgd) and the projected demand for the I2-Zone (8.5 mgd). The future 30-inch south main would be operated at G-Zone pressure from a future booster station outside of the HAMP area.

A conceptual local distribution plan was modeled using WaterCAD by assigning demand in each TAZ as shown in Table 4-1. This conceptual distribution plan is shown in Figure 4-4. A conceptual distribution system was laid out using existing public rights-of-way (ROWs), conceptual arterial alignments, and section boundaries. For the purpose of developing the conceptual distribution system, the HAMP G/I-Zone reservoir was located at the site of the existing Old Vail G-Zone Reservoir. The HAMP F-Zone Reservoir was conceptually located south of Valencia Road along a conceptual arterial road such that its elevation corresponded with the elevation of other F-Zone reservoirs. The pipes then were sized to supply peak hour demands while meeting velocity and headloss standards. Reservoirs were sized based on criteria presented in Table 4-3 and rounded up to an even 5-MG increment based on Tucson Water general practice. A fire flow analysis was then conducted to ensure that each individual TAZ could meet fire flow requirements while the remainder of the system met peak day demand while maintaining a residual pressure of 20 psi. Each TAZ was evaluated at a fire flow demand of 1,500 gpm with the exception of TAZ 662, which required 4,000 gpm because of the proposed Town Center area.



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POTABLE ALTERNATIVE 1 - PEAK DAY

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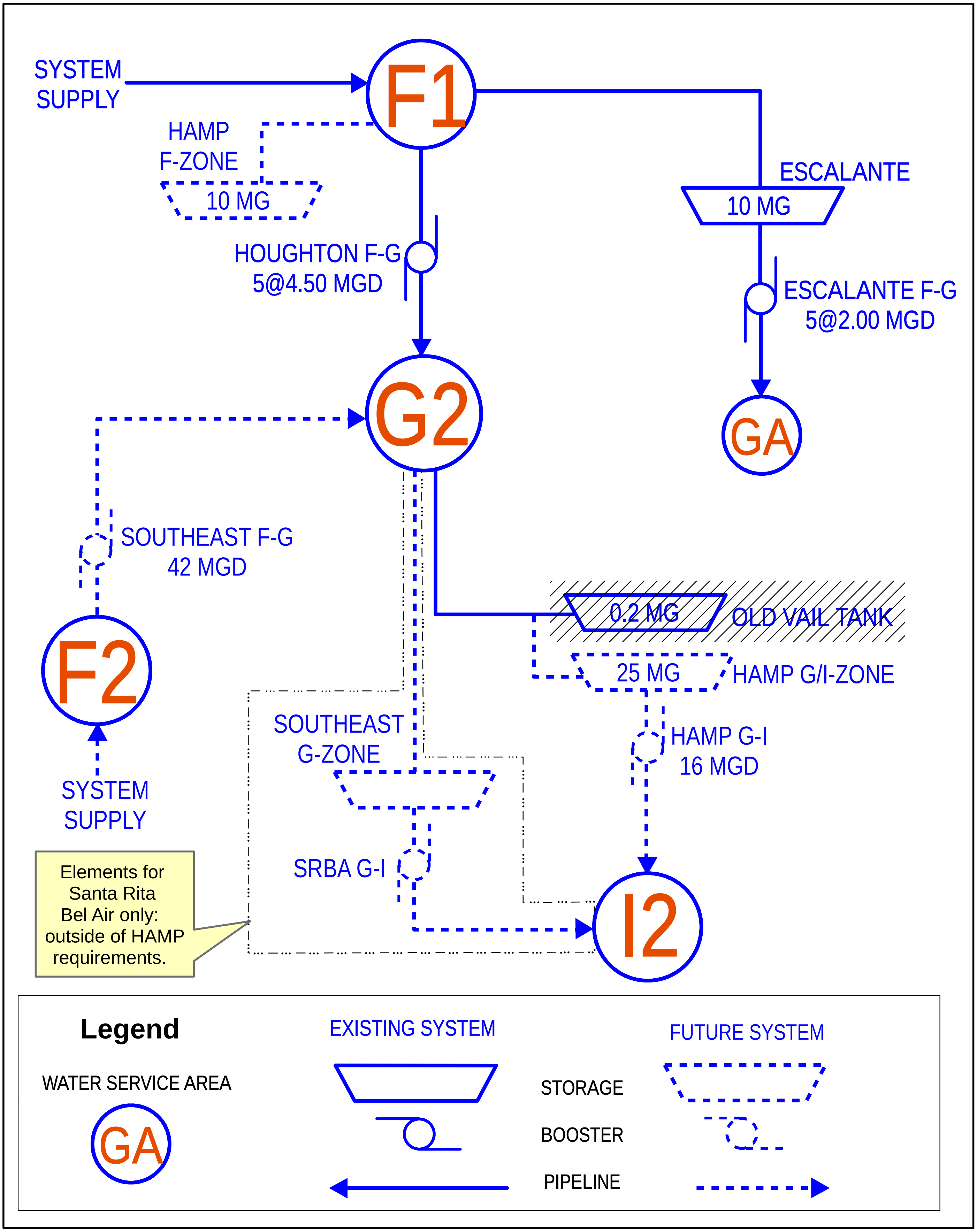
FIGURE 4-2



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POTABLE ALTERNATIVE 1 - SCHEMATIC

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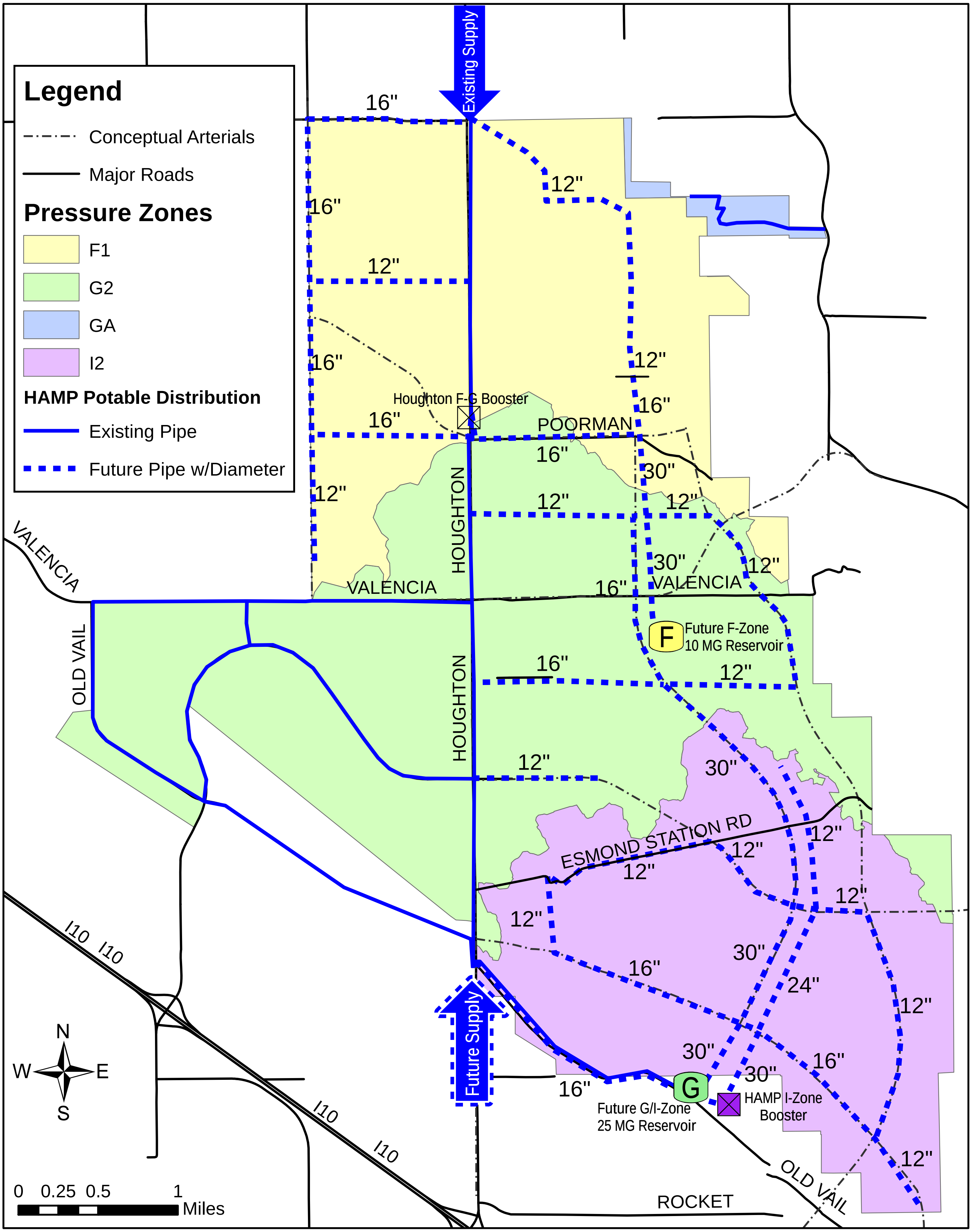
FIGURE 4-3



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ALT. 1 DISTRIBUTION LAYOUT AT BUILDOUT

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FIGURE 4-4

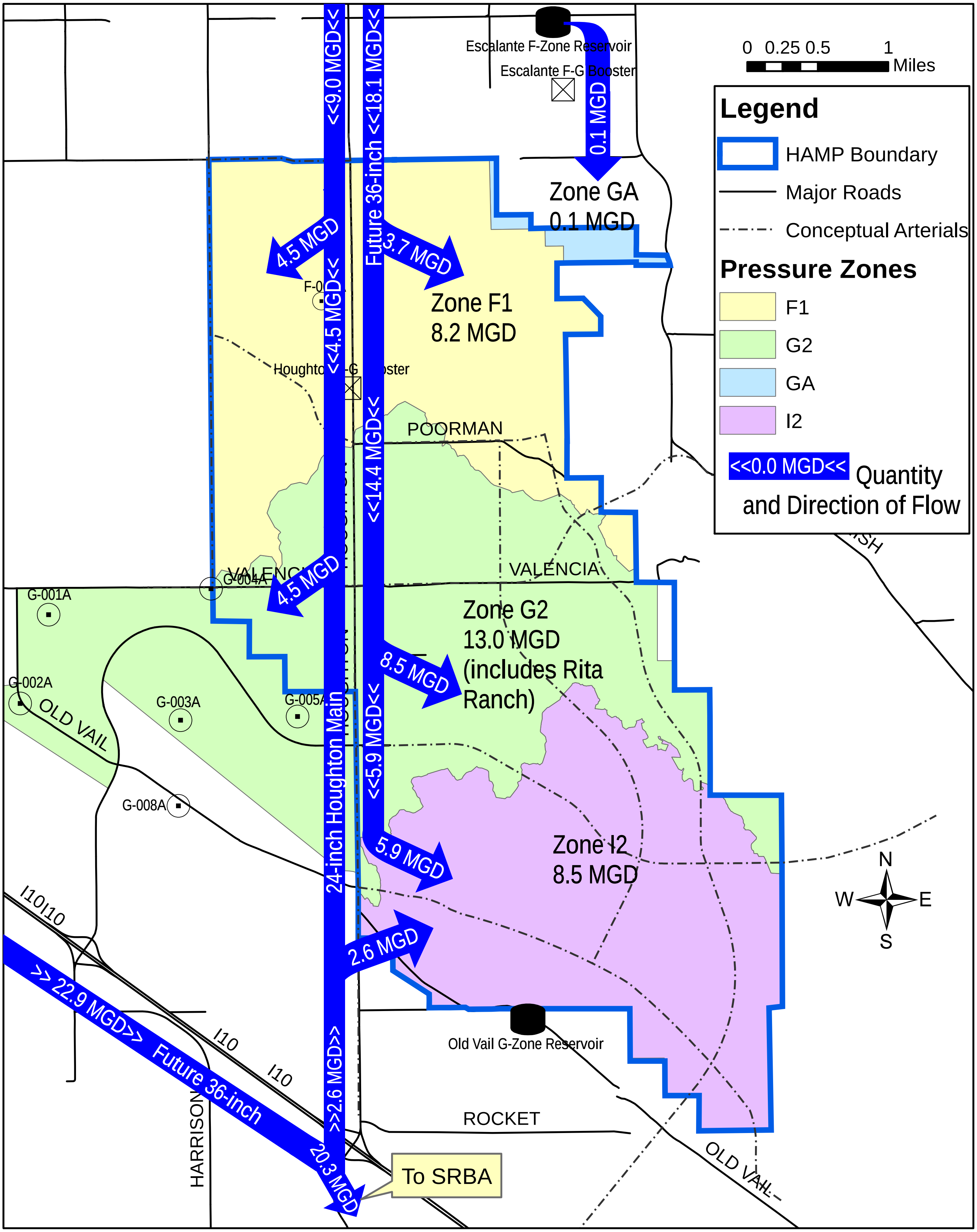
The conceptual distribution system would consist mostly of 12-inch and 16-inch diameter mains. The F1-Zone and G2-Zone would also require 30-inch diameter mains to connect the local distribution systems to their respective reservoirs. A 30-inch main would be required for the discharge from the HAMP I-Zone booster station, and another 24-inch main would be required in the central portion of the I-Zone. Under this alternative, a 16-inch main would be required to augment the capacity of the existing 24-inch main between Houghton Road and the proposed G-Zone reservoir site along Old Vail Road.

Alternative 1 would utilize the existing 24-inch Houghton Main from both the north and the south ends of the HAMP area and thus would limit the transmission main requirements within the HAMP area. Supply requirements for SRBA were handled outside of the HAMP area in this alternative, which is discussed further in Section 4.4.

4.3.3 Potable System Alternative 2

Alternative 2 was developed to accommodate future water delivery from both the north and the south to serve the HAMP/SRBA areas using two proposed mains of equal size. Under this alternative, projected peak day demand would require an additional 36-inch main from both the north and the south, although a significant portion of the south main capacity would replace the Houghton Main capacity needed to serve SRBA. The existing 24-inch Houghton Main would partially supply both the F1-Zone and G2-Zone from the north in order to fully utilize the existing 4.5 mgd F-G booster station. The balance of F-Zone and G-Zone demand would be supplied by the future 30-inch main, which would also contribute to the I-Zone via the HAMP G/I-Zone reservoir. The balance of I-Zone demand would be supplied from the proposed south main via the existing Houghton Main and proposed G/I-Zone reservoir. A 15-mgd booster station would be required on the proposed north main in the vicinity of the existing Houghton F-G booster, and a 24-mgd booster would be required outside of the HAMP area on the south. The proposed transmission layout for Alternative 2 is shown in Figure 4-5. The schematic for Alternative 2 is presented in Figure 4-6.

The distribution system for Alternative 2 (Figure 4-7) was laid out and sized with the same methodology used for Alternative 1. Conceptual reservoir locations and pipeline



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HAMP Potable and Reclaimed Water Conceptual Plan

POTABLE ALTERNATIVE 2 - PEAK DAY

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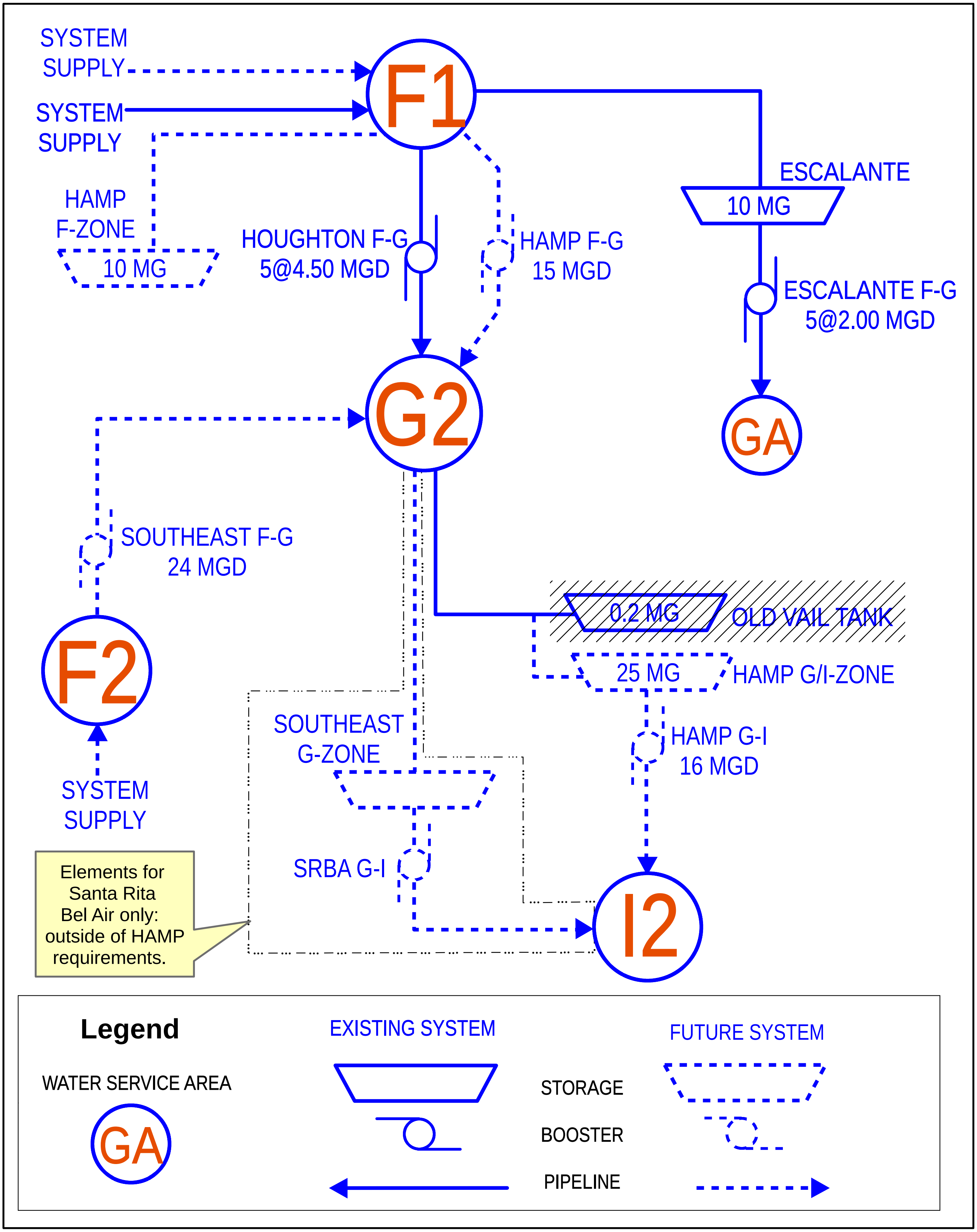
FIGURE 4-5



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POTABLE ALTERNATIVE 2 - SCHEMATIC

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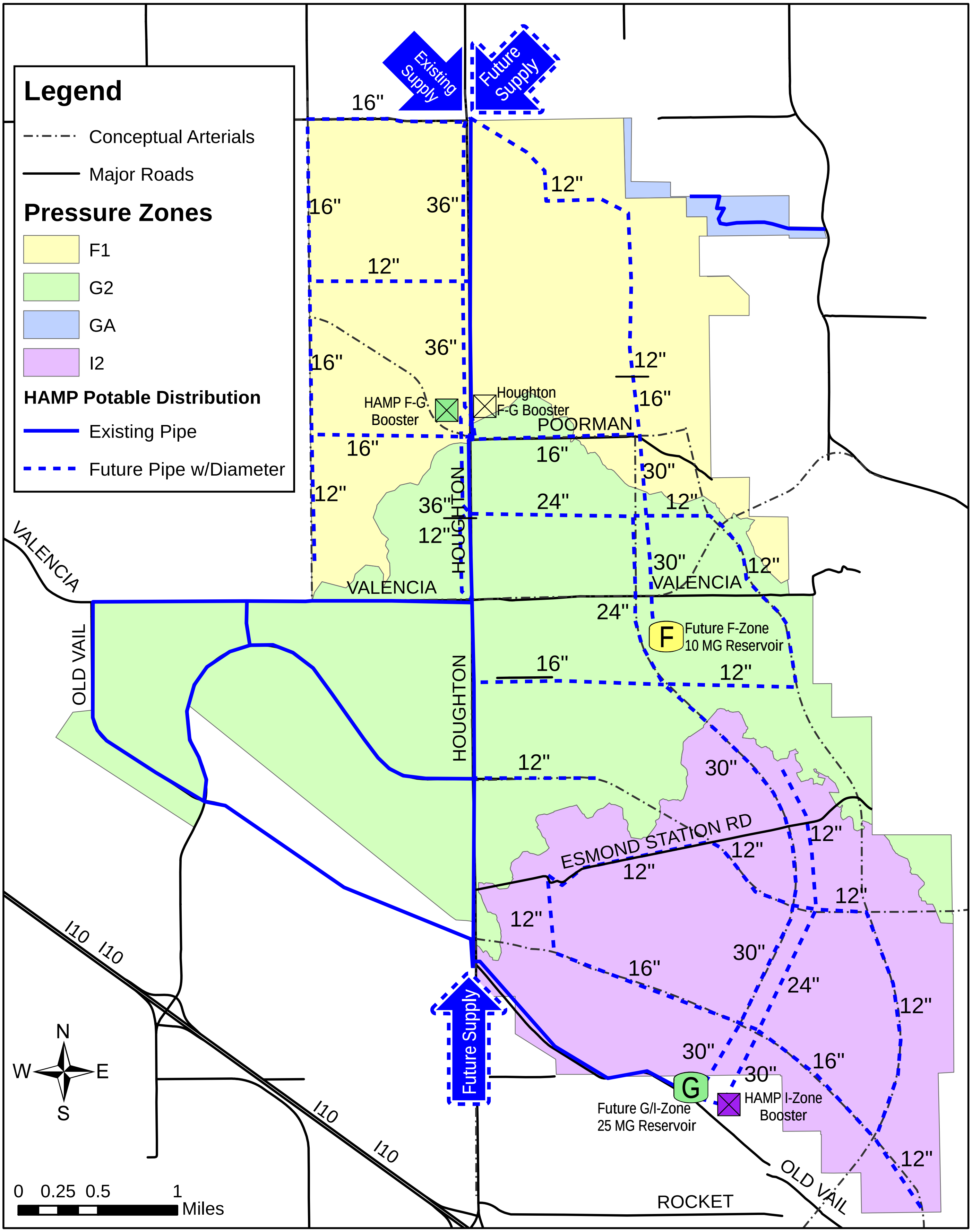
FIGURE 4-6



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ALT. 2 DISTRIBUTION LAYOUT AT BUILDOUT

FIGURE 4-7

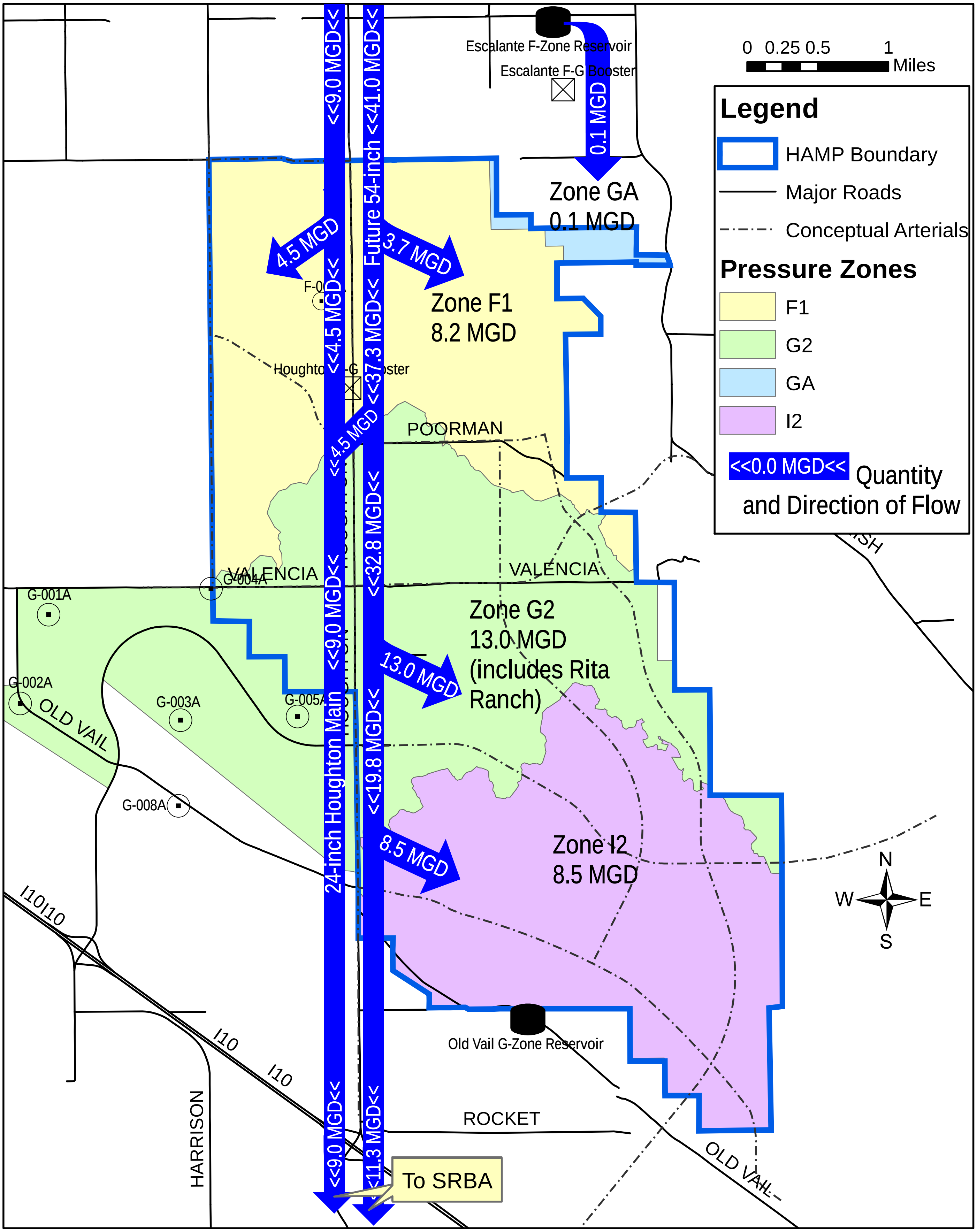
alignments were similar to facilitate comparison. Alternative 2 required more transmission infrastructure within the HAMP area compared to Alternative 1. Approximately 2.5 miles of 36-inch main were required along Houghton Road, and mains in the central G2-Zone were larger. However, augmentation along Old Vail Road would not be required.

4.3.4 Potable System Alternative 3

Alternative 3 was developed with future supply provided exclusively from the north of the HAMP area. A new 54-inch main would be required to bring new supplies into HAMP from the north and a new 38-mgd F-G booster station would be required in HAMP under this alternative. The F1-G booster station would be slightly smaller under Alternative 3 than the F2-G booster station in Alternative 1 because the spatial arrangement allows for greater use of the existing 4.5 mgd Houghton F-G booster station. However, this alternative would require additional transmission piping along Houghton Road to supply the SRBA area. Figure 4-8 shows the general transmission layout, and Figure 4-9 shows the flow schematic for Alternative 3.

The F-Zone would be supplied in the same manner as Alternative 2 in order to utilize the existing Houghton F-G booster. The existing 24-inch Houghton Main south of the booster would be used exclusively for transmission to SRBA. The future transmission main along Houghton Road would supply the HAMP F-Zone, G-Zone, and I-Zone as well as augment supply capacity to SRBA.

Development of the conceptual distribution system for Alternative 3 was similar to that described in the previous alternatives. The prominent feature of Alternative 3 was a larger transmission main along Houghton Road, which ranged in diameter from 36 inches to 48 inches within the HAMP area. Because of the configuration of an additional transmission main along Houghton Road, the distribution main connecting the G-Zone distribution network to the G/I-Zone reservoir was reduced to 24-inch diameter in Alternative 3. The conceptual distribution layout for Alternative 3 is shown in Figure 4-10.



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POTABLE ALTERNATIVE 3 - PEAK DAY

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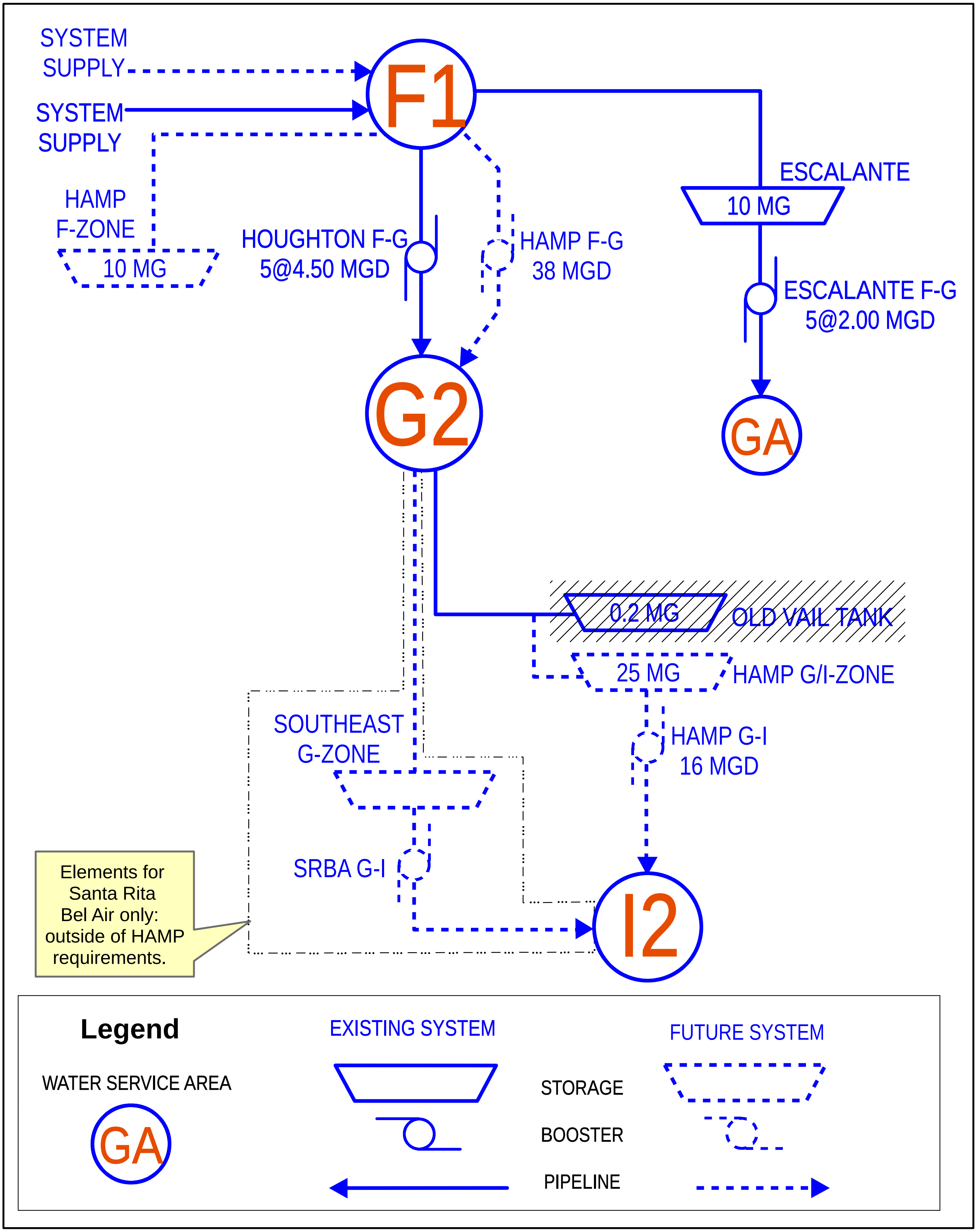
FIGURE 4-8



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HAMP Potable and Reclaimed Water Conceptual Plan

POTABLE ALTERNATIVE 3 - SCHEMATIC

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FIGURE 4-9

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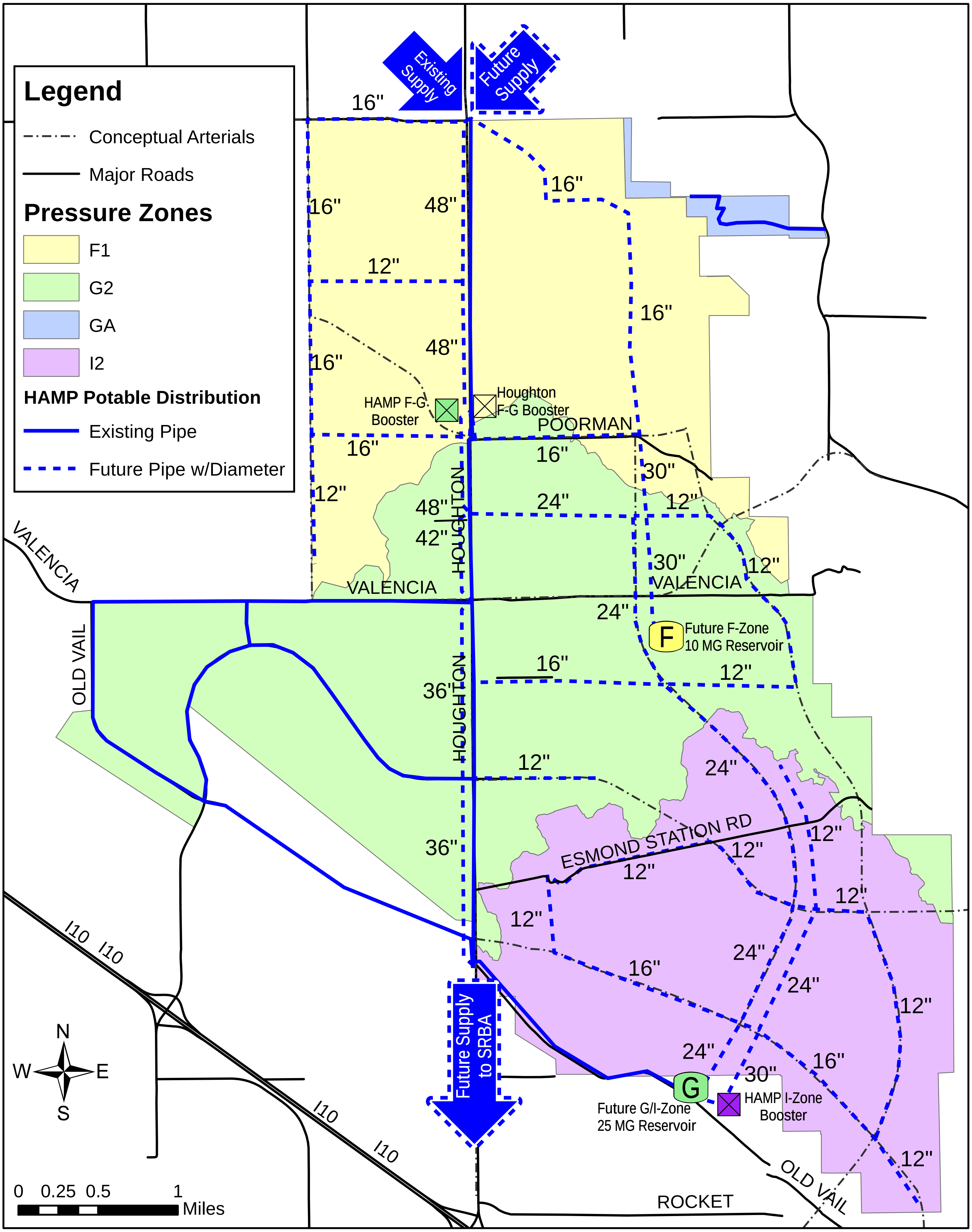

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ALT. 3 DISTRIBUTION LAYOUT AT BUILDOUT

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FIGURE 4-10

4.4 TRANSMISSION IMPROVEMENTS FOR HAMP ALTERNATIVES

The existing and planned potable water distribution system was evaluated to determine the extent of improvements needed to accommodate demand from the HAMP area. This section describes the existing potable water transmission system and future improvements that will be impacted by HAMP-area developments.

Tucson Water's current delivery system relies on the Hayden-Udall Water Treatment Plant (WTP) to treat and distribute recovered CAP water from the Clearwater Program. Treated water from the Hayden-Udall WTP is pumped to the Clearwell Reservoir and transmitted to the distribution system. Tucson Water's current CIP includes design and construction of major segments of a new transmission main intended to augment the existing transmission system and provide service to the area south and west of HAMP. The planned transmission main will originate at the Hayden-Udall WTP and terminate south of I-10 at Harrison Road. Using this planned transmission main to also serve the HAMP area would require increasing its size. The overall size impact and effects to other portions of the distribution system vary depending on which HAMP alternative is pursued.

Evaluations of existing and planned improvements to the potable transmission system were performed for each of the HAMP alternatives. Capacities based on the potable CIP were evaluated under revised flows for each alternative along the entire length of the proposed infrastructure. Modifications to infrastructure sizing were identified where necessary. To facilitate the evaluation of three transmission alternatives to support the HAMP area improvement alternatives described previously, the following assumptions were made for all transmission scenarios:

- Incremental capacity expansions to CIP components were identified back to the Hayden-Udall WTP for each alternative.
- Transmission main sizing was based on peak day demands.
- Existing CIP pipeline alignments were used to the extent possible.
- Transmission mains in the CIP were assumed to have no capacity for HAMP demands.

- Booster station capacity was equal to the pipeline capacity where booster stations were not identified in the CIP but would be required to operate a transmission main.
- As directed by Tucson Water, demand from the Santa Rita Bel Air area was included when sizing transmission mains. Transmission zone sizing included:
  - Demand for SRBA based on Transportation Analysis Zones 715, 732, 742, 749, 771, 772, 785, and 797 (2030 population projection of 69,130).
  - Supply to SRBA was assumed to be delivered at G-Zone elevation south of the junction of Houghton Road and I-10 for this analysis.

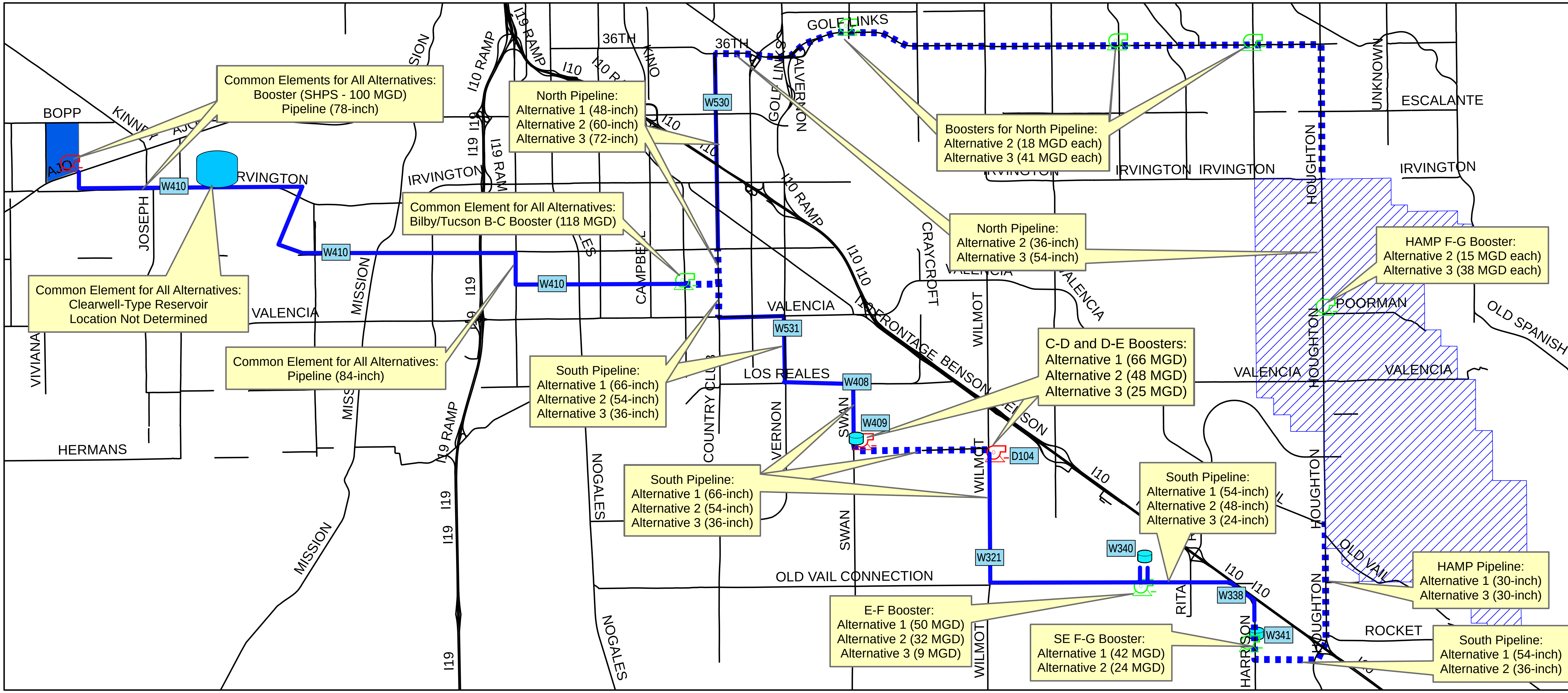
Figure 4-11 shows the transmission improvements that would be required for the three alternatives. The three transmission alternatives correspond with the potable system alternatives described in Section 4.3. The City's currently planned transmission main to serve new development to the south is referred to in the alternative descriptions as the South Main. The existing potable transmission main that extends along 36th Street and Golf Links Road from Country Club Road to Houghton Road is referred to as the North Main.

4.4.1 Potable System Alternative 1

To support Potable System Alternative 1, a 42-mgd booster station (SE F-G) would be required on the South Main. Transmission mains will be required as far as the Hayden-Udall WTP, but most transmission capacity can be obtained by increasing the diameter of existing CIP pipes and booster stations. Construction could be concentrated along corridors with low to moderate existing development.

4.4.2 Potable System Alternative 2

To support Potable System Alternative 2, a 24-mgd booster station (SE F-G) would be required on the South Main and a series of booster stations would be required on the North Main including a 15-mgd HAMP F-G booster. Transmission mains will be required as far as the Hayden-Udall WTP, but most transmission capacity to the south and a portion on the north could be obtained by increasing the capacity of existing CIP pipelines and booster stations. Under this alternative, construction would be spread across a much wider area including some densely developed areas along 36th Street and Golf Links Road.



Legend

- HAMP Area
- Major Roads
- Hayden Udall Water Treatment Plant
- W408 Tucson Water 2006 CIP Numbers
- Current CIP Pipes
- HAMP Alternative Boosters
- CIP Reservoirs
- HAMP Alternative Pipes
- Current CIP Boosters

NOTE: This map represents three alternatives for supplying water to the HAMP, Rita Ranch, and SRBA areas at the projected buildout peak day demand. Elements in the existing CIP were assumed to not include capacity for supplying HAMP, Rita Ranch, or SRBA with non-well water. Existing CIP elements were up-sized as needed to supply these areas for the three alternatives. Other demands may exist that will require further up-sizing of CIP elements. This map, therefore, should not be considered comprehensive.

0 0.5 1 2 Miles

N W E S

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HAMP Potable and Reclaimed Water Conceptual Plan

CURRENT POTABLE SYSTEM CIP AND ADDITIONAL IMPROVEMENTS TO SUPPORT HAMP ALTERNATIVES

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FIGURE 4-11

4.4.3 Potable System Alternative 3

To support Potable System Alternative 3, a 38-mgd booster station (HAMP F-G) and three 41-mgd booster stations would be required on the North Main. Transmission mains will be required as far as the Hayden-Udall WTP, and only a portion of the northern capacity can be obtained by increasing the capacity of existing CIP pipelines and booster stations. Much of the required infrastructure for this alternative will be along alignments that do not currently have CIP projects. Under this alternative, construction would be through developed areas along 36th Street and Golf Links Road.

4.5 CAPITAL IMPLEMENTATION SCHEDULE

The demands that form the basis of the operation planning are presented in Table 4-4 (See Figure 2-1 TAZ locations in the HAMP area). Demands from GA-Zone are presented in the tables and figures, but were assumed to be operationally separate from the other pressure zones because of how GA-Zone is currently linked to the Escalante Reservoir (See Figures 4-2, 4-5, and 4-8).

TABLE 4-4

DETAILED HAMP WATER DEMAND ESTIMATES

TAZ	Average Day Potable Water Demand Projections (mgd)					
	2005	2010	2015	2020	2025	2030
598	0.00	0.18	0.35	0.53	0.71	0.88
616	0.00	0.17	0.34	0.51	0.69	0.86
627	0.17	0.30	0.44	0.57	0.70	0.96
628	0.00	0.19	0.37	0.56	0.74	0.93
643	0.00	0.17	0.34	0.52	0.69	0.86
654	0.00	0.18	0.31	0.44	0.58	0.71
662	0.00	0.18	0.32	0.46	0.60	0.88
665	0.00	0.08	0.15	0.23	0.30	0.38
668	0.04	0.04	0.05	0.05	0.06	0.07
676	0.15	0.27	0.39	0.51	0.64	0.88
685	0.00	0.00	0.11	0.29	0.47	0.65
688	0.00	0.00	0.00	0.00	0.00	0.00
690	0.11	0.21	0.30	0.39	0.49	0.67
702	0.00	0.00	0.32	0.76	1.19	1.62
712	0.00	0.33	1.13	1.93	2.73	3.54
740	0.00	0.00	0.05	0.17	0.29	0.41
Totals	0.5	2.3	5.0	7.9	10.9	14.3
Average Day	0.5	2.3	5.0	7.9	10.9	14.3
Peak Day	0.9	4.1	9.0	14.3	19.6	25.7
Peak Hour	1.5	7.2	15.7	25.0	34.2	45.1

4.5.1 Initial Conditions

The initial conditions in the HAMP area are characterized by low water demands due to relatively low population densities in the area. The principal source of water is from the G-Zone production wells located in Rita Ranch. The quantity of water pumped from these wells is generally more than the combined demands from Rita Ranch and the HAMP area. The additional flow goes north via the Houghton main to the larger distribution system.

4.5.2 Buildout

The predicted condition at buildout is very different from the initial condition. Tucson Water plans to phase out the routine use of production wells near the HAMP area, and Rita Ranch wells will only be used in emergencies. The three alternatives described in Sections 4.3 and 4.4 address the buildout condition.

4.5.3 Transition Plan

A transition plan was developed to highlight milestones when major infrastructure would need to be in place in order to meet demands in the HAMP area. The transition plan also highlights when water resources will likely shift from exclusive reliance on local groundwater to system water.

The initial condition of water resources is that local groundwater from the Rita Ranch area is more than sufficient to meet demands in the HAMP area. However, groundwater pumping rates have declined over time and are expected to continue to decline as groundwater levels drop. Tucson Water has indicated that use of wells near the HAMP area will be discontinued, although no firm date has been set for discontinuation. Declines in pumping rates over time for the G-Zone wells in Rita Ranch have been projected for the planning period and are included in Table 4-5.

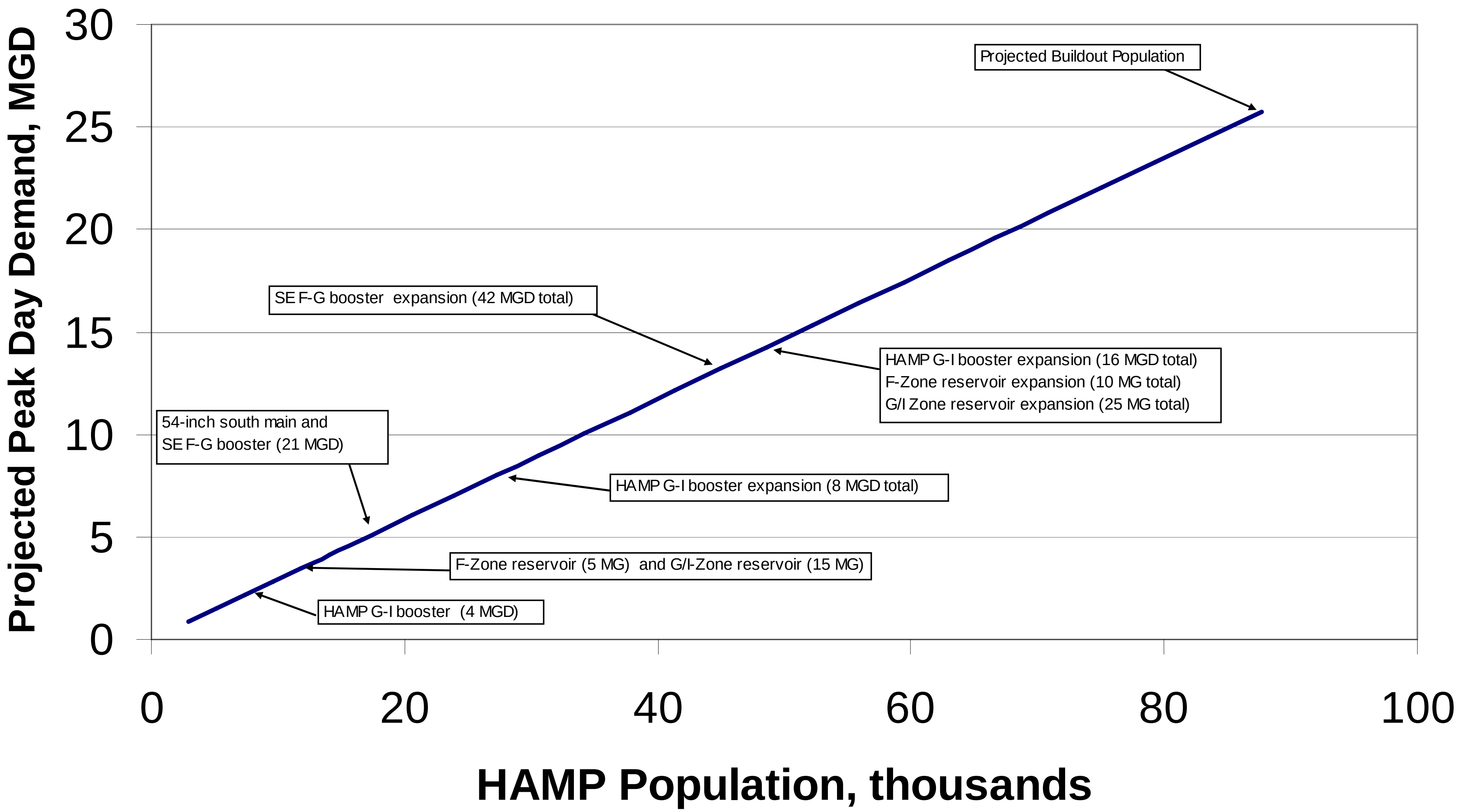
TABLE 4-5

RITA RANCH G-ZONE WELL PEAK PRODUCTION ESTIMATES

		Estimated Maximum Flow, gpm[1]					
Well	Start Year	2005	2010	2015	2020	2025	2030
G-001	1996	764	636	508	380	252	123
G-002	1995	882	854	827	800	772	745
G-003	1996	847	753	660	566	472	379
G-004	1997	787	663	538	413	288	164
G-005	1998	498	426	353	281	208	135
G-008	2000	1450	1255	1059	863	667	472
	Sum, gpm	**5,229**	**4,587**	**3,944**	**3,302**	**2,660**	**2,017**
	Sum, MGD	**7.5**	**6.6**	**5.7**	**4.8**	**3.8**	**2.9**

[1]Projected from Maximum Pumping Test Data, Standard Linear Regression

The estimates for G-Zone well production were used to estimate when infrastructure must be in place to bring additional water resources to the HAMP area independent of Tucson Water's planned transition to renewable water sources. Implementation schedules were developed for each alternative based on population and demand projections. Figures 4-12, 4-13, and 4-14 show proposed capital implementation schedules for Alternative 1, Alternative 2, and Alternative 3, respectively. Several major infrastructure components are equivalent for the three alternatives including reservoir



Note: Buildout population was based on PAG projections for 2030. Population/demand estimates for infrastructure components are based on completion of the infrastructure. Areas outside of HAMP (Rita Ranch and Corona de Tucson) were also considered in the implementation schedule.

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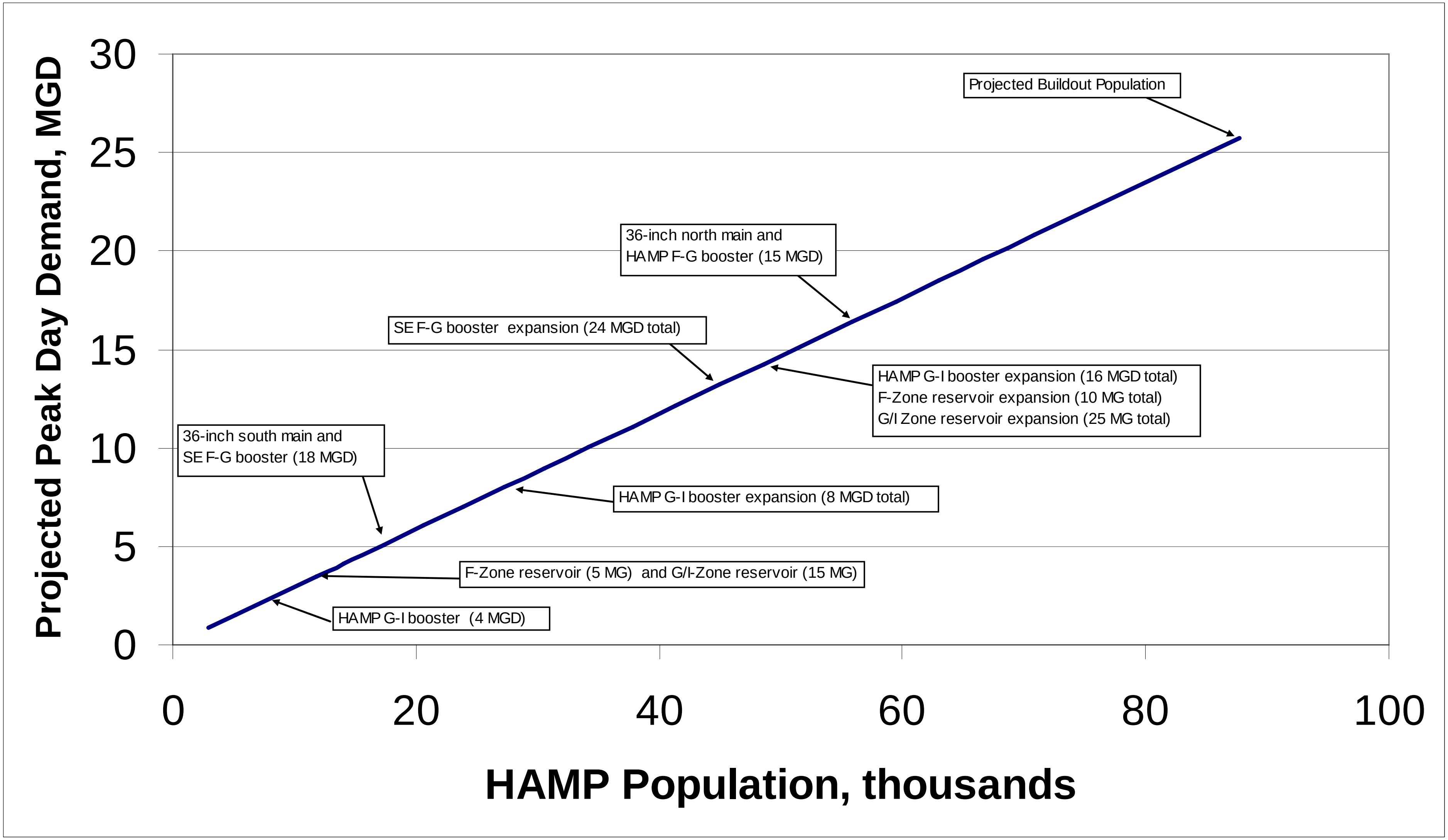

Note: Buildout population was based on PAG projections for 2030. Population/demand estimates for infrastructure components are based on completion of the infrastructure. Areas outside of HAMP (Rita Ranch and Corona de Tucson) were also considered in the implementation schedule.

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CAPITAL IMPLEMENTATION SCHEDULE POTABLE ALTERNATIVE 2

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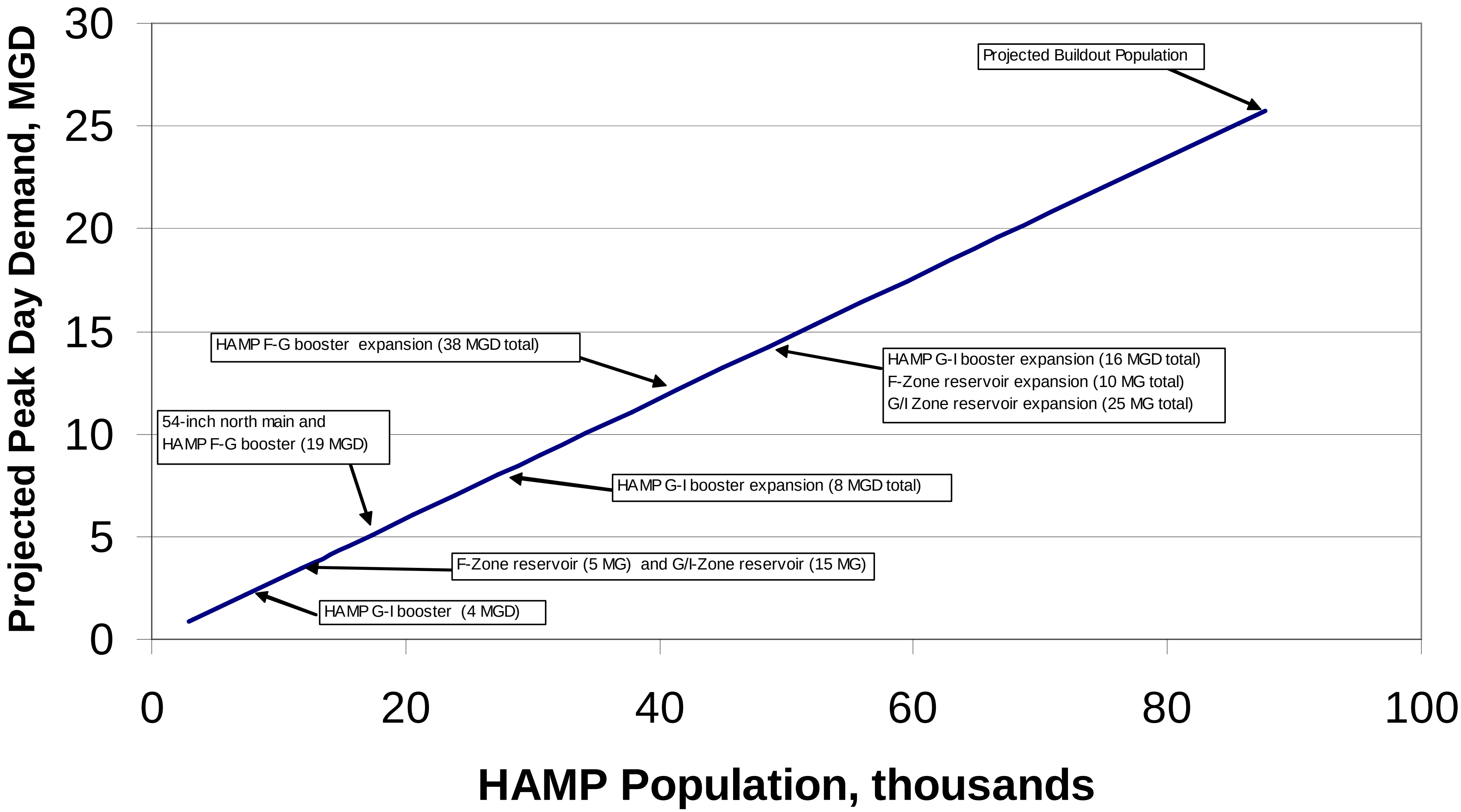
FIGURE 4-13



Note: Buildout population was based on PAG projections for 2030. Population/demand estimates for infrastructure components are based on completion of the infrastructure. Areas outside of HAMP (Rita Ranch and Corona de Tucson) were also considered in the implementation schedule.

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capacity for all zones and the booster capacity of the HAMP G-I booster. Reservoir phasing will depend on actual development within the HAMP area and may require additional analysis to optimally phase in reservoir capacity to avoid excess volumes that could lead to water quality problems associated with water age. The major component of the implementation plan for all alternatives will be completion of a transmission main to the HAMP area from the Hayden-Udall WTP before the HAMP population reaches approximately 20,000, which is projected to occur in 2011.

5.0 RECLAIMED WATER SYSTEM

The principal documents describing the City's planned reclaimed water usage are the *Reclaimed Water System Master Plan* and *Water Plan: 2000-2050* (Water Plan). The recommendations from the Water Plan that may affect reclaimed water use in the HAMP area include:

- **Fully Utilize Effluent for Future Supply –** Tucson Water has a goal to minimize discharge of its effluent to the Santa Cruz River. Development in the HAMP area will be an opportunity for planning of reclaimed water use ahead of development.
- **Utilize Effluent as a Wet-Water Resource** - Recharge in the HAMP area could be considered if a HAMP area wastewater treatment facility is constructed.
- **Expand Regional Cooperation –** Expansion of the reclaimed water system in the HAMP area opens the possibility of cooperation with the Vail Water Company whose service area is located southeast of the HAMP area. Delivery and use of reclaimed water in the Vail area would ease demand on groundwater pumping in the Tucson AMA and would provide the Vail Water Company with another option for a sustainable water resource.

5.1 EXISTING RECLAIMED WATER PRODUCTION FACILITIES

5.1.1 Roger Road Reclaimed Water Plant

The Roger Road Reclaimed Water Plant receives effluent from Pima County's Roger Road WWTP to produce reclaimed water. A combination of pressure filters and chlorine contact is used to meet ADEQ reclaimed water standards for open access irrigation. The filtration capacity is approximately 8.3 mgd. The Pima County Regional Wastewater Reclamation Department (PCRWRD) has begun implementing the Regional Optimization Master Plan (ROMP which includes replacing the Roger Road WWTP with a new Water Reclamation Campus. Tucson Water and PCRWRD are currently planning a strategy for integrating the ROMP with the reclaimed water system that also includes effluent generated by the Ina Road WPCF. Final planning could impact the long-term operating plans of the Roger Road Reclaimed Water Plant, although it is not expected to significantly affect the portion of the reclaimed water system that serves the HAMP area.

5.1.2 Sweetwater Underground Storage and Recovery Facility

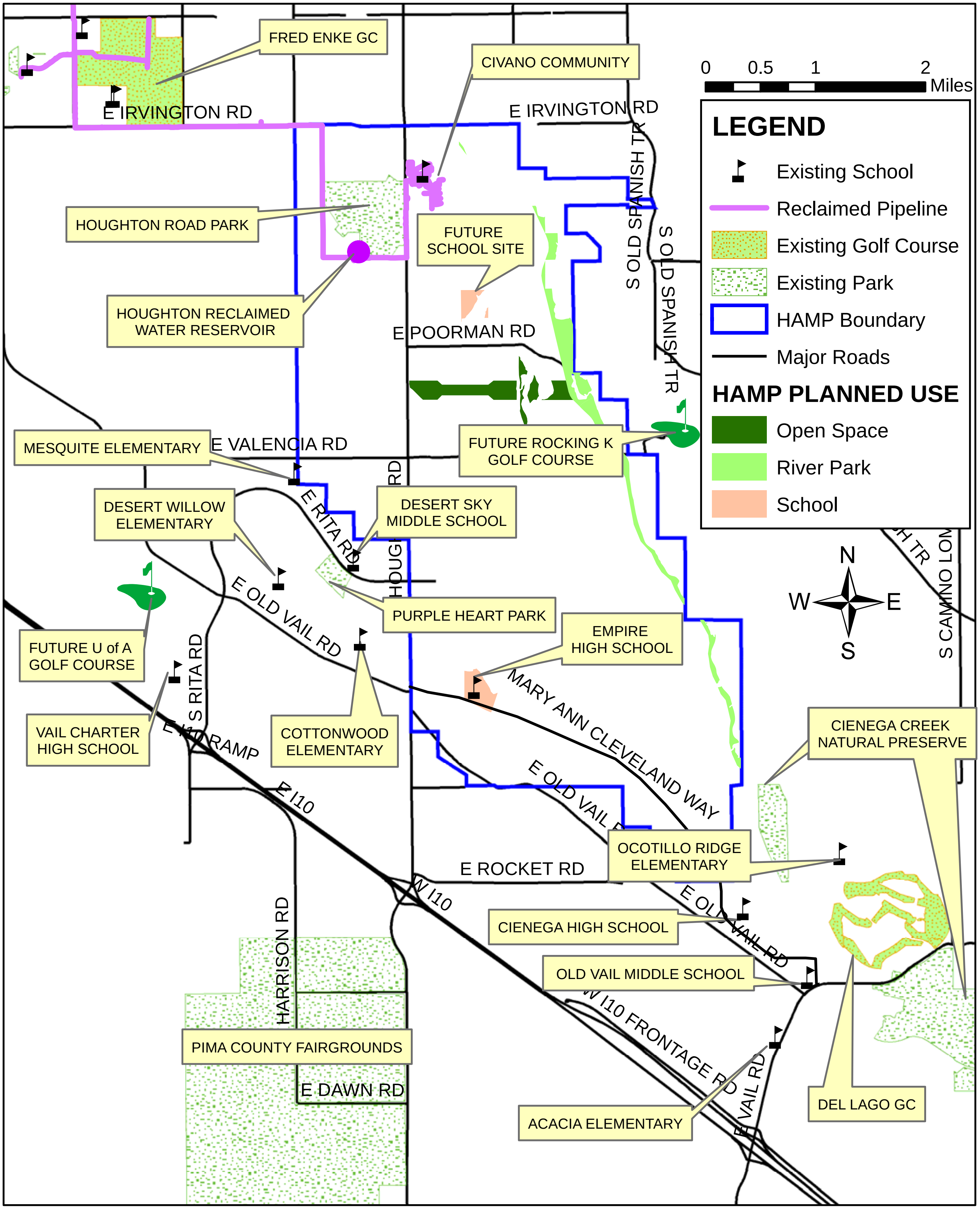
When the demand in the reclaimed system is less than the production rate at the Roger Road Reclaimed Water Plant, the excess water is stored at the Sweetwater Underground Storage and Recovery (US&R) Facility. This stored water is recovered to augment the production capacity of the filtration plant to meet summer peak reclaimed water system demands. The Sweetwater US&R facility is a quasi-production facility in that its function is principally to store reclaimed water, but it also provides filtration and limited nitrogen removal capacity.

5.1.3 Randolph Park Water Reclamation Facility

The Randolph Park Water Reclamation Facility is owned and operated by PCRWRD. Approximately 3.0 mgd of Class A+ reclaimed water is produced at this facility and pumped directly into the reclaimed water distribution system via a booster station located adjacent to the facility. A membrane bioreactor configuration is used for BOD and turbidity removal, which is followed by UV disinfection. When reclaimed demands fall below the production level of this facility, the water is piped through the reclaimed system and recharged at the Sweetwater US&R facility.

5.2 EXISTING AND PLANNED RECLAIMED WATER SYSTEM IN THE HAMP PLANNING AREA

The extent of existing reclaimed water system infrastructure in the HAMP area is currently very limited. The 4.5 MG Houghton Reservoir is located in the northwestern portion of the HAMP area, as shown in Figure 5-1. A booster station is located adjacent to the Houghton Reservoir to supply existing customers in the HAMP area. A 24-inch transmission main connects the reservoir and booster station to a pressure relief valve (PRV) located along Houghton Road to regulate pressure at the Civano Community. The main reduces to 12 inches north (downstream) of the PRV. Currently the Civano Community is the only area served in the HAMP planning area.



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HAMP Potable and Reclaimed Water Conceptual Plan

EXISTING RECLAIMED WATER INFRASTRUCTURE AND POTENTIAL REUSE SITES

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FIGURE 5-1

5.3 PROJECTED RECLAIMED WATER USE

In Section 2.0, preliminary estimates of reclaimed water demand in the HAMP planning area were developed using Tucson Water's system-wide reclaimed water demand factor of eight percent of the total water demand. The Wastewater Conceptual Plan also included an initial survey of existing schools and golf courses in and near the HAMP area to provide an estimate of potential reclaimed water demand. This section presents refinements to the reclaimed water demand projections for the HAMP area and also identifies potential reclaimed water customers outside of, but near, the HAMP area. Figure 5-2 shows the spatial arrangement of those potential reclaimed system demands identified in the Wastewater Conceptual Plan.

5.3.1 HAMP Area Demands

In *Exhibit 9* of the *Houghton Area Master Plan*, guidelines for new park facilities in the HAMP area were defined. The quantity, sizes, and projected reclaimed water demand for parks in the HAMP planning area, using the established guidelines, are summarized in Table 5-1. The planned park acreages were projected based on a HAMP population of 88,000. City of Tucson Department of Parks and Recreation staff have indicated that detailed planning has not begun. Staff indicated that new parks will not be turf "curb-to-curb" as in the past, but that an average for all parks (including sports fields) will be at least 30% turf to possibly 50% turf. As shown in Table 5-1, the required average reclaimed water demand for parks in the HAMP area will be in the range of 0.64 to 1.51 mgd. A conservative estimate of 1.5 mgd was assumed as the total reclaimed water demand for parks in the HAMP area. Although this demand by itself is higher than eight percent of the total projected water use for the area, it recognizes that the City of Tucson has historically had low park acreage per capita and that the Parks and Recreation Department plans to be more aggressive with acquiring park acreage in the HAMP area.

TABLE 5-1

PLANNED PARK ACREAGE AND PROJECTED WATER DEMAND

Facility Type	Standard Park Size[1]	Service Radius of Park[1]	Facility/Total Population Ratio[1]	Total Estimated Park Area[2]	Reclaimed Water Required[3] - 30%	Reclaimed Water Required[3] - 50% Turf
	Acres	Miles	Acres/1000 people	Acres	MGD, average	MGD, average
Mini	1 max.	0.25	1	88	0.08	0.13
Neighborhood	1-15	0.5	2.5	220	0.19	0.31
Community	15-40	1	3	264	0.23	0.38
Metro	40-200	2.5	3.5	308	0.26	0.44
Regional	>200	7	2	176	0.15	0.25
			Total, all parks	1056	0.90	1.51
			Total, parks >15 acres	748	0.64	1.07

[1]Based on Houghton Area Master Plan

[2]Based on a HAMP buildout population of 88,000

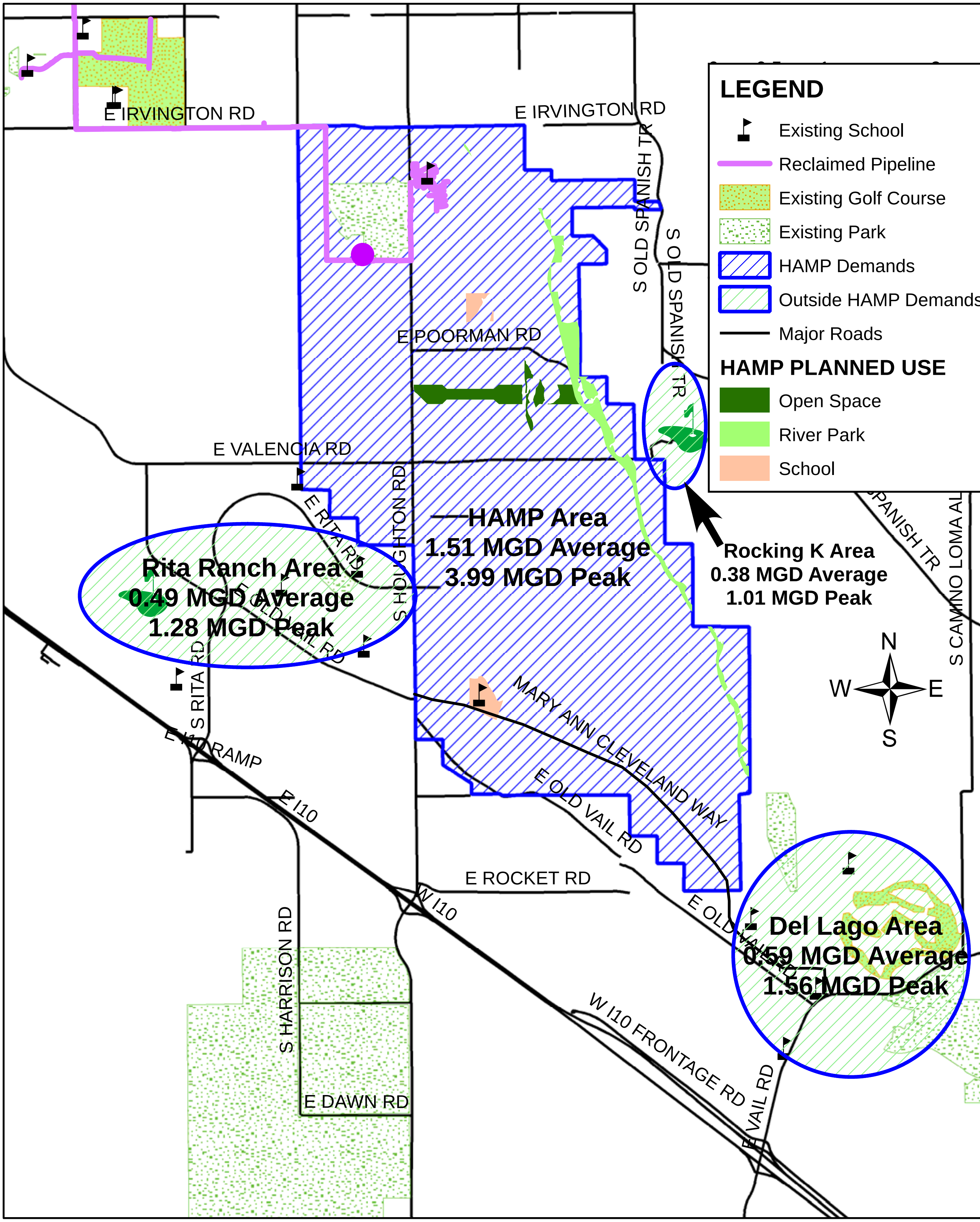
[3]Based on 3.2 acre-feet per acre for parks per Reclaimed Water Master Plan

The City of Tucson-owned area in northwest HAMP that is identified on Figure 5-1 as Houghton Road Park is now anticipated to be incorporated into the existing Fantasy Island mountain bike park. Because the irrigation requirement for this park is not yet known, its reclaimed water demand was only based on the criteria of Table 5-1 and will require revision as specific plans are developed.

Both Empire High School and a future Vail School District site were also identified to require approximately 12 acres each of irrigated turf. Demand at the Civano Community was estimated based on previous averages.

5.3.2 Adjacent Areas

Potential reclaimed water customers have also been identified in areas directly adjacent to the HAMP area and are shown on Figure 5-2. Rita Ranch includes several existing schools and a park that could utilize reclaimed water. The Del Lago area also has several existing schools and the Del Lago Golf Course. The golf course has surface water rights on Cienega Creek, which the owners currently use for irrigating the golf course; however, Del Lago's development agreement with Pima County stipulates that the course must be converted to reclaimed water if the reclaimed water system is extended to within three miles of the golf course. The Del Lago area is approximately 400 feet higher in elevation than the Houghton Reservoir, which is the current high point in the reclaimed water system. The area south of Interstate 10 along Houghton Road has potential



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RECLAIMED WATER -PROJECTED DEMANDS

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FIGURE 5-2

reclaimed users including the Santa Rita Golf Club. However, the area is approximately 650 feet higher than the Houghton Reservoir, and the 1999 *Reclaimed Master Plan* determined that service to the Santa Rita Golf Club was not economically justified. Table 5-2 lists estimated reclaimed water demands adjacent to the HAMP area.

TABLE 5-2

POTENTIAL RECLAIMED WATER CUSTOMERS

ADJACENT TO THE HAMP AREA

Area	Acres[1]	Category	Estimated Irrigated Acres	Existing Demand		Future Demand	
				Average, MGD	Peak Day, MGD	Average, MGD	Peak Day, MGD
Rita Ranch Area							
Purple Heart Park (Rita Ranch)	39	Park	12	0.03	0.09	-	-
Future UA Tech Park Golf Course[2]	-	Golf Course	83	-	-	0.38	1.01
Mesquite Elementary	15	School[3]	5	0.02	0.04	-	-
Desert Willow Elementary	16	School	5	0.02	0.04	-	-
Desert Sky Middle School	28	School	8	0.02	0.06	-	-
Cottonwood Elementary	15	School	5	0.02	0.04	-	-
			Sum	0.10	0.27	0.38	1.01
Rocking K Ranch Area							
Future Golf Course[2]	-	Golf Course	83	-	-	0.38	1.01
			Sum	-	-	0.38	1.01
Del Lago Area							
Del Lago[4]	195	Golf Course	-	0.48	1.28	-	-
Cienega High School[4]	55	School	-	0.05	0.14	-	-
Acacia Elementary	15	School	5	0.02	0.04	-	-
Old Vail Middle School	29	School	8	0.02	0.06	-	-
Ocotillo Ridge Elementary	12	School	5	0.02	0.04	-	-
			Sum	0.59	1.56	-	-

[1]Acreage based on Pima County GIS for existing parcels and HAMP GIS for future use.

[2]Based on Arizona Department of Water Resources limit of 428.5 AF/yr for new 18 hole golf courses. These limits do not necessarily apply if only reclaimed water is used.

[3]The Reclaimed Water Master Plan assumes turfed acreages for high schools, middle schools, and elementary schools of 12, 8, and 5 acres, respectively.

[4]Based on historical use data.

5.4 SUPPLEMENTING RECLAIMED WATER SYSTEM PRODUCTION WITH NEW TREATMENT FACILITY IN HAMP AREA

5.4.1 Screened Wastewater Treatment Alternatives

After non-cost screening of the wastewater treatment alternatives, only one scenario that included constructing a new treatment of wastewater in the HAMP area was considered viable. The treatment scenario would involve treating an average wastewater flow of 5.0 mgd at buildout. The proposed site for this facility is located in the northeast corner of the Poorman Gunnery Range (southwest corner of Irvington Road and Harrison Road), and discharge to the reclaimed system was assumed to include pumping to the high water level of the Houghton Reclaimed Reservoir.

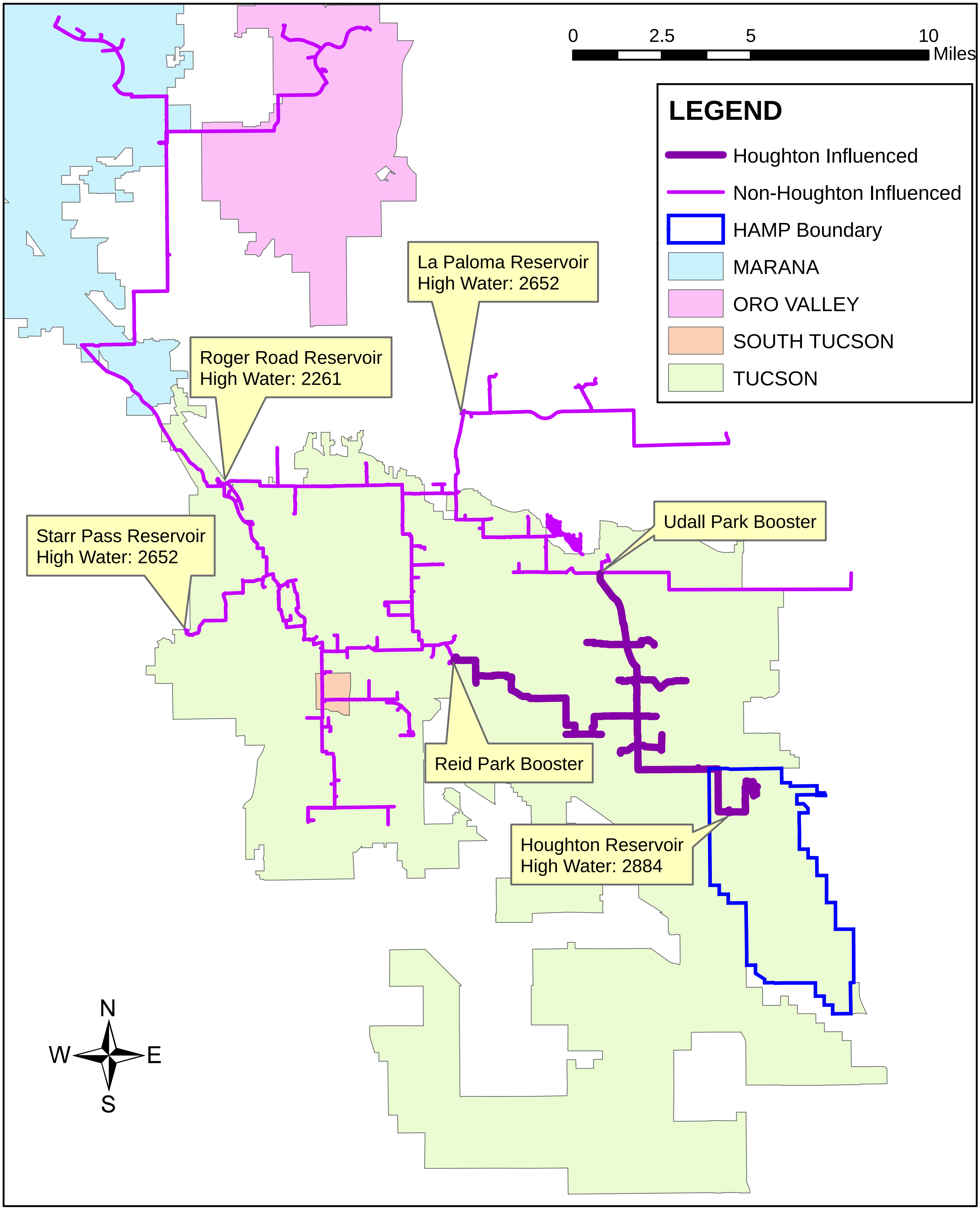
5.4.2 Seasonal Demand

Seasonal demand in the reclaimed system varies widely. High demands are experienced during the hot summer months when irrigation water use is high. However, demand is reduced significantly during winter months. The recent summer peak day demand of 28.4 mgd occurred on June 20, 2006. From 2001 to 2005, the minimum winter single-day demand varied from 0.2 to 0.8 mgd. The variance in seasonal reclaimed water demand would require finding a use for wastewater effluent from the proposed HAMP wastewater treatment facility during periods of low demand.

Tucson Water currently uses the Sweetwater US&R Facility to store effluent during low demand periods. 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 recharge capacity or construction of alternative facilities for effluent management would be required to accept the additional HAMP flows during low-demand periods.

5.4.3 Performance Evaluation

A principal driver for a wastewater treatment facility in the HAMP area has been to have a reclaimed water source at a higher elevation to save pumping costs. To evaluate potential energy savings from reduced pumping requirements, the reclaimed system was divided into two areas: 1) the portion of the reclaimed distribution system that is directly influenced by the Houghton Reservoir, and 2) the remainder of the system. Figure 5-3 shows the two areas of influence. The average demands in each area were then analyzed (using 2005 demands) and presented as a percentage of the total system demand. Projected demands developed in Section 5.3 were used to estimate future system influences due to development in the HAMP area. The number of days per year falling within specific demand increments was estimated for 2005 based on historical data and



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RECLAIMED INFLUENCE ZONES

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FIGURE 5-3

for 2030 based on extrapolations of demand and historic seasonal variation. Assumptions for the analysis included:

- A hypothetical 5.0 mgd reclaimed source is available at the Houghton reservoir.
- Water is fully utilized in the Houghton Influenced area before being utilized in the lower area.
- If the demand for both areas on a given day was estimated to be less than 5.0 mgd, then the difference was not counted towards pumping savings.
- Electric power costs were based on the 2006 rate of $0.08 per kilowatt hour.
- The differences in static water levels from the Sweetwater US&R Facility to the Houghton and Non-Houghton influence area high-water levels shown on Figure 5-3 were used as the basis for static pumping head requirements.
- Pipeline friction losses were estimated based on 0.7 feet of head per 1,000 feet with an average transmission distance of 85,000 feet for the Houghton Influenced Area and 25,000 feet for the non-Houghton Influenced Area.
- Disregarding the effects of the Randolph Park WRF would not influence the analysis.

The analyses showed that by 2030, the Houghton Influenced Area could use the entire 5.0 mgd of effluent generated within the HAMP area approximately 225 days per year. A summary of the calculations is presented in Table 5-3.

TABLE 5-3

PERFORMANCE EVALUATION CALCULATIONS

	Houghton Influenced	Non-Houghton Influenced	
Max Elevation above Sweetwater, feet	559	391	
Estimated Dynamic Head, feet	60	18	
Average Total Dynamic Head, feet	619	409	
Year 2005			SUM
Approximate % of Total Demand	14.5%	85.5%	100.0%
Winter Pumping Saved, MG	142	597	740
Summer Pumping Saved, MG	386	529	915
Total $ Saved per Year	$57,000	$81,000	$138,000
		Total $ Saved per Year	$138,000
Year 2030			SUM
Approximate % of Total Demand	32.8%	67.2%	100.0%
Winter Pumping Saved, MG	516	286	802
Summer Pumping Saved, MG	915	0	915
Total $ Saved per Year	$155,000	$21,000	$176,000

Note: Costs are in 2006 dollars.

5.4.4 System Improvements

Operation of the reclaimed water distribution system with a production facility in the HAMP area would require changes to the distribution system. A hydraulic model showed that the existing reclaimed distribution system could move HAMP effluent to be recharged at the Sweetwater US&R Facility without major improvements. However, system modifications would be required to allow water from the reclaimed system to be released to the Sweetwater US&R. This arrangement would include automated valves designed to divert flow to the Sweetwater US&R when the La Paloma, Starr Pass, and Thornydale Reservoirs are full.

5.4.5 Conclusions

The apparent power savings provided by introducing effluent from a HAMP area treatment facility to the reclaimed water system are projected to vary between $138,000 per year and $176,000 per year. In addition, modifications to the reclaimed system and Sweetwater US&R to accept the additional flow from the reclaimed system would be required, including the addition of new basins and modifications to enable increased flow from the system to the basins.

The PCRWRD HAMP Wastewater Conceptual plan identified projected costs of building a new facility in HAMP are between $81.3 million and $123.5 million, depending on the process selected. In addition, annual operating costs were estimated at $1 million, based on PCRWRD experience operating similar facilities.

Based on this analysis, the projected cost benefits to the reclaimed system are considerably less than the combination of costs associated with modifications to the reclaimed system and constructing and operating a new water reclamation facility in the HAMP area. The recommended planning alternative of the HAMP Wastewater Conceptual Plan includes flexibility to construct a treatment facility in the area should the policies and economics in the area determine that at HAMP treatment facility is warranted sometime in the future.

5.5 DEVELOPMENT OF RECLAIMED SYSTEM ALTERNATIVES

WaterCAD hydraulic modeling software was used to evaluate system alternatives in the HAMP area. Alternatives for expanding the reclaimed water system to serve existing and potential demand in and adjacent to the HAMP planning area were developed and evaluated. Because only one wastewater treatment scenario evaluated in the *HAMP Wastewater Conceptual Plan* included discharging reclaimed water to the Houghton Reservoir, the reclaimed water system alternatives developed focused only on improvements in the HAMP area, downstream of the existing Houghton Reservoir.

Peaking factors developed in the *1999 Reclaimed Water System Master Plan* were used for system evaluation. The peaking factors are summarized below:

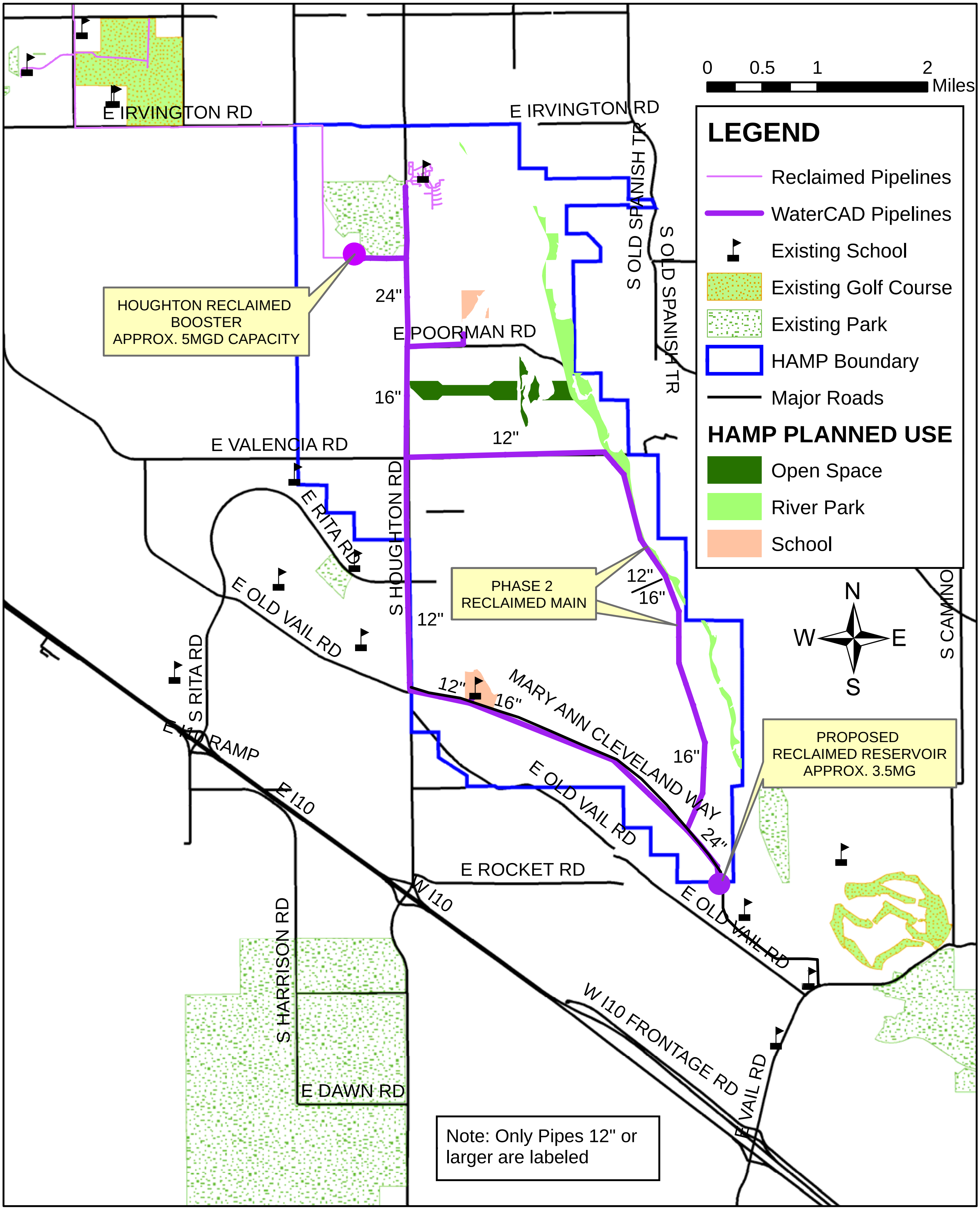
- Peak day – 2.9 times average day demand.
- Peak hour (facilities with on-site storage) – 3.49 times average day demand
- Peak hour (facilities without on-site storage) – 8.70 times average day demand

For the purposes of evaluation, golf courses were assumed to have one day of on-site storage in accordance with Tucson Water policies. All other facilities were assumed not to have on-site storage.

Three reclaimed water system alternatives were developed and evaluated. WaterCAD hydraulic modeling software was used to simulate system operation for each of the alternatives using performance criteria established in the 1999 *Reclaimed Water System Master Plan*. The reclaimed water system alternatives and evaluation assumptions are described below:

5.5.1 Alternative 1

The initial alternative was developed with a looped concept for HAMP area demands only, which included Civano, HAMP area schools, and parks. The estimated 1.5 mgd average day demand for parks was assumed to be distributed evenly throughout the HAMP area to 18 nodes at roughly half-mile intervals. A new reservoir located in the southeast portion of HAMP was also assumed. Figure 5-4 shows the reclaimed Alternative 1 layout and pipe sizes. Within the looped portion, the majority of the piping would be 12-inch with the southern portion of the loop requiring larger 16-inch piping to



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RECLAIMED INFRASTRUCTURE ALT. 1

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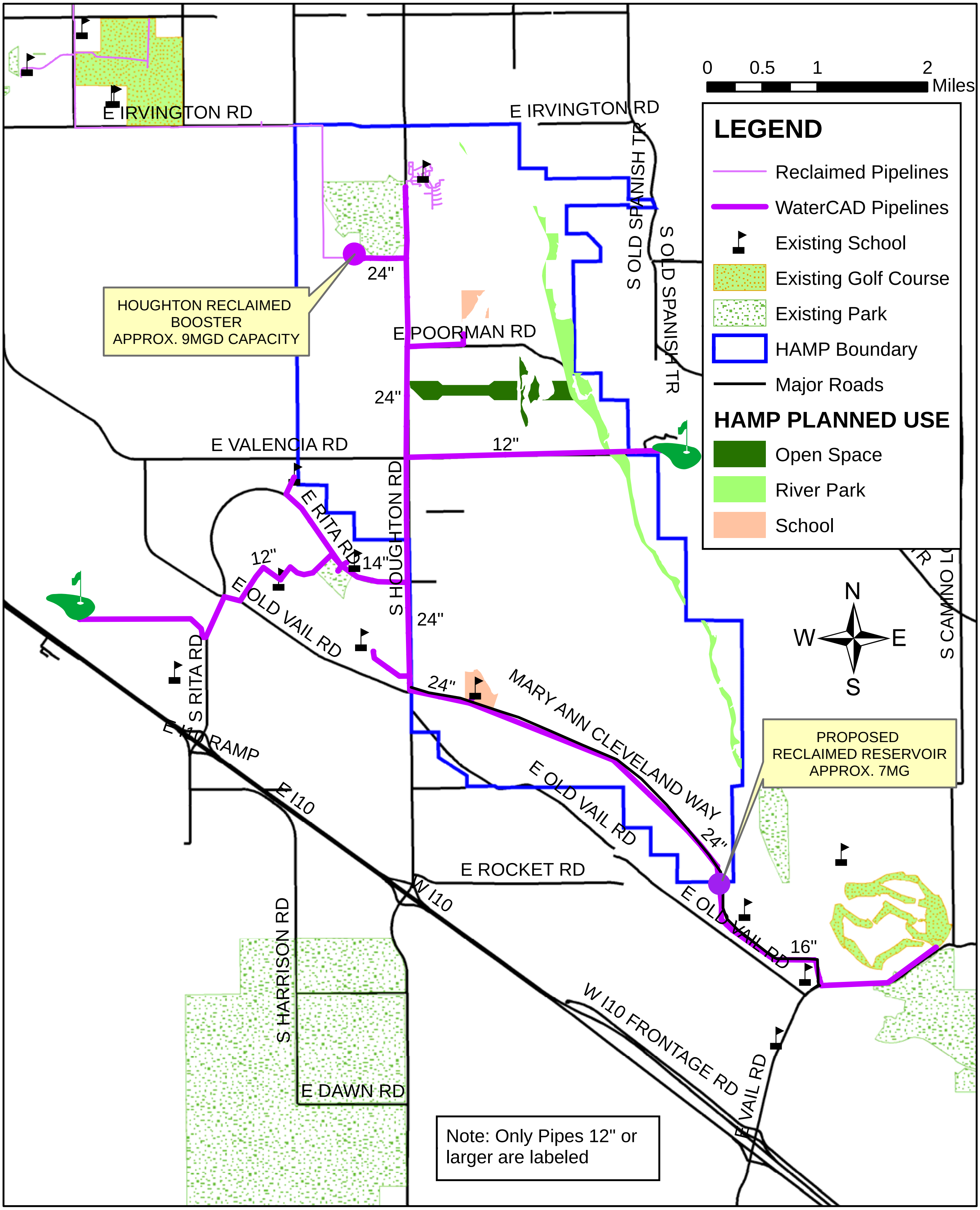
FIGURE 5-4

meet velocity criteria under peak demand conditions. The west branch of the loop would likely be completed first because of the existing demand at Empire High school.

5.5.2 Alternatives 2 and 3

Two additional alternatives were developed to include the HAMP demands and the potential demands from the Rita Ranch Area, Rocking K Area, and Del Lago Area summarized in Table 5-2. Demand nodes were assigned to representative locations in Rita Ranch, and the Del Lago demands were consolidated into one demand. The Rocking K Golf Course was also included in the adjacent demands, but demands south of I-10 (South Facilities) were considered infeasible by the 1999 *Reclaimed Water Master Plan*. The location of the new reservoir described in Alternative 1 was assumed to be the same for Alternative 2 and 3, and reclaimed water would be pumped from this reservoir to the Del Lago area. Alternative 2, shown in Figure 5-5, was laid out to provide a single transmission pipeline to feed all demands. This transmission main was sized at 24-inch to meet Tucson Water design criteria. Alternative 3, shown in Figure 5-6 would be looped similar to Alterative 1 but with the addition of the adjacent area demands. Alternative 3 would require 16-inch piping for the entire loop and a 24-inch transmission main along Houghton Road from the Houghton Reservoir to Valencia Road.



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HAMP Potable and Reclaimed Water Conceptual Plan

RECLAIMED INFRASTRUCTURE ALT. 2

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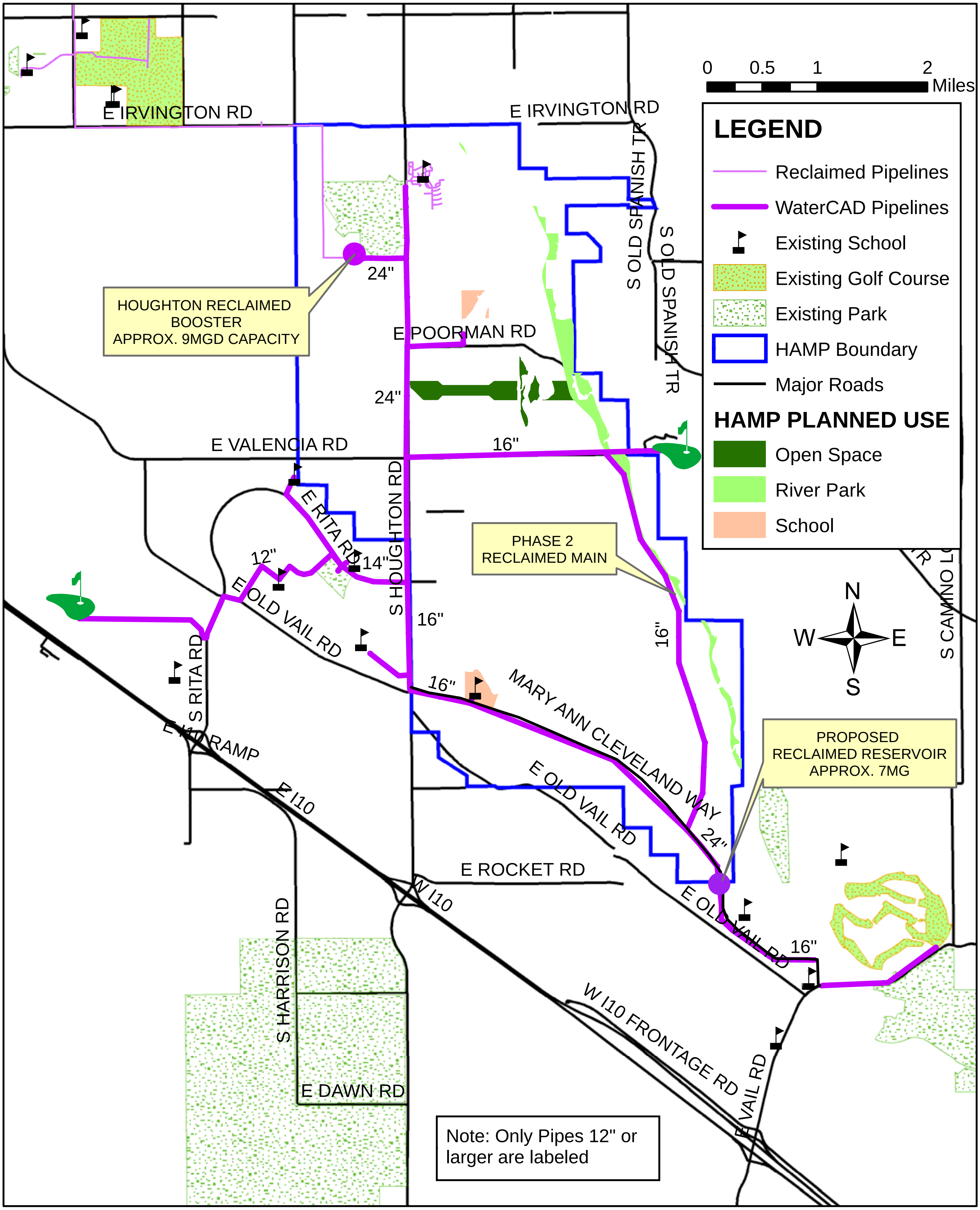
FIGURE 5-5



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RECLAIMED INFRASTRUCTURE ALT. 3

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FIGURE 5-6

6.0 COST EVALUATION

Conceptual-level cost opinions were developed for each of the potable and reclaimed water system alternatives described in Sections 4.0 and 5.0 to provide a basis for comparison of the alternatives. This section presents the basis of unit costs and development of conceptual-level cost opinions for each of the improvement alternatives.

6.1 BASIS OF COSTS

6.1.1 Basis of Cost Opinion

Conceptual opinions of probable capital and operation and maintenance (O&M) costs were developed from vendor and contractor quotations to the extent possible, from previous project data, and from RS Means cost estimating guides as necessary. 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 the 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. Annualized capital and operation and maintenance (O&M) costs were developed using an annual interest rate of six percent over a 20-year operation period.

6.1.2 Unit Cost Development

6.1.2.1 Pipelines

Unit costs were developed for the potable and reclaimed water distribution system improvement alternatives described in Sections 4.0 and 5.0. Unit costs were developed using information from RS Means cost estimating manuals and include pipe; installation; excavation; equipment; and a 30 percent allowance for fittings, valves, air/vacuum valves, blowoffs, and paving replacement. The unit costs also include a 15 percent allowance for contractor overhead and profit. The resulting unit costs for pipeline construction are presented in Table 6-1.

TABLE 6-1

UNIT CAPITAL COSTS FOR DISTRIBUTION AND TRANSMISSION PIPING

Pipe Diameter, inches	Unit Price, $/foot installed[1]	Contractor Overhead and Profit (15%)	Total, $/ft
6	$57	$9	$66
8	$64	$10	$74
10	$77	$12	$89
12	$88	$14	$102
16	$117	$18	$135
20	$156	$24	$180
24	$192	$29	$221
30	$211	$32	$243
36	$262	$40	$302
42	$328	$50	$378
48	$411	$62	$473
54	$480	$72	$552
60	$538	$81	$619
66	$608	$92	$700
72	$678	$102	$780
78	$748	$113	$861
84	$818	$123	$941

6.1.2.2 Booster Stations

Booster station cost opinions developed include pumps, concrete, building structure, fencing, site work, electrical, mechanical, instrumentation, SCADA, emergency power generation, and other treatments needed to make a complete system. Table 6-2 provides a summary the unit cost used for booster stations.

TABLE 6-2

BOOSTER STATION UNIT CAPITAL COSTS, X$1,000

Capcity (MGD)	Constructed Cost, x$1,000	Contractor OH&P, x$1,000	Total, x$1,000
5	$1,297	$195	$1,492
10	$1,685	$253	$1,938
15	$2,163	$325	$2,488
20	$2,514	$378	$2,892
30	$2,977	$447	$3,424
40	$3,476	$522	$3,998
60	$4,369	$656	$5,025

6.1.2.3 Reservoirs

Reservoir construction was assumed to be conducted in two phases. Construction cost opinions were developed for first and second phase reservoir construction based on costs for reservoir, fencing, access gates, site paving, landscaping, excavation, concrete, electrical, mechanical, instrumentation and SCADA. Table 6-3 presents a summary of the construction costs used for various sizes of reservoirs.

TABLE 6-3

PHASED RESERVOIR UNIT COST OPINION, X$1,000

	Costructed Cost		Contractor OH&P (15%)		Total	
Volume per Phase, (MG)	Phase 1[1]	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2
5	$3,183	$2,740	$478	$411	$3,661	$3,151
10	$5,602	$5,058	$841	$759	$6,443	$5,817
15	$7,768	$7,122	$1,166	$1,069	$8,934	$8,191
20	$9,965	$9,210	$1,495	$1,382	$11,460	$10,592

[1]Half of reservoir volume built in each phase.

6.2 POTABLE WATER SYSTEM IMPROVEMENTS

6.2.1 Capital Costs

Capital cost opinions for the HAMP area improvement alternatives were based on unit costs for major infrastructure components including transmission mains, booster stations, and reservoirs. Because the components of the 2006 CIP were used as the basis for routing transmission mains from Hayden-Udall to the HAMP area, a cost estimate was made for the applicable 2006 CIP components using the unit costs developed in this report. This additional estimate was conducted to aid in comparison of system transmission costs.

As discussed in Section 4.3, demand from the Santa Rita Bel Air (SRBA) area was included in estimating the required size of transmission mains and boosters for the system-wide distribution system. All of the HAMP area alternatives developed in Section 4.0 include supplying water to the SRBA area in the vicinity of Houghton Road and I-10 at the G-Zone elevation. Additional infrastructure will be required for delivery to SRBA that are not included in the HAMP area evaluations.

Table 6-4 summarizes the capital cost opinion for the three potable water alternatives. For comparison purposes, capital costs were calculated for Tucson Water's 2006 CIP infrastructure projects using the unit costs from Section 6.1.2. These CIP costs differ from the Tucson Water cost estimates for the CIP projects. More detailed cost information is included in Appendix D.

TABLE 6-4

POTABLE WATER CAPITAL COST OPINION

	2006 CIP	Alternative 1	Alternative 2	Alternative 3
"Outside HAMP" Transmission Cost Opinion, $million				
Transmission Mains	$75.8	$123.7	$130.0	$131.5
Boosters	$13.8	$21.6	$27.4	$27.3
Subtotal	$89.7	$145.4	$157.4	$158.8
"Inside HAMP" Transmission/Distribution Cost Opinion, $million				
Transmission Mains	$0.0	$23.6	$27.9	$36.4
Boosters	$0.0	$6.7	$8.2	$6.5
Subtotal	$0.0	$30.3	$36.1	$42.9
HAMP Reservoir Cost Opinion, $million				
Reservoirs	$0.0	$21.6	$21.6	$21.6
Subtotal	$0.0	$21.6	$21.6	$21.6
Subtotal	$89.7	$197.2	$215.0	$223.3
Engineering, Legal, and Administrative (25%)	$22.4	$49.3	$53.7	$55.8
Subtotal	$112.1	$246.5	$268.7	$279.1
Contingency (30%)	$33.6	$73.9	$80.6	$83.7
Total	$145.7	$320.4	$349.4	$362.8

6.2.2 Operation and Maintenance Costs

The operation and maintenance (O&M) cost opinions were developed for energy required for pumping, booster station maintenance, and transmission/distribution pipeline maintenance. The energy cost required for pumping was estimated based on the following assumptions:

- Pumping efficiency of 70 percent
- Average energy cost of $0.08 per KWh
- Initial high water elevation of the Clearwater Reservoir of 2,792 feet
- The high water elevation of each respective pressure zone
  - F-Zone at 3,002 feet
  - G-Zone at 3,107 feet
  - I-Zone at 3,317 feet
- Projected average day HAMP area demand by pressure zone
  - F-Zone demand of 4.56 mgd

  - G-Zone demand of 5.04 mgd
  - I-Zone demand of 4.70 mgd

- Approximate transmission main distance from the Clearwater Reservoir to the HAMP area (140,000 feet)
- Average dynamic headloss per length of transmission main (of 0.7 feet per 1,000 feet).

The estimated annual maintenance budget for HAMP booster stations was based on a factor of five percent of capital cost per year. This cost does not include an estimate for operation and maintenance of booster stations outside of the HAMP area. Table 6-5 shows the operating cost opinion.

TABLE 6-5

PROJECTED POTABLE WATER SYSTEM O&M COSTS

	2006 CIP	Alternative 1	Alternative 2	Alternative 3
Annual Energy Cost, $1,000	$412	$412	$412	$412
Annual O&M Cost, $1,000	$0	$542	$663	$526
Total, $1,000	$412	$954	$1,075	$938

6.3 RECLAIMED WATER SYSTEM IMPROVEMENTS

6.3.1 Capital Costs

Capital cost opinions for the three reclaimed water system improvement alternatives described in Section 5.5 were developed. The WaterCAD model files developed for the three alternatives were used to estimate pipe lengths and diameters as well as reservoir and booster station capacity requirements. Detailed capital cost opinions are presented in Appendix D. Alternative 1 was developed to supply the HAMP area only, and Alternative 2 and Alternative 3 were developed to supply the HAMP area plus adjacent areas. The reclaimed capital cost opinions of the three alternatives are given in Table 6-6.

TABLE 6-6

RECLAIMED WATER CAPITAL COST OPINIONS

Costs, $million			
	Alternative 1 - HAMP Only, Looped	Alternative 2 - Single Trunk	Alternative 3 - Looped
Transmission Piping	$6.1	$9.1	$10.2
Reservoirs	$5.5	$9.0	$9.0
Boosters	$1.9	$3.7	$3.7
Subtotal	$13.5	$21.8	$22.9
Engineering, Legal, and Administrative (25%)	$3.4	$5.5	$5.7
Subtotal	$16.8	$27.3	$28.7
Contingency (30%)	$5.0	$8.2	$8.6
Total	$21.9	$35.4	$37.3

Additionally, Alternative 1 was evaluated as an oversized alternative to accommodate future expansion to Alternative 3. The cost to oversize the piping would increase the capital piping costs approximately 16 percent and the overall reclaimed capital cost by approximately nine percent for the HAMP area.

6.3.2 Operation and Maintenance Costs

Operation and Maintenance costs for the reclaimed water system were developed using the same methodology described above for the potable system. Assumptions for the reclaimed water system included:

- The low-water elevation for pumping analysis was the Sweetwater recharge facility (2,261 feet)
- The high-water elevation for the HAMP, Rita Ranch, and Rocking K reclaimed water demands was based on a potential elevation of 3,193 feet corresponding with the site elevation of a proposed reclaimed water reservoir in the southeast portion of the HAMP area.
- The high-water elevation for the Del Lago area was estimated at 3,275 feet.

Table 6-7 shows the estimated operating costs for the three reclaimed water alternatives.

TABLE 6-7

RECLAIMED WATER OPERATING COST OPINIONS

	Alternative 1	Alternative 2	Alternative 3
Annual Energy Cost, $1,000	$100	$202	$202
Annual O&M Cost, $1,000	$158	$304	$304
Total, $1,000	$258	$506	$506

6.4 COST EVALUATION OF ALTERNATIVES

6.4.1 Potable Water System

All three potable water system improvement alternatives include sufficient transmission capacity for the projected HAMP area demands as well as the Rita Ranch and Santa Rita Bel Air areas. Cost differentiation between alternatives primarily depends on differences in the configurations of the transmission system serving the HAMP area. Although some cost differentiation was realized for transmission/distribution within the HAMP area, most of the additional costs associated with Alternative 2 and Alternative 3 is due to transmission cost influences by areas outside of HAMP. Of the three potable water system alternatives, the projected cost for Alternative 1 was lower than the other two alternatives on a system-wide basis from both a capital and O&M perspective. The primary advantages of Alternative 1 that lead to lower capital costs are: 1) new construction is primarily concentrated in the southern portion of HAMP, and 2) the economy of scale associated with constructing one large transmission main rather than two smaller mains. Table 6-8 summarizes projected annualized costs of the three potable water system alternatives and includes both annualized capital and annual O&M costs.

TABLE 6-8

POTABLE WATER ANNUALIZED COST OPINION SUMMARY

	Annualized Cost Opinion, $million		
	Alternative 1	Alternative 2	Alternative 3
Capital Improvement Plan			
"Outside HAMP" Transmission	$20.6	$22.3	$22.5
"Inside HAMP" Transmission/Distribution	$4.3	$5.1	$6.1
HAMP Reservoirs	$3.1	$3.1	$3.1
Subtotal	$27.9	$30.5	$31.6
Operations and Maintenance			
Pumping Energy	$0.4	$0.4	$0.4
Booster Station Maintenance	$0.5	$0.7	$0.5
Subtotal	$1.0	$1.1	$0.9
Total	$28.9	$31.5	$32.6
Percent difference	-	9.2%	12.7%

6.4.2 Reclaimed Water System

Of the three reclaimed water infrastructure improvement alternatives, Alternative 1 is projected to have lower overall costs, but it does not include provisions for serving potential existing and future customers outside of the HAMP planning area. Both Alternative 2 and Alternative 3 would provide the ability to supply to customers outside of the HAMP area. Alternative 2 is projected to have a nominally lower transmission cost than Alternative 3 (less than three percent difference). However, the final costs are dependent upon where reclaimed water demands develop within the HAMP area (i.e. where future parks are located), and Alternative 3 provides better distribution to the east side of the HAMP area. Table 6-9 presents a summary of projected annualized reclaimed water systems costs associated with each of the three reclaimed water system improvement system alternatives.

TABLE 6-9

RECLAIMED WATER ANNUALIZED COST OPINION SUMMARY

	Annualized Cost Opinion, $million		
	Alternative 1	Alternative 2	Alternative 3
Capital Improvement Plan			
Transmission Piping	$0.86	$1.29	$1.44
Reservoirs	$0.77	$1.27	$1.27
Boosters	$0.27	$0.53	$0.53
Subtotal	$1.91	$3.09	$3.25
Operations and Maintenance			
Pumping Energy	$0.10	$0.20	$0.20
Booster Station Maintenance	$0.16	$0.30	$0.30
Subtotal	$0.52	$1.01	$1.01
Total	$2.42	$4.10	$4.26

7.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the findings and analyses presented in this Houghton Area Master Plan Potable and Reclaimed Water Conceptual Plan, the following conclusions and recommendations relating to the potable and reclaimed water systems were developed.

7.1 CONCLUSIONS

7.1.1 General Conclusions

1. The HAMP planning area has a projected buildout population of approximately 88,000 based on PAG TAZ population data. The buildout population is similar to planning information developed by URS Engineering for the Arizona State Land Department (ASLD).
2. The planning area encompasses approximately 10,800 acres with approximately 7,740 acres managed by the ASLD.

7.1.2 Potable Water System Conclusions

1. Average day, peak day, and peak hour buildout demands (year 2030) for the HAMP planning area are projected to be 14 mgd, 26 mgd, and 45 mgd, respectively.
2. The projected water resource requirement is 16,000 acre-feet per year for the HAMP area of which 11,500 acre-feet per year is associated with ASLD managed parcels.
3. The combined projected peak day demand for the HAMP, Rita Ranch, and SRBA areas is 50 mgd.
4. The HAMP area lies primarily in three potable water pressure zones: F1, G2, and I2.
5. Current Tucson Water plans include only using the existing Rita Ranch G-wells for emergencies when sufficient renewable water resources become available to the area.
6. Approximately 35 million gallons of storage will be required in the combined HAMP and Rita Ranch areas at buildout.
7. Based on the population model, additional conveyance capacity will be required to the HAMP area by 2011.
8. Communication with the ASLD regarding their schedule for HAMP land sales is critical to determining a schedule for CIP implementation.
9. Recommendations of the City of Tucson’s Water Plan 2000-2050 include the need to acquire additional water supplies from one or more potential

sources. The potable water demand associated with future development of ASLD managed land in the HAMP area has been accounted for in Tucson Water's planning process. However, the availability of water resources required to fully meet this projected demand may prove problematic. One potential water source that may be needed in the future is the ASLD's CAP allocation for the Tucson AMA.

7.1.3 Reclaimed Water System Conclusions

1. Average day reclaimed water demand in the HAMP area is projected to be 1.2 mgd at buildout using Tucson Water's current system-wide estimates of 8 percent of total water demand.
2. Potential customers in areas adjacent to the HAMP area were identified with a projected average day reclaimed water demand of approximately 1.5 mgd.
3. Constructing a wastewater reclamation facility in the HAMP area, as described in Alternative 2B of the PCRWRD *HAMP Wastewater Conceptual Plan* could provide up to 5 mgd of reclaimed water to the reclaimed water system at the Houghton Reservoir and reduce pumping costs by as much as $176,000 per year (in 2006 dollars). The capital cost associated with constructing this facility was estimated to be between $81.3 million and $123.5 million. Annual operation and maintenance costs of this reclamation facility were estimated at $1 million.

7.2 RECOMMENDATIONS

7.2.1 General Recommendations

1. **Continue discussions with the ASLD regarding HAMP area development.** 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 ASLD schedule for HAMP area land auction(s). Knowing the timing of development will be crucial for validating CIP schedules.
2. **Continue cooperation with PCRWRD on infrastructure planning**. Continued cooperation between Pima County and the City of Tucson is essential to providing comprehensive potable 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.

7.2.2 Potable Water System Recommendations

1. **Continue discussions with the ASLD regarding transfer of CAP allocation from ASLD to Tucson Water.** Approximately 11,500 acre-feet per year of renewable water supply will be required for the ASLD managed parcels in the HAMP area. The ASLD has a CAP allocation of

14,000 acre-feet per year in the Tucson AMA and has statutory authority to transfer those rights to any provider of permanent municipal water service.

2. **Pursue a capital infrastructure plan based on potable water Alternative 1.** This alternative is projected to be the most economical and also makes best use of currently planned transmission alignments for serving the southeast portions of the potable water service area.

7.2.3 Reclaimed Water System Recommendations

1. **Determine if reclaimed water service will be provided beyond the HAMP area.** Alternative 1 could be constructed at a lower cost than Alternatives 2 and 3, both of which are sized to serve additional potential demands identified outside of the HAMP area. While Alternative 3 provides the most flexibility to serve additional demand both within and adjacent to the HAMP area, it is also the most costly of the three alternatives. It is recommended that if areas beyond the HAMP area (outside of the City's potable water service area) will not be served, that Alternative 1 be constructed. However, if expansion of the reclaimed water service outside of the HAMP area is anticipated, it is recommended that Alternative 3 be pursued.

2. **Do not continue to pursue a HAMP wastewater reclamation facility.** The recommendation of the *HAMP Wastewater Conceptual Plan* was contingent on the economic evaluation of this *HAMP Potable and Reclaimed Water Conceptual Plan*. The projected energy cost savings due to reduced reclaimed water pumping is $176,000 per year by 2030 (in 2006 dollars). This savings does not justify the estimated $81 million to $124 million in capital costs to construct a wastewater facility. The Wastewater Conceptual Plan recommended infrastructure improvements, however, that do provide flexibility to construct a wastewater reclamation facility in the future should policies or economics become favorable.

REFERENCES

Arizona Department of Water Resources. *Tucson AMA Third Management Plan.* ADWR, December 1999.

Pima County Regional Wastewater Reclamation Department. 2008 *HAMP Wastewater Conceptual Plan.* Malcolm Pirnie, February 2008.

Pima County Wastewater Management Department. *2006 Metropolitan Area Facility Plan Update.* Brown and Caldwell and PCRWRD, 2006.

Tucson Department of Urban Planning and Design. TDUPD June 7, 2005.

Tucson Water. *Reclaimed Water System Master Plan.* Malcolm Pirnie, December 1999.

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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
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May 18, 2006

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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 are 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
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	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

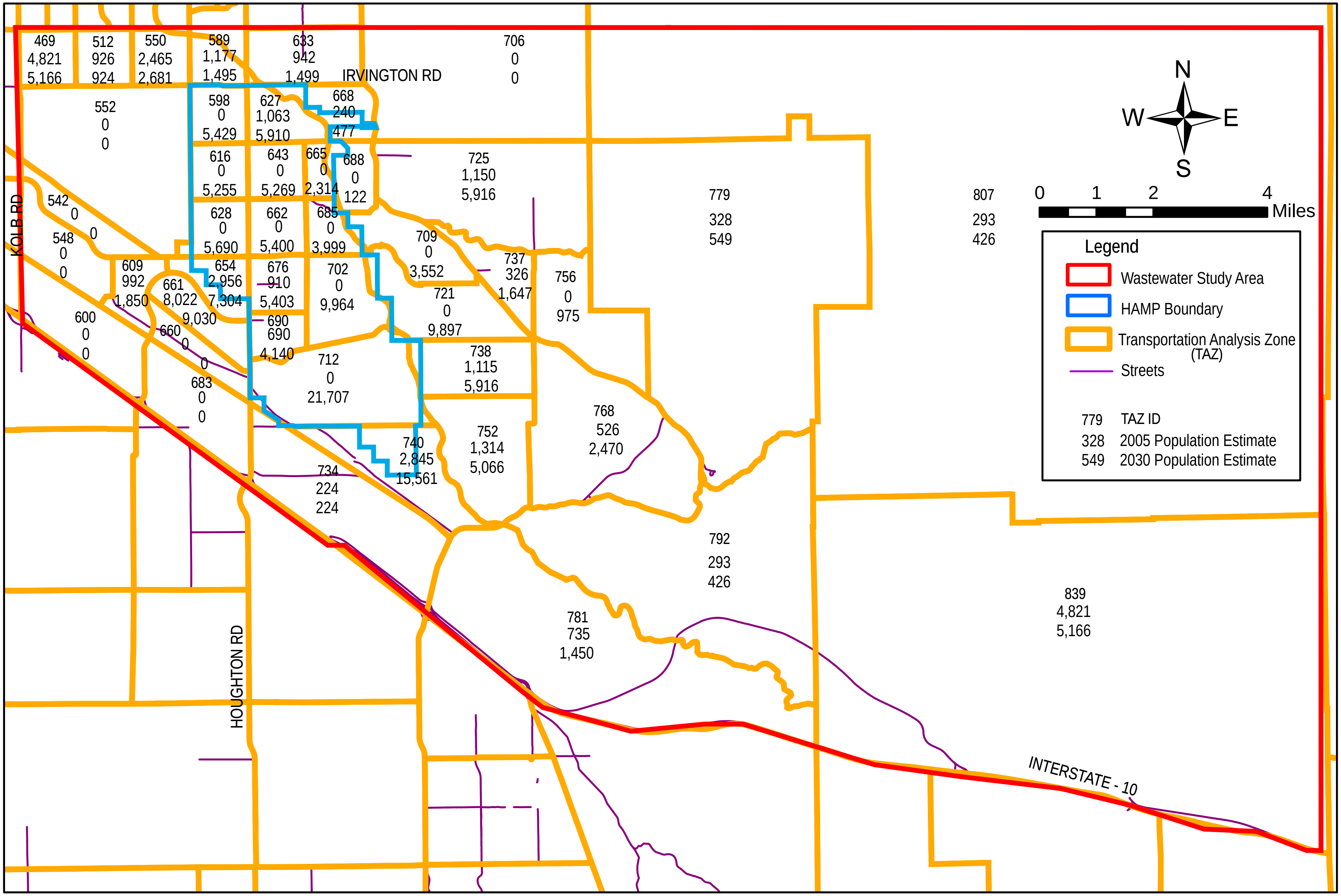
Water Demand Projections (gpm)

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

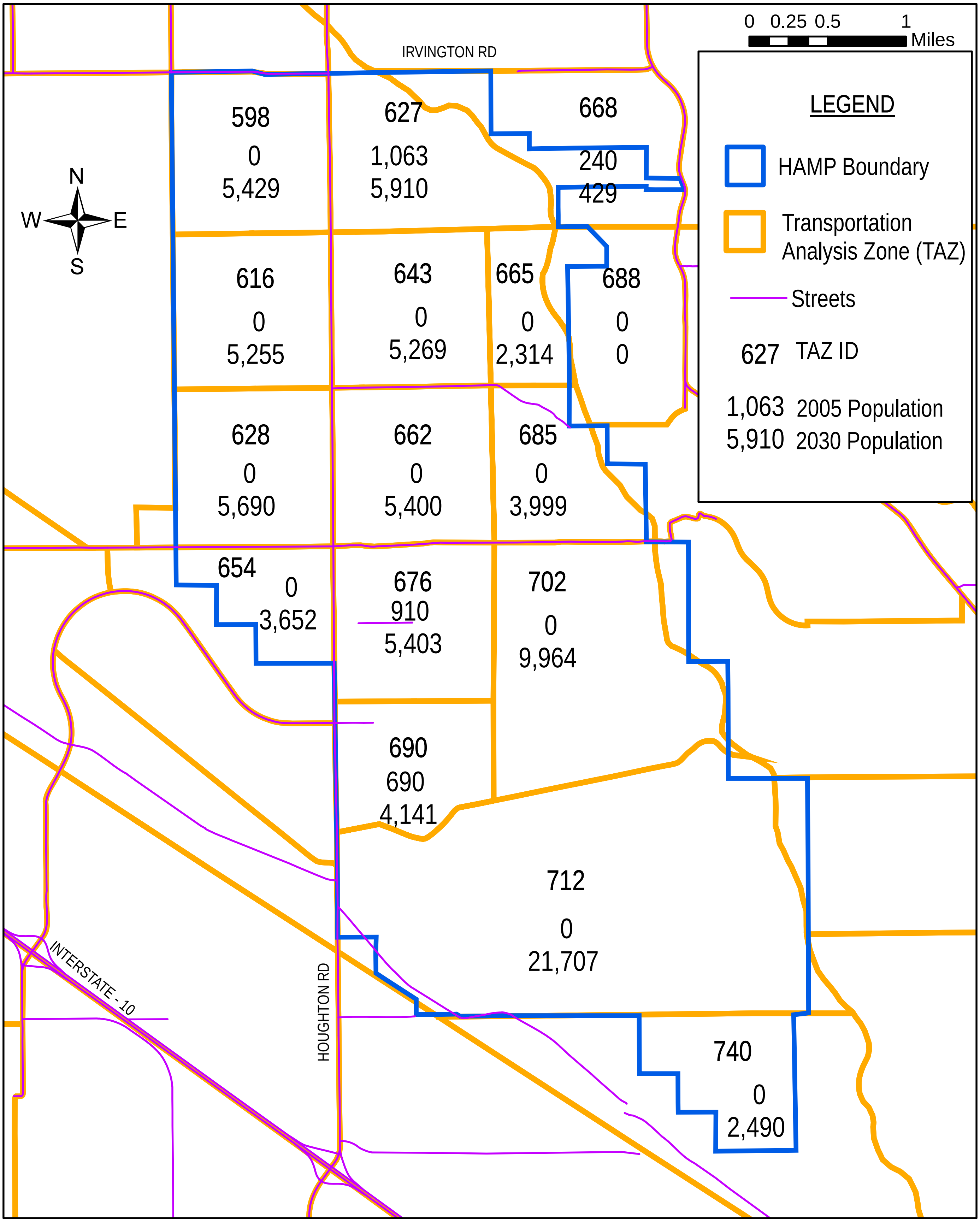
PIMA COUNTY WASTEWATER MANAGEMENT DEPARTMENT

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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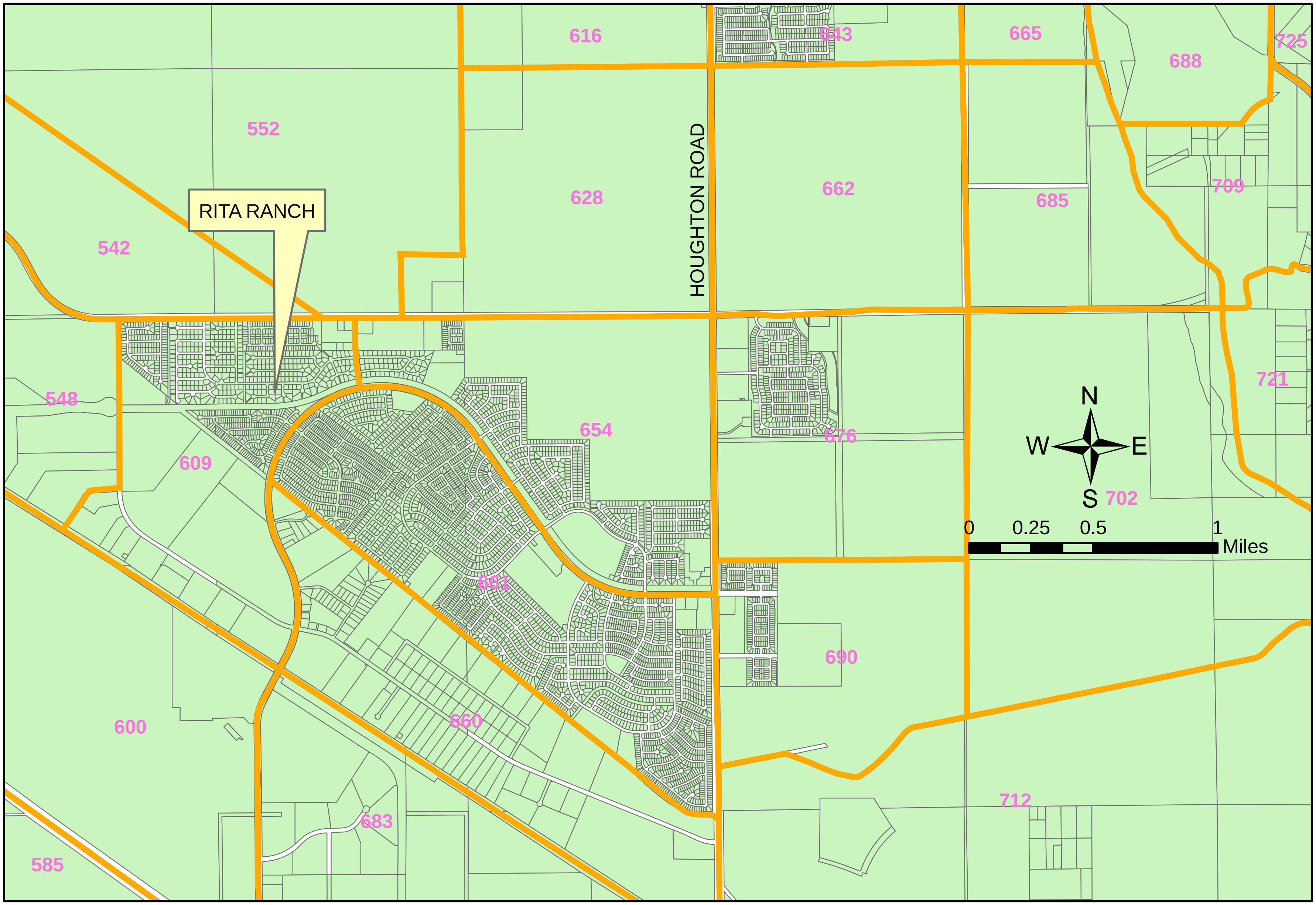
HOUGHTON AREA MASTER PLAN

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

POPULATION PROJECTIONS WITHIN HAMP

MALCOLM PIRNIE, INC.

FIGURE 2



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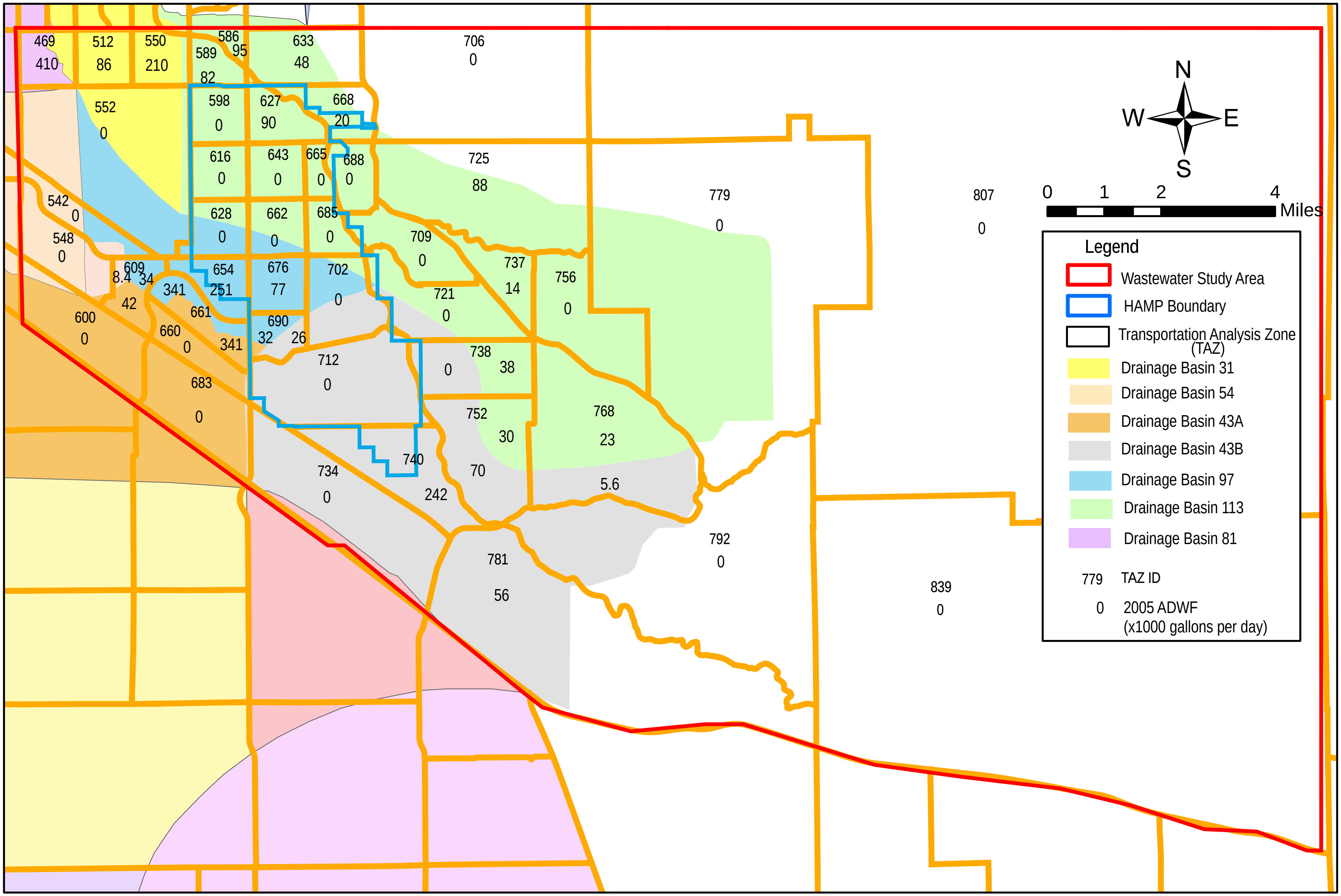
HOUGHTON AREA MASTER PLAN

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

RITA RANCH PARCEL MAP

MALCOLM PIRNIE, INC.

FIGURE 3



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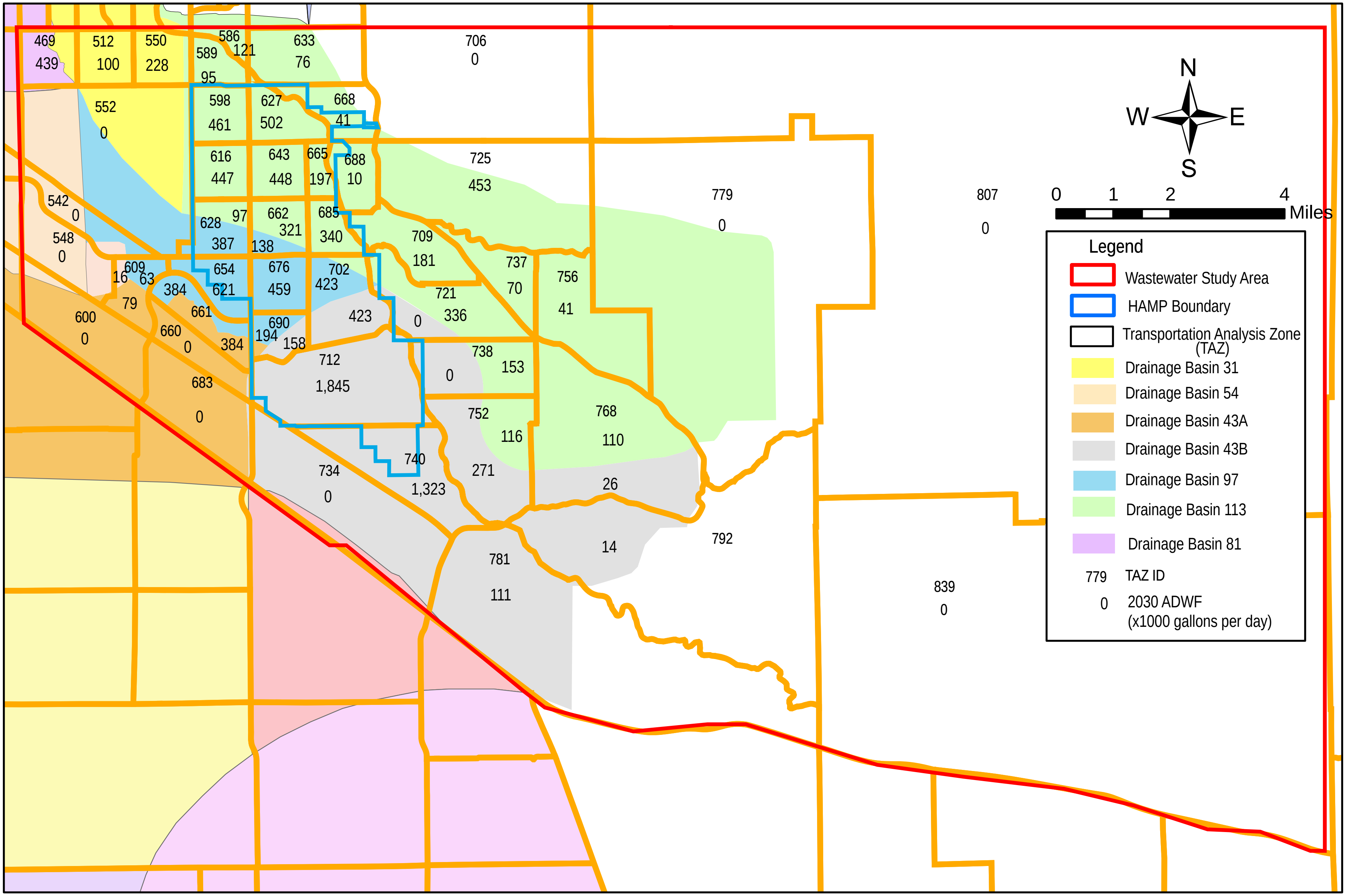
HOUGHTON AREA MASTER PLAN

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

SUMMARY OF 2005 AVERAGE DRY WEATHER FLOW (ADWF)

MALCOLM PIRNIE, INC.

FIGURE 4



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PIMA COUNTY WASTEWATER MANAGEMENT DEPARTMENT

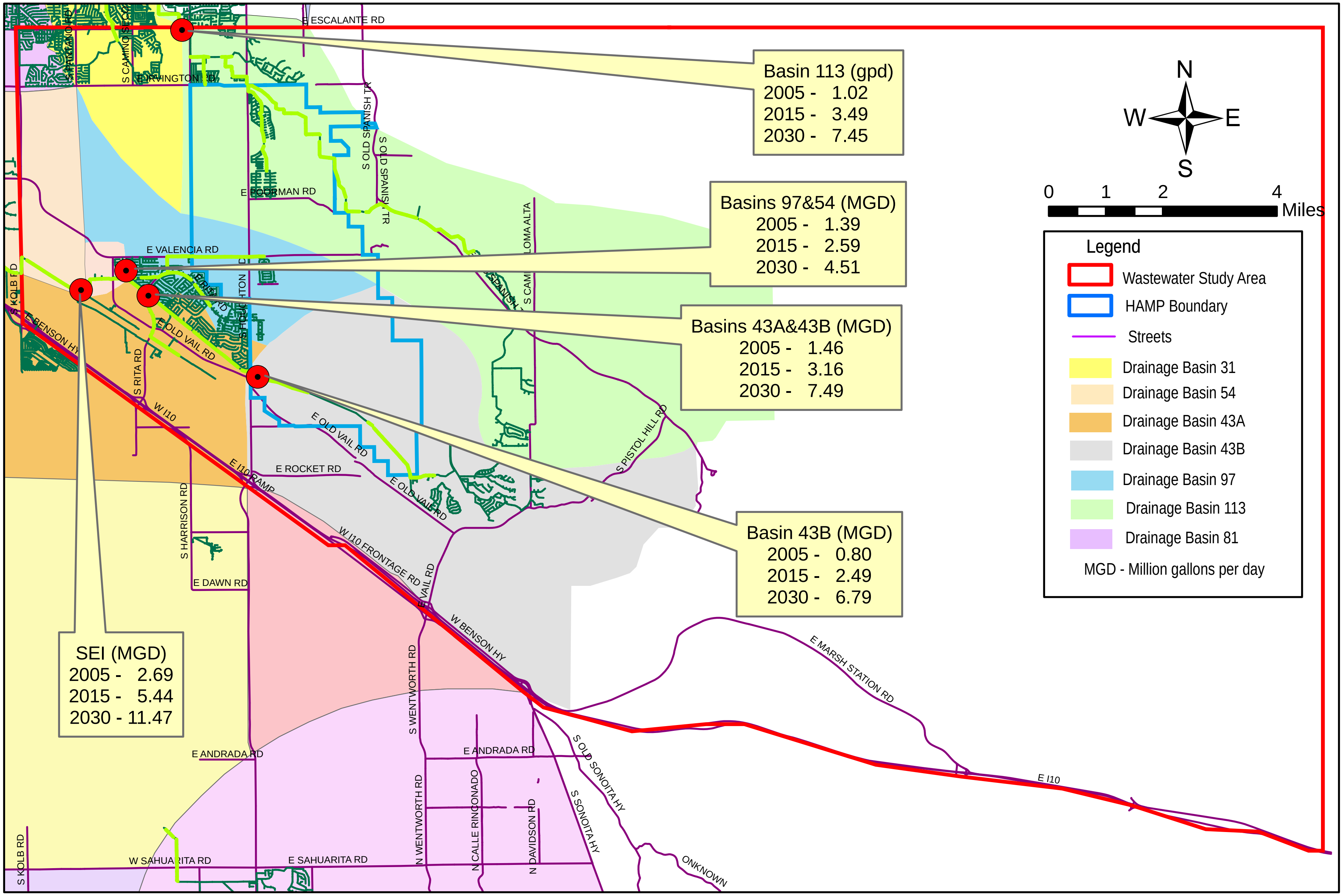
HOUGHTON AREA MASTER PLAN

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

SUMMARY OF 2030 AVERAGE DRY WEATHER FLOW (ADWF)

MALCOLM PIRNIE, INC.

FIGURE 5



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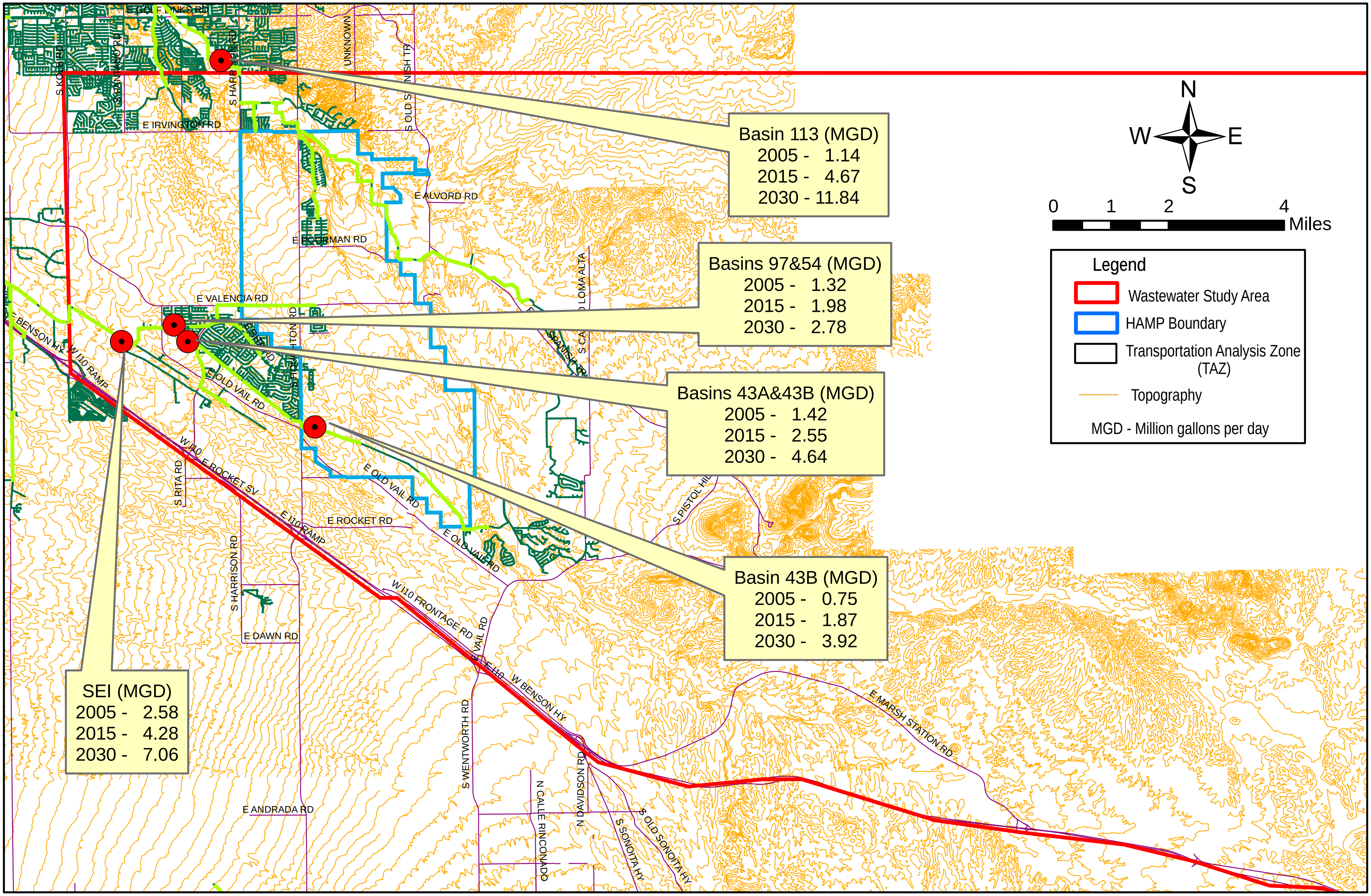
HOUGHTON AREA MASTER PLAN

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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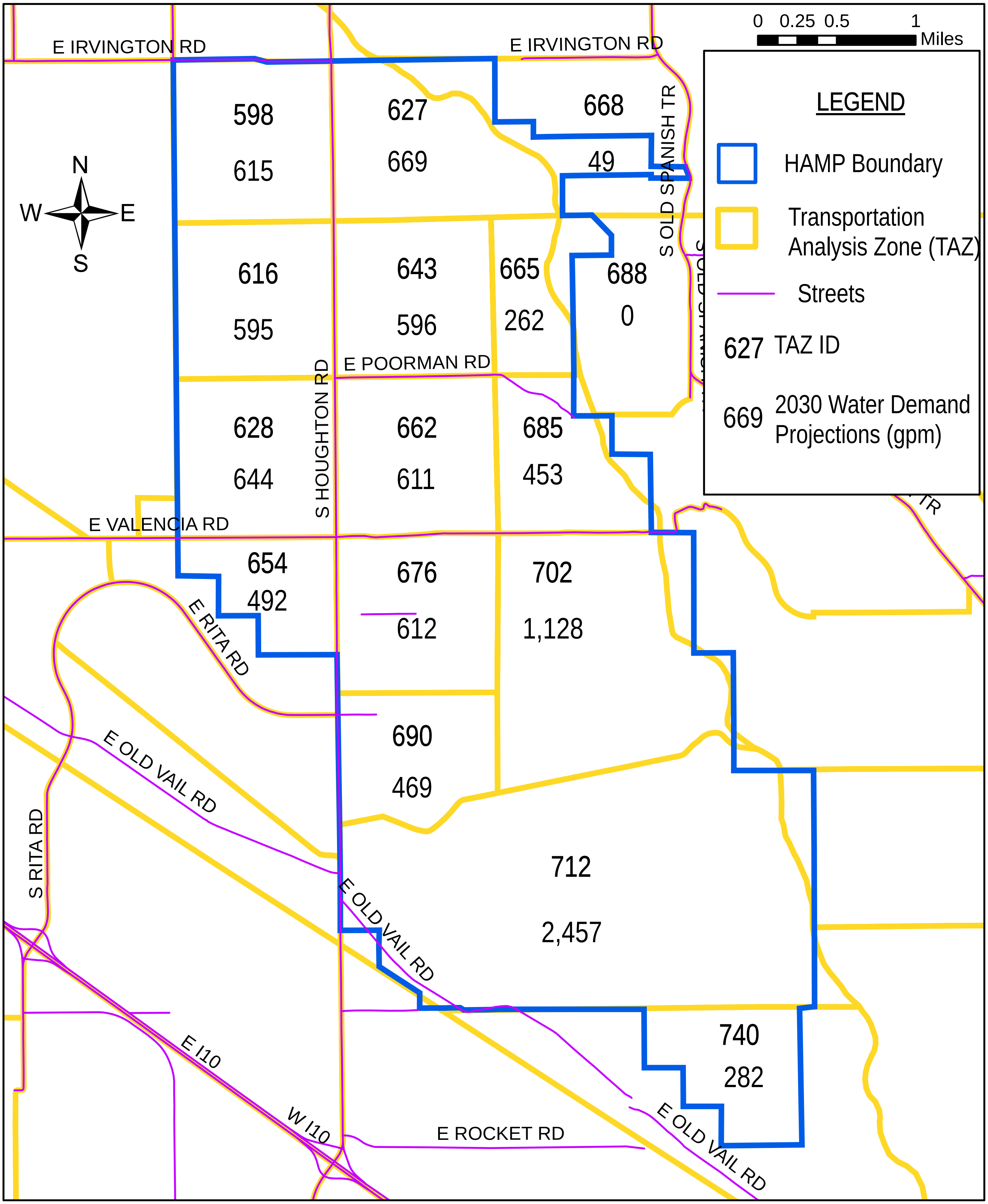
HOUGHTON AREA MASTER PLAN

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



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.
	2030 AVERAGE POTABLE DEMAND PROJECTIONS	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

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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

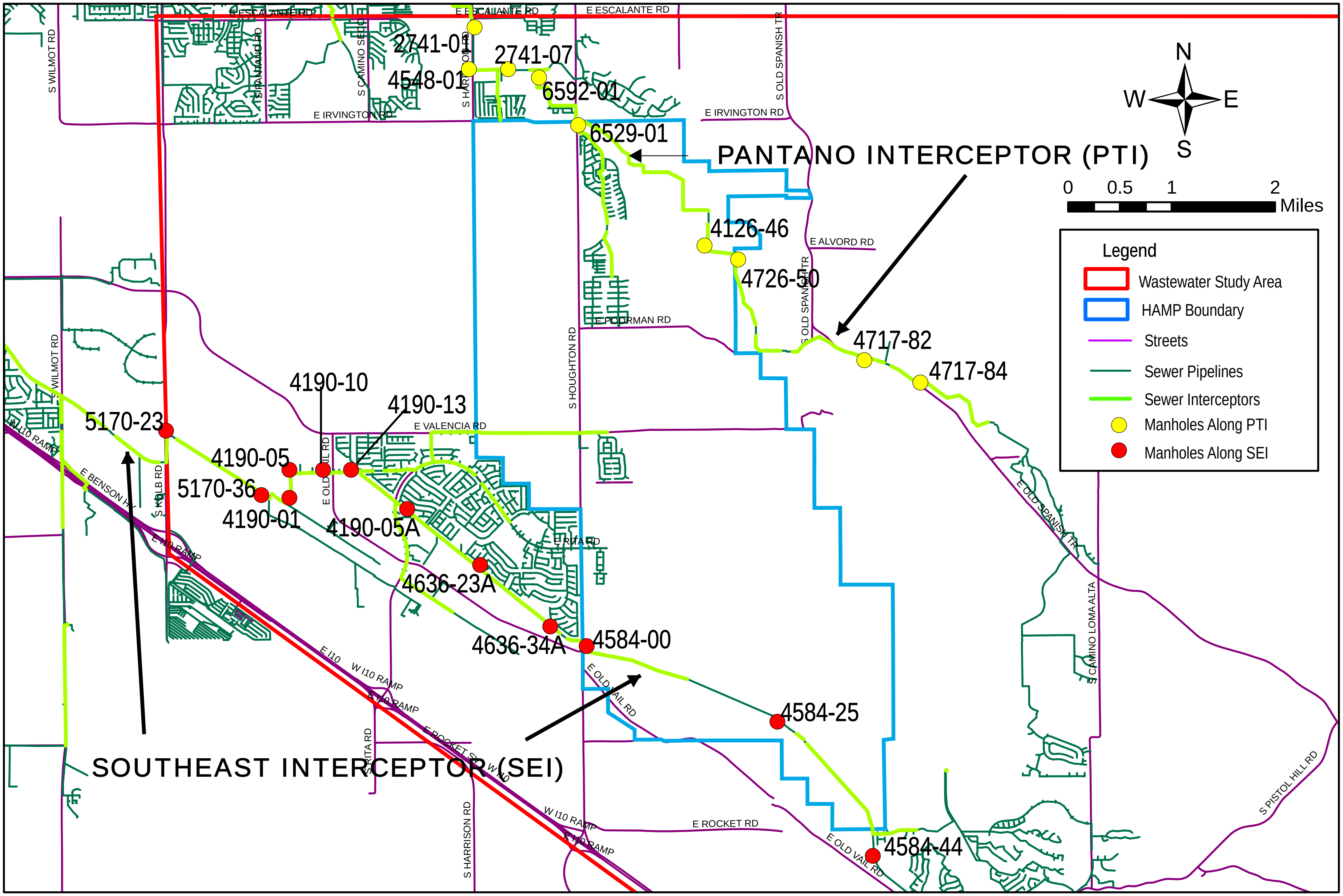
gch

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



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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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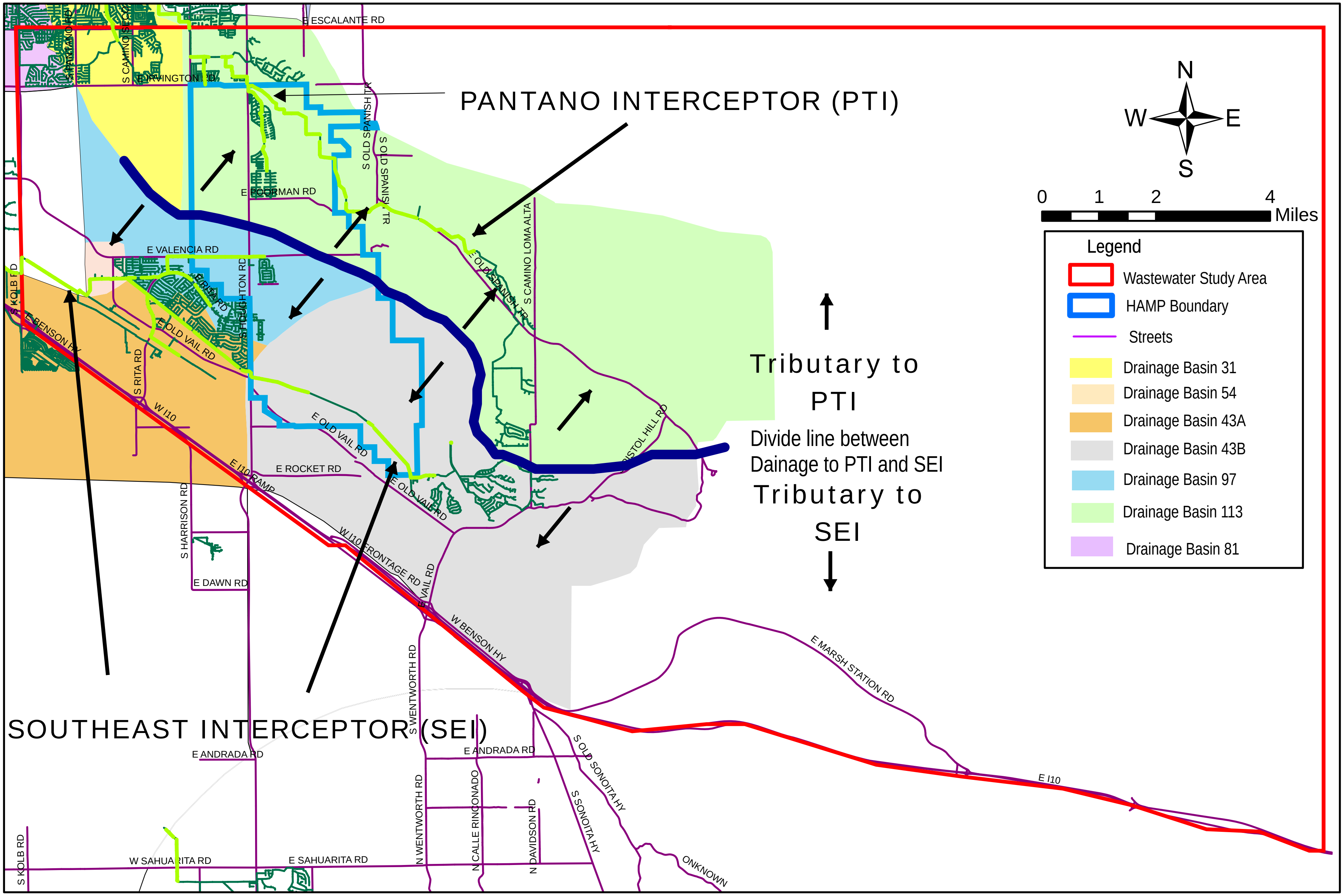
FIGURE 1



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PIMA COUNTY WASTEWATER MANAGEMENT DEPARTMENT

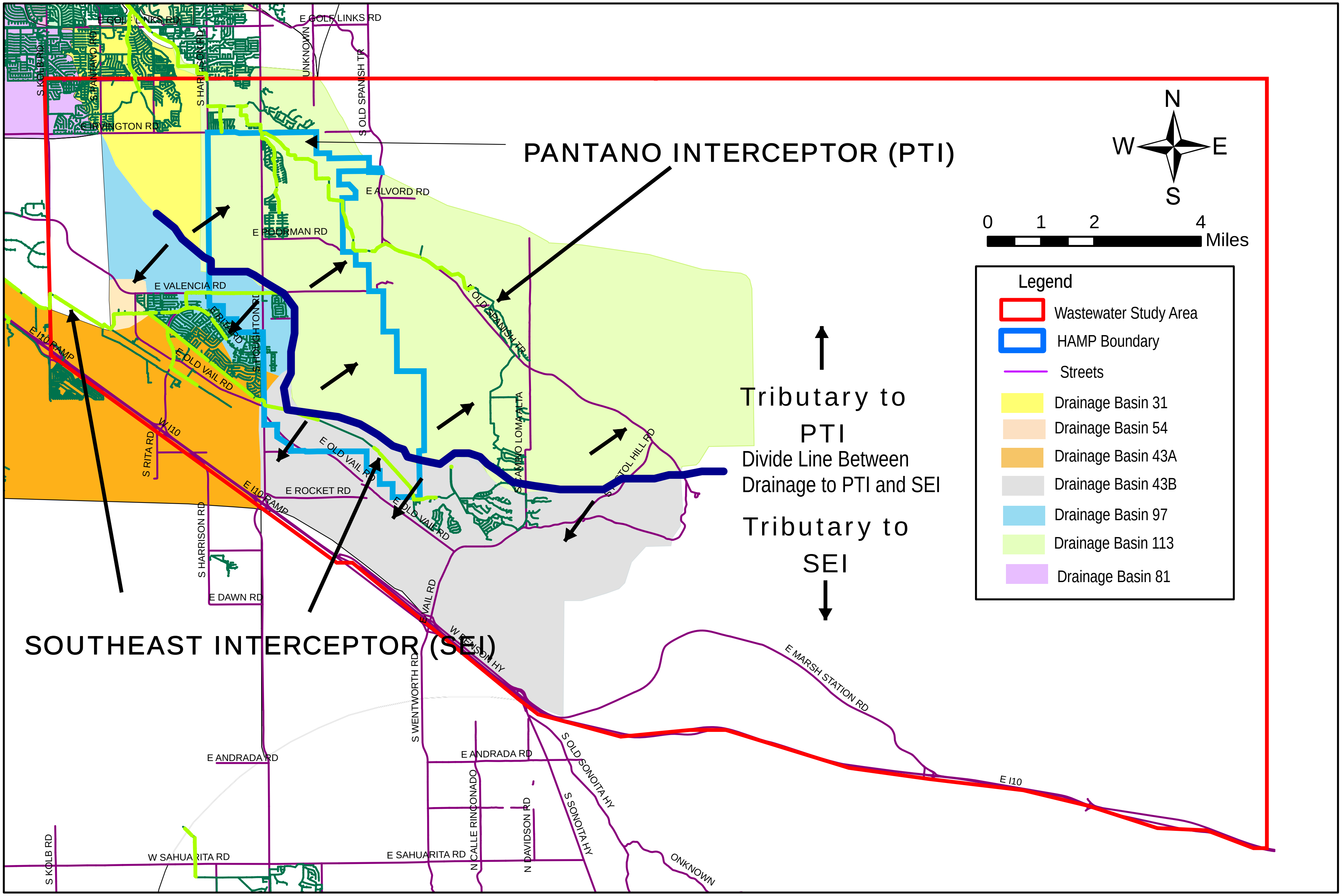
HOUGHTON AREA MASTER PLAN

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

SEI WASTEWATER FLOW
ALTERNATIVE DRAINAGE BASINS

MALCOLM PIRNIE, INC.

FIGURE 2



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PIMA COUNTY WASTEWATER MANAGEMENT DEPARTMENT

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

PTI WASTEWATER FLOW ALTERNATIVE DRAINAGE BASINS

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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

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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

Scenario 1B

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

Scenario 2A

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

<u>Scenario 2B</u>

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

<u>Scenario 3A</u>

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

<u>Scenario 3B</u>

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

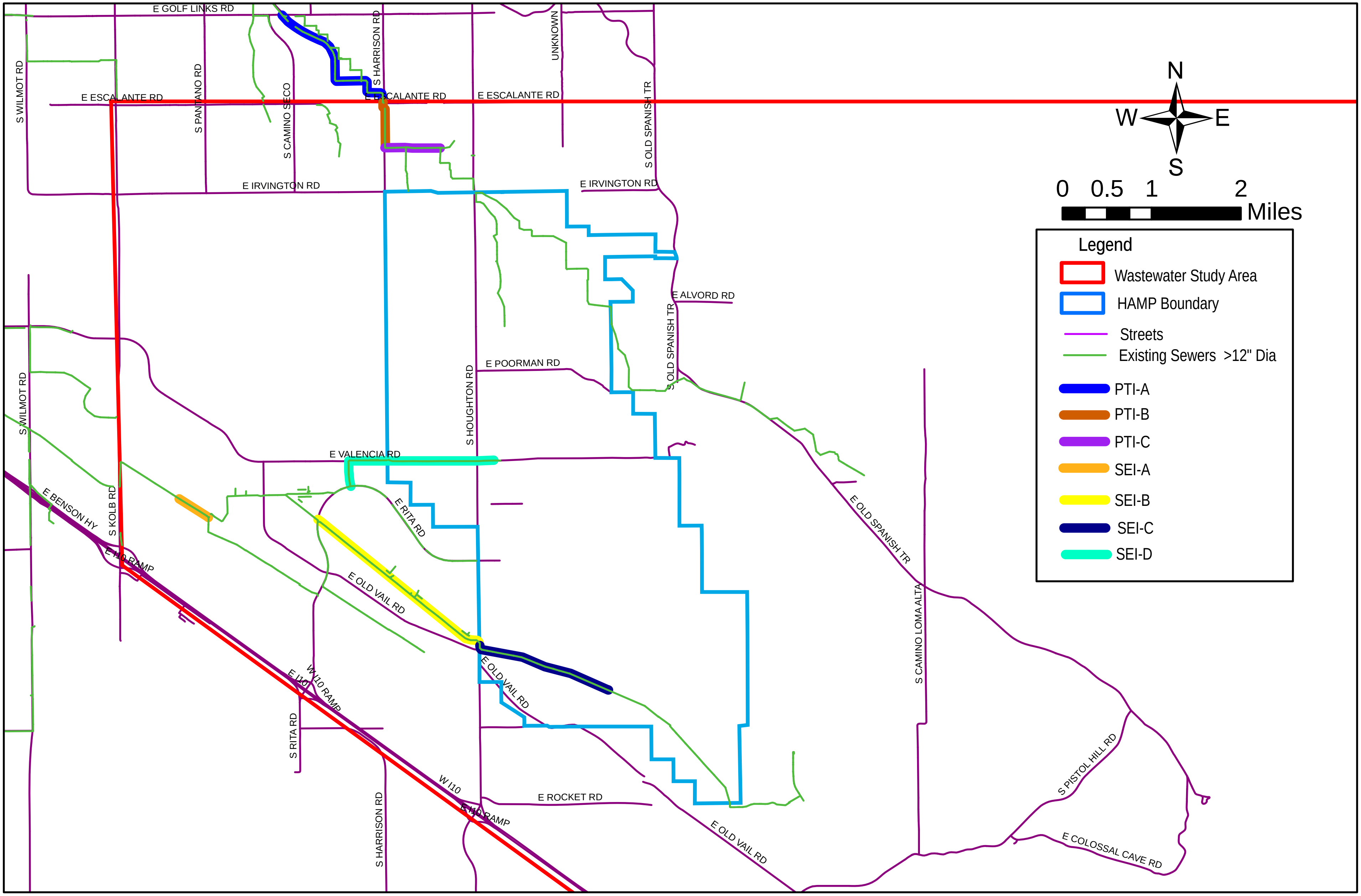
shs

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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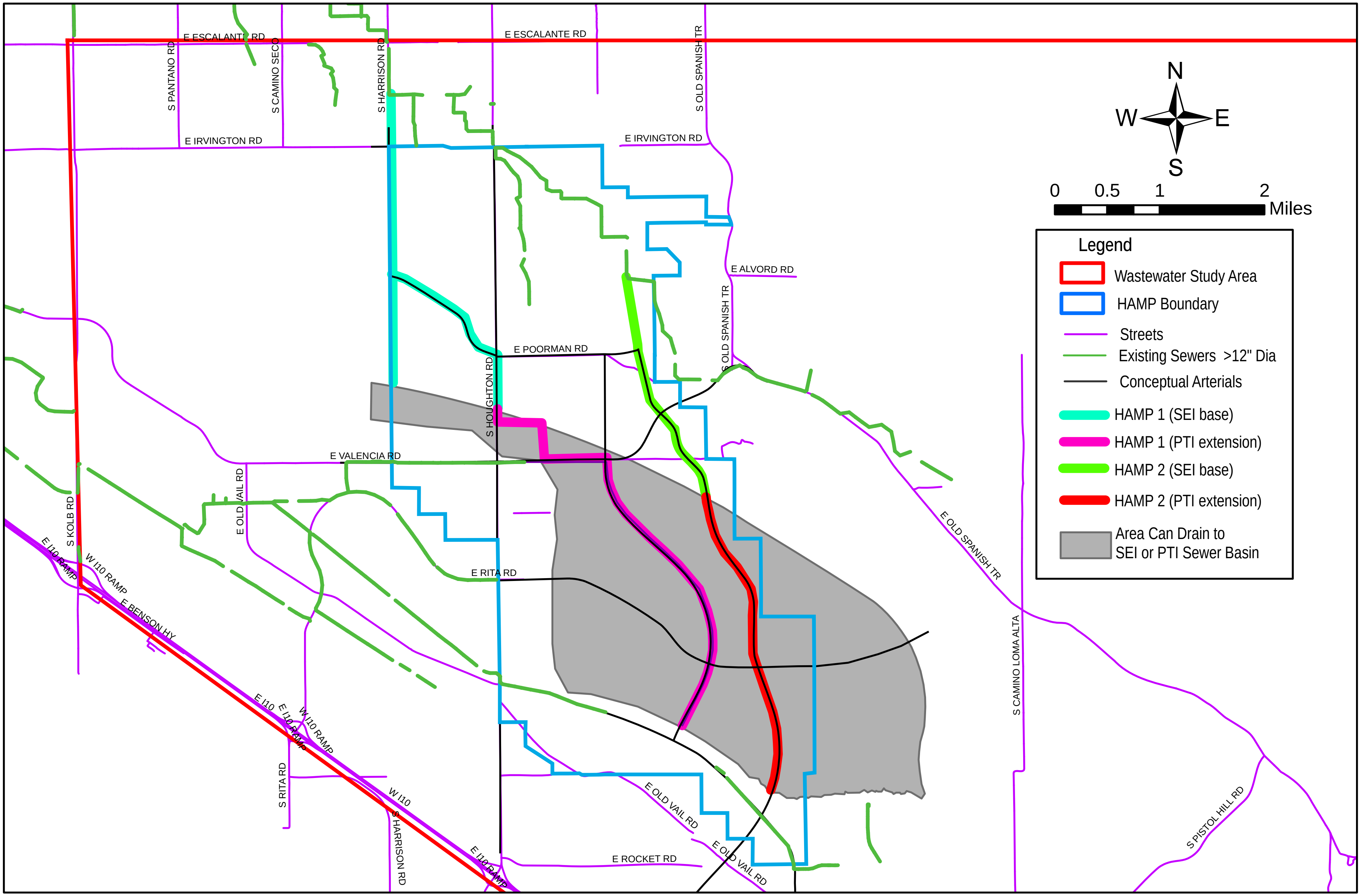
FIGURE 1



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HAMP TRUNK SEWERS

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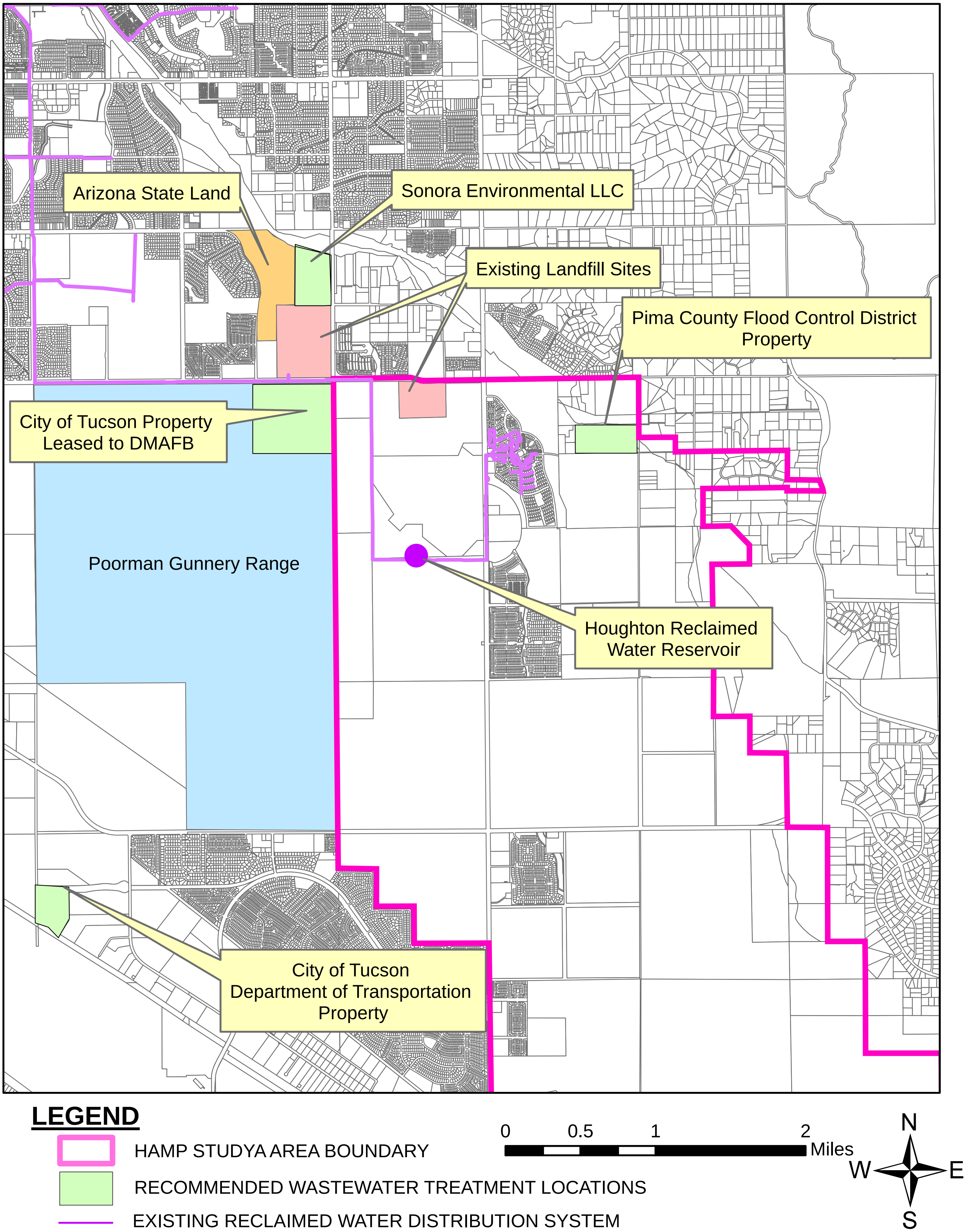
FIGURE 2



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RECOMMENDED TREATMENT PLANT SITES

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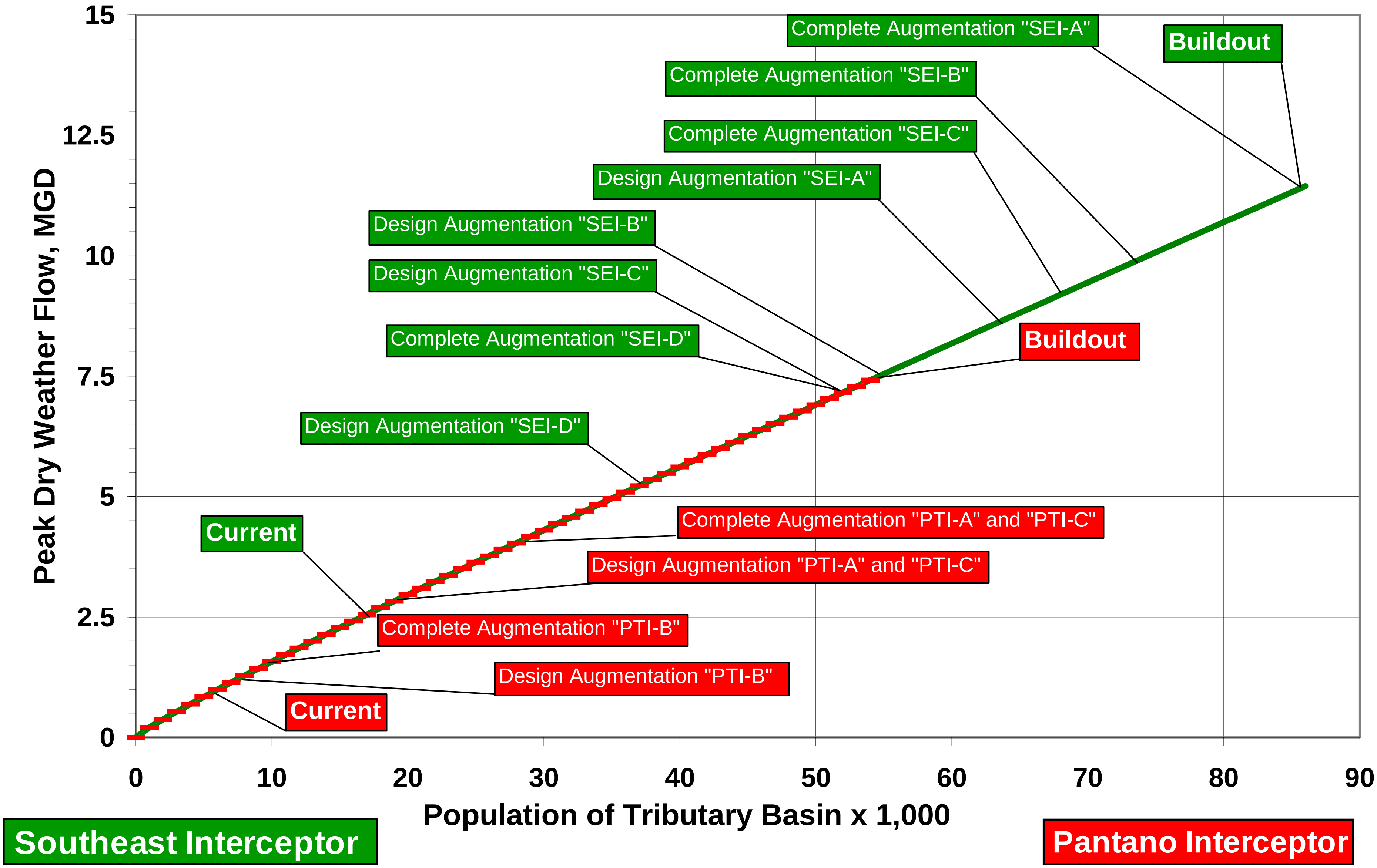
FIGURE 3



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Implementation Schedule
Scenario 1A

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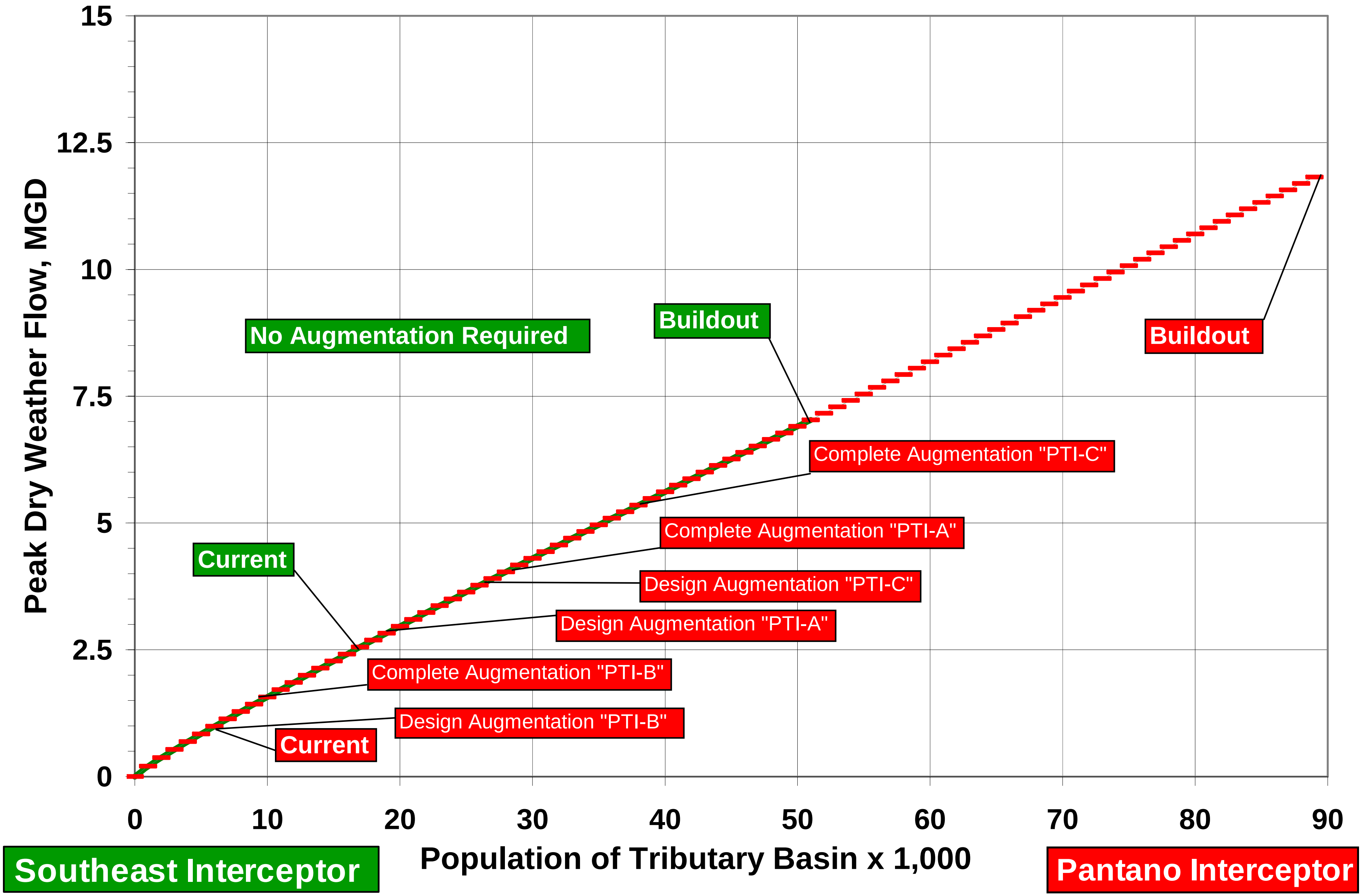
FIGURE 4



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Implementation Schedule
Scenario 1B

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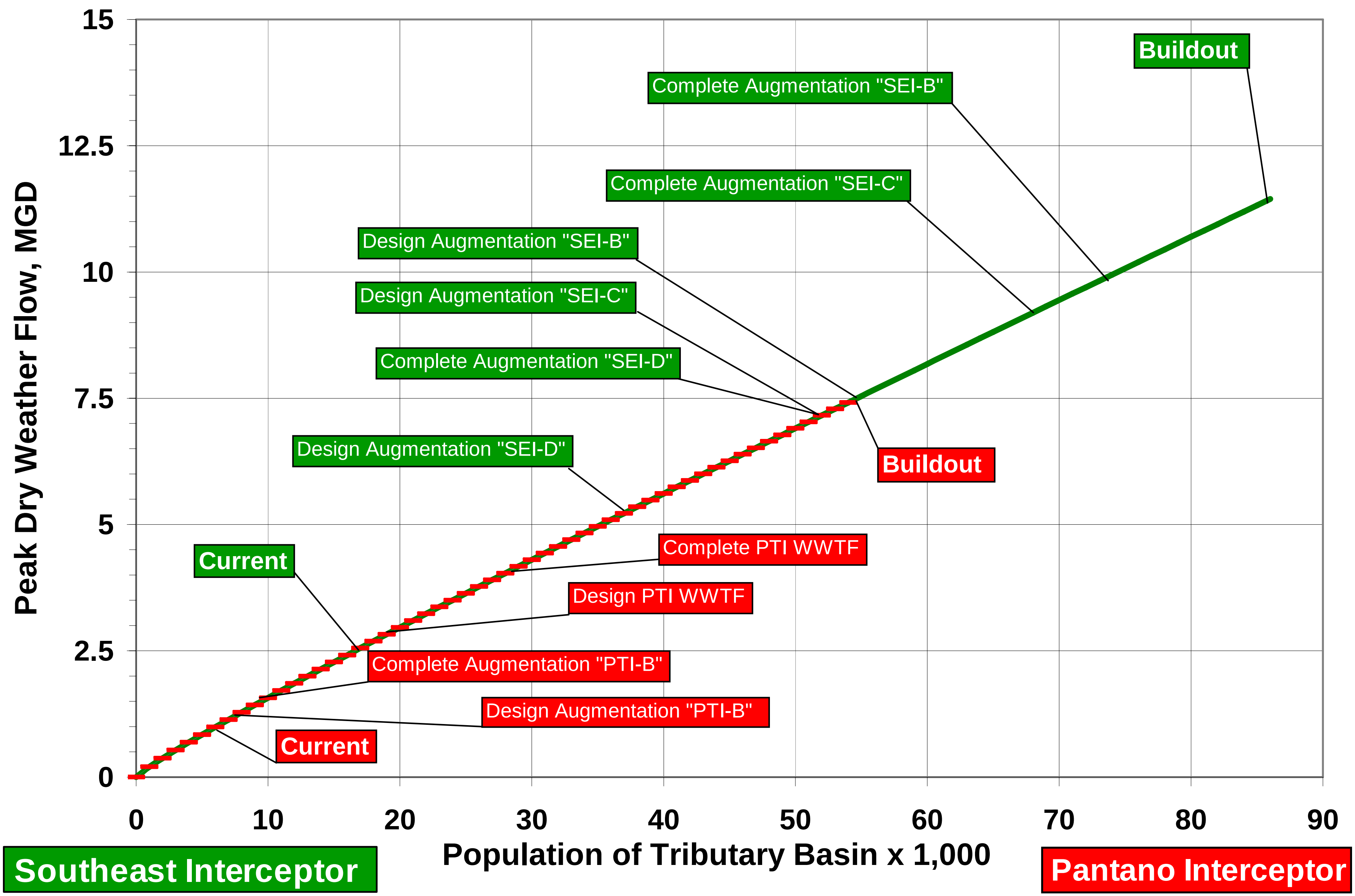
FIGURE 5



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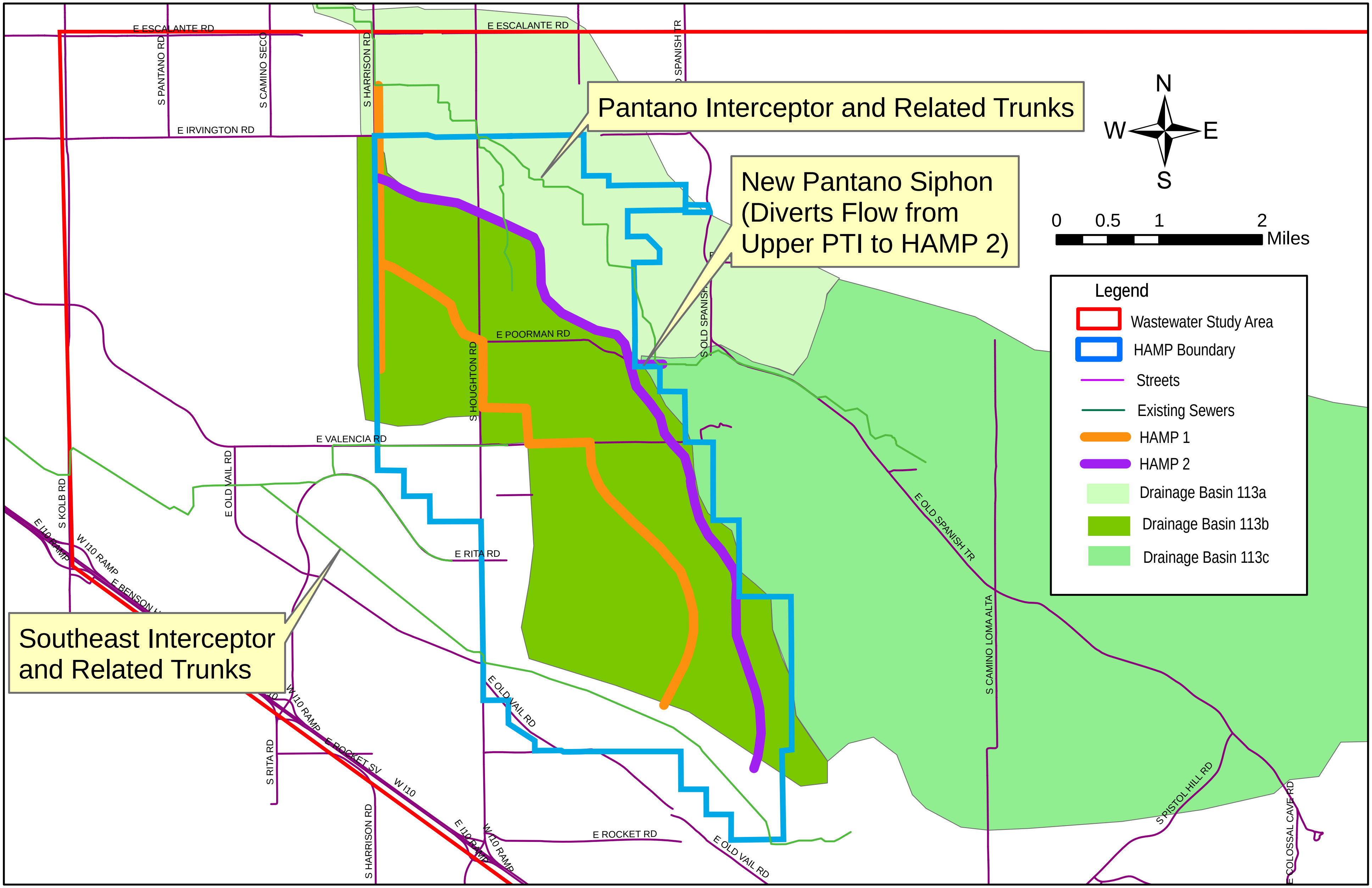

PIMA COUNTY WASTEWATER MANAGEMENT DEPARTMENT

HOUGHTON AREA MASTER PLAN

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SCENARIO 2B DRAINAGE BASIN CONFIGURATION

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FIGURE 7

MALCOLM PIRNIE

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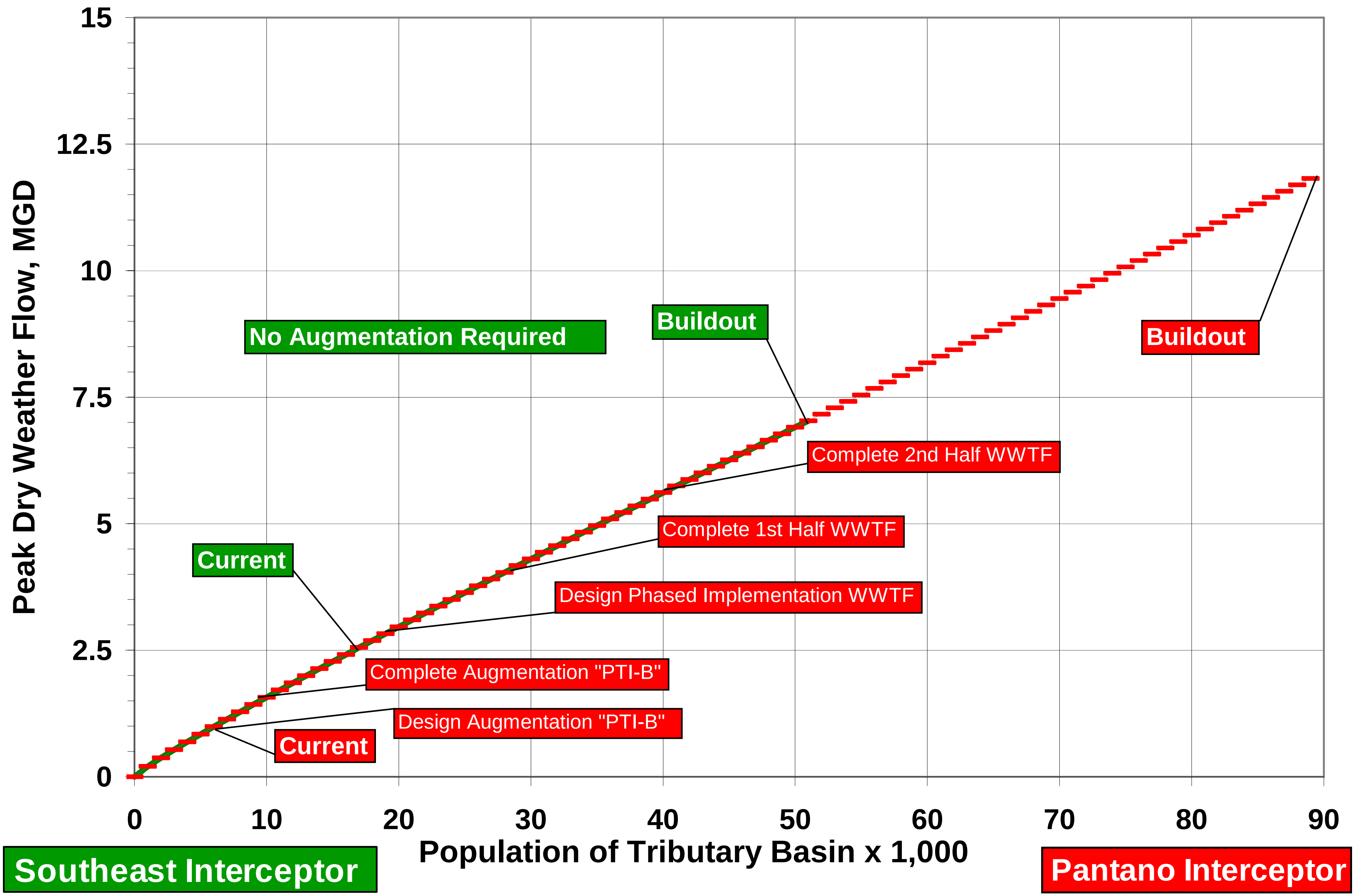

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Implementation Schedule
Scenario 2B

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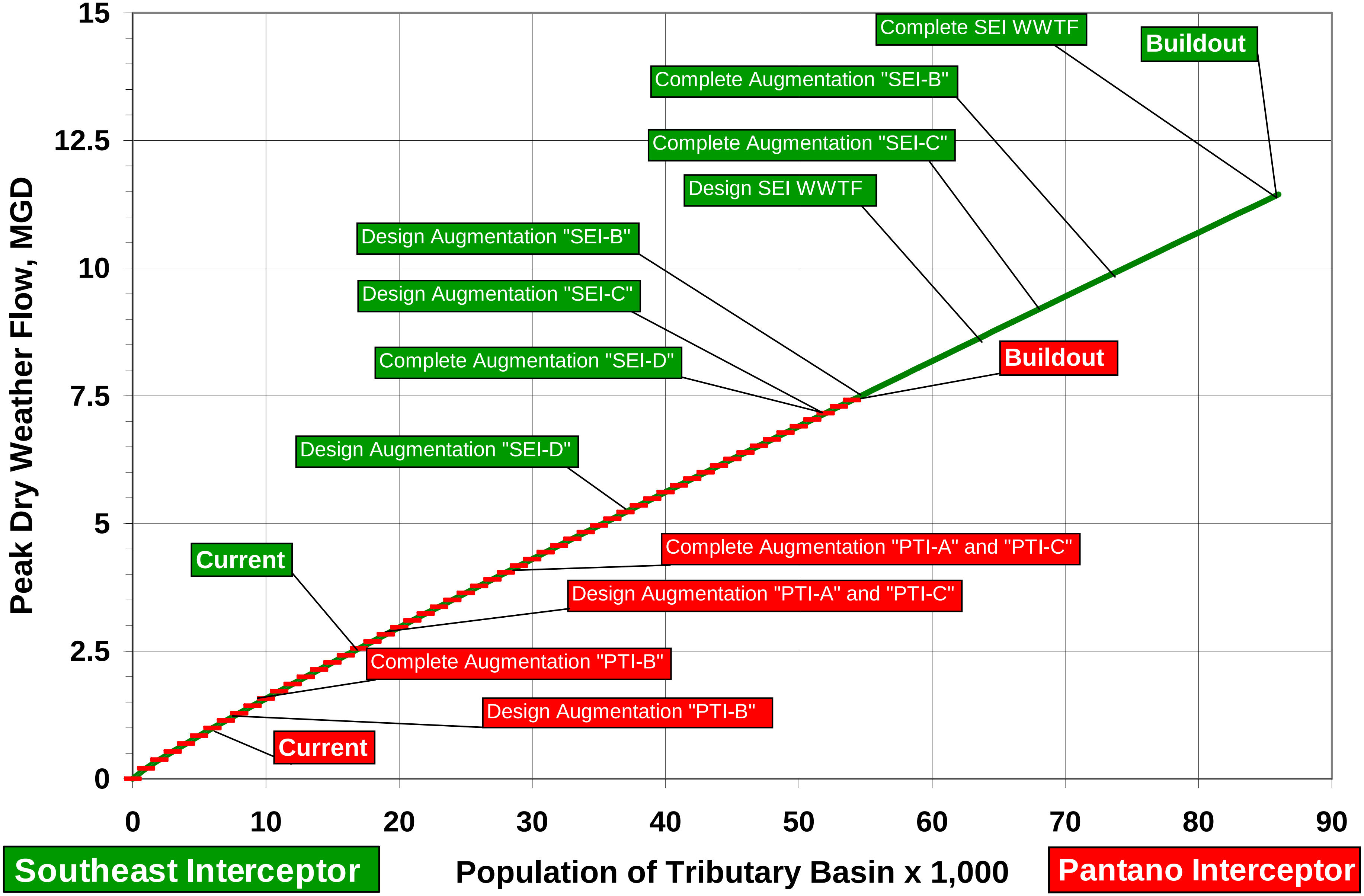
FIGURE 8



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Implementation Schedule
Scenario 3A

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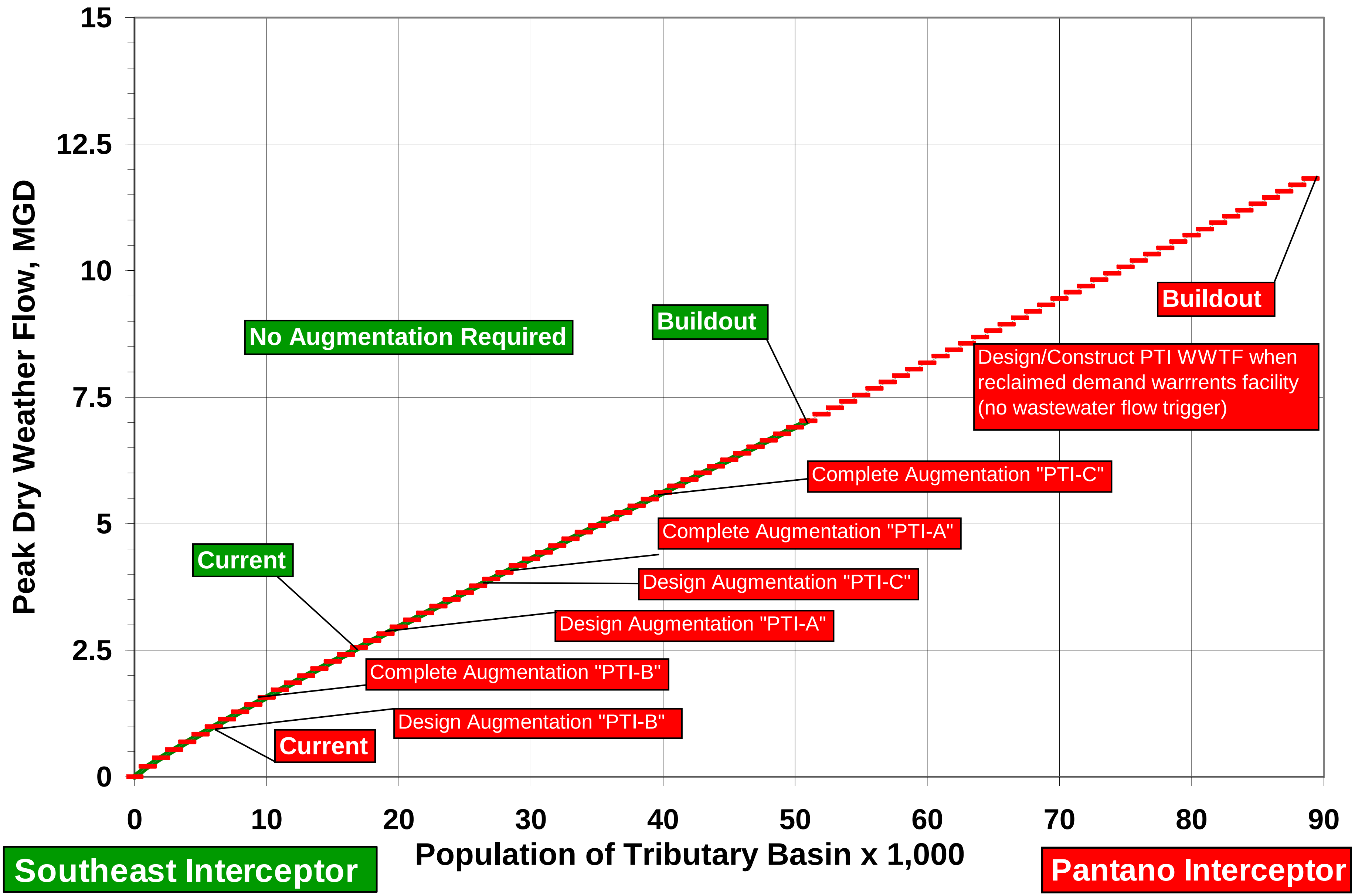
FIGURE 9



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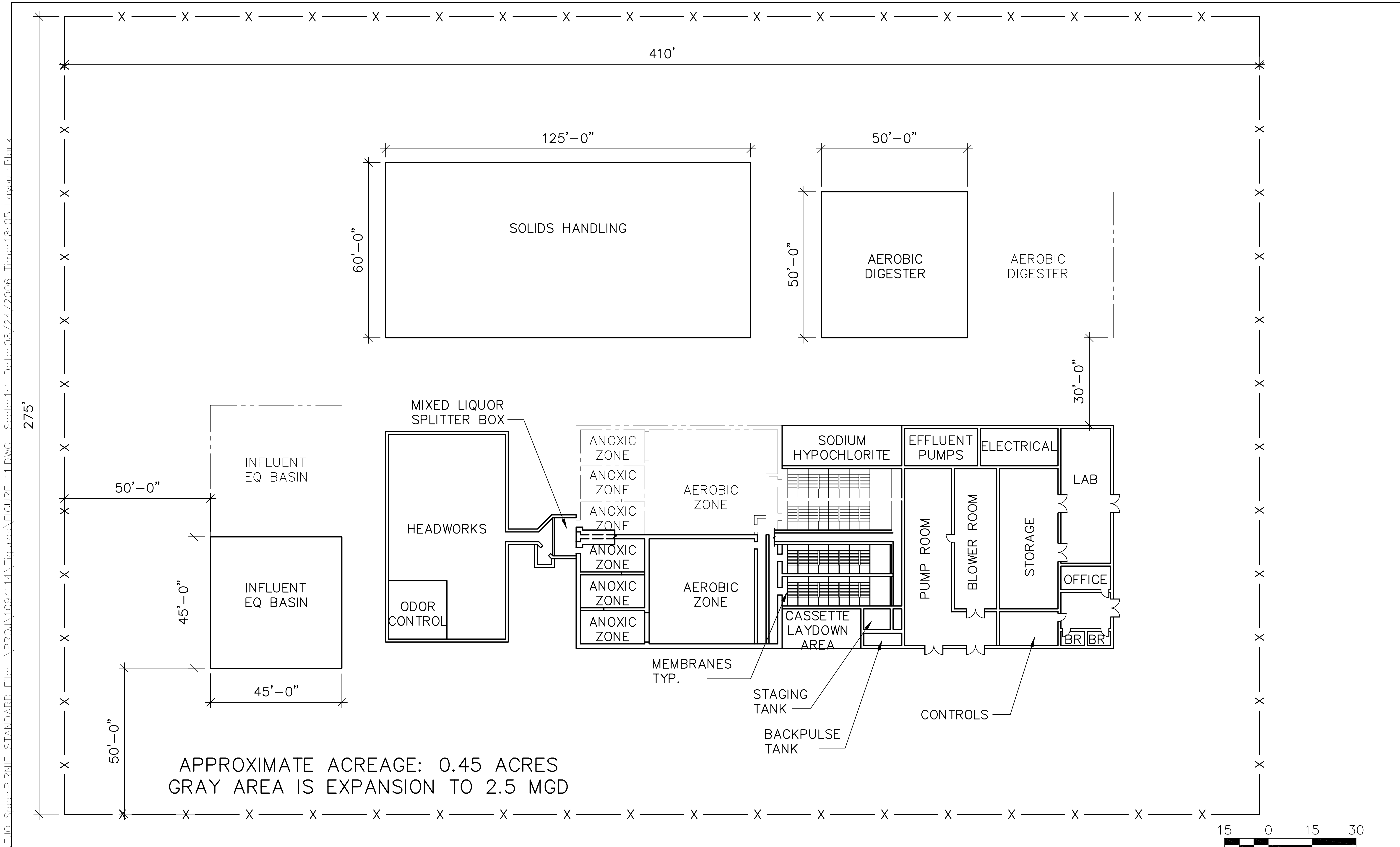

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User: CORNEJO Spec: PIRNIE STANDARD File: I:\PROJ\1094114\Figures\FIGURE 11.DWG Scale:1:1 Date:08/24/2006 Time:18:05 Layout:Blank

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PIMA COUNTY WASTEWATER MANAGEMENT

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SCENARIO 3:
1.2 MGD MEMBRANE BIOEACTOR PLANT

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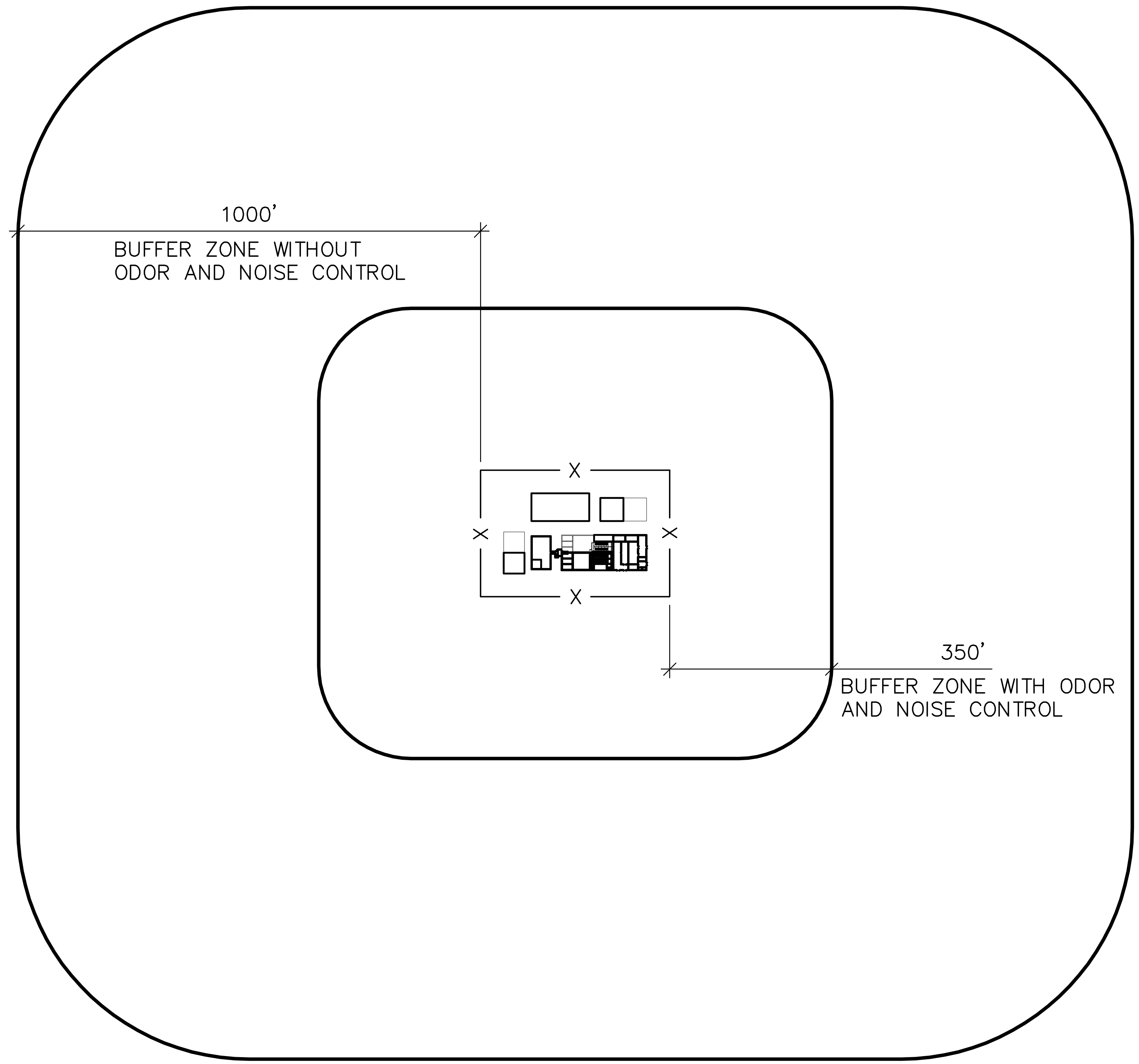
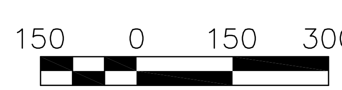
FIGURE 11



PLANT ACREAGE: 2.5 ACRES

350' SETBACK: 24 ACRES

1000' SETBACK: 120 ACRES



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PIMA COUNTY WASTEWATER MANAGEMENT

HOUGHTON AREA MASTER PLAN

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

SCENARIO 3:

1.2 MGD MEMBRANE BIOEACTOR PLANT

MALCOLM PIRNIE, INC.

FIGURE 12

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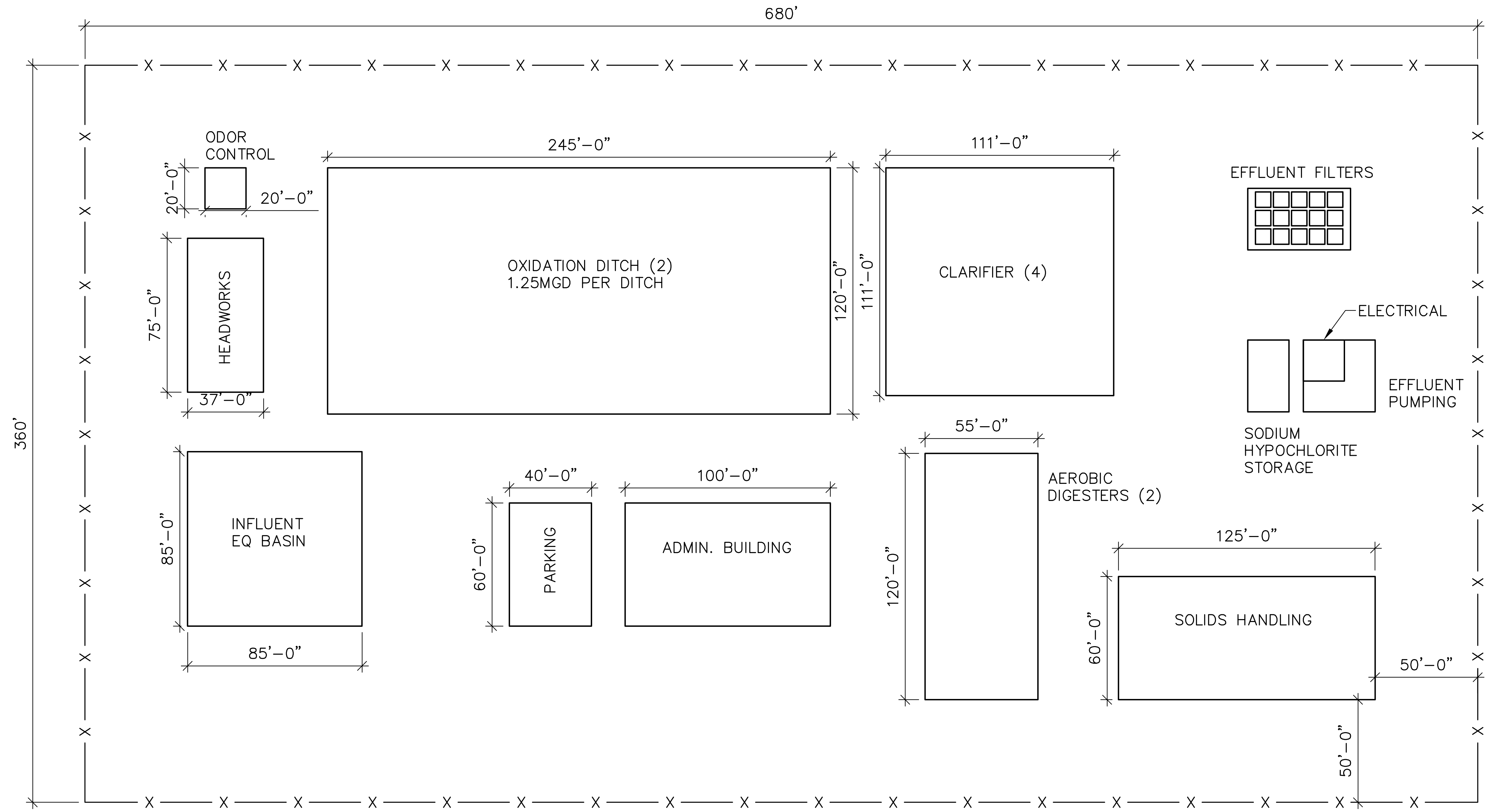
User: CORNEJO Spec: PIRNIE STANDARD File: I:\PROJ\1094114\Figures\FIGURE 12.DWG Scale: 1:1 Date: 08/24/2006 Time: 18:07 Layout: Blank



APPROXIMATE ACREAGE: 5.6 ACRES

25 0 25 50

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PIMA COUNTY WASTEWATER MANAGEMENT

HOUGHTON AREA MASTER PLAN

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SCENARIO 2A

2.5 MGD OXIDATION DITCH

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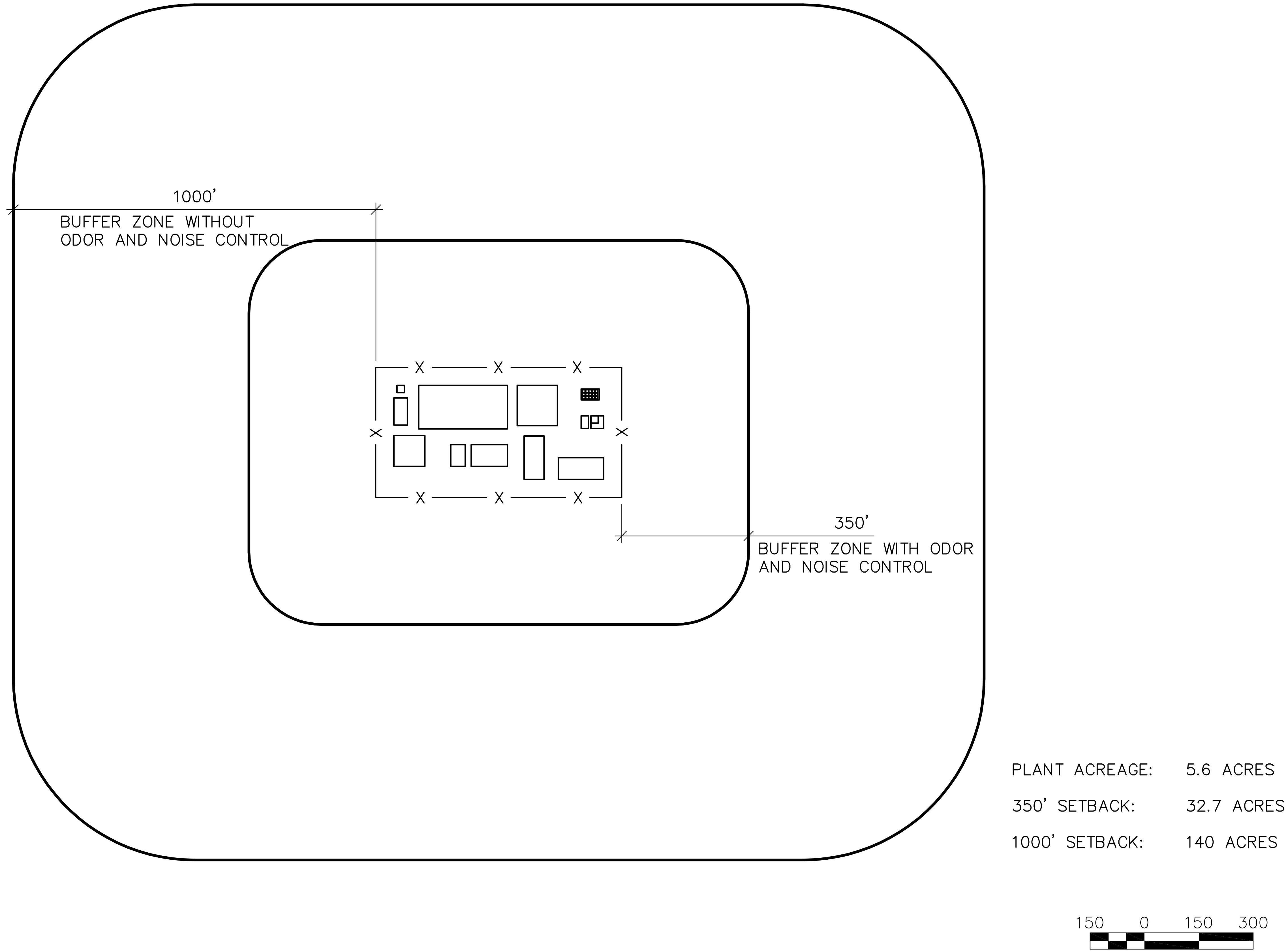
FIGURE 13



MALCOLM PIRNIE

PIMA COUNTY WASTEWATER MANAGEMENT

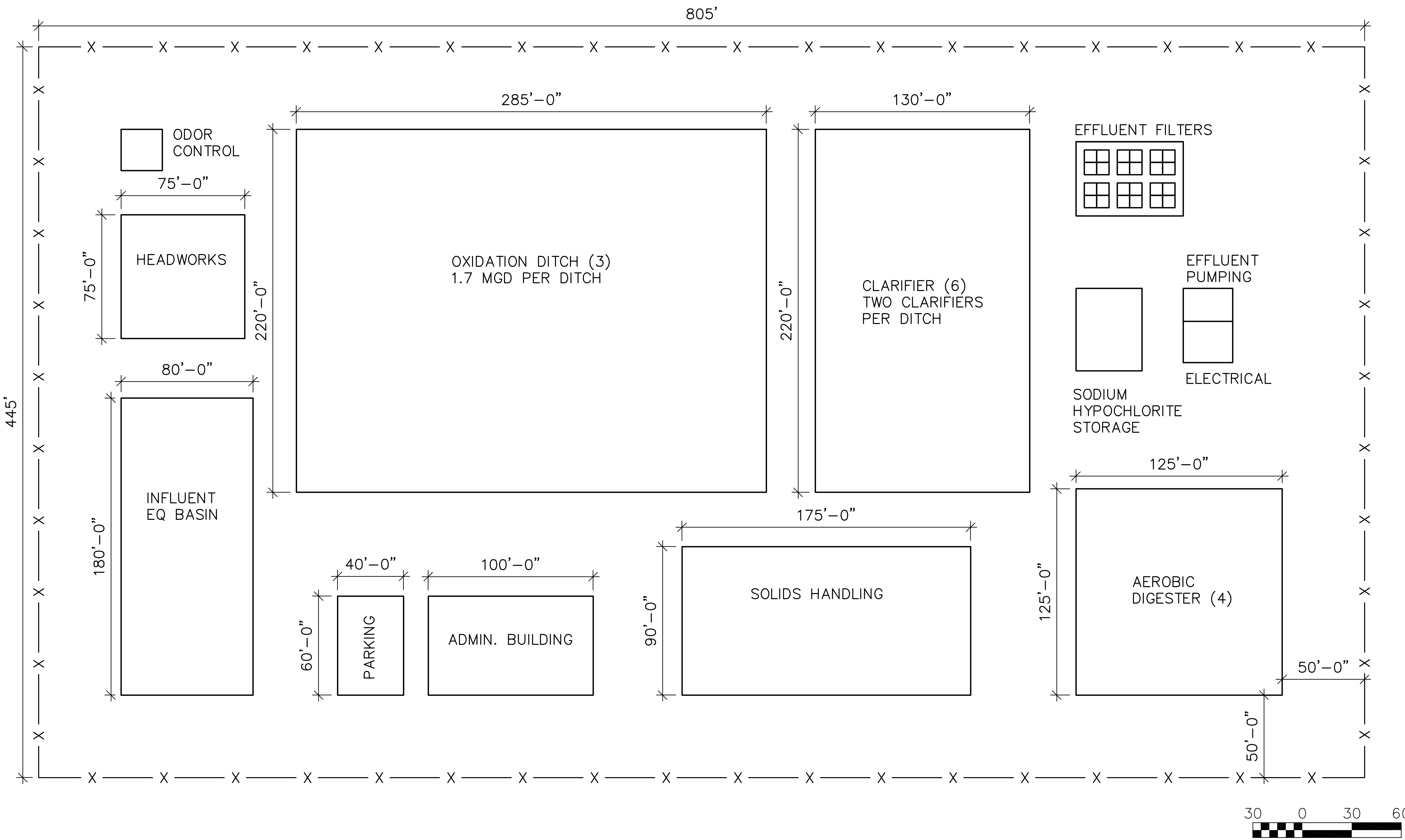
HOUGHTON AREA MASTER PLAN
PIMA CO CONTRACT NO. 25-03-M-137732-0306

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

MALCOLM PIRNIE INDEPENDENT ENVIRONMENTAL ENGINEERS, SCIENTISTS AND CONSULTANTS	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 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

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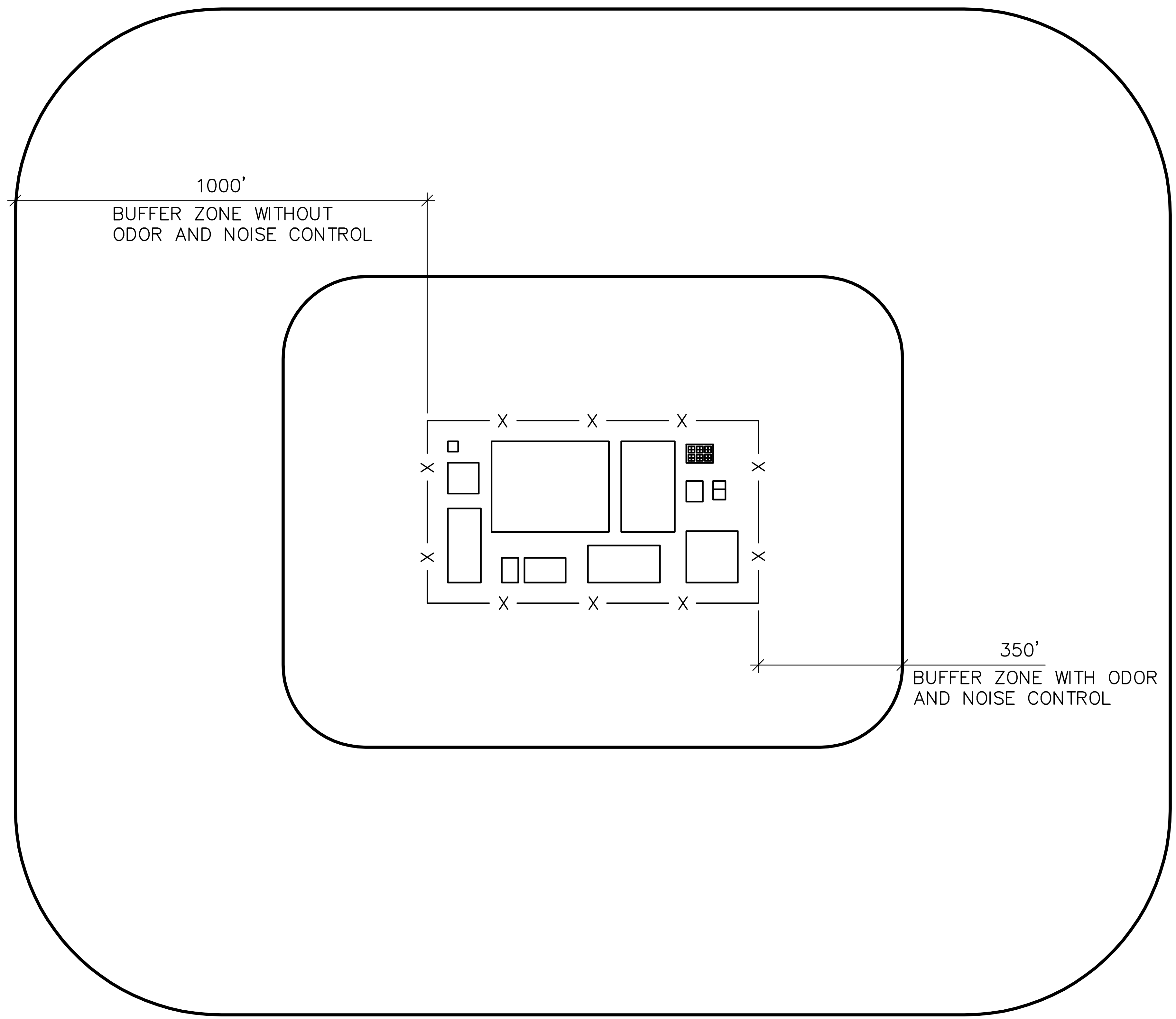
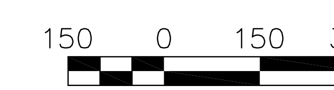
User:CORNEJO Spec:PIRNIE STANDARD File:L:\PROJ\1094114\Figures\FIGURE 16.DWG Scale:1:1 Date:08/24/2006 Time:18:06 Layout:Blank



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



MALCOLM PIRNIE

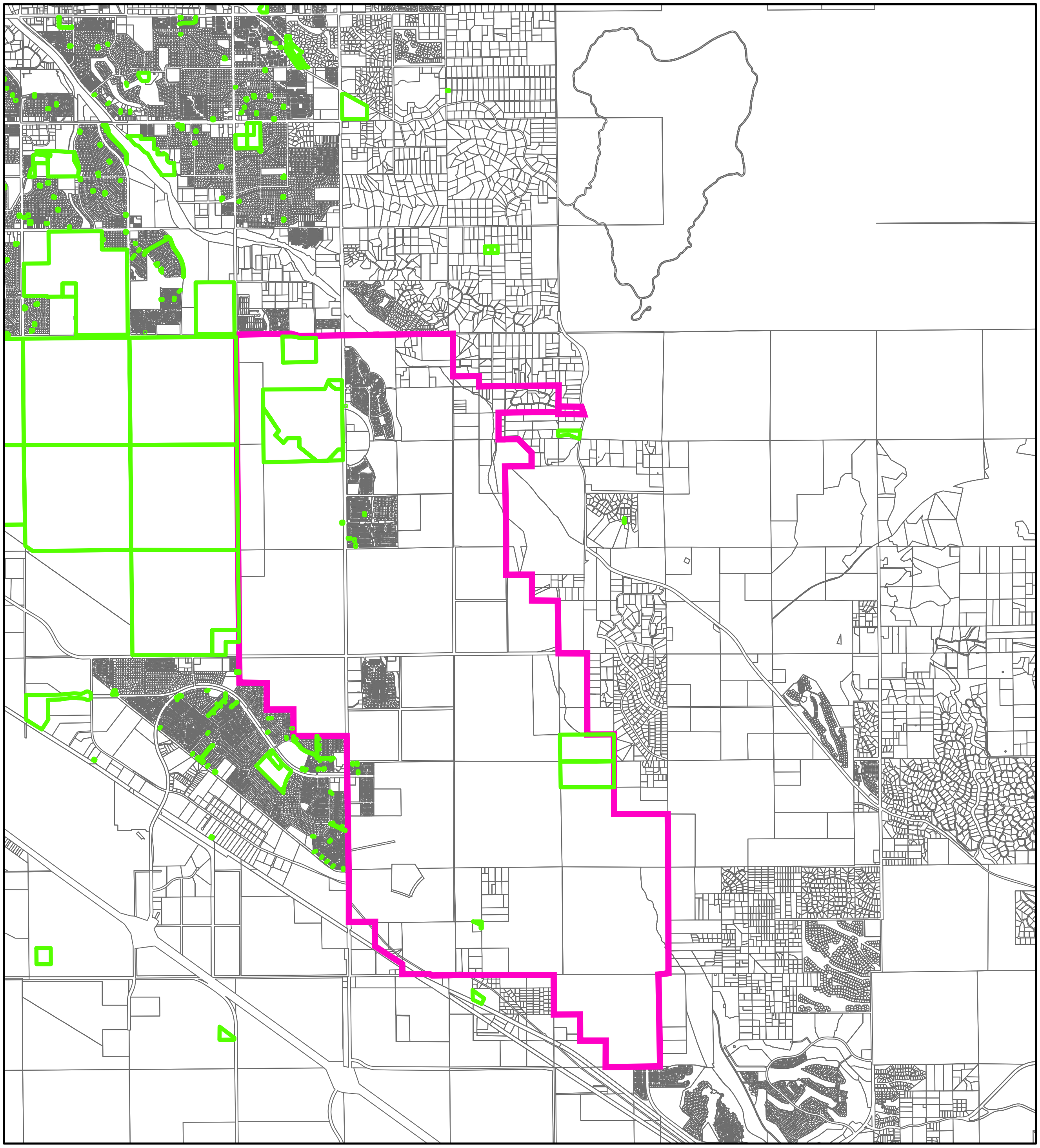
PIMA COUNTY WASTEWATER MANAGEMENT

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



LEGEND


HAMP STUDY AREA BOUNDARY


CITY-OWNED PROPERTY BOUNDARIES

MALCOLM PIRNIE

INDEPENDENT ENVIRONMENTAL ENGINEERS, SCIENTISTS AND CONSULTANTS

PIMA COUNTY WASTEWATER MANAGEMENT DEPARTMENT

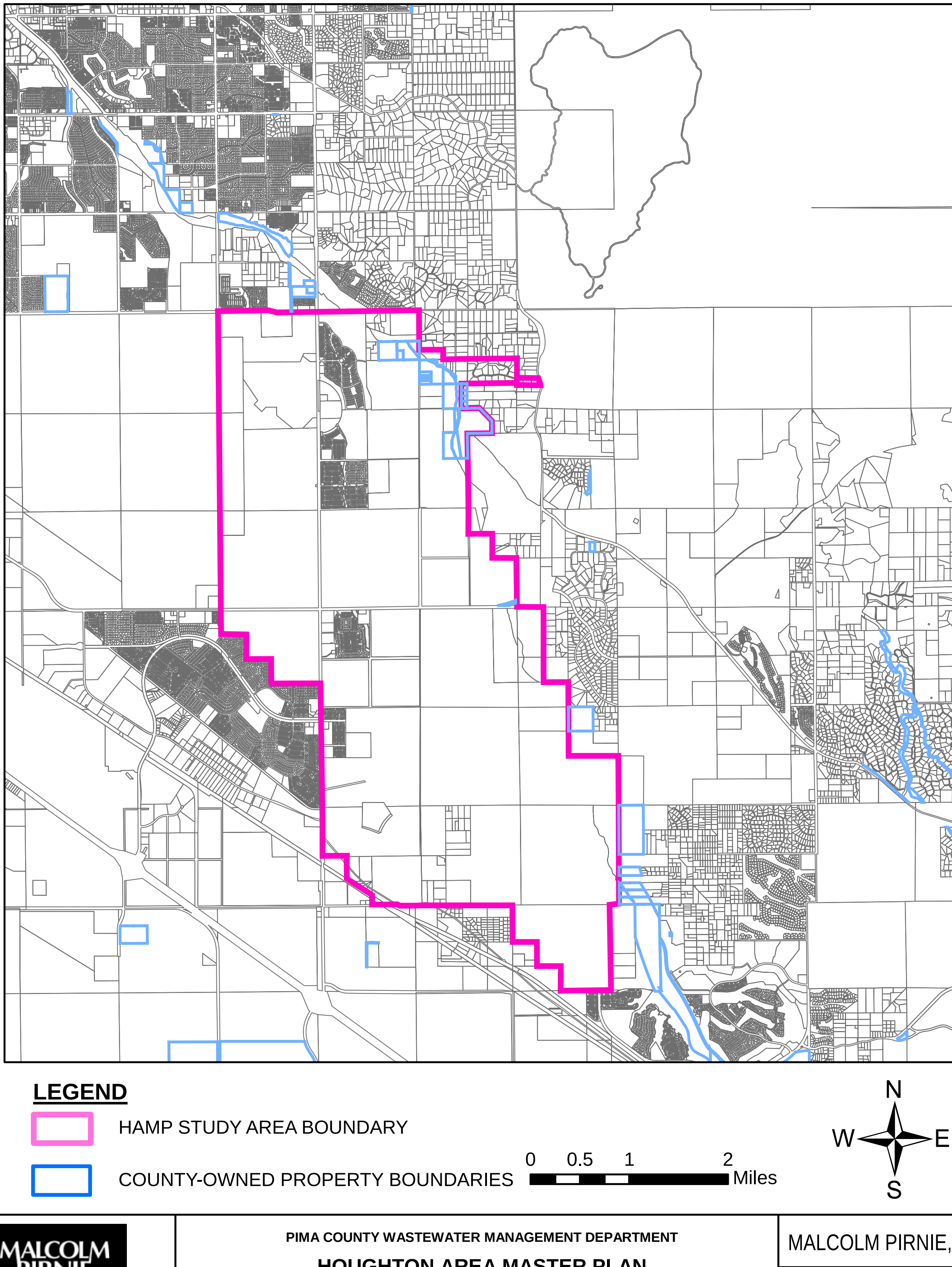
HOUGHTON AREA MASTER PLAN

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

MALCOLM PIRNIE, INC.

FIGURE 17

CITY-OWNED PROPERTY



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.

FIGURE 18

COUNTY-OWNED PROPERTY

Appendix D

Conceptual Cost Opinion Information

Potable Water Capital Cost Opinion for Transmission/Distribution and Booster Station Improvement Alternatives

Approximate Locations: From	Approximate Locations: To	Planned CIP Number	Approx Length, feet	CIP Diameter, inches	Planned CIP Capacity, MGD	Required Supply Capacity, MGD: Alternative 1	Alternative 2	Alternative 3	Estimated Pipe Diameter: Alternative 1	Alternative 2	Alternative 3	Pipe Cost Opinion (x$1,000): 2006 CIP	Alternative 1	Alternative 2	Alternative 3
Common Pipeline															
Hayden-Udall WTP	Future Clearwell-style reservoir	W410	10,000	66	76.8	99.5	99.5	99.5	78	78	78	$7,000	$8,610	$8,610	$8,610
Future Clearwell-style reservoir	Bilby/Tucson BL	W410	50,000	66	76.8	117.7	117.7	117.7	84	84	84	$35,000	$47,050	$47,050	$47,050
											Subtotal	$42,000	$55,660	$55,660	$55,660
South Pipeline															
Bilby/Tucson BL	Country Club/Valencia	No CIP	5,000	48	40.6	81.6	63.4	40.6	72	60	48	$2,365	$3,900	$3,095	$2,365
Country Club/Valencia	Los Reales/Alvernon	W531	11,000	48	40.6	81.6	63.4	40.6	72	60	48	$5,203	$8,580	$6,809	$5,203
Los Reales/Alvernon	Swan/Hermans	W408	9,000	36	22.8	63.8	45.7	22.8	66	54	36	$2,718	$6,300	$4,968	$2,718
Swan/Hermans	Wilmont/Hermans	No CIP	13,000	36	22.8	63.8	45.7	22.8	66	54	36	$3,926	$9,100	$7,176	$3,926
Wilmont/Hermans	S. Pantano/Old Vail Connection	W321	24,000	36	22.8	63.8	45.7	22.8	66	54	36	$7,248	$16,800	$13,248	$7,248
S. Pantano/Old Vail Connection	Rocket/Harrison	W338	11,000	24	9.0	50.0	31.8	9.0	54	48	24	$2,431	$6,072	$5,203	$2,431
Rocket/Harrison	Houghton/I-10	No CIP	9,000	0	0.0	41.0	22.8	0.0	54	36	0	$0	$4,968	$2,718	$0
Houghton/I-10	Houghton/Old Vail	No CIP	10,000	0	0.0	11.7	0.0	11.3	30	0	30	$0	$2,430	$0	$2,430
											Subtotal	$23,891	$58,150	$43,217	$26,321
North Pipeline															
Bilby/Tucson BL	Country Club/Drexel	No CIP	5,000	48	40.6	40.6	58.7	81.6	48	60	72	$2,365	$2,365	$3,095	$3,900
Country Club/Drexel	Country Club/S. 36th	W530	16,000	48	40.6	40.6	58.7	81.6	48	60	72	$7,568	$7,568	$9,904	$12,480
Country Club/S. 36th	Houghton/Irvinton	No CIP	60,000	0	0.0	0.0	18.1	41.0	0	36	54	$0	$0	$18,120	$33,120
											Subtotal	$9,933	$9,933	$31,119	$49,500

"Local" HAMP Distribution/Transmission

Pipe Diameter	Approximate Length, feet: Alternative 1	Alternative 2	Alternative 3	Pipe Cost Opinion (x$1,000): 2006 CIP	Alternative 1	Alternative 2	Alternative 3
12	73,800	71,500	57,100	$0	$7,528	$7,293	$5,824
16	65,500	50,500	71,000	$0	$8,843	$6,818	$9,585
24	4,300	15,600	31,700	$0	$950	$3,448	$7,006
30	25,800	29,500	9,700	$0	$6,269	$7,169	$2,357
36	0	10,500	12,400	$0	$0	$3,171	$3,745
42	0	0	3,100	$0	$0	$0	$1,172
48	0	0	14,200	$0	$0	$0	$6,717
			Subtotal	$0	$23,590	$27,898	$36,405

Pipe Cost Opinion, Total: 2006 CIP	Alternative 1	Alternative 2	Alternative 3
$75,824	$147,333	$157,894	$167,886

Booster Station Approximate Location	Planned CIP Number	Estimated CIP Capacity, MGD	Supply Booster Capacity Required, MGD: Alternative 1	Alternative 2	Alternative 3	Booster Cost Opinion, (x$1,000): 2006 CIP	Alternative 1	Alternative 2	Alternative 3
Common Booster Requirements									
Snyder Hill Pump Station	No CIP	76.8	99.5	99.5	99.5	-	-	-	-
Bilby/Tucson B-C	No CIP	76.8	117.7	117.7	117.7	$5,542	$6,842	$6,842	$6,842
					Subtotal	$5,542	$6,842	$6,842	$6,842
South Supply Booster Requirements									
Hermans/Swan C-D	W409	25.0	66.0	47.8	25.0	$3,189	$5,143	$4,390	$3,189
Hermans/Wilmont D-E	D104	25.0	66.0	47.8	25.0	$3,189	$5,143	$4,390	$3,189
S. Pantano/Old Vail E-F	No CIP	9.0	50.0	31.8	9.0	$1,929	$4,485	$3,593	$1,929
					Subtotal	$8,306	$14,771	$12,374	$8,306
North Supply Booster Requirements									
Swan/Golf Links C-D	No CIP	0.0	0.0	18.1	41.0	$0	$0	$2,721	$4,067
Pantano/Golf Links D-E	No CIP	0.0	0.0	18.1	41.0	$0	$0	$2,721	$4,067
Harrison/Golf Links E-F	No CIP	0.0	0.0	18.1	41.0	$0	$0	$2,721	$4,067
					Subtotal	$0	$0	$8,162	$12,200
"Local" HAMP Booster Requirements									
Southeast F-G	No CIP	0.0	42	24	0	$0	$4,118	$3,125	$0
HAMP G-I	No CIP	0.0	16	16	16	$0	$2,559	$2,559	$2,559
North HAMP F-G	No CIP	0.0	0	15	38	$0	$0	$2,479	$3,919
					Subtotal	$0	$6,677	$8,164	$6,479

Booster Cost Opinion, Total: 2006 CIP	Alternative 1	Alternative 2	Alternative 3
$13,848	$28,289	$35,541	$33,827

Revervoir Zone	Planned CIP Number	Estimated CIP Capacity, MGD	Reservoir Capacity Required, MG: Alternative 1	Alternative 2	Alternative 3	Reservoir Cost Opinion, (x$1,000): 2006 CIP	Alternative 1	Alternative 2	Alternative 3
"Local" HAMP Reservoirs									
F-Zone	No CIP	0.0	10.0	10.0	10.0	$0	$6,812	$6,812	$6,812
G/I-Zone	No CIP	0.0	25.0	25.0	25.0	$0	$14,751	$14,751	$14,751

Reservoir Cost Opinion, Total: 2006 CIP	Alternative 1	Alternative 2	Alternative 3
$0	$21,563	$21,563	$21,563

	Subtotal of Pipes, Boosters, and Reservoirs, (x$1,000): 2006 CIP	Alternative 1	Alternative 2	Alternative 3
	$89,672	$197,185	$214,998	$223,276
Engineering, Legal, and Administrative (25%)	$22,418	$49,296	$53,749	$55,819
Subtotal	$112,091	$246,482	$268,747	$279,095
Contingency (30%)	$33,627	$73,944	$80,624	$83,728
Total	$145,718	$320,426	$349,371	$362,823

Detailed Reclaimed Water Capital Cost Opinion, $1,000

	Alternative 1 - HAMP Only, Two Phase, Looped			Alternative 2 - Single Phase, Single Trunk	Alternative 3 - Two Phase, Looped			Alternative 1 Oversized[1] - HAMP Only- Two Phase, Looped		
	Phase 1[2]	Phase 2[2]	Total	Single Phase	Phase 1[2]	Phase 2[2]	Total	Phase 1[2]	Phase 2[2]	Total
Size, in	Length, ft									
6	3,500	0	3,500	11,600	11,500	0	11,500	3,500	0	3,500
12	23,600	6,700	30,300	29,000	19,700	0	19,700	0	0	0
16	17,600	10,700	28,300	17,500	53,300	19,400	72,700	35,800	17,500	53,300
20	0	1,900	1,900	0	0	0	0	0	1,900	1,900
24	7,400	0	7,400	39,000	12,700	0	12,700	12,700	0	12,700
	Cost, x$1,000									
6	$231	$0	$231	$766	$759	$0	$759	$231	$0	$231
12	$1,746	$496	$2,242	$2,146	$1,458	$0	$1,458	$0	$0	$0
16	$1,566	$952	$2,519	$1,558	$4,744	$1,727	$6,470	$3,186	$1,558	$4,744
20	$0	$194	$194	$0	$0	$0	$0	$0	$194	$194
24	$873	$0	$873	$4,602	$1,499	$0	$1,499	$1,499	$0	$1,499
Subtotal	$4,417	$1,642	$6,059	$9,071	$8,459	$1,727	$10,186	$4,916	$1,751	$6,667
Reservoir Capacity, MG	3.5	0.0	3.5	7.0	7.0	0.0	7.0	3.5	0.0	3.5
Estimated Cost	$5,457	$0	$5,457	$8,998	$8,998	$0	$8,998	$5,457	$0	$5,457
Subtotal	$5,457	$0	$5,457	$8,998	$8,998	$0	$8,998	$5,457	$0	$5,457
Houghton Booster, MGD	5.0	0.0	5.0	9.0	9.0	0.0	9.0	5.0	0.0	5.0
Del Lago Booster, MGD	0.0	0.0	0.0	2.0	2.0	0.0	2.0	0.0	0.0	0.0
Houghton Booster[3] Cost	$1,940	$0	$1,940	$2,469	$2,469	$0	$2,469	$1,940	$0	$1,940
Del Lago Booster Cost	$0	$0	$0	$1,277	$1,277	$0	$1,277	$0	$0	$0
Subtotal	$1,940	$0	$1,940	$3,746	$3,746	$0	$3,746	$1,940	$0	$1,940
Subtotal: Pipes, Reservoirs, and Boosters	$11,814	$1,642	$13,455	$21,815	$21,203	$1,727	$22,929	$12,312	$1,751	$14,064
Engineering, Legal, and Administrative (25%)	$2,953	$410	$3,364	$5,454	$5,301	$432	$5,732	$3,078	$438	$3,516
Subtotal	$14,767	$2,052	$16,819	$27,269	$26,504	$2,158	$28,662	$15,390	$2,189	$17,580
Contingency (30%)	$4,430	$616	$5,046	$8,181	$7,951	$647	$8,599	$4,617	$657	$5,274
Total	$19,197	$2,668	$21,865	$35,449	$34,455	$2,806	$37,260	$20,008	$2,846	$22,853

[1]Represents costs based on the pipeline alignments of Alternative 1 with increased pipe diameters to allow future expansion to Alternative 3.

[2]Phased piping is indicated on Figure 5-4 and Figure 5-6.

[3]Because of high head requirements at this booster station, 30-percent was added to the cost.