APPENDIX A

Surface Water Treatment Plant Siting Evaluation

APPENDIX A. SURFACE WATER TREATMENT PLANT SITING EVALUATION

PREFACE AND UPDATE

This City of Fresno (City) Surface Water Treatment Plant (SWTP) Siting Evaluation was conducted by West Yost Associates in 2006 and completed in February 2007. It recommended the construction of a new 30-million gallon per day (mgd) SWTP and identified the 23-acre site located at the southeast corner of Clovis Avenue and McKinley Avenue near the Fresno Airport as the preferred project site (identified as Alternative 4 in the February 2007 Siting Evaluation). This recommendation was based on the evaluation of four alternatives that include expanding the existing SWTP in northeastern Fresno, and building a new SWTP at one of three new potential sites. The analysis indicated that expansion of the existing SWTP would be more costly than construction of a new SWTP located in southeastern Fresno, primarily due to the cost of "backbone" pipeline transmission capacity to connect the expanded SWTP facility to the existing and future water demands in the southeastern portion of the City's service area. This conclusion was consistent with the recommendations of the 1996 Metro Plan.

Since the completion of the Siting Evaluation, the availability of the recommended 23-acre site has changed, and the site is no longer available for the construction of a future surface water treatment plant. However, in April 2009, the City Council approved the acquisition of an approximately 58-acre parcel in the southwestern portion of the City, located at the northwest corner of Armstrong and Olive Avenues, for the proposed new SWTP (see Figure A-1). This alternative site is just east of the previously recommended site (Alternative 4), is near the proposed water source (the Mill Ditch), and is of an appropriate size for the proposed new SWTP. Because of this, the evaluation described below is considered to still be applicable and valid.

Also, since the completion of the Siting Evaluation, the recommended treatment capacity of the new surface water treatment plant has been increased from 30 mgd to 80 mgd (see Chapter 6). This recommended treatment capacity increase will allow the City to maximize its use of available surface water supplies and increase conjunctive use of available surface water and groundwater supplies. The evaluation described below is considered to be applicable and valid for a proposed 80 mgd SWTP.

INTRODUCTION

Groundwater quality in southeastern Fresno has been impacted by contaminants such as trichloropropane (TCP), 1,2-dibromo-3-chloropropane (DBCP), ethylene dibromide (EDB), and nitrate, causing the City to construct high cost wellhead treatment facilities and to look for alternative sources of supply to supplement the impacted and low-yielding production wells in this area. For the purposes of this evaluation, it was assumed that the City would plan on increasing its total surface water treatment capacity by 30 mgd (to a total of 60 mgd) to take advantage of available surface water resources in meeting the water demands in this region of the City.

Four different alternatives were evaluated and ranked in terms of economic and non-economic considerations. The following topics are addressed in this evaluation.

- Potential SWTP sites
- Proposed alternatives
- Evaluation of alternatives
  - Economic considerations
  - Non-economic considerations
- Weighted alternatives ranking
- Recommendation

POTENTIAL SWTP SITES

Potential SWTP sites were selected based on the availability of land, their proximity to the raw water supply, and discussions with City staff. A reconnaissance level site visit was conducted on March 10, 2006. The four potential SWTP sites which were evaluated, including the assessor's parcel numbers (APN), are listed below:

- Site #1 – Existing SWTP site (APN 57802004T)
- Site #2 – "Series 6 Ponds" at the Leaky Acres Project Area (APN 43062113T and 43004036ST)
- Site #3 – Farmland at the northeast corner of Shields Avenue and Leonard Avenue (APN 31029010)
- Site #4 – Southeast corner of Clovis Avenue and McKinley Avenue (APN 31007059ST)

Site #1 – Existing SWTP site

The existing 35-acre SWTP site is located near the northeastern section of the City, bounded by Fresno Irrigation District's (FID) Enterprise Canal to the west, and surrounded by the developing State Center Community College District campus to the north and east. The current source of the raw water supply for the existing SWTP is FID's Enterprise Canal.

The advantages of this site are:

1. No land acquisition costs are required since it is City-owned property.
2. The existing raw water supply facilities which currently deliver supply to the site were originally designed to handle the anticipated 60 mgd flow.
3. The existing SWTP was originally designed and constructed to be easily expandable by an additional 30 mgd of treatment capacity.
4. The City plans to construct a pipeline from the Friant-Kern Canal to the SWTP (and keep the Enterprise Canal a secondary raw water supply source) to provide raw water quality enhancements, increase public health protection and develop adequate hydraulic head to operate the treatment plant by gravity feed.

The disadvantages of this site are:

1. It is far away from the demand area of the southeastern portion of the City's service area.
2. There are inadequate "backbone" pipeline transmission facilities to connect the existing SWTP site to the southeastern portion of the City's service area.

Site #2 – "Series 6 Ponds" at the Leaky Acres Project Area

This site is composed of two parcels (33.5 acres total) and is located on the north side of Ashlan Avenue, just east of Highway 168. These parcels are being used as groundwater recharge ponds (called the "Series 6 Ponds"), and are currently a part of the City's Leaky Acres Project area. Localized presence of shallow clay layers at this potential SWTP site makes this location less permeable than the recharge ponds located south of Ashlan Avenue. The source of the raw water supply to this potential site is FID's Gould Canal, adjacent to the property.

The advantages of this site are:

1. The site requires no land acquisition costs since it is City-owned property.
2. A 24-inch diameter potable water transmission main is located just south of the site along Ashlan Avenue.
3. The source of the raw water supply, FID's Gould Canal, is very close to the site.

The disadvantages of this site are:

1. The raw water supply may be interrupted several times a year when FID's Gould Canal is treated with aquatic herbicides to control weed and algae growth. It may be

possible to reduce the frequency or duration of the interruptions by taking advantage of Leaky Acres as a forebay. However, many factors must be considered including the hydraulics, infrastructure, impact to groundwater recharging operations and water quality in Leaky Acres.

2. A conveyance capacity study and subsequent channel improvements may be necessary to ensure the conveyance of the raw water supply from FID's Gould Canal to the proposed site.
3. There will be a slight reduction in groundwater recharge due to the loss of these percolation ponds.
4. Soil modifications may be necessary prior to constructing the SWTP.
5. Possible Federal Aviation Administration (FAA) clear zone restrictions.

Site #3 – Farmland at the NE corner of Shields and Leonard

There is a 60-acre parcel located at the northeast corner of Shields and Leonard. This site is located outside of the City limits, but within the eastern border of the City's adopted Sphere of Influence (SOI). The land is privately held and is being actively farmed. It is assumed that a 20-acre parcel is available for purchase by the City. The source of the raw water supply would be FID's Gould Canal adjacent to the property.

The advantages of this site are:

1. The parcel has a wide canal frontage and is suitable to facilitate onsite groundwater recharge activities.
2. It is very close to the source of the raw water supply, which is FID's Gould Canal.

The disadvantages of this site are:

1. There is an associated land acquisition cost to the City.
2. A prolonged negotiation for land acquisition may adversely impact the project implementation schedule.
3. The raw water supply may be interrupted several times a year when FID's Gould Canal is treated with aquatic herbicides to control weed and algae growth.
4. City may need to fund a conveyance capacity study and subsequent channel improvements to ensure the conveyance of the raw water supply from FID's Gould Canal to the proposed site.

Site #4 – Southeast corner of Clovis and McKinley

This is a 23-acre parcel located southeast of the Fresno Airport at the southeastern corner of Clovis Avenue and McKinley Avenue. This property is already owned by the City, and is vacant. The source of the raw water supply to this potential SWTP site would be FID's Mill Ditch, located adjacent to the property.

The advantages of this site are:

1. No land acquisition costs are required since it is City-owned property under management by the Fresno Airport. However, a long-term lease agreement would have to be negotiated.
2. The source of the raw water supply, Mill Ditch, is very close to the site.
3. High flows and high velocities in the Mill Ditch hinder the weed and algae growth, which results in less frequent treatment with aquatic herbicides.

The disadvantages of this site are:

1. City may need to fund a conveyance capacity study and subsequent channel improvements to ensure the conveyance of the raw water supply from FID's Mill Ditch to the proposed site.
2. Possible FAA clear zone restrictions.
3. City would need to enter into a long-term lease agreement with the Airport, and bear the cost of the lease.

A summary of the potential SWTP sites is presented in Table A-1. Aerial photos of each site are included in Appendix A-1.

Figure A-1 shows the potential SWTP sites, City's adopted SOI boundary, roads, three raw water supply canals, pressure zones, and existing active wells.

Table A-1. Summary of the Potential SWTP Sites

Items	Site #1	Site #2	Site #3	Site #4
Location	NE Sector of City	"Leaky Acres" Project Area	Near Eastern SOI Boundary	SE of Fresno Airport
Acreage (acre)	35	33.5	20 (out of 60 acres total)	23
Ownership	City	City	Private Owner	City
Raw Water Supply Conveyance	FID's Enterprise Canal[(a)]	FID's Gould Canal	FID's Gould Canal	FID's Mill Ditch
Existing Land Use	SWTP	Groundwater Recharge FAA restriction	Farmland	Vacant FAA restriction
Proximity to Demand Area	5 + miles	3 miles	2 miles	0 mile

(a) The Enterprise Canal is to become a secondary raw water supply source with the construction of the five mile pipeline from the Friant-Kern Canal to the existing SWTP site.

PROPOSED ALTERNATIVES

Four alternatives were evaluated. Each alternative was evaluated based on construction of a 30-mgd surface water treatment plant at the proposed site, and associated conveyance transmission pipelines and booster pump stations required to deliver this treated potable water to southeastern Fresno. Because the City's water demands were met entirely by groundwater until approximately 2004, the City's water distribution system is composed of relatively small diameter pipelines (as wells were generally located fairly close together to serve new demand areas). Therefore, new major "backbone" transmission pipelines are necessary to be able to provide adequate system flows and pressures during high demand periods. Consequently, each alternative consists of constructing water treatment facilities and associated transmission pipeline facilities.

Alternative 1: Expand the existing SWTP (Site #1) by taking advantage of the existing SWTP design that allows facilities expansion into the adjacent City-owned lands.

From this site, the additional 30-mgd treated surface water will be boosted and conveyed south, through a new 48-inch diameter transmission main for several miles along N. Willow Avenue, and then continues in an easterly direction following the SOI boundary (see Figure A-2). Traversing south along S. Temperance Avenue, 16- and 24-inch laterals would branch out and serve local demands. The transmission main, which is now 36-inches in diameter south of crossing Olive Avenue, continues south on S. Fowler Avenue, then west on E. North Avenue, while serving local demands. As the diameter further reduces to a 24-inch pipeline, 16- and 24-inch laterals would branch out and serve additional demands, and complete system looping in the southeastern section of the City.

Alternative 2: Construction of a new SWTP at Site #2. As shown on Figure A-3, the 30 mgd treated surface water would be boosted and conveyed east along E. Ashlan Avenue for approximately one mile in a 48-inch transmission main until it intersects the SOI boundary. Following the SOI boundary, the 48-inch transmission main continues in an easterly direction for approximately five miles until it intersects S. Temperance Avenue. Then, continuing south along S. Temperance Avenue, 16- and 24-inch laterals would branch out from the 48-inch transmission main and serve local demand areas. The transmission main, which is now 36 inches in diameter, continues south along S. Fowler Avenue then west on E. North Avenue, with the diameter further reduced to a 24-inch pipeline; 16- and 24-inch laterals would branch out and serve the remaining demands, and complete system looping in this southeastern section of the City.

Alternative 3: Construction of a new SWTP at Site #3. For the purposes of this evaluation, it was assumed that City would acquire a 20-acre (out of 60 acres total) parcel from the current land owner. As shown on Figure A-4, the 30 mgd treated surface water would be boosted and conveyed west along E. Shields Avenue for approximately two miles in a 48-inch transmission main. This transmission main would then traverse south on S. Temperance Avenue with 16- and 24-inch laterals branching out to serve local demands. The transmission main, which is now 36 inches in diameter, would be routed south on S. Fowler Avenue then west on E. North Avenue, with the diameter further reduced to a 24-inch pipeline; 16- and 24-inch laterals would branch out and serve the remaining demands, and complete system looping in this southeastern section of the City.

Alternative 4: Construction of a new SWTP at Site #4 at the southeast corner of Clovis Avenue and McKinley Avenue. However, due to concerns about possible airport glide path airspace restrictions, to provide flexibility, a reasonable alternative site such as along the corridor adjacent to Mill Ditch, perhaps from Clovis Avenue to Temperance Avenue, should also be considered, if Site #4 is unavailable. As shown on Figure A-5, the 30 mgd of treated surface water would be boosted and conveyed east along E. Olive Avenue for approximately two miles in a 48-inch transmission main to Temperance Avenue. At Temperance Avenue and Olive Avenue, a 24-inch transmission main would continue north on Temperance Avenue, while a 36-inch transmission main would continue south on Temperance Avenue. While traversing south on S. Temperance Avenue, 16- and 24-inch laterals would branch out and tie into existing transmission mains to serve local demands. The transmission main, which is now 24 inches in diameter, traverses south on S. Fowler Avenue then west on E. North Avenue; 16- and 24-inch laterals would branch out and serve the remaining demands from the south to north direction, and complete system looping in this southeastern section of the City.

EVALUATION OF ALTERNATIVES

Four alternatives were evaluated for economic and non-economic considerations. Various hydraulic model water system simulations were developed and used to simulate the peak hour system-wide demand condition experienced in 2005. The average day demand condition was not simulated since the higher peak hour demand conditions would dictate the required sizes for booster pumps and transmission pipeline facilities.

Economic Considerations

The economic considerations include capital and operation and maintenance (O&M) costs. Capital construction costs for the SWTP, and the annual O&M cost estimates were based on the Final technical memorandum by Carollo Engineers, dated October, 2006 (Carollo, 2006), included in Appendix A-2.

Capital Cost

Capital cost[1] consists of site acquisition cost, SWTP facilities cost, and treated water transmission facilities cost.

Sites #1, #2, and #4 are already owned by the City and it is assumed that these sites would be available for the construction of the City's new SWTP at no cost to the City. Site #3, the farmland located at the northeast corner of E. Shields Avenue and Leonard Avenue, is privately owned. It is unknown if the owner is willing to sell and, if so, what the sale price would be. The 60-acre total parcel size is nearly three times the 20 acre SWTP site requirement. At the current

[1] The channel improvements cost for the raw water supply conveyance is excluded from the capital cost at this time because this information is not available for FID's Gould Canal and Mill Ditch. For the Enterprise Canal, FID has made channel improvements in the past according to the recommendations found in the "Enterprise Canal Estimate of Capacity and Future Flow Study" (December 2002). However, discussions with FID staff showed that additional, and much more extensive, channel improvements are required to allow the delivery of additional 30 mgd to the existing SWTP site.

market rate of approximately $350,000 per acre in this neighborhood, the purchase price could be approximately $7.7 million for a 20-acre subdivided parcel, or as much as $21 million for the entire 60-acre parcel. Alternatively, the City could exercise condemnation as an option. For Alternative 3, purchase of the 20-acre subdivided parcel at $7.7 million was assumed.

The expansion of the existing SWTP (Alternative 1) includes construction of the following hydraulic- and process-related facilities at the existing SWTP site:

- Two clarification basins, each with 18.5 minute detention time
- Two ozone contact basins, each with 16 minute detention time (eight-stage counter/co-current)
- Six new GAC/sand filters, each with a 592 square-foot filter area
- One filter building
- One chemical storage building
- One 4.0 million gallon (MG) treated water storage reservoir
- Two 7.5 horsepower (hp) washwater pumps
- One 100,000 gallon volume washwaster equalization basin
- Two 80 foot by 324 foot solids drying beds
- Minor changes to the plaza area or operations building

The expansion of the existing SWTP would also include costs to account for site work, submittals, approvals, fabrication and delivery, and mobilization.

The following existing hydraulic- and process-related facilities do not need to be expanded at this time as these existing facilities already have sufficient capacity to accommodate the 30-mgd expansion:

- Electrical substation
- Ozone generator
- Backwash pump
- Operations building

Results using the City's existing water system hydraulic model simulation indicated that, because the City has an inadequate treated water "backbone" pipeline transmission main system, a major new transmission pipeline is required to provide adequate flows and pressures from the expanded SWTP alternative to the southeastern demand area. While the treated water booster pumps at the existing SWTP would continue to serve the existing service area, the new 45-mgd treated water booster pump station would be dedicated to serve the southeast demand area. The following is the proposed transmission facilities for Alternative 1:

- 45 mgd treated water booster pump station at 235 feet TDH
- 36,000 feet of 16-inch pipeline

- 38,000 feet of 24-inch pipeline
- 21,000 feet of 36-inch pipeline
- 8,300 feet of 42-inch pipeline
- 63,000 feet of 48-inch pipeline

The expanded SWTP with a booster pump station and the layout of the proposed transmission pipeline facilities for Alternative 1 are shown in Figure A-2. The estimated capital cost for Alternative 1 is summarized in Table A-2.

Table A-2. Estimated Capital Cost for Alternative 1

Cost Component	Project Cost, $[(a)]
Land	0
Electrical Substation	0
30-mgd SWTP Expansion	51,300,000
Booster Pump Station	2,300,000
Transmission Pipelines	112,800,000
Total Project Cost	166,400,000

(a) Project cost = estimated construction cost + 30 percent estimating contingency + 20 percent for engineering, legal, and administrative costs.
All costs are based on a 20-City average ENR of 7722 for August 2006.

The construction of Alternatives 2, 3, and 4 include the following hydraulic- and process-related facilities at each proposed SWTP site.

- One 4,160 Volt electrical substation (including transformer and 500 feet allowance for a high voltage line from PG&E)
- Four raw water pumps, 10 mgd each, and one raw water pump station
- Two clarification basins, 18.5 minute detention time each
- Two ozone contact basins (eight-stage counter/co-current), 16 minute detention time each
- Six new GAC/sand filters, 592 square foot filter area each
- One filter building
- One chemical storage building
- Plaza, tunnel, and meter facility
- One 4.0 MG treated water storage reservoir
- Two backwash pump, 300 hp each
- Two washwater pumps, 7.5 hp each

- One washwaster equalization basin, 100,000 gallon
- Four solids drying beds, 80 feet by 324 feet each
- Ozone generator
- Operations building

In addition, the new SWTP construction would include costs to account for site work, submittals, approvals, fabrication and delivery, mobilization and general condition.

Results from various water system hydraulic model simulations showed that improvements to the existing treated water transmission system are necessary to provide adequate flows and pressures from the Alternative 2 SWTP site to the southeast demand area. The following are the proposed transmission facilities for Alternative 2:

- 45-mgd treated water booster pump station at 185 feet TDH
- 22,000 feet of 48-inch pipeline
- 8,300 feet of 42-inch pipeline
- 21,000 feet of 36-inch pipeline
- 38,000 feet of 24-inch pipeline
- 36,000 feet of 16-inch pipeline

The new SWTP and the layout of the proposed transmission pipeline facilities for Alternative 2 are shown in Figure A-3. The estimated capital cost for Alternative 2 is summarized in Table A-3.

Table A-3. Estimated Capital Cost for Alternative 2

Cost Component	Project Cost, $[(a)]
Land	0
Electrical Substation	1,000,000
New 30-mgd SWTP	58,400,000
Booster Pump Station	2,300,000
Transmission Pipelines	74,700,000
Total Project Cost	136,400,000

(a) Project cost = estimated construction cost + 30 percent estimating contingency + 20 percent for engineering, legal, and administrative costs.
All costs are based on a 20-City average ENR of 7722 for August 2006.

Results of the hydraulic model simulations showed that improvements to the existing treated water transmission system are necessary to provide adequate flows and pressures from the

Alternative 3 SWTP site to the southeast demand area. The following are the proposed transmission facilities for Alternative 3:

- 45-mgd treated water booster pump station at 185 feet TDH
- 6,000 feet of 48-inch pipeline
- 8,300 feet of 42-inch pipeline
- 21,000 feet of 36-inch pipeline
- 38,000 feet of 24-inch pipeline
- 36,000 feet of 16-inch pipeline

The new SWTP and the layout of the proposed transmission pipeline facilities for Alternative 3 are shown in Figure A-4. The estimated capital cost for Alternative 3 is summarized in Table A-4.

Table A-4. Estimated Capital Cost for Alternative 3

Cost Component	Project Cost, $[(a)]
Land	7,700,00
Electrical Substation	1,000,0
New 30-mgd SWTP	58,400,00
Booster Pump Station	2,300,0
Transmission Pipelines	60,100,00
Total Project Cost	$129,500,000

(a) Project cost = estimated construction cost + 30 percent estimating contingency + 20 percent for engineering, legal, and administrative costs.
All costs are based on a 20-City average ENR of 7722 for August 2006.
(b) Based on current rate of $350,000 per acre and the acquisition of the 20-acre subdivided parcel.

Results of the water system hydraulic model simulations showed that improvements to the existing treated water transmission system are necessary to provide adequate flows and pressures from the Alternative 4 SWTP site to the southeast demand area. The following are the proposed transmission facilities for Alternative 4:

- 45-mgd treated water booster pump station at 185 feet TDH
- 12,000 feet of 48-inch pipeline
- 21,000 feet of 36-inch pipeline
- 32,000 feet of 24-inch pipeline
- 35,000 feet of 16-inch pipeline

The new SWTP and the layout of the proposed transmission pipeline facilities for Alternative 4 are shown in Figure A-5. Although City-owned, Site #3 is managed by the Airport. Therefore, the City would need to enter into a long-term agreement to lease the 23-acre parcel under a "99-year" lease. Based on the lease terms of selected parcels leased by Fresno Airport, it was determined that the average lease cost is $9,060 per acre per year (see Appendix A-3). The estimated capital cost for Alternative 4 is summarized in Table A-5.

Table A-5. Estimated Capital Cost for Alternative 4

Cost Component	Project Cost, $[(a)]
Land	6,600,000[(b)]
Electrical Substation	1,000,000
New 30-mgd SWTP	58,400,000
Booster Pump Station	2,300,000
Transmission Pipelines	55,600,000
Total Project Cost	$123,900,000

(a) Project cost = estimated construction cost + 30 percent estimating contingency + 20 percent for engineering, legal, and administrative costs.
All costs are based on a 20-City average ENR of 7722 for August 2006.

(b) "99-year" lease cost, shown as lump sum cost at 3% discount rate and 99-year period for the purpose of this study.

The capital cost for Alternative 4 is the lowest among the alternatives considered. The primary reasons for this are: Alternative 4 requires no land acquisition cost, and the proposed SWTP site is located within the new 30-mgd demand area, thereby significantly reducing the transmission pipeline construction costs.

O&M Cost

The O&M costs associated with Alternatives 1, 2, 3, and 4 include the following costs:

- Labor cost for the operation and maintenance of the new treatment facilities
- Maintenance cost (e.g., replacement parts) for the new treatment facilities
- Power cost to operate the new treatment facilities and store/pump/distribute these flows
- Chemical costs to produce the treated surface water

New O&M personnel are required with the construction of a new SWTP. Therefore, the labor cost for Alternatives 2, 3, and 4 would be identical. Since the new SWTP is similar to the existing SWTP in terms of capacity and treatment process, it is assumed that the staffing level for Alternatives 2, 3, and 4 would be equal to that of the existing SWTP, which consists of four full-time licensed water treatment operators. The estimated annual labor cost for the O&M is

approximately $330,000 for Alternatives 2, 3, and 4 for retaining four, full-time licensed water treatment operators.

For Alternative 1, it is anticipated that the expanded facilities would be integrated into the existing facilities via the existing SCADA system, and operations of the entire facilities would be performed by the existing O&M personnel. However, due to the increase in the mechanical and electrical equipment on site with the expansion, it is assumed that one additional employee would be required to operate the expanded facilities. Therefore, the estimated annual labor cost for the O&M is approximately $80,000 for Alternative 1 for retaining one, full-time licensed water treatment operator.

Current power costs for the existing SWTP facilities is approximately $500,000 per year including the power to operate the treated water booster pumps. Considering that the treated water booster pumps represent approximately 50 percent of the total motor hp at the existing SWTP, the power cost for the expanded facilities is approximately $250,000 for Alternative 1. It is estimated that the power cost for Alternatives 2, 3, and 4 is approximately $300,000, to factor in the costs for additional illumination, climate control, and electricity for the control equipment in the new operations building.

Power cost for the treated water transmission facilities was estimated based on operating a booster pump station equipped with vertical turbine pumps at 90 percent motor efficiency, and 80 percent pump efficiency. Pumping at an annual average of 30 mgd (although capable of designed to deliver 45 mgd during peak hour), the power cost for the treated water transmission facilities is estimated at $1.13 million per year for Alternative 1 and $890,000 for Alternatives 2, 3, and 4, based on 10 cents per kilowatt hour (kWh). The power cost for the treated water transmission facilities for Alternative 1 is greater than that of Alternatives 2, 3, and 4 due to additional energy required to overcome additional head losses for conveying the water through longer transmission pipelines.

Chemical usage for all four alternatives is expected to be essentially the same, because all alternatives would be treating similar source waters using the same treatment processes. Based on chemical usage at the existing SWTP, the estimated annual cost for chemicals is approximately $1.3 million for each alternative.

Annual maintenance costs for replacement parts are assumed to be 0.25 percent of the total construction cost, excluding land acquisition costs (Carollo, 2006). Therefore, the estimated annual maintenance cost is approximately $90,000 for Alternative 1 and $100,000 for Alternatives 2, 3, and 4.

In the end, the O&M cost is approximately $2.9 million per year for all alternatives despite significant difference in the labor cost between Alternative 1 and the remaining alternatives. This is primarily due to fact that the additional labor cost for the new SWTP operation was offset by the energy savings from the treated water transmission costs for its proximity to the southeast demand area.

Tables A-6 and A-7 show the estimated O&M costs for Alternative 1 and Alternatives 2, 3, and 4, respectively.

Table A-6. Estimated O&M Cost for Alternative 1

Cost Component	Annual Cost, $
Labor	80,000
Power (SWTP)	250,000
Power (Transmission)	1,130,000
Chemicals	1,300,000
Maintenance	90,000
Total	$2,850,000

Table A-7. Estimated O&M Cost for Alternatives 2, 3, and 4

Cost Component	Annual Cost, $
Labor	330,000
Power (SWTP)	300,000
Power (Transmission)	890,000
Chemicals	1,300,000
Maintenance	100,000
Total	$2,920,000

Non-Economic Considerations

The non-economic considerations include implementation timing, environmental/permitting issues, construction-related disruptions to the public, land use compatibility, raw water supply conveyance and reliability, and quality of the raw water supply.

Implementation Timing

It typically takes four to five years to plan, design, and construct a new conventional SWTP. Therefore, an implementation timing of four to five years can be expected for Alternative 2, 3, and 4, although prolonged negotiation for land acquisition may adversely impact the implementation timing for Alternative 3.

The implementation time for Alternative 1 may be shorter than four to five years for the facility expansion, because: (1) the existing facilities were already designed and constructed to accommodate this future expansion; (2) additional land for the expansion is already available; (3) environmental and permitting issues are simpler based on the experience gained from the initial construction of the SWTP; and (4) the construction of the 36-inch diameter pipeline in Chestnut Avenue could be completed and tied into the existing 24-inch diameter pipeline on the north side of the 168 Freeway, in parallel with the plant expansion. However, the overall implementation

timing for Alternative 1, which includes the construction of 48-inch diameter transmission pipelines, may still be four to five years, due to the added complexity associated with any major transmission pipeline construction.

Therefore, in terms of implementation timing, none of the alternatives appear to have a clear advantage over the others.

Environmental/Permitting Issues

The majority of these impacts are anticipated to be related to the construction of the necessary infrastructure associated with each alternative including the extensive transmission pipeline construction associated with each alternative. Although it is assumed that the pipeline alignment would be within the existing or planned public rights-of-way, mitigation measures must be in place and each project will probably be phased to minimize the construction-related environmental impacts.

Therefore, all alternatives are considered essentially equally impacted in terms of environmental consequences.

Construction-related Disruption to the Public

It is anticipated that there will be disruption to the public due to construction of the necessary infrastructure associated with each alternative. Construction-related impacts for each alternative would include localized traffic and circulation disruptions, dust and noise, and would be of short duration. Disruption to traffic movement could adversely impact typical daily activities associated with residential and commercial land uses in the immediate construction vicinity. Construction of the pipelines would cause temporary closure of streets and driveways. After construction, there would be no land use conflicts.

Each alternative has construction elements that are near residential and/or commercial zones, and some construction-related disruption to the public is unavoidable. Proposed Sites #3 and #4 require the least linear footage of trenching for pipeline installation, and therefore has the smallest construction-related impacts. Because Alternative 1 has the longest transmission pipelines, Alternative 1 would require the most extensive mitigation program compared to the other alternatives.

Land Use Compatibility

The land use would have to be changed for Site #3 from agricultural to municipal use for the construction of the treatment facilities. Even though no land use change is required, the City may need to be sensitive to the fact that Sites #1 and #2 are adjacent to or surrounded by residential zones. Site #4 is surrounded by open space except for the commercial zone to the west, and the Fresno Airport to the northwest.

It is assumed that the transmission pipeline alignment would be within the existing or planned public rights-of-way. Therefore, there would be no land use issues after the transmission pipeline construction is completed.

Therefore, land use compatibility is of the greatest concern with Alternative 3, and the least concern with Alternative 4.

Raw Water Supply Conveyance and Reliability

FID's Enterprise Canal, a 28-mile (from the head gate to SWTP site), circuitous, open channel that winds its way through agricultural and urban settings, supplies the raw water for the existing SWTP at Site #1. Based on the Enterprise Canal Estimate of Capacity and Future Flow Study (December 2002), this canal does not have the conveyance capacity to deliver an additional 30 mgd to the existing SWTP site without channel improvements. According to FID staff, the Enterprise Canal would require several months of canal shut downs to complete the required channel improvements.

The City plans to construct a five-mile pressure pipeline from the Friant-Kern Canal to the existing SWTP to provide raw water quality enhancements, increase public health protection and develop adequate hydraulic head to operate the treatment plant by gravity feed. When the pipeline construction is completed, the Enterprise Canal would become a secondary supply source. However, as long as the expanded SWTP receives the raw water supply from the Enterprise Canal, Alternative 1 would be impacted by the raw water supply conveyance and reliability associated with the Enterprise Canal, including potential contamination from overland flow, and scheduled shut downs for annual canal maintenance.

The raw water source for Alternatives 2 and 3 is FID's Gould Canal. The canal conveys approximately 50 mgd in the southeast part of the City near De Wolf Avenue during the peak irrigation season and is master planned to convey approximately 130 mgd during storm events. According to FID staff, the canal could probably handle the additional 30 mgd and possibly an additional 60 mgd. However, physical improvements such as lining, raising banks, and enlarging certain sections, may also be required for the canal to convey the additional flow required by the new SWTP. Furthermore, a significant routine maintenance including dredging and application of aquatic herbicide would be required to ensure the delivery of the additional flow to the proposed SWTP. Alternatives 2 and 3 would be impacted by the raw water supply conveyance and reliability associated with the Gould Canal, including potential contamination from overland flow, and scheduled shut downs for annual canal maintenance similar to that of the Enterprise Canal.

The raw water supply conveyance facility for Alternative 4 is FID's Mill Ditch. The ditch currently conveys approximately 650 mgd during the peak irrigation season and is master planned to convey 580 mgd during the storm season. FID staff believes that adding flows in excess of 30 mgd to the ditch for the new SWTP would not be problematic, although further discussions with FID may lead to a conveyance capacity study for FID's Mill Ditch and subsequent channel improvements to ensure the raw water supply conveyance to the proposed site. Alternative 4 would be impacted by the raw water supply conveyance and reliability associated with the Mill Ditch, which includes potential contamination from overland flow, and scheduled shut downs for annual canal maintenance similar to that of the Enterprise Canal.

Therefore, Alternatives 2 and 3 are the least favorable alternatives based on the limited raw water supply conveyance capacity and significant maintenance issues associated with FID's Gould Canal. Alternative 4 is favorable in that there appears to be sufficient conveyance capacity in

FID's Mill Ditch to convey the raw water supplies required for the new SWTP. Alternative 1 is the most favorable, because the Enterprise Canal is already in use and the construction of the five-mile pressure pipeline from the Friant-Kern Canal to the SWTP that would improve the raw water supply reliability is planned and moving forward.

Quality of the Raw Water Supply

Precipitation and snow melt from the San Joaquin watershed is provided to the City under a contract with the Bureau of Reclamation for Central Valley Project (CVP) water. Water from the Kings River is also provided to the City by contract from the FID. For each of the four alternatives, these raw water supplies are delivered via open channel water ways that are subject to contamination from overland flow and illicit discharges.

The Enterprise Canal, Gould Canal, and Mill Ditch are unlined, open channels with similar source waters. However, the delivered water quality is probably slightly better from the Mill Ditch during the irrigation season, because the Mill Ditch has higher flow rates with higher velocities. Because of the higher velocities, weed growth is much less in Mill Ditch, which results in less frequent treatment with aquatic herbicides. According to FID, the Gould Canal may require significant routine maintenance, including dredging and application of aquatic herbicide to maintain the canal cross section so that the additional flows for the SWTP can be conveyed. The Gould Canal is currently treated with several aquatic herbicides, including Magnicide and Copper Sulfate.

Other means of treating aquatic weeds is with mechanical methods (e.g. chaining). However, using mechanical methods usually results in the aquatic weeds breaking off and decomposing. FID considers the removal of aquatic weeds by mechanical means excessive, and will probably request reimbursement for such extraordinary activities.

As mentioned previously, the City plans to construct a five-mile pressure pipeline from the Friant-Kern Canal to the SWTP. Upon completion of the Project, the pipeline can provide the raw water supply quality enhancements to the existing and proposed expansion of the SWTP.

Thus, the quality of the raw water supply is an issue with Alternatives 2 and 3, and the most favorable with Alternative 1.

WEIGHTED ALTERNATIVES RANKING

Four alternatives were ranked based on economic and non-economic considerations as discussed. Six parameters of non-economic considerations were weighted equally. For the overall ranking determination, the economic and non-economic considerations were also weighted equally.

Table A-8 shows the comparison of the annualized project cost and rank for each alternative based on economic considerations. A net escalation rate of three percent over 25 years was assumed for converting the capital cost to annual cost. The annual O&M cost was then added to the annualized capital cost in order to develop the total annual project cost.

Table A-8. Comparison of the Annualized Project Cost and Rank

Cost Component	Alt. 1, $	Alt. 2, $	Alt. 3, $	Alt. 4, $
Land[(a)]	0	0	440,000	210,000
Electrical Substation	0	60,000	60,000	60,000
SWTP[(a)]	2,950,000	3,350,000	3,350,000	3,350,000
Booster Pump Station[(a)]	130,000	130,000	130,000	130,000
Transmission Pipelines[(a)]	6,480,000	4,290,000	3,450,000	3,190,000
Labor	80,000	330,000	330,000	330,000
Power (SWTP)	250,000	300,000	300,000	300,000
Power (Transmission)	1,130,000	890,000	890,000	890,000
Chemicals	1,300,000	1,300,000	1,300,000	1,300,000
Maintenance	90,000	100,000	100,000	100,000
Total Annual Project Cost	$12,410,000	$10,750,000	$10,350,000	$9,860,000
Rank	4	3	2	1

Rank: 1 – Most favorable; 2 – Favorable; 3 – Somewhat favorable; 4 – Least favorable.

(a) Annualized project cost calculated based on three percent net escalation and 25 year period for the purchase of Site #3 and "99-year" lease cost for leasing Site #4 at $9,060 per acre per year.

Based on the economic considerations (capital and O&M), Alternative 4 is ranked the most favorable. Although Alternative 1 was as competitive as the rest of the alternatives with respect to O&M cost, this alternative was found to be the most costly due to high capital cost of the required transmission pipelines.

Parameters used to evaluate the non-economic considerations and assigned ranks are shown in Table A-9. Based on the non-economic considerations, Alternatives 1 and 4 are ranked equally the most favorable. The strength of Alternative 1 comes from the planned construction of the five-mile pressure pipeline from the Friant-Kern Canal to the existing SWTP site, while the construction of long transmission pipeline is the weakness. Alternative 4 scored well with the non-economic considerations with particular strength at its central location to the demand area.

The economic and non-economic considerations rank for each alternative was combined to develop the overall rank. Table A-10 shows the overall rank for each alternative with equal weight given to the economic considerations and non-economic considerations.

Table A-9. Parameters of the Non-Economic Considerations and Rankings

Parameters	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Implementation Timing	3	3	3	3
Environmental/Permitting Issues	3	3	3	3
Construction-related Disruption to the Public	2	3	4	4
Land Use Compatibility	3	3	2	4
Raw Water Supply Conveyance and Reliability	4	2	2	3
Quality of the Raw Water Supply	4	2	2	3
Average Score	3.2	2.7	2.7	3.2
Rank	1	3	3	1

Rank: 1 – Most favorable; 2 – Favorable; 3 – Somewhat favorable; 4 – Least favorable.

Table A-10. Overall Rank of Alternatives

Considerations	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Rank, Economic	4	3	2	1
Rank, Non-economic	1	3	3	1
Average Score	2.5	3.0	2.5	1.0
Overall Rank	2	4	2	1

Overall Rank: 1 – Most favorable; 2 – Favorable; 3 – Somewhat favorable; 4 – Least favorable.

Overall, Alternative 4 is ranked as the most favorable alternative. Although Alternative 1 ranked equally favorable to Alternative 4 for the non-economic considerations, this alternative was the most costly in terms of economic considerations primarily due to inadequate "backbone" transmission facilities to connect the expanded SWTP facility to the southeastern portion of the City's service area.

RECOMMENDATION

WYA recommends the construction of a new 30-mgd SWTP at Site #4, as described in Alternative 4. This site is a 23-acre area located at the southeast corner of Clovis Avenue and McKinley Avenue next to FID's Mill Ditch, which would convey the raw water supply to the new SWTP. Advantages of this alternative include cost savings from having no land acquisition cost, the lowest transmission facilities cost, and having no particular issues with any of the six non-economic considerations evaluated.

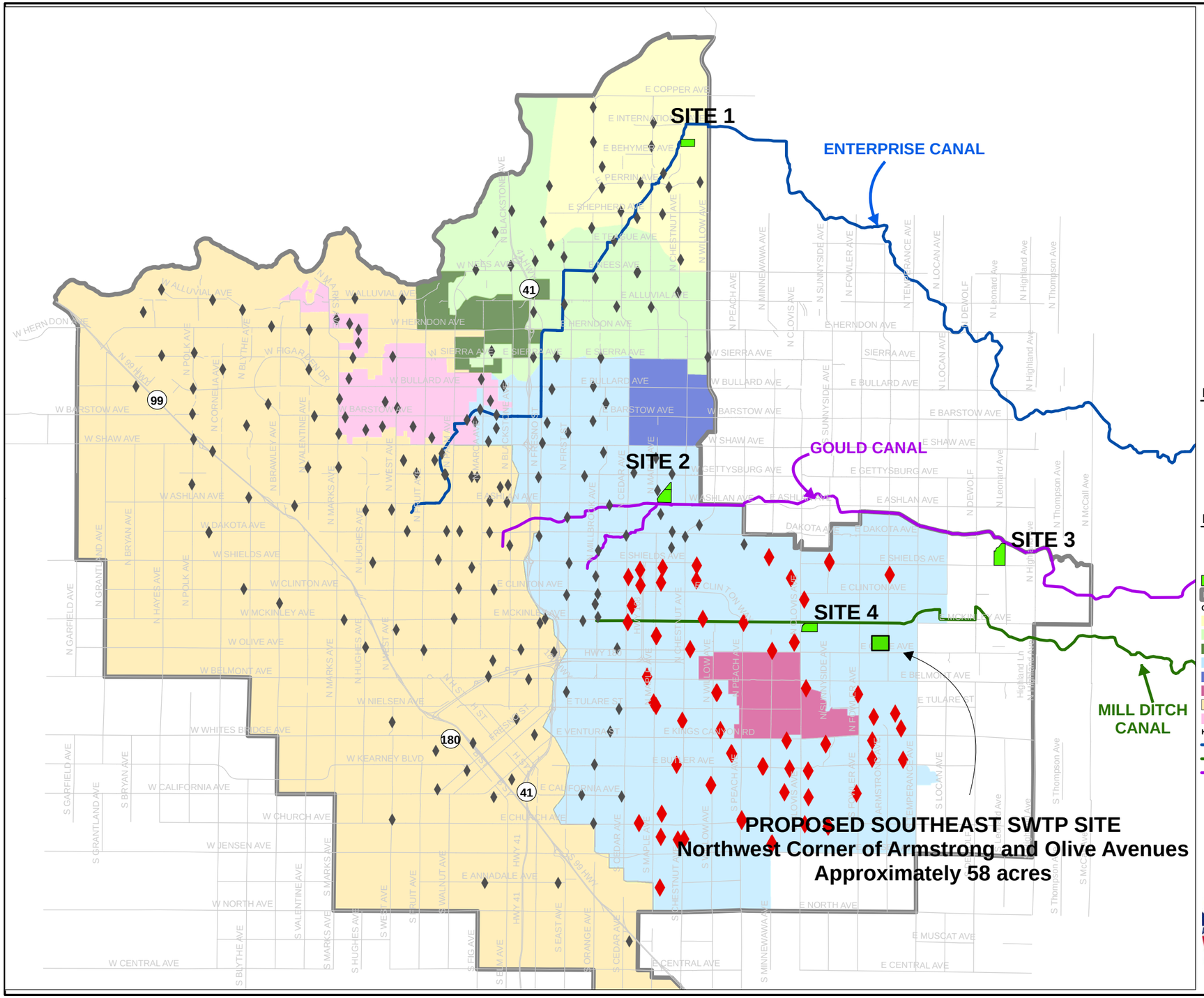

FIGURE A-1

City of Fresno
Metropolitan Water Resources
Management Plan Update

POTENTIAL SURFACE WATER
TREATMENT PLANT SITES

N

0 2,750 5,500 11,000
Scale in Feet

NOTES:

LEGEND:

- Active Well
- Active Well Where Production Could Be Decreased If a New SWTP Was Constructed
- Potential SWTP Sites
- Fresno Sphere of Influence

Gate Zones

- Shepherd
- Sierra A
- Sierra B (Pinedale County Water District)
- Highway 41
- Highway 41B (Cal State University, Fresno)
- Highway 41C (Bakman Water Company)
- Westside
- Fluoride Districts

Key FID Canals

- Enterprise Canal
- Mill Ditch Canal
- Gould Canal

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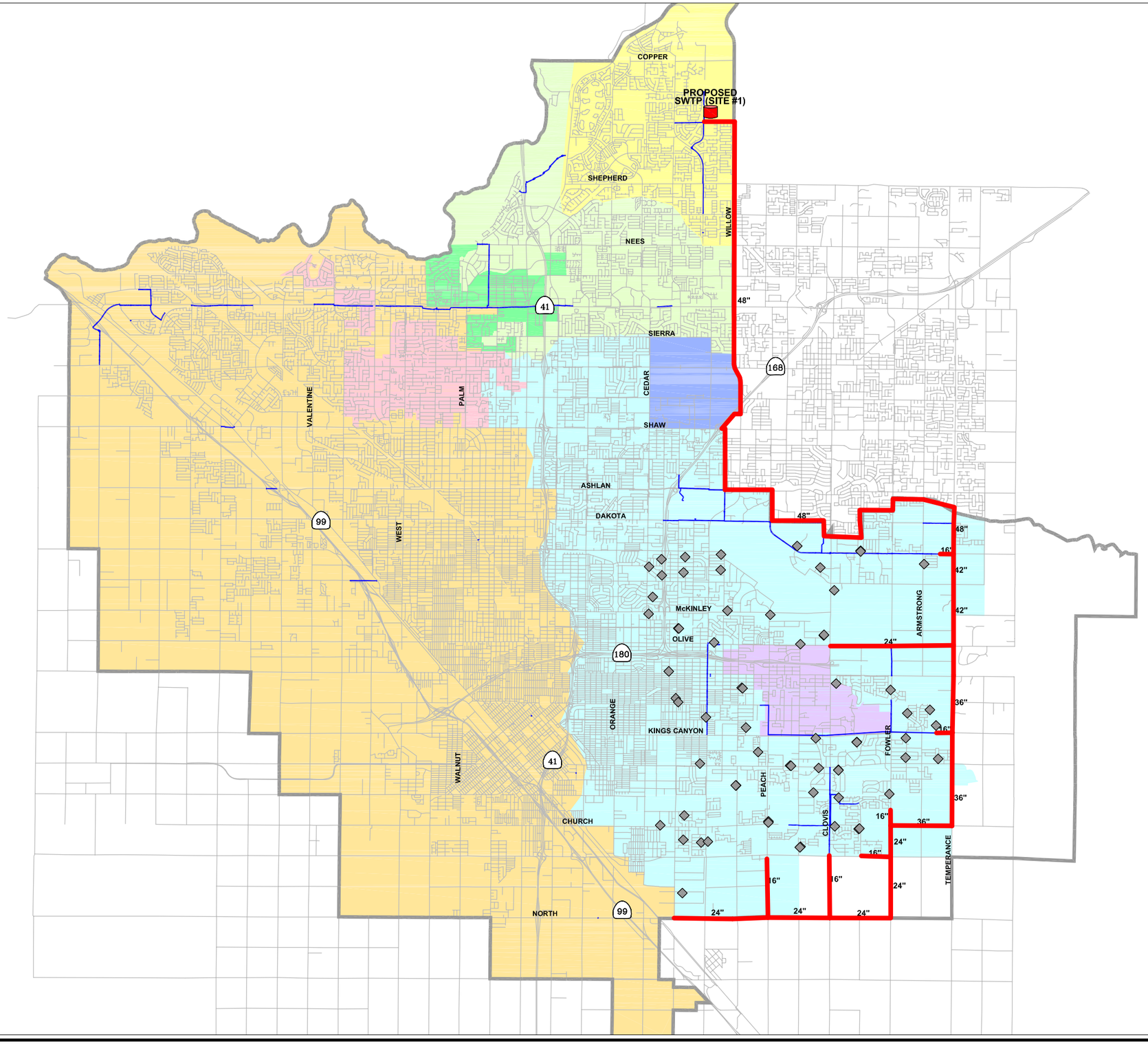
FIGURE A-2

City of Fresno Metropolitan Water Resources Management Plan Update

PROPOSED FACILITIES FOR ALTERNATIVE 1



0 4600 9200
SCALE IN FEET

NOTES:

A. Pressure zone boundaries are approximated based on gate valve locations as shown by GIS information provided by City Staff.

LEGEND:

- SOI Boundary
- Existing 16-inch & Larger Pipe
- Well Assumed to be Offline for Study
- Proposed SWTP
- Proposed Pipelines
- Shepherd
- Sierra A
- Sierra B (Pinedale County Water District)
- Highway 41
- Highway 41B (Cal State University, Fresno)
- Highway 41C (Bakman Water Company)
- Westside
- Fluoride Districts

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FIGURE A-3

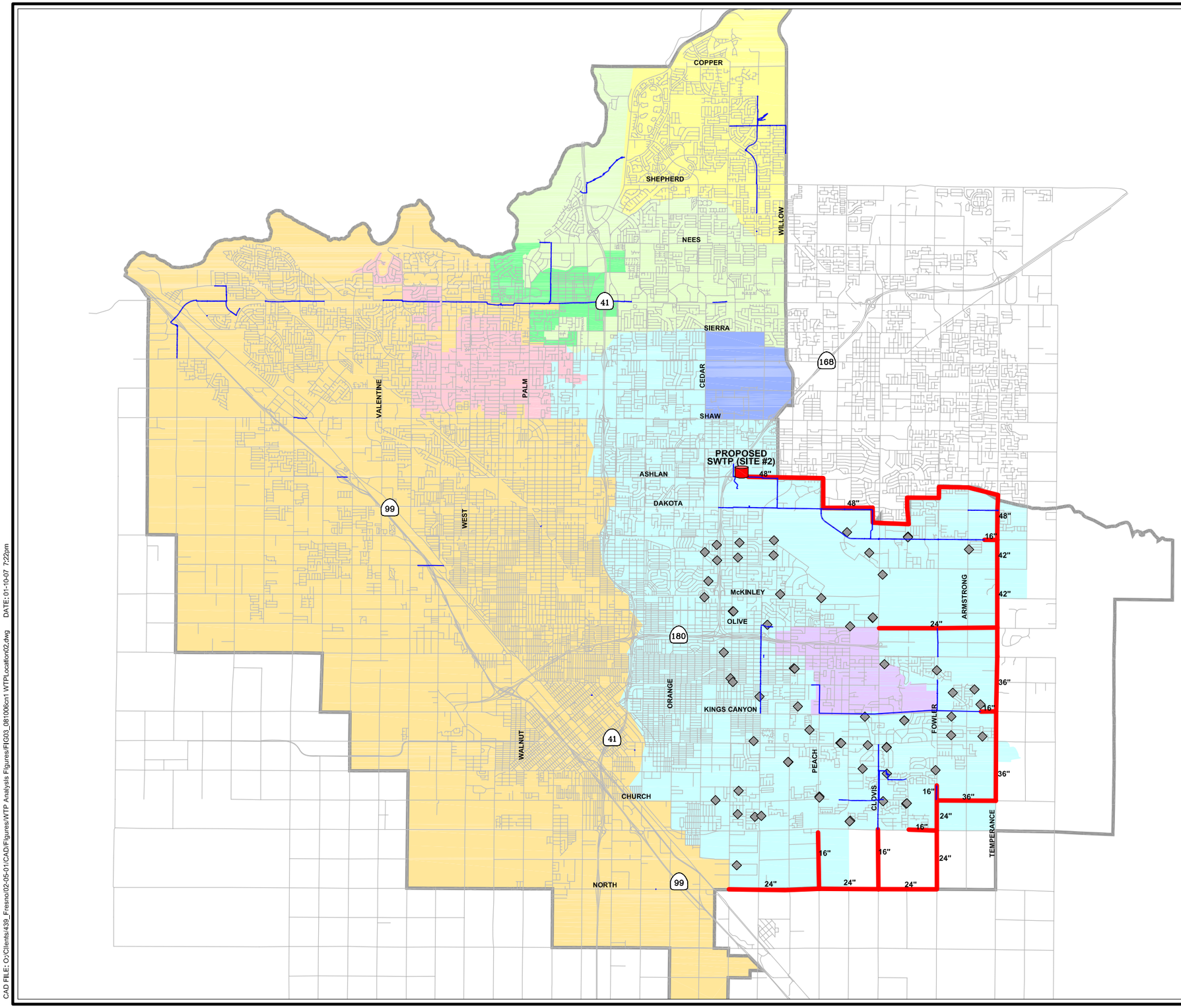
City of Fresno Metropolitan Water Resources Management Plan Update

PROPOSED FACILITIES FOR ALTERNATIVE 2

0 4600 9200
SCALE IN FEET

NOTES:

A. Pressure zone boundaries are approximated based on gate valve locations as shown by GIS information provided by City Staff.



LEGEND:

- SOI Boundary
- Existing 16-inch & Larger Pipe
- Well Assumed to be Offline for Study
- Proposed SWTP
- Proposed Pipelines
- Shepherd
- Sierra A
- Sierra B (Pinedale County Water District)
- Highway 41
- Highway 41B (Cal State University, Fresno)
- Highway 41C (Bakman Water Company)
- Westside
- Fluoride Districts

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FIGURE A-4

City of Fresno Metropolitan Water Resources Management Plan Update

PROPOSED FACILITIES FOR ALTERNATIVE 3

0 4600 9200
SCALE IN FEET

NOTES:

A. Pressure zone boundaries are approximated based on gate valve locations as shown by GIS information provided by City Staff.

LEGEND:

- SOI Boundary
- Existing 16-inch & Larger Pipe
- Well Assumed to be Offline for Study
- Proposed SWTP
- Proposed Pipelines
- Shepherd
- Sierra A
- Sierra B (Pinedale County Water District)
- Highway 41
- Highway 41B (Cal State University, Fresno)
- Highway 41C (Bakman Water Company)
- Westside
- Fluoride Districts

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FIGURE A-5

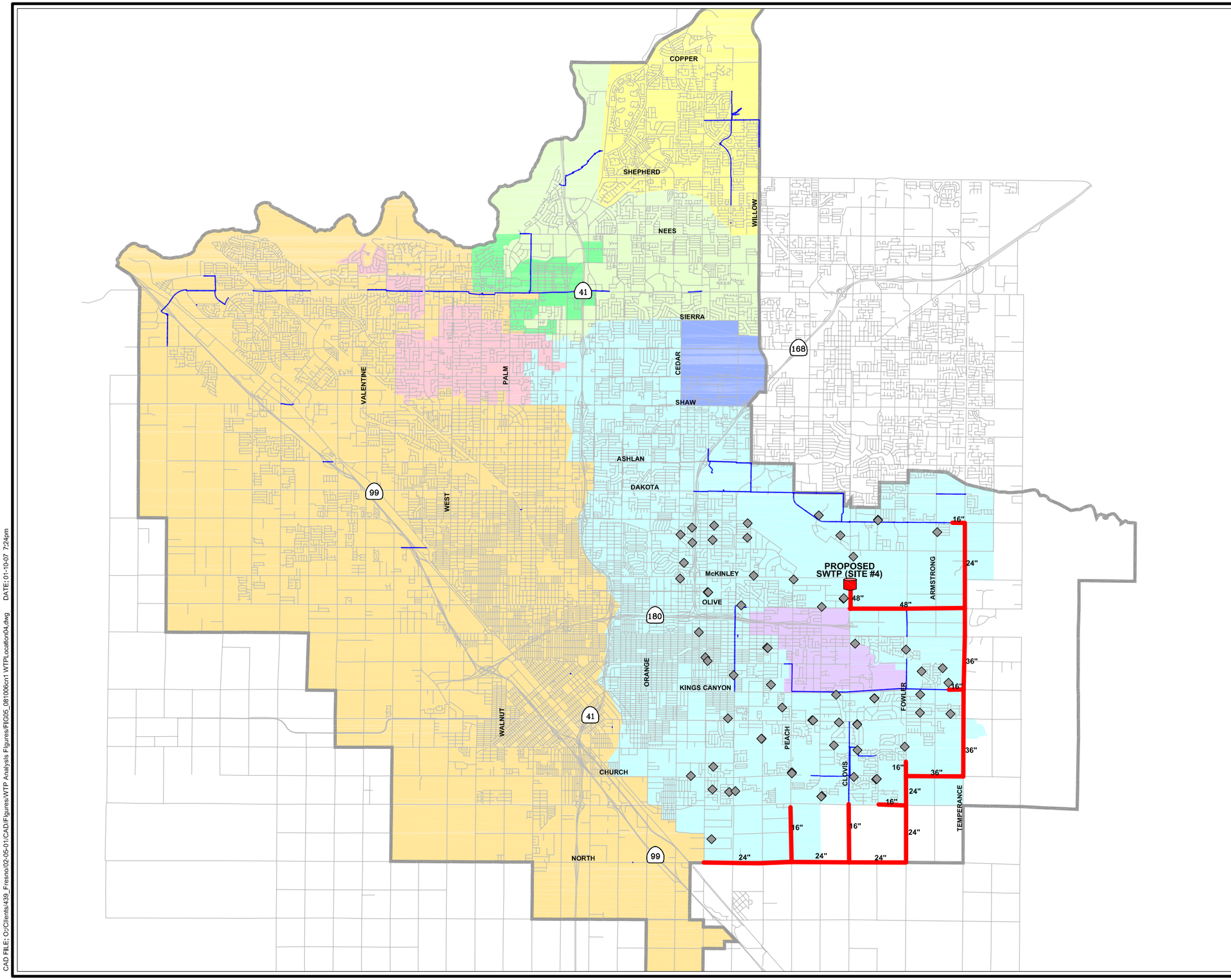
City of Fresno Metropolitan Water Resources Management Plan Update

PROPOSED FACILITIES FOR ALTERNATIVE 4

0 4600 9200
SCALE IN FEET

NOTES:

A. Pressure zone boundaries are approximated based on gate valve locations as shown by GIS information provided by City Staff.



LEGEND:

- SOI Boundary
- Existing 16-inch & Larger Pipe
- Well Assumed to be Offline for Study
- Proposed SWTP
- Proposed Pipelines
- Shepherd
- Sierra A
- Sierra B (Pinedale County Water District)
- Highway 41
- Highway 41B (Cal State University, Fresno)
- Highway 41C (Bakman Water Company)
- Westside
- Fluoride Districts

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CAD FILE: O:/Clients/439_Fresno/02-05-01/CAD/Figures/WTP Analysis Figures/FIG05_081006cn1 WTPLocation04.dwg DATE: 01-10-07 7:24pm