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LIST OF ABBREVIATIONS AND ACRONYMS

ac-ft.	acre-feet
AD	Average Day
APAI	Alan Plummer Associates, Inc.
CAMPO	Capitol Area Metropolitan Planning Organization
CCN	Certificate of Convenience and Necessity
CIP	capital improvement projects
City	City of San Marcos
EAA	Edwards Aquifer Authority
EPA	Environmental Protection Agency
ft.	feet
GBRA	Guadalupe-Blanco River Authority
GIS	Geographic Information System
gpm	gallons per minute
in.	inches
MD	maximum day
MG	million gallon
MGD	million gallons per day
mi.	mile
msl	mean sea level
PH	Peak Hour
PRV	Pressure Reducing Valve
PWSG	Pitometer Water Services Group
RFC	Rate of Flow Control
SCADA	Supervisory Control and Data Acquisition
STPS	Severn Trent Pipeline Services
SWTP	Surface Water Treatment Plant
SWTSU	Southwest Texas State University Campus
TAC	Texas Administrative Code

LIST OF ABBREVIATIONS AND ACRONYMS - CONTINUED

TCEQ	Texas Commission on Environmental Quality
TDH	Total Discharge Head
TSZ	Traffic Survey Zone
USGS	US Geological Survey
VFD	variable frequency drive
WSC	Water Supply Corporation
WTP	Water Treatment Plant

EXECUTIVE SUMMARY

The City of San Marcos (City) retained the services of Alan Plummer Associates, Inc. (APAI) to prepare a comprehensive plan for providing potable water throughout the City's proposed water service area. During the Water Master Plan study, APAI evaluated the existing water system, reviewed current system operation, evaluated Capitol Area Metropolitan Planning Organization (CAMPO) population projections, created a calibrated computer model of the existing water distribution facilities, evaluated necessary improvements, and recommended capital improvement projects (CIP) to provide adequate service through the year 2027.

The City owns and operates a water treatment and distribution system to meet the potable water needs of its customers. This system includes over one million linear feet of pipeline ranging in size from 1-in. to 24-in. in diameter. The City obtains raw water from the Guadalupe River via a pipeline operated by the Guadalupe-Blanco River Authority (GBRA). This water is treated at the City's Surface Water Treatment Plant (SWTP) and then distributed to its customers. The City of San Marcos currently obtains approximately 70 percent of its potable water from the SWTP and augments the remaining 30 percent from groundwater sources located at five separate well plants. The production and distribution facilities provide service to more than 8,000 connections in the 55 square mile (mi.) service area.

The City of San Marcos service area population was approximately 44,951 as of January 1, 2003. The service area population is projected to more than double to approximately 99,368 within the next 25 years based upon CAMPO data. The CAMPO population data are projected based upon current and future land use information for its three county jurisdictional area. Table ES-1 presents the annual population projections through 2027. Figure ES-1 illustrates the City Limits and current water service area boundary. The City currently provides potable water to customers within the city limits, with a few exceptions. There is a portion of the City's service area that is currently served by Crystal Clear Water Supply Corporation (WSC). In addition, the City only provides water to the Southwest Texas State University (SWTSU) campus on an as-needed basis because the University maintains its own potable water production facilities.

A representative computer model of the City's water distribution system was developed to aid in the evaluation of the existing water distribution system, including water mains, storage facilities,

TABLE ES-1

CITY OF SAN MARCOS
POPULATION PROJECTIONS

Year	Approximate Population Served	% Growth	Total Growth
2000	35,368 [1]		
2001	37,946	7.29%	2,578 [2]
2002	41,255	8.72%	3,308 [2]
2003	44,951	8.96%	3,696 [2]
2004	46,695	3.88%	1,744
2005	48,507	3.88%	1,812
2006	50,390	3.88%	1,882
2007	52,345 [3]	3.88%	1,955
2008	54,271	3.68%	1,926
2009	56,269	3.68%	1,997
2010	58,340	3.68%	2,071
2011	60,487	3.68%	2,147
2012	62,713	3.68%	2,226
2013	65,021	3.68%	2,308
2014	67,414	3.68%	2,393
2015	69,895	3.68%	2,481
2016	72,467	3.68%	2,572
2017	75,134 [3]	3.68%	2,667
2018	77,264	2.84%	2,130
2019	79,455	2.84%	2,190
2020	81,707	2.84%	2,253
2021	84,023	2.84%	2,316
2022	86,406	2.84%	2,382
2023	88,855	2.84%	2,450
2024	91,374	2.84%	2,519
2025	93,965	2.84%	2,590
2026	96,629	2.84%	2,664
2027	99,368 [3]	2.84%	2,739

[1] U.S. Census Bureau data
[2] Growth based on City of San Marcos building permit data
[3] Based on Capitol Area Metropolitan Planning Organization data

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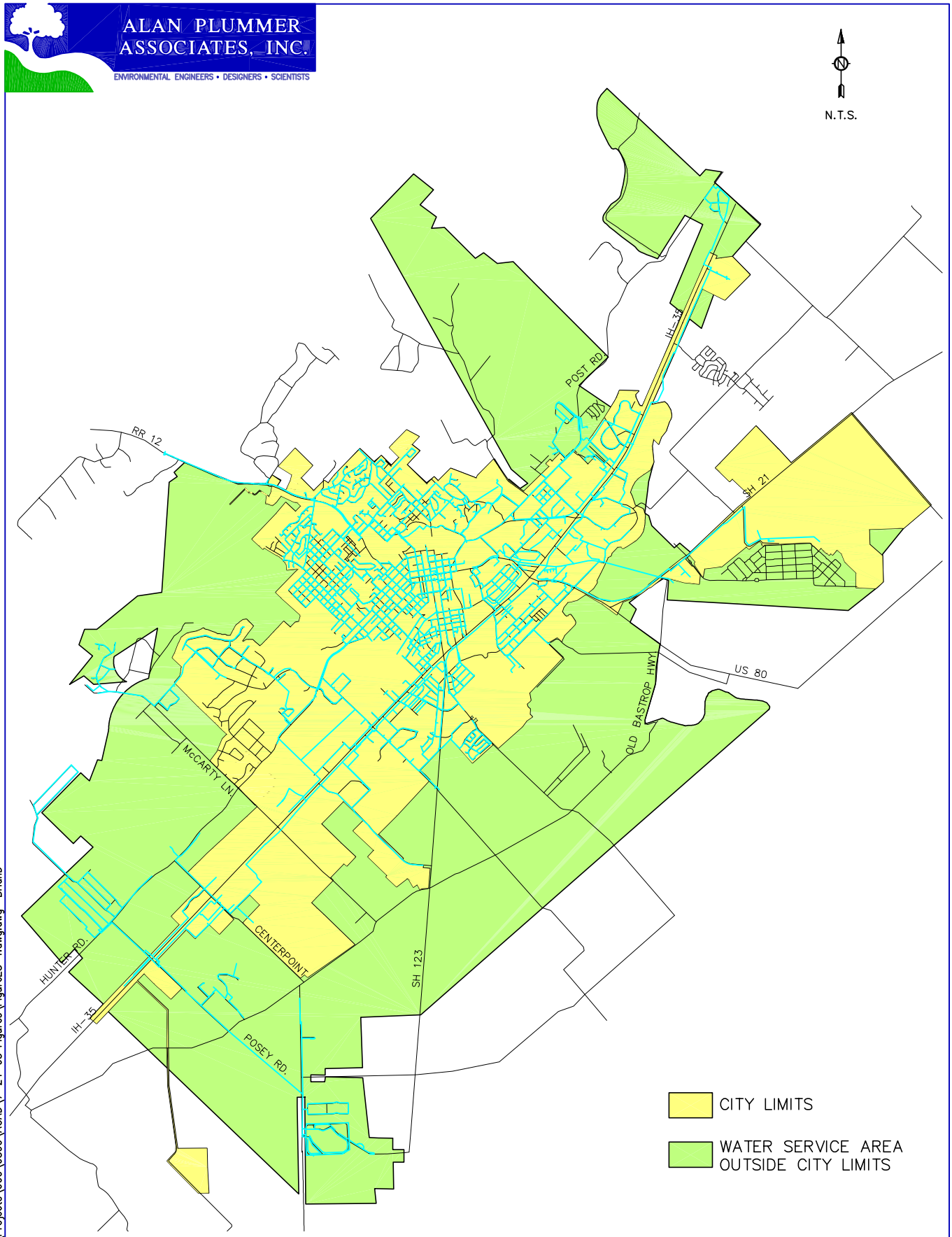

FIGURE ES-1
CITY OF SAN MARCOS
CITY LIMITS & CURRENT WATER SERVICE AREA

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and pumping stations. This tool was also utilized to evaluate and optimize necessary improvements required to provide adequate service to future growth areas that are currently anticipated through 2027 according to the CAMPO population projections. The development of a computer model distribution system was based upon the City's recently created distribution system geographic information system (GIS) database. Modeled water demands were based upon actual meter billing records.

Water production records indicated a daily per capita consumption of 162.9 gallons. This per capita consumption includes all unaccounted water, commercial, industrial, and various maintenance uses. Review of the system-wide historical MD/AD ratio indicated that the historical high MD/AD factor is 1.66. Peak hour/maximum day (PH/MD) peaking factors of 1.66 and 1.35 were determined for the SWTP Upper Plane and SWTP Lower Plane, respectively, during the model calibration effort.

The City's 6 million gallons per day (MGD) surface water treatment plant started operation on January 5, 2000. The SWTP consists of a solids contact clarifier; high rate dual media filters, a clearwell, and a high service pump station. The plant was originally rated for a maximum flow of 6 MGD. However, historic plant performance indicated that a higher capacity was possible with minor modifications. Therefore, the City is currently seeking a 9 MGD uprating for the plant from the Texas Commission on Environmental Quality (TCEQ). The GBRA currently has a contract that reserves 1.5 MGD of the plant capacity for users other than the City until December 2003. However, it is probable that this agreement, or some modified form of it, will be continued.

In addition to obtaining water from the SWTP, the city also obtains water from wells throughout the system. Each of these wells obtains groundwater from the Edwards Aquifer. The Edwards Aquifer Authority (EAA) regulates pumping rates to prevent damaging the critical habitat that rely upon the springs fed by the Aquifer. Recent discussions with EAA indicated that the City currently has a permit that authorizes pumping based upon an annual limit of 5,426.229 ac-ft. of groundwater per year, or 4.8 mgd.

The EAA has additional restrictions during periods of decreased aquifer water levels at specific gauging locations. During the most restrictive conservation periods, Stage III conservation is initiated, which reduces the pumping to 85% of the authorized monthly pumping rate. The City's

current quarterly pumping rate schedule is based upon the recent groundwater usage pattern after commencement of the SWTP. This quarterly schedule will be re-evaluated annually.

For planning purposes, APAI applied the MD/AD factor of 1.66 to the annual average day groundwater withdrawal rate of 4.8 MGD to determine the available water during maximum demand conditions. Since the City is only obtaining 30% of the total water supplied from groundwater, it is anticipated that a revised EAA groundwater pumping schedule would allow for a higher maximum month/average month pumping factor than the schedule presented in the 2000 groundwater investigation report.

SWTSU currently obtains most of its potable water from their wells. However, the University also has water service from the City. It is possible that the University's wells could be determined to be under the influence of groundwater in the future, since one of the Comanche wells was recently given this classification. From a planning perspective, it is recommended that impact of the University becoming a "full-time" customer be considered. Table ES-2 and Figure ES-2 present the water system future demand and implementation timing of water production improvements that includes providing "full-time" service to SWTSU.

The City's existing water distribution system is composed of seven pressure planes with six water supply facilities, six booster pump stations, eight operational water storage tanks, and over 1,000,000 linear ft. of pipeline. Figure ES-3 illustrates the current system pressure plane boundaries along with the water supply, pump station, and storage tank locations.

Evaluation of the City's current distribution system based upon TCEQ capacity criteria indicated booster pump and total storage deficiencies for the Oak Ridge Lower and Upper Pressure Planes. The plan to remedy the deficiencies includes shifting services from the Oak Ridge Lower Pressure Plane to the McCarty Lower Pressure Plane and increasing the Oak Ridge Upper Pressure Plane booster pump station firm pumping capacity. The shifting of services will bring the Oak Ridge total storage and lower pressure plane pumping capacity into compliance, as will the addition of pumping capacity to the upper pressure plane.

In addition to the TCEQ compliance improvements, the City has identified several security and maintenance projects by staff in the water department. Major projects identified include:

TABLE ES-2

CITY OF SAN MARCOS
RECOMMENDED WATER SYSTEM FUTURE DEMANDS

Year	Approximate Pop Served	% Growth	Total Growth	Average Day Demand (MGD)	Maximum Day Demand (MGD)	Water Production Capacity (MGD)
2000	35,368 [1]			5.6 [4]	9.3 [4]	12.5 [6]
2001	37,946	7.29%	2,578 [2]	5.5 [4]	7.8 [4]	12.5
2002	41,255	8.72%	3,308 [2]	5.6 [4]	7.7 [4]	12.5
2003	44,951	8.96%	3,696 [2]	7.3 [5]	12.2	15.5 [7]
2004	46,695	3.88%	1,744	7.6 [5]	12.6	15.5
2005	48,507	3.88%	1,812	7.9 [5]	13.1	15.5
2006	50,390	3.88%	1,882	8.2 [5]	13.6	15.5
2007	52,345 [3]	3.88%	1,955	8.5 [5]	14.2	15.5
2008	54,271	3.68%	1,926	8.8 [5]	14.7	15.5
2009	56,269	3.68%	1,997	9.2 [5]	15.2	15.5
2010	58,340	3.68%	2,071	9.5 [5]	15.8	24.5 [8]
2011	60,487	3.68%	2,147	9.9 [5]	16.4	24.5
2012	62,713	3.68%	2,226	10.2 [5]	17.0	24.5
2013	65,021	3.68%	2,308	10.6 [5]	17.6	24.5
2014	67,414	3.68%	2,393	11.0 [5]	18.2	24.5
2015	69,895	3.68%	2,481	11.4 [5]	18.9	24.5
2016	72,467	3.68%	2,572	11.8 [5]	19.6	24.5
2017	75,134 [3]	3.68%	2,667	12.2 [5]	20.3	24.5
2018	77,264	2.84%	2,130	12.6 [5]	20.9	24.5
2019	79,455	2.84%	2,190	12.9 [5]	21.5	24.5
2020	81,707	2.84%	2,253	13.3 [5]	22.1	24.5
2021	84,023	2.84%	2,316	13.7 [5]	22.7	24.5
2022	86,406	2.84%	2,382	14.1 [5]	23.4	24.5
2023	88,855	2.84%	2,450	14.5 [5]	24.0	24.5
2024	91,374	2.84%	2,519	14.9 [5]	24.7	33.5 [9]
2025	93,965	2.84%	2,590	15.3 [5]	25.4	33.5
2026	96,629	2.84%	2,664	15.7 [5]	26.1	33.5
2027	99,368 [3]	2.84%	2,739	16.2 [5]	26.9	33.5

[1] U.S. Census Bureau data
[2] Growth based on City of San Marcos building permit data
[3] Based on Capitol Area Metropolitan Planning Organization data
[4] Historical water production
[5] Includes SWTSU on campus population of 4278 people. SWTSU currently provides potable water, however, they have an agreement with the City to provide supplemental and/or emergency water
[6] 4.5 MGD SWTP (COS portion of 6 MGD plant) capacity plus 1.66*4.843 MGD EAA permitted capacity
[7] SWTP uprated to 7.5 MGD (COS portion of 9 MGD plant)
[8] Parallel 9.0 MGD train constructed at SWTP
[9] Third 9.0 MGD train constructed at SWTP

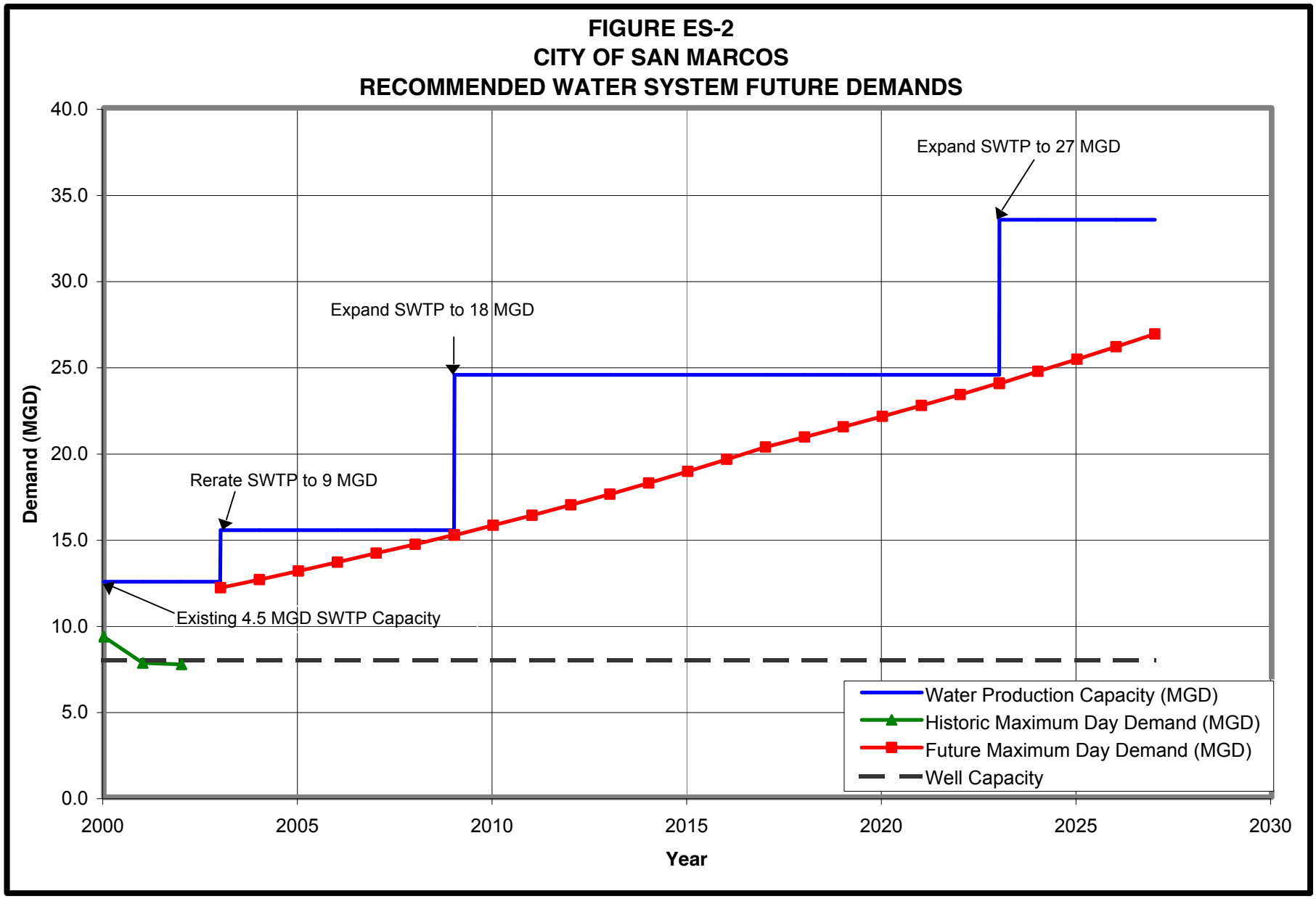
FIGURE ES-2
CITY OF SAN MARCOS
RECOMMENDED WATER SYSTEM FUTURE DEMANDS
Expand SWTP to 27 MGD
Expand SWTP to 18 MGD
Rerate SWTP to 9 MGD
Existing 4.5 MGD SWTP Capacity
Demand (MGD)
Year
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
2000
2005
2010
2015
2020
2025
2030
Water Production Capacity (MGD)
Historic Maximum Day Demand (MGD)
Future Maximum Day Demand (MGD)
Well Capacity

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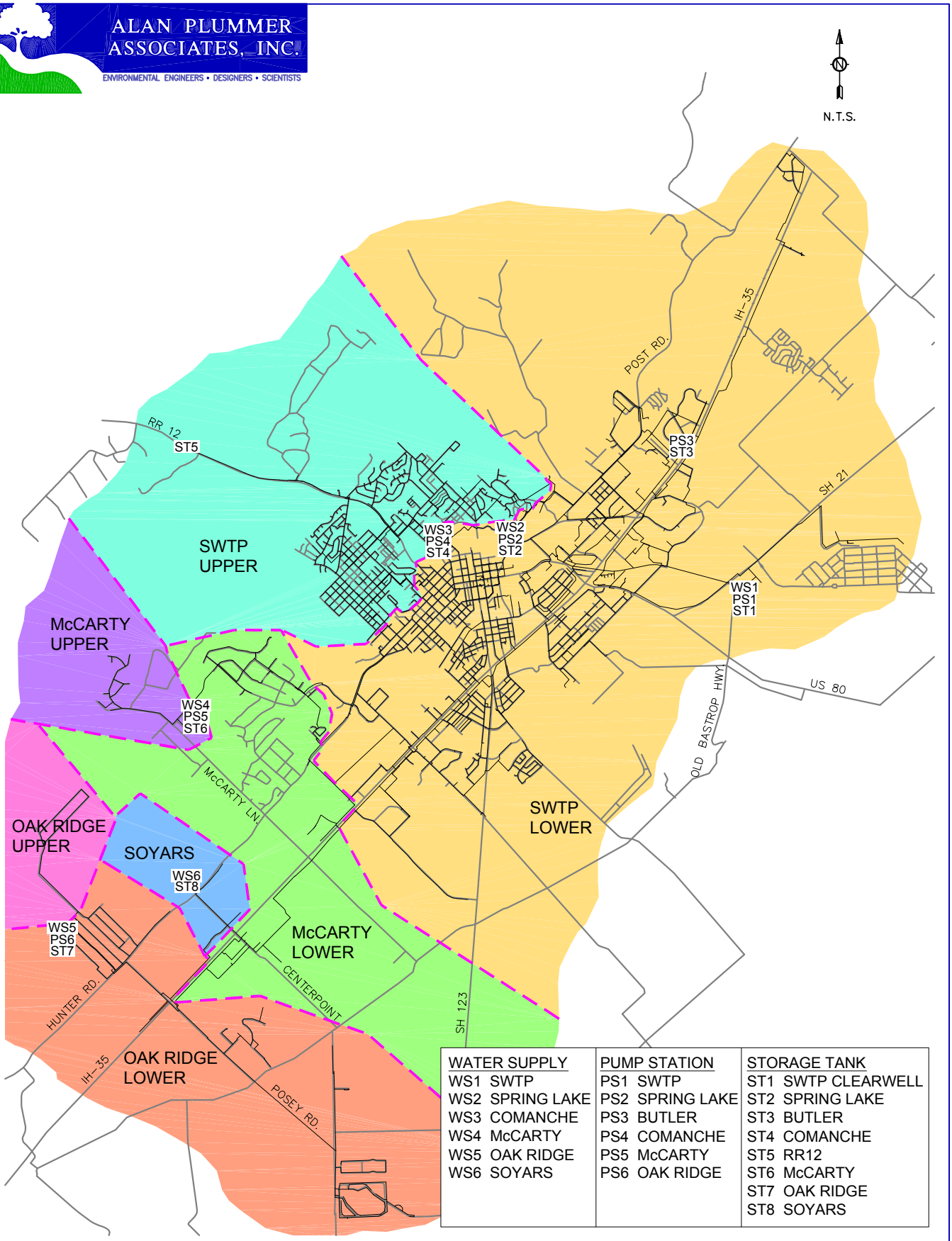

WATER SUPPLY	PUMP STATION	STORAGE TANK
WS1 SWTP	PS1 SWTP	ST1 SWTP CLEARWELL
WS2 SPRING LAKE	PS2 SPRING LAKE	ST2 SPRING LAKE
WS3 COMANCHE	PS3 BUTLER	ST3 BUTLER
WS4 McCARTY	PS4 COMANCHE	ST4 COMANCHE
WS5 OAK RIDGE	PS5 McCARTY	ST5 RR12
WS6 SOYARS	PS6 OAK RIDGE	ST6 McCARTY
		ST7 OAK RIDGE
		ST8 SOYARS

FIGURE ES-3
CITY OF SAN MARCOS
CURRENT PRESSURE PLANE BOUNDARIES

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replacement of approximately 110,000 linear feet of small diameter waterlines in the Heritage Neighborhood, Rio Vista Terrace Subdivision, Deerwood Estates, Sleepy Hollow subdivision, Southridge Estates, Greenhaven Subdivision, and Dunbar Neighborhood to meet current design criteria; replacement of several large diameter pipelines that were constructed with asbestos concrete material; and other miscellaneous water valve, fire hydrant, pump station, water well, and storage tank improvements. The security and maintenance projects identified by City staff are included in Table ES-3 as projects 49 through 76.

Major storage, pumping, and conveyance improvements are typically required for a water distribution system as population grows and demands increase. The City of San Marcos is no different. As previously indicated, the City's service area population is estimated to increase over 200 percent between 2003 and 2027 growing from 44,951 to 99,368 and maximum day demand is projected to increase to 26.9 MGD over that same timeframe. This growth will require significant improvements to the water distribution system to supply water to new population hubs.

The 2027 distribution system will operate significantly different than the current system operation. This includes lowering the SWTP Lower Pressure Plane operational grade, consolidation of pressure planes to create two primary planes, construction or modification of six booster pump stations, construction of three new elevated storage tanks, and installation of more than 950-in. diameter miles of pipeline. Figure ES-4 illustrates the proposed 2027 system pressure plane boundaries along with the water supply, pump station, and storage tank locations.

The proposed CIP identified in the master planning process for the next 25 years are listed in Table ES-3 and illustrated on Figure ES-5. The master plan CIP projects are based upon the magnitude and location of growth identified in the CAMPO population projections. The timing of the master plan CIP projects may differ from the current CIP schedule, as the City's Engineering Department must expedite some projects based upon land development service applications.

Significant CIP projects include: the SWTP Uprating to 9 MGD and two parallel 9 MGD treatment trains; the 37,000 linear feet El Camino Real water transmission pipeline from the SWTP to the intersection of Centerpoint Road and Old Bastrop Highway; the Comanche

TABLE ES-3

CITY OF SAN MARCOS
25-YEAR CIP IMPROVEMENTS

Project Number	Project Description	Line Size or Facility Capacity	Number of Units	Opinion of Construction Cost
Water Distribution Lines (Units are Linear Feet)				
1	Hwy 123 12" Line	12"	5,400	$510,000
2	Davis Ln. 12" Line	12"	2,700	$253,000
3	Stagecoach Trail- McCarty Tank	16"	5,800	$626,000
4	Westover Water Imp.	8"	2,500	$269,000
5	El Camino Real Transmission Ph 1	30"	16,900	$3,984,000
5	El Camino Real Transmission Ph 2	24"	10,500	$1,593,000
5	El Camino Real Transmission Ph 3	24"	9,800	$1,459,000
6	12" Comanche to University	12"	2,800	$667,000
7	IH 35 12" from FM 3407 to Civic Center	12"	6,800	$780,000
8	Comanche Transmission Main (24")	24"	5,200	$1,040,000
9	Posey Rd - Hunter Rd to Old Bastrop	12"	10,700	$2,359,000
10	Old Bastrop Hwy - Posey to Cntr Pt.	16"	5,700	$610,000
11	Centerpoint to Southridge 12"	12"	9,100	$864,000
12	Purgatory Creek Park	16"	8,000	$918,000
13	Post Road - City Limits to Champions	16"	18,400	$2,663,000
14	River Ridge IH 35- Hwy 21	12"	8,100	$767,000
15	Hunter Road 12" Waterline	12"	6,400	$603,000
16	S Bishop-Belvin to FM 3407 12"	12"	5,400	$506,000
17	Leah Drive 12" Cottonwood Pkwy to Civic Center	12"	3,100	$294,000
18	Airport - River Ridge to William Petus	12"	9,600	$911,000
19	Old Bastrop - Posey to Fransis Harris Ovr.	12"	4,100	$387,000
20	IH 35 - Posey to CCN Oversize	12"	5,500	$1,062,000
21	Hwy 21 - SWTP to River Ridge	16"	6,100	$656,000
22	McCarty Rd - IH 35 to Old Bastrop Ovr.	16"	12,300	$1,350,000
23	Center Point Rd - IH 35 to Old Bastrop Ovr.	24"	6,300	$934,000
24	IH35-N of McCarty to Centerpoint	12"	7,200	$678,000
25	Redwood- Hwy 123- FM 621	16"	5,400	$782,000
26	FM 621- Old Bastrop-DeZavala	16"	6,800	$732,000
27	Hwy 123S Transmission Main - 12" Portion	12"	1,500	$138,000
27	Hwy 123S Transmission Main - 18" Portion	18"	4,200	$515,000
49	Water System Security			$386,284
50	Craddock 12" AC Replacement (Allen to RR12)	12"	4,000	$300,000
51	Pressure Monitoring Locations		12	$150,000
52	River Road W.L. from Davis to Uhland	8"	3,800	$380,000
53	N. LBJ W.L. from Sessom to Craddock	12"	6,300	$630,000
54	Replace multiple waterlines in Heritage Neighborhoo	4",6",8"	13,000	$1,800,000
55	Gravel Road W.L. extension	8"	1,800	$180,000
56	Southwest Fire Hydrant Improvements			$100,000
57	Rio Vista Water System Improvements		16,000	$1,495,000
58	Main Extensuions / Replacements			$2,130,000
59	Post Road 8 Inch water Line Replacements	8"		$370,000
60	Lockwood - Del Sol Water Replacements			$125,000
61	Water Distribution Improvements			$1,474,494

TABLE ES-3 (cont.)

CITY OF SAN MARCOS
25-YEAR CIP IMPROVEMENTS

Project Number	Project Description	Line Size or Facility Capacity	Number of Units	Opinion of Construction Cost
65	Victory Gardens Water Improvements	2",6"	8,450	$545,000
66	Railroad Water Line Encasements			$438,900
67	Staples Road 12 Inch Water - Broadway to Zavala	12"	2,033	$205,000
68	Water Master Plan			$950,000
69	Deerwood Estates - Sleepy Hollow Water Line Replacement		40,900	$3,500,000
70	Highway 123 AC Replacement	12"		$950,000
71	Red Sky Subdivision Water Line Replacement	8"	7,800	$530,000
72	Wallace Addition Water Improvements	2",6",8"		$800,000
73	Dunbar Water Replacement	8"	11,400	$1,000,000
74	Green Haven & Briarwood Water Improvements	8"	6,450	$600,000
75	Southridge Estates Water Line Replacements	8"	23,650	$2,000,000
76	IH 35 S 12" Water - Marshall to Wonder World	12"	5,315	$530,000
101	McCarty to 936 Pressure Plane 12"	12"	14,900	$1,404,000
102	Middle Plane Booster & Pipeline to Trunk Hill Tank	12"	12,100	$1,140,000
103	Connection of Bishops Crossing to Lower Plane	12"	2,200	$212,000
104	Wonder World Overpass Utilities	16"	8,300	$1,908,000
105	Sleepy Hollow Upper Pipe 1	8"	6,400	$430,000
106	Center Point Rd - Hunter to IH 35	24"	5,000	$743,000
107	McCarty Rd to San Marcos Estates	12"	3,100	$293,000
108	Railroad Water Line	12"	5,000	$475,000
Water Distribution Sub-Total				**$57,084,678**
Water Supply				
63	Water Well Improvements			$460,000
110	3 MGD Uprating	3 MGD		$600,000
111	SWTP first 9 MGD plant train	9 MGD		$8,500,000
112	2nd 9 MGD Plant Train	9 MGD		$10,000,000
Water Supply Sub-Total				**$19,560,000**
Pumping Station				
62	Water Pump Station Improvements			$1,452,525
120	Soyars to 936 Plane (Pump Replacement Only)	1100 gpm		$150,000
121	Modify McCarty to 936 Plane	2000 gpm		$613,000
122	936-1020 North (middle-high)	700 gpm		$233,000
123	Sleppy Hollow 936 to 1,005 Plane	350 gpm		$138,000
124	Soyars Pumping to McCarty	600 gpm		$300,000
125	Oak Ridge Capacity Improvements	500 gpm		$130,000
Pumping Station Sub-Total				**$3,016,525**
Storage Tank				
31	Northside Tank	0.5 MG		$1,053,000
64	Water Storage Tank Improvements			$270,000
130	Cottonwood Tank	1 MG		$2,363,000
132	Trunk Hill (936)	0.5 MG		$675,000
133	Technology Way Ground Storage w/ Fire Pumps	.200 MG		$500,000
Storage Tank Sub-Total				**$4,861,000**
			Cumulative Total	**$84,522,203**

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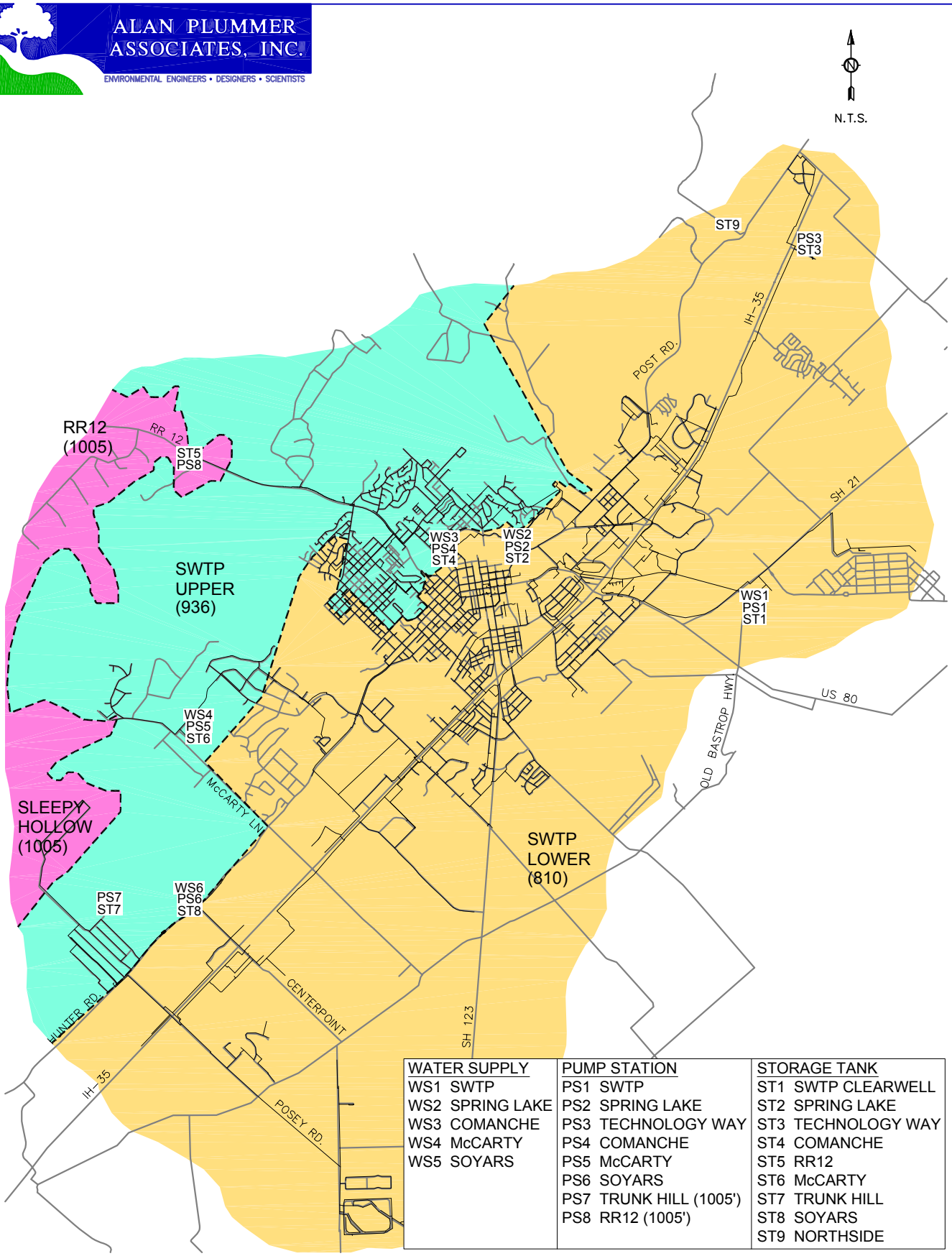

WATER SUPPLY	PUMP STATION	STORAGE TANK
WS1 SWTP	PS1 SWTP	ST1 SWTP CLEARWELL
WS2 SPRING LAKE	PS2 SPRING LAKE	ST2 SPRING LAKE
WS3 COMANCHE	PS3 TECHNOLOGY WAY	ST3 TECHNOLOGY WAY
WS4 McCARTY	PS4 COMANCHE	ST4 COMANCHE
WS5 SOYARS	PS5 McCARTY	ST5 RR12
	PS6 SOYARS	ST6 McCARTY
	PS7 TRUNK HILL (1005')	ST7 TRUNK HILL
	PS8 RR12 (1005')	ST8 SOYARS
		ST9 NORTHSIDE

FIGURE ES-4
CITY OF SAN MARCOS
2027 PRESSURE PLANE BOUNDARIES

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THE CITY OF SAN MARCOS

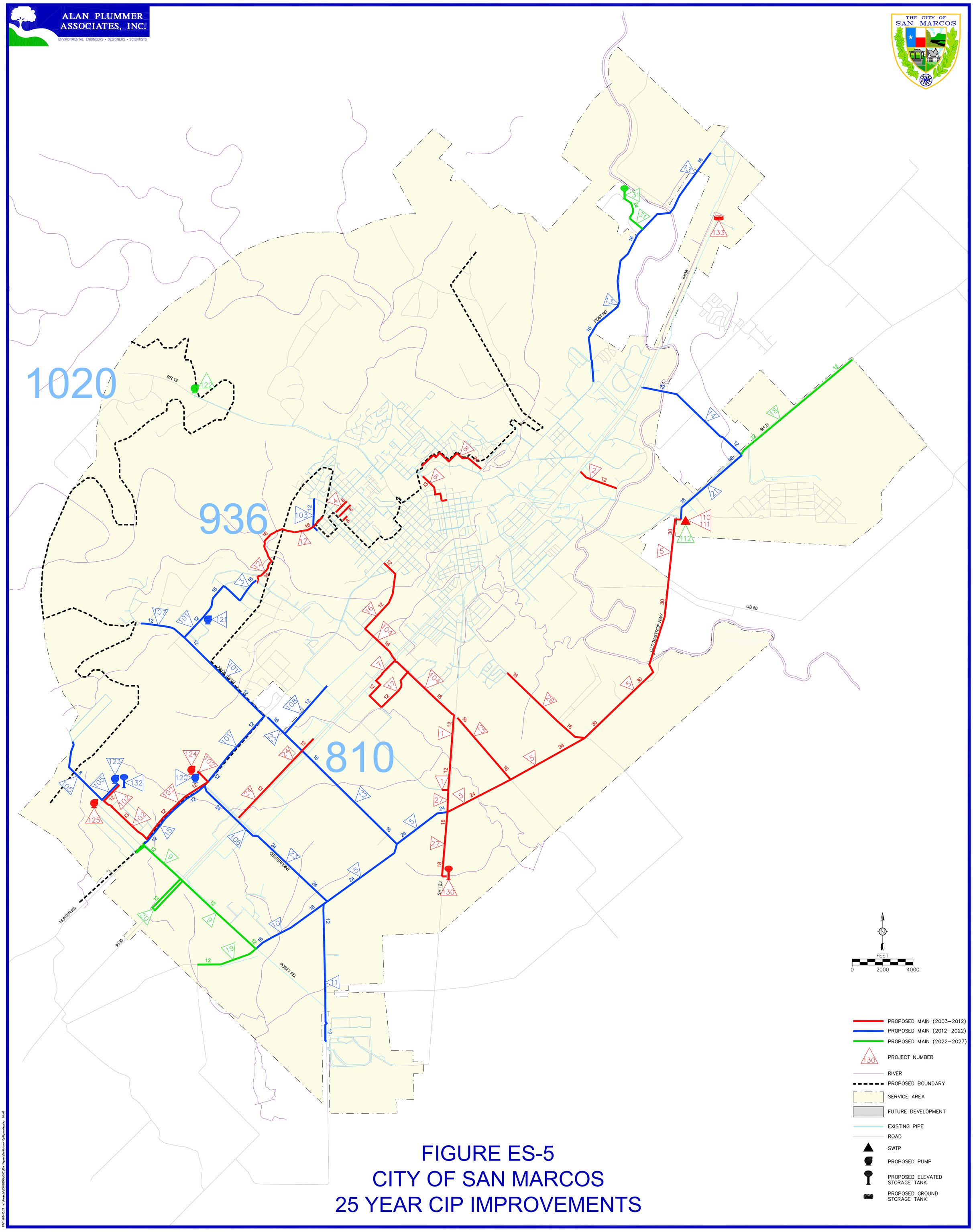

FIGURE ES-5
CITY OF SAN MARCOS
25 YEAR CIP IMPROVEMENTS

Transmission Main extension from Spring Lake pump station to the Comanche tank; the Purgatory Creek pipeline that will provide surface water to the McCarty Standpipe; the Post Road pipeline from the current City Limits to the Champions Crossing Development; the 1 MG Cottonwood elevated tanks; and the 0,5 MG Trunk Hill and Northside elevated tanks. Appendix E contains the anticipated timing in addition to the opinion of probable construction cost for each of these. The opinion of probable construction cost for all projects identified to be completed by 2027 is $83.6 million.

CHAPTER I

INTRODUCTION

The City of San Marcos has retained the services of Alan Plummer Associates, Inc. to prepare a comprehensive plan to provide potable water throughout the City's proposed water service area. The primary means of analyzing the water distribution system's ability to provide water to all customers is through hydraulic modeling. The modeling analysis and this report cover the proposed water distribution system master plan for the City. Although the proposed system is designed to accommodate the anticipated growth of the City and the service area distribution system infrastructure to the year 2027, it is recommended that the model and report be updated at regular intervals and revised to reflect the changing conditions that may arise as the City's population grows. Additionally, prior to construction of projects that constitute a major capital expenditure, it is recommended that an evaluation be performed to verify that the design criteria utilized in development of the master plan still adequately represent the developed conditions.

The last comprehensive evaluation of the City's water distribution system was completed in 1997 as part of the SWTP design performed by APAI. Prior to that evaluation, Freese and Nichols, Inc conducted a Master Plan Study in 1983. In the 1997 distribution system analysis, a Haestad Methods WaterCAD computer model of the City's distribution system was developed based upon historic grid mapping records. However, the City recently digitized their distribution system into a GIS database. Since a significant level of effort and quality control was provided for the digitizing project, City staff directed APAI to utilize the GIS information in the building of the new model. This report presents a summary of the modeling effort and the capital improvement recommendations associated with the growth of the water distribution system as of January 2003.

The primary tasks included on the Water Master Plan Update scope of services include:

- Data Collection and System Inventory – Review existing reports that pertain to the existing water system, including water production, pumping stations, storage facilities, and water distribution piping.
- Land Use and Demographics – Review existing land use and population reports and prepare future service area population projections.

- Field Testing Program – Obtain system performance data to determine current operation of pumps and piping network. This summary is included as Appendix A to this report.
- Water Requirements – Evaluate existing water use data to determine historic per capita use and population per connection density. The future water requirements are based upon historic per capita use and population per connection density
- Water Supply and Treatment Facilities – Evaluate existing water supply and treatment facilities to determine the adequacy of the existing facilities and necessary improvements to meet projected water demands.
- Water Distribution Facilities – Evaluate existing water distribution system and determine the adequacy of existing pumping, storage, pressure stations and distribution components and necessary improvements to meet projected water demands.
- Water Quality Issues – Evaluate existing and proposed water distribution system to identify areas of inadequate circulation that could cause deterioration in water quality based upon an average water age analysis.
- Planned Improvements and Alternatives – Develop and evaluate system improvements needed to meet projected demand increases and provide adequate system redundancies to all areas of the system operated by the City. This includes development of a Capital Improvement program to meet the needs of the 10-year, 20-year, and 25-year planning periods.
- Final Report – Prepare capital improvement implementation program recommendations based on the results of the hydraulic analyses. This includes the water supply, treatment, and distribution improvements required to meet projected water demands in 10-year, 20-year, and 25-year planning periods.
- Design Criteria – Review City's current information related to design criteria for typical design features of a distribution system and compare the current criteria to TCEQ criteria and information from other cities. Prepare a complete design criteria manual based upon the findings. This will be provided under separate cover.

CHAPTER II

EXISTING SYSTEM

The City of San Marcos owns and operates the City's water distribution system that includes the following major components: One 6 MGD surface water treatment plant, five well plant sites with a total of seven operational wells, eight operational water storage tanks, five pressure reducing valves, and over 1,000,000 linear feet (ft.) of pipeline ranging in diameters from 1-in. to 24-in. These facilities are currently providing service to more than 8,000 connections in the 55 square mi. service area.

Water Supply Facilities

The City of San Marcos currently obtains approximately 70 percent of its potable water from the SWTP and 30 percent from groundwater sources. The City owns the SWTP, which is operated under a contract by the GBRA. The SWTP obtains water from Lake Dunlap on the Guadalupe River via a 20-mi. long 30-in. diameter pipeline. The City operates seven wells, in five locations, that withdraw water from the Edwards Aquifer. Figure II-1 illustrates the location of the water supply facilities. Information concerning the capacities of the water supply facilities is presented in Table II-1. Information concerning the historic production of the water supply facilities is presented in Table II-2.

Pump Stations

The City of San Marcos operates a total of five pumping stations that provide service to three pressure planes. Pump performance tests were conducted by Severn Trent Pipeline Services (STPS) Pitometer Water Services Group (PWSG) at the Spring Lake Pump Station and Comanche Pump Station as part of this project. The methods, procedures, and results of the complete field-testing conducted by STPS PWSG are contained in Appendix A of this report. Figure II-2 illustrates the location of each of the pump stations. Specific information related to the number of pumps, pump capacities, and motor sizes at each of the pump stations are presented in Table II-3.

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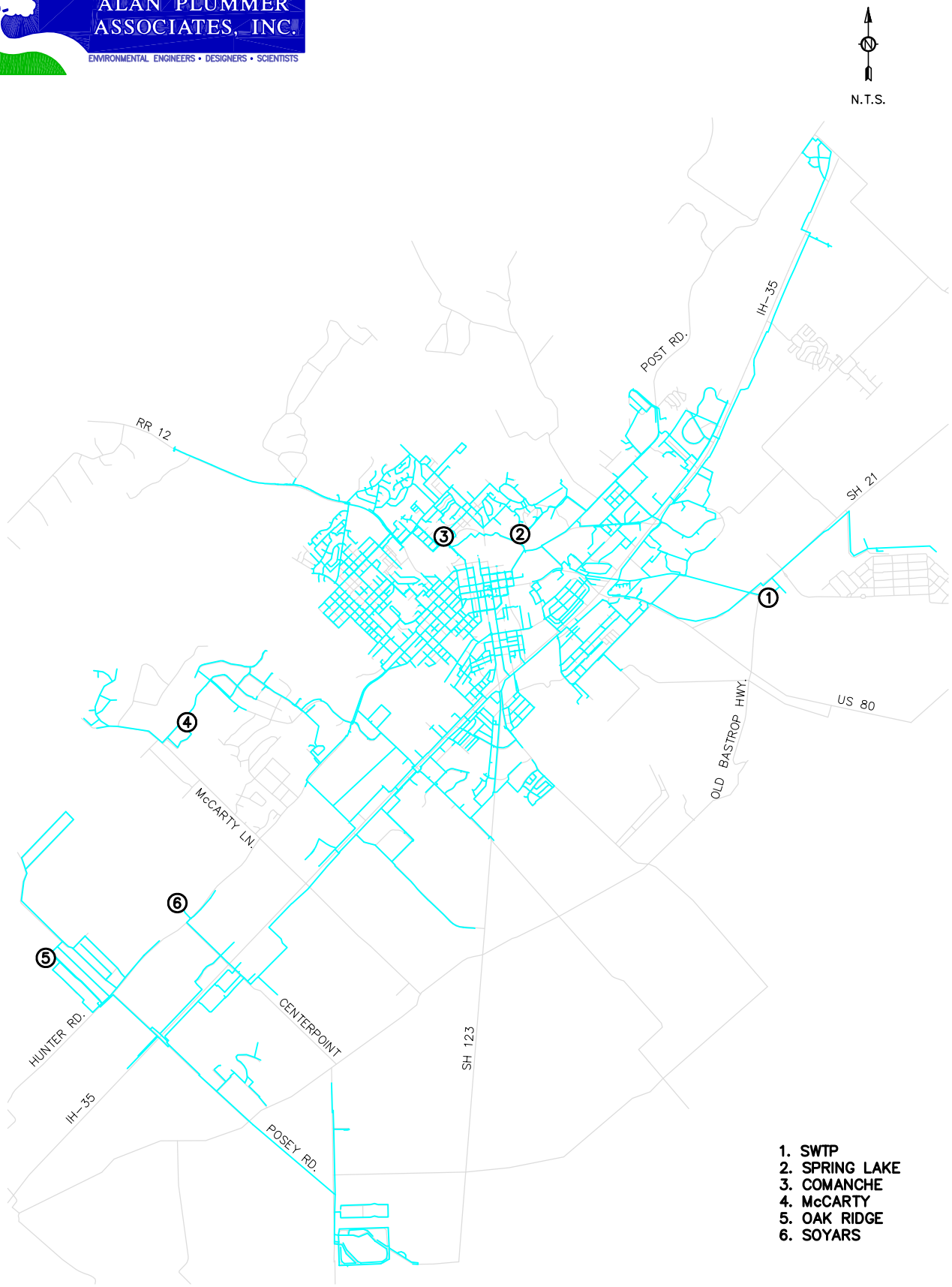

FIGURE II-1
CITY OF SAN MARCOS
WATER SUPPLY FACILITIES

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TABLE II-1

CITY OF SAN MARCOS
WATER SUPPLY FACILITY CAPACITIES

Map No.	Facility Name	Capacity (gpm)	Depth (ft)	Motor (hp)	Plane	Comment
1	SWTP	3,125*	N/A	N/A	SWTP Lower	Capacity Increase to 6 MGD in 2005 once GBRA reserve capacity is returned.
2	Spring Lake #1	4,230	130	75	SWTP Lower	
	Spring Lake #2	2,250	118	150	SWTP Lower	
3	Comanche #5	2,700	270	300	SWTP Lower	
4	McCarty	1,428	261	150	McCarty Upper/Lower	
5	Oak Ridge #1	350	225	40	Oak Ridge Upper/Lower	Pump set at 190-ft.
	Oak Ridge #2	350	233	40	Oak Ridge Upper/Lower	Pump set at 190-ft.
6	Soyars	400	189	40	Soyars	

* 4.5 MGD SWTP (COS portion of 6 MGD plant) capacity

TABLE II-2

CITY OF SAN MARCOS
HISTORIC PRODUCTION OF SUPPLY FACILITIES

Map No.	Facility Name	Water Production (thousands of gallons)					
		1997	1998	1999	2000	2001	2002
1	SWTP	64,798	1,890,244	1,846,173	1,386,900	1,323,400	1,491,889
2	Spring Lake #1	19,475	567,360	582,348	161,119	127,078	44,843
	Spring Lake #2	28,188	932,797	923,210	127,662	96,692	134,586
3	Comanche #5	8,149	181,331	109,693	51,418	3,294	12,900
4	McCarty	7,946	310,426	450,732	189,747	288,564	214,844
5	Oak Ridge #1	467	41,801	44,684	49,278	84,829	87,353
	Oak Ridge #2	1,695	31,618	29,566	23,346	22,639	5,691
6	Soyars	1,405	49,202	35,452	24,440	54,864	43,416

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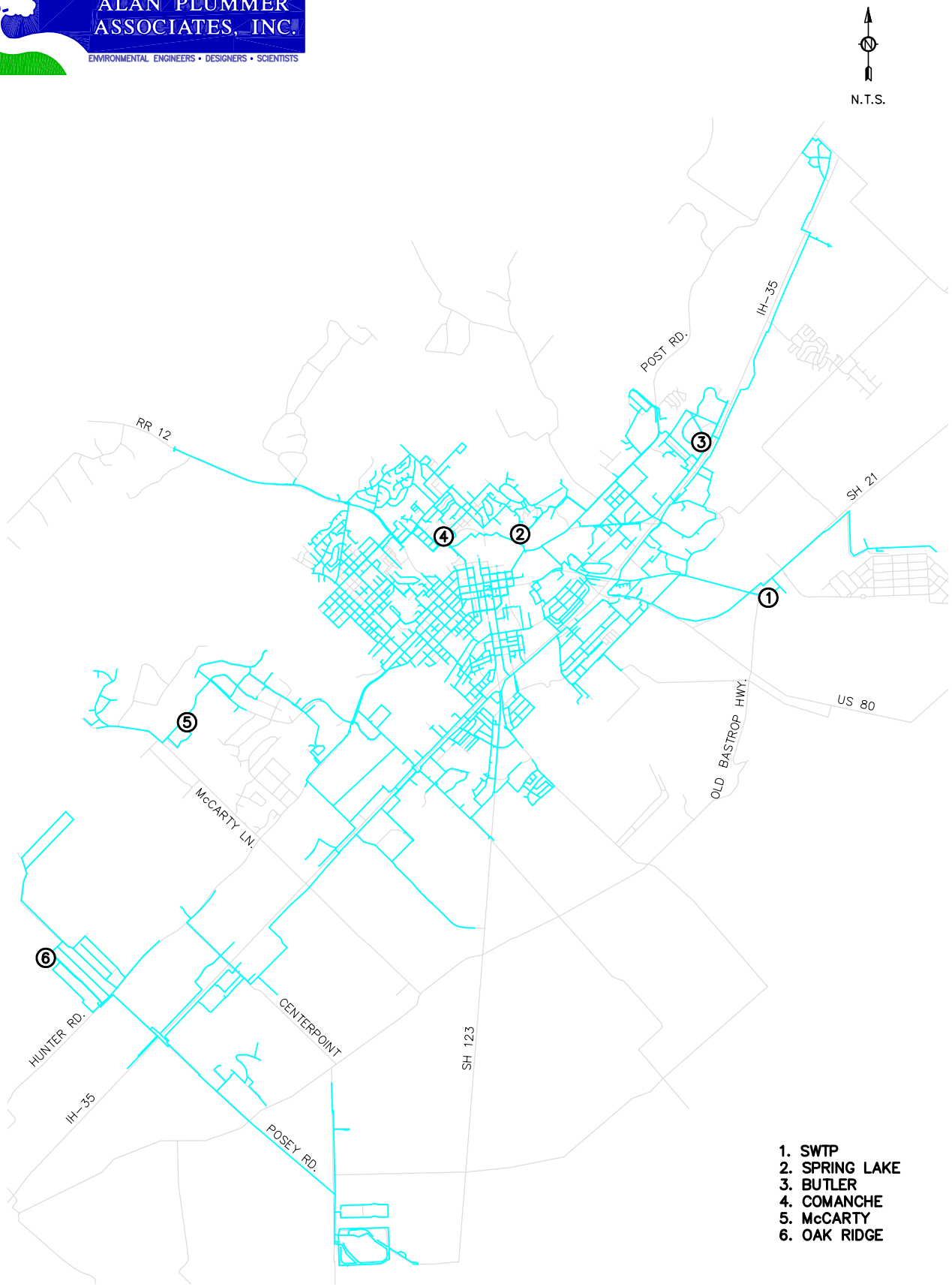

FIGURE II-2
CITY OF SAN MARCOS
PUMPING STATIONS

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TABLE II-3

CITY OF SAN MARCOS
PUMP STATION FACILITIES

Map No.	Facility Name	Capacity (gpm)	Head (ft)	Motor (hp)	Plane	Comment
1	SWTP					Operated on Comanche level.
	Pump #1	4,200	325	500	SWTP Lower	
	Pump #2	4,200	325	500	SWTP Lower	
2	Spring Lake					All pumps operated on system pressure.
	Pump #1	1,200	210	125	SWTP Lower	
	Pump #2	2,200	180	150	SWTP Lower	
	Pump #4	1,200	210	125	SWTP Lower	
3	Butler					
	Pump #1	250	160	20	SWTP Lower	
	Pump #2	750	160	50	SWTP Lower	
	Fire #1	1,700	160	100	SWTP Lower	Fire pumps don't operate with pump 1 or 2
	Fire #2	1,700	160	100	SWTP Lower	
4	Comanche					Operated on Ranch Road 12 level.
	Pump #1	1,200	140	60	SWTP Upper	
	Pump #2	600	140	30	SWTP Upper	
	Pump #3	600	140	30	SWTP Upper	
	Pump #4	600	140	30	SWTP Upper	
5	McCarty		VFD			Operated on system pressure.
	Pump #1	200	175-190	15	McCarty Upper	
	Pump #2	200	175-190	15	McCarty Upper	
	Pump #3	200	175-190	15	McCarty Upper	
6	Oak Ridge					Operated on system pressure. Both pumps operating at 350 gpm.
	Pump #1	460	160	25	Oak Ridge Lower	
	Pump #2	460	160	30	Oak Ridge Lower	
	Sleepy Hollow	100	266	15	Oak Ridge Upper	

Storage Tanks

The City operates 8 storage tanks. Figure II-3 illustrates the location of the storage tanks. Information concerning the storage volume, overflow elevation, and other physical and operational aspects of each tank is presented in Table II-4. Schematic drawings of each of the tanks with associated wells and/or booster pump stations are included in Appendix B.

Distribution Piping

The water distribution system for the City of San Marcos contains over 1,000,000 linear ft. of pipeline ranging in size from 1-in. in diameter to 24-in. in diameter. The current service area is divided into seven service area pressure planes. These include: SWTP Lower, SWTP Upper, McCarty Lower, McCarty Upper, Oak Ridge Lower, Oak Ridge Upper, and Soyars. Figure II-4 illustrates the approximate boundaries of these pressure planes.

Pressure Reducing Valves

The City has six pressure reducing valves (PRVs) throughout the water distribution system. There are three PRVs off the SWTP treated water transmission main to distribute water to the system at multiple points. These locations are at State Highway 21 and County Line Road, Post Road and Uhland Road, and at the Spring Lake booster pump station header 10-in. waterline that provides water to the downtown area.

The remaining three PRVs are located on Stagecoach Drive, Oak Ridge Drive, and Allen Street. The Stagecoach Drive PRV was installed to provide emergency service from the McCarty Lower Pressure plane to the SWTP Lower Pressure Plane, but has been temporarily taken out of service. The Oak Ridge Drive PRV provides service to connections in the SWTP Upper Pressure Plane that would observe pressures in excess of 100 psi due to the low elevations in the area. The Allen Street PRV was installed to provide emergency service from the SWTP upper Pressure Plane to the SWTP Lower Pressure Plane. However, this PRV has been temporarily taken out of service.

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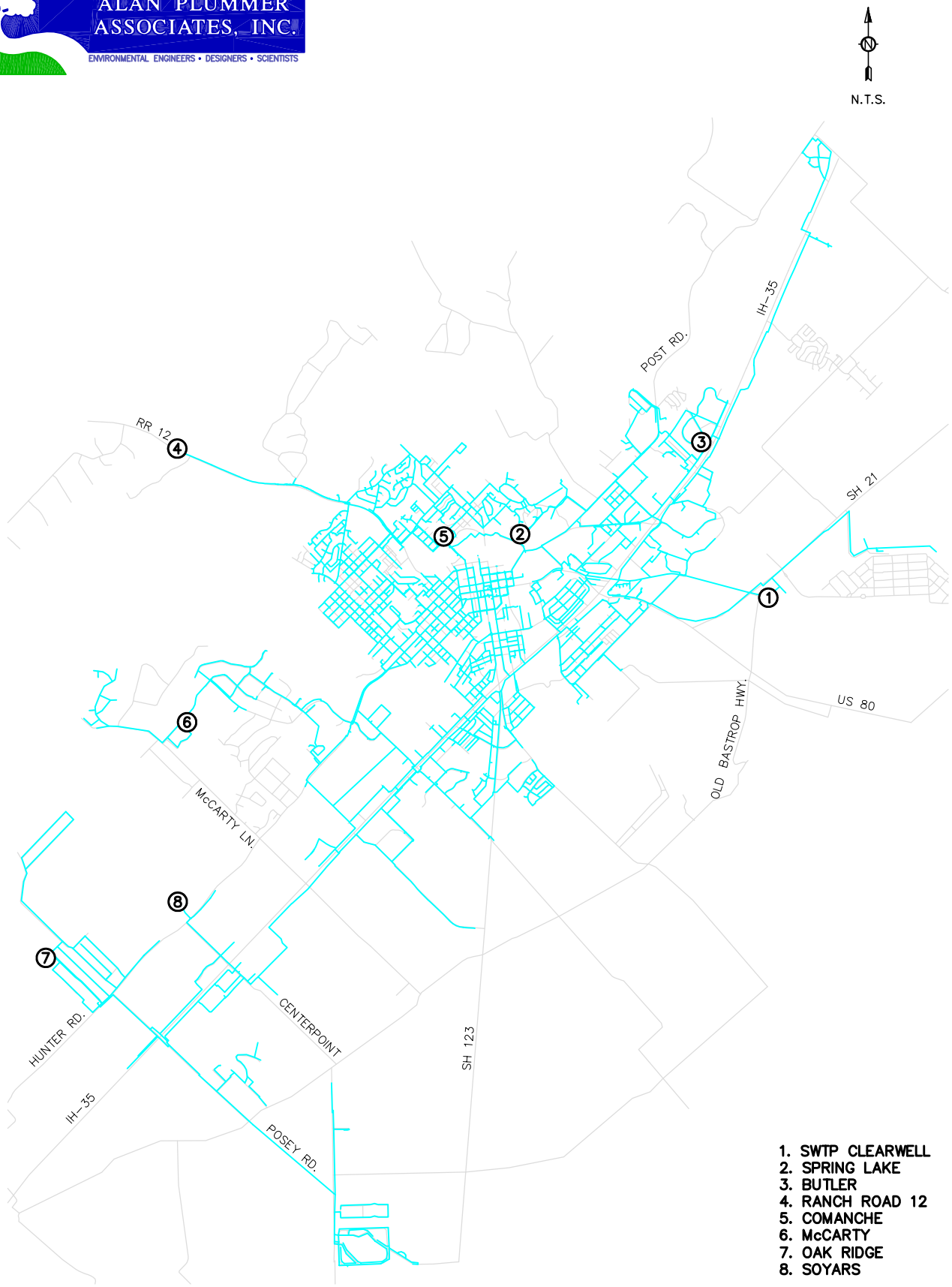

FIGURE II-3
CITY OF SAN MARCOS
STORAGE TANKS

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TABLE II-4

CITY OF SAN MARCOS
STORAGE FACILITIES

Map No.	Facility Name	Volume (gal)	Overflow Elevation (ft)	Diameter (ft)	Construction	Comment
1	SWTP Clearwell	1,000,000	585	100	Ground	
2	Spring Lake	1,500,000	654	100	Ground	
3	Butler	200,000	629	40	Ground	
4	Ranch Road 12	1,000,000	936	74	Ground	Serving as elevated
5	Comanche	1,000,000	826	50	Standpipe	
6	McCarty	500,000	857	30	Standpipe	
7	Oak Ridge	50,000	764	18	Ground	
8	Soyars	500,000	805	30	Standpipe	

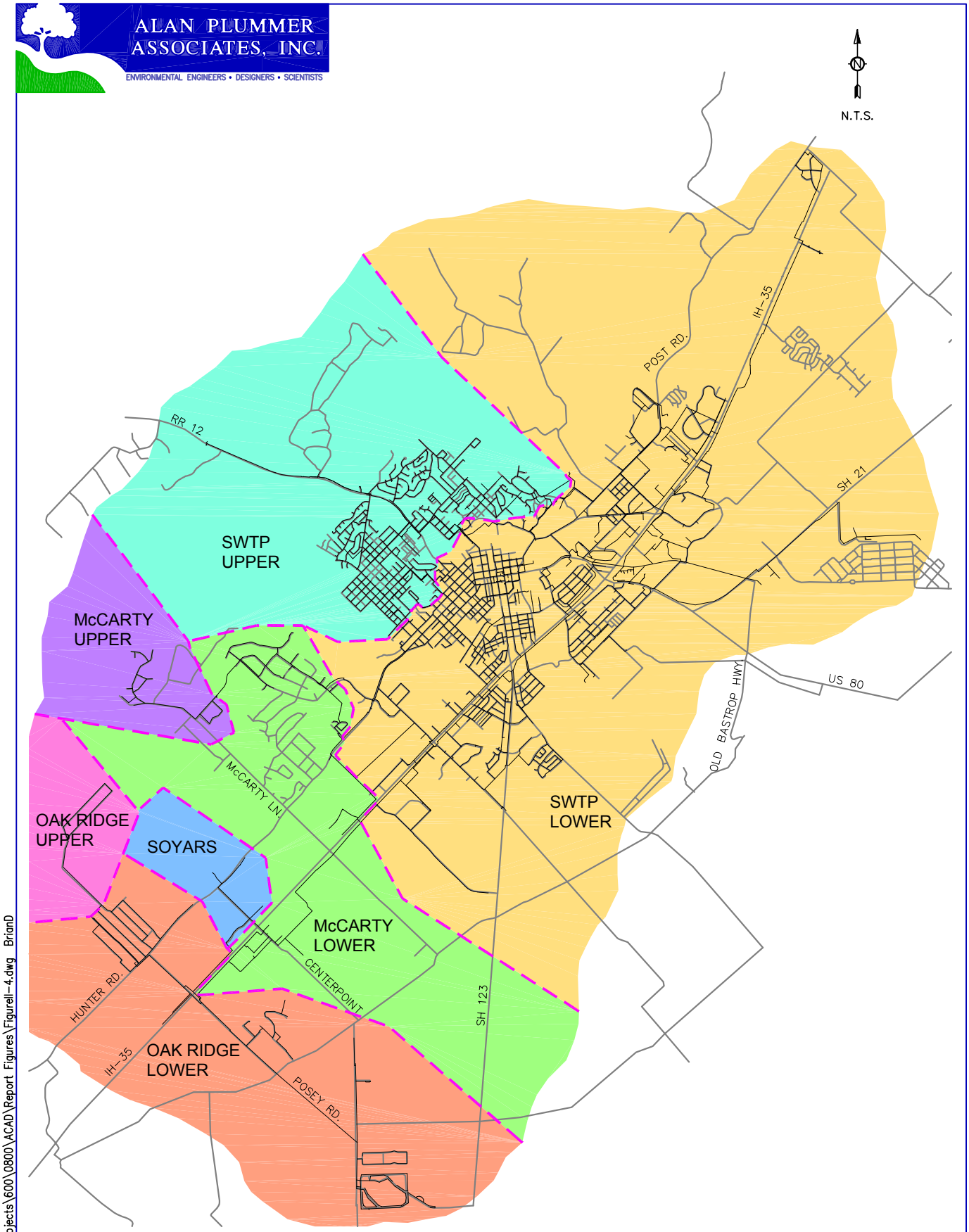

FIGURE II-4
CITY OF SAN MARCOS
CURRENT PRESSURE PLANE BOUNDARIES

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CHAPTER III

CURRENT SYSTEM OPERATION

The current service area is divided into seven service area pressure planes. These include: SWTP Lower, SWTP Upper, McCarty Lower, McCarty Upper, Oak Ridge Lower, Oak Ridge Upper, and Soyars.

The naming convention for each of the planes consists of the primary source of potable water followed by the relative hydraulic grade elevation. Table III-1 contains detailed information regarding potable water supply source and hydraulic operational grade.

SWTP Lower Plane Operation

The Lower SWTP Pressure Plane serves 4,532 connections ranging in elevation from 572 ft. mean sea level (msl) to 710 ft. msl. Supply facilities for the SWTP Lower Pressure Plane include the surface water treatment plant with dual high service pumps each rated at 4,000 gpm at 325 ft. head, the two Spring Lake wells rated at 2,250 gpm and 4,230 gpm, the four Spring Lake booster pumps with ratings ranging from 1,600 gpm to 1,880 gpm at 190 ft. of head, and the 2,700 gpm Comanche well pump that discharges directly to the Comanche tank. Storage facilities for the SWTP Lower Pressure Plane include the 1 million gallon plant clearwell; 200,000 gallon Butler booster ground storage tank; 1.3 million gallon Spring Lake ground storage tank; and the 64 ft. tall Comanche standpipe tank that has a total volume of 1 million gallons, of which approximately 510,000 gallons serve as elevated storage for the lower pressure plane.

The SWTP high service pumps discharge to the 24-in. transmission main that currently ends at the Spring Lake booster pump station manifold where water is conveyed in a 12-in. pipe to the Comanche tank. There are three pressure-reducing valves off the SWTP treated water transmission main to distribute water to the system at multiple points. These locations are at State Highway 21 and County Line Road, Post Road and Uhland Road, and at the Spring Lake booster pump station header 10-in. waterline that provides water to the downtown area.

TABLE III-1

CITY OF SAN MARCOS
SYSTEM SUPPLY AND OPERATION GRADE

Pressure Plane	Primary Potable Source	Alternative Potable Source(s)	Operational Hydraulic Grade (ft. msl)
SWTP Lower	SWTP	Spring Lake Wells Comanche Well	826
SWTP Upper	SWTP	Spring Lake Wells Comanche Well	936 (Currently operating at 925)
McCarty Lower	McCarty Well	SWTP Lower (emergency operation)	857
McCarty Upper	McCarty Well	SWTP Lower (emergency operation)	940
Oak Ridge Lower	Oak Ridge Wells		906
Oak Ridge Upper	Oak Ridge Wells		1006
Soyars	Soyars Well		805

The suction for the SWTP high service pumps is the SWTP clearwell. One of the SWTP high service pumps is called when the Comanche tank reaches a hydraulic grade of 815 ft. msl, or 53 ft. of water in the tank. The high service pump is turned off when the Comanche tank reaches the hydraulic grade of 822 fl. msl, or 60 ft. of water in the tank.

The suction for the Spring Lake booster pumps is the Spring Lake ground storage tank. The Spring Lake booster pumps are controlled by the discharge manifold pressure. The first pump is called when the discharge manifold pressure falls below 100 psi, or a hydraulic grade of 810 ft. msl. The second, third, and fourth pumps are called at pressures of 95 psi, 90 psi, and 85 psi respectively, or hydraulic grades of 798 ft. msl, 787 ft. msl, and 775 ft. msl. All of the Spring Lake booster pumps are turned off when the discharge pressure reaches 105 psi, or a hydraulic grade of 822 ft. msl. This hydraulic grade is typically achieved when the SWTP high service pump is turned on, but can also occur if the Spring Lake Pumps fill the Comanche Tank to approximately 820 ft. msl.

The Spring Lake wells are controlled by the water level in the Spring Lake ground storage tank. The first Spring Lake well pump is called when the water level in the Spring Lake ground storage tank falls below 15.5 ft., or hydraulic grade of 690.5 ft. msl, and the second well pump is called when the tank water level reaches 15 ft., or hydraulic grade of 690 ft. msl. The Spring Lake well pumps are turned off when the water level in the Spring Lake tank reaches 22 ft., or hydraulic grade of 697 ft. msl.

The Comanche well is controlled by the water level in the Comanche tank. The Comanche well pump is called when the water level in the Comanche tank falls below 45 ft., or hydraulic grade of 807 ft. msl. The Comanche well pump is turned off when the water level in the Comanche tank reaches 55 ft., or hydraulic grade of 817 ft. msl.

SWTP Upper Plane Operation

The Upper SWTP Pressure Plane serves 2,714 connections ranging in elevation from 680 ft. msl to 825 ft. msl. There are no separate supply facilities for the SWTP Upper Pressure Plane. The only storage facility for the SWTP Upper Pressure Plane is the 1 million gallon Ranch Road 12 storage tank. The Ranch Road 12 tank is filled from the Comanche Booster Pumps.

The suction for the Comanche booster pumps is the Comanche standpipe. The Comanche booster pumps cycle the call order. Generally, pump 1 or 2 is the lead pump, while pump 3 or 4 is the first lag pump, then the non-lead pump from the pump 1 or 2 pair is the second lag pump, and the remaining pump is the third lag pump. For example, if pump 2 is called as the lead pump, and pump 3 is called as the first lag pump, then pumps 1 and 4 will be called as the second and third lag pumps when needed.

The lead Comanche booster pump is called when the Ranch Road 12 tank falls to a level of 15 ft., or hydraulic grade of 920 ft. msl. The first lag, second lag, and third lag pumps are called when the Ranch Road 12 tank falls to levels of 14.5 ft., 14 ft., and 13.5 ft., or hydraulic grades of 919.5 ft. msl, 919 ft. msl, and 918.5 ft. msl. All of the Comanche booster pumps are turned off when the Ranch Road 12 Tank fills to a level of 20 ft., or hydraulic grade of 925 ft. msl.

McCarty Lower Pressure Plane Operation

The Lower McCarty Pressure Plane serves 163 connections ranging in elevation from 625 ft. msl to 735 ft. msl. Supply and storage facilities within the McCarty Lower Pressure Plane include the McCarty well and associated vertical turbine pump rated at 1,300 gpm at 430 ft. head and the 97 ft. tall McCarty standpipe with 215,000 gallons of elevated storage.

The McCarty well pumps directly to the McCarty tank and is called when the water level in the McCarty tank falls to the hydraulic grade of 845 ft. msl, or 87 ft. msl of water in the tank. The McCarty well pump is turned off when the McCarty tank reaches the hydraulic grade of 855 ft. msl, or 97 ft. of water in the tank. The plane is fed without the aid of any additional pumping.

McCarty Upper Plane Operation

The Upper McCarty Pressure Plane serves 97 connections ranging in elevation from 710 ft. msl to 815 ft. msl. There are no separate supply or storage facilities within the McCarty Upper Pressure Plane. This system is fed via three variable frequency drive (VFD) pumps located at the McCarty well and tank site. These pumps are controlled to maintain a discharge pressure between 76 psi and 82 psi. The equivalent hydraulic grade is between 926 ft. msl and 940 ft. msl.

Oak Ridge Lower Plane Operation

The Lower Oak Ridge Pressure Plane serves 489 connections ranging in elevation from 600 ft. msl to 785 ft. msl. Supply and storage facilities within the Oak Ridge Lower Pressure Plane include the Oak Ridge wells, associated well pump, disposable cartridge micro-filtration plant, ground storage tank, booster pumps, and pressure tank.

Both Oak Ridge Wells pump to a pre-filter, then a micro-filtration plant prior to the ground storage tank because the source water has been determined to be "under the influence of surface water." The Oak Ridge Lower booster pumps then pump from the ground storage tank into the lower plane. The pressure tank maintains system pressures between 55 psi and 72 psi at the discharge of the pumps. The equivalent hydraulic grade is between 867 ft. msl and 906 ft. msl.

Oak Ridge Upper Plane Operation

The Upper Oak Ridge Pressure Plane serves 83 connections ranging in elevation from 780 ft. msl to 920 ft. msl. There are no separate supply or storage facilities within the Oak Ridge Upper Pressure Plane. This system is fed via two Oak Ridge Upper pumps and a pressure tank at the Oak Ridge well and ground storage tank site. The pressure tank is operated to maintain a system pressure of 115 psi at the discharge of the pumps. The equivalent hydraulic grade is 1,006 ft. msl.

Soyars Plane Operation

The Soyars Pressure Plane serves 6 connections ranging in elevation from 680 ft. msl to 710 ft. msl. Supply and storage facilities within the Soyars Pressure Plane include the Soyars well, associated well pump, and the 70 ft. tall Soyars standpipe with 74,000 gallons of elevated storage.

The Soyars well pumps directly to the tank and is called when the water level in the tank falls to the hydraulic grade of 800 ft. msl, or 65 ft. msl of water in the tank. The well pump is turned off when the tank reaches the hydraulic grade of 804 ft. msl, or 69 ft. of water in the tank. The plane is fed without the aid of any additional pumping.

CHAPTER IV

POPULATION

The City of San Marcos population was 34,733 according to the U.S. Census Bureau 2000 Census of Population and Housing. The City performs an annual update of population estimates utilizing building permit data. Since the 2000 Census, the City has experienced annual growth in excess of 7 percent placing the 2003 population at an estimated 44,144. The city limits and current water service area are shown in Figure IV-1.

The CAMPO is responsible for projecting population data in Hays, Travis, and Williamson Counties. The CAMPO planning area incorporates most of the City of San Marcos city limits and water service area. The CAMPO population data are projected based upon current and future land use information associated within each specific Traffic Survey Zone (TSZ) and include projections for the years 2007, 2017, and 2027. There are more than 1000 TSZs within the CAMPO planning area of which 124 are partially or completely within the current water service area. Appendix C contains detailed information for the TSZs in and around the City.

The City of San Marcos Planning and Zoning Department processes applications from commercial and residential developers that plan on developing and improving a parcel of land within the City of San Marcos development jurisdiction. The significant developments that have submitted applications are shown in Figure IV-2. In general, the CAMPO population projections incorporated the population growth for the anticipated developments. However, there are several TSZ's where the CAMPO projections show that the growth is not sufficient to reach the developer's expected build-out populations by 2027. Table IV-1 summarizes the development applications and corresponding TSZ information. The CAMPO growth values were utilized as the basis for the study at the direction of City staff.

The City currently provides potable water to customers within the city limits, with a few exceptions. The TCEQ is responsible for recording potable water service areas by issuing a Certificate of Convenience and Necessity (CCN) to a potable water retailer. The CCN

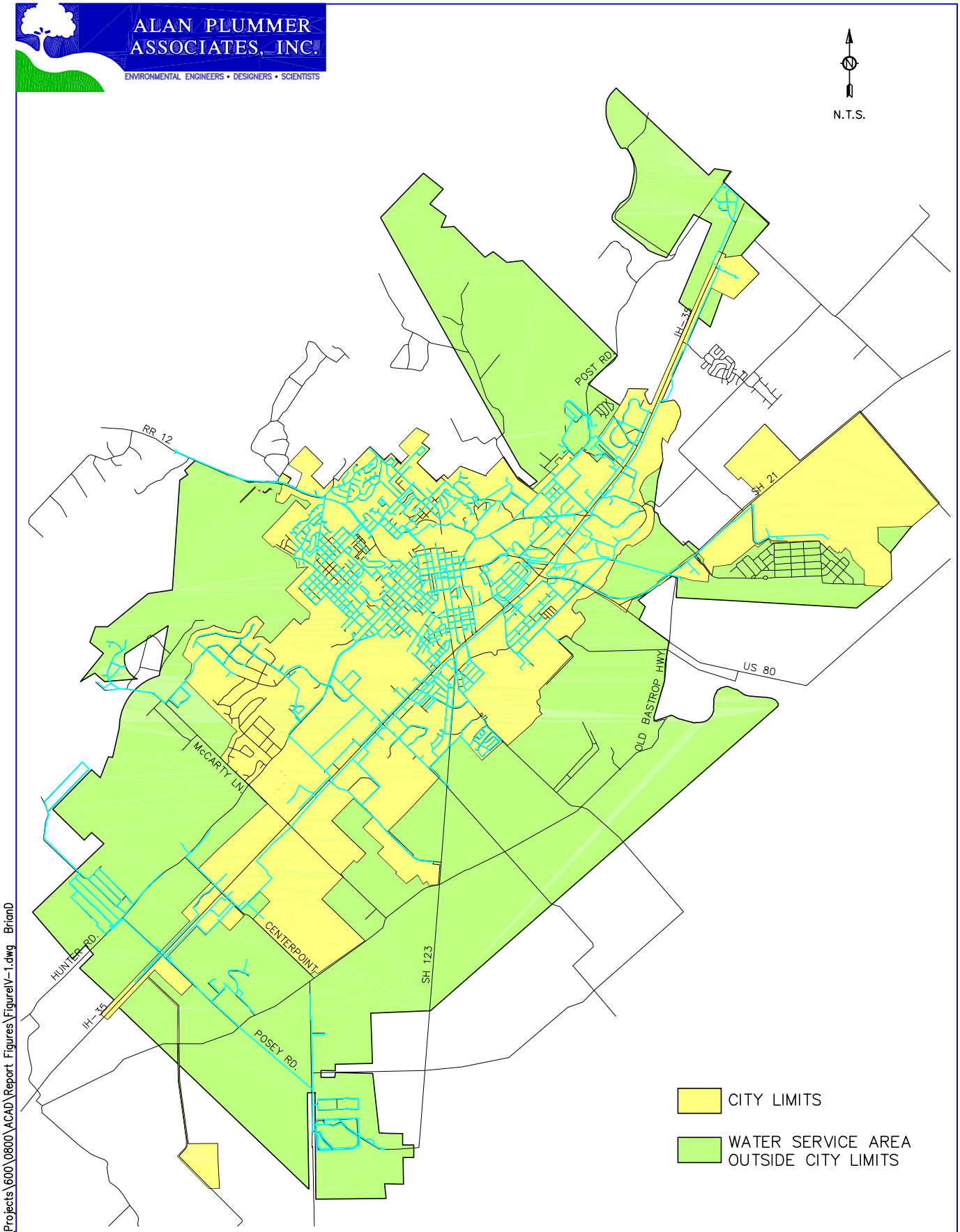

FIGURE IV–1
CITY OF SAN MARCOS
CITY LIMITS & CURRENT WATER SERVICE AREA

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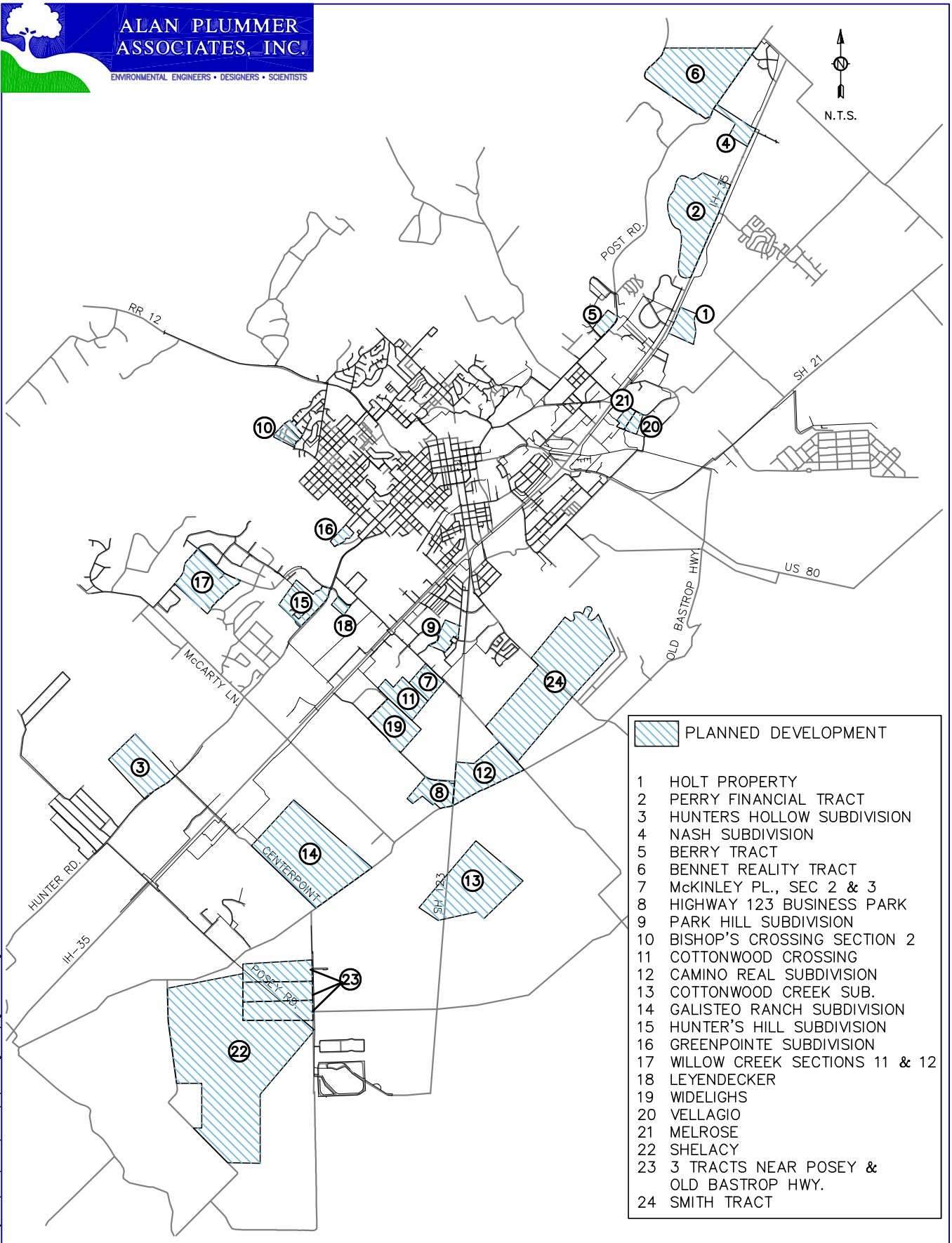

FIGURE IV–2
CITY OF SAN MARCOS
DEVELOPMENTS SUBMITTING LAND DEVELOPMENT APPLICATIONS

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TABLE IV-1

DEVELOMENT APPLICATIONS COMPARED TO TSZ DATA
CITY OF SAN MARCOS

Development	Map Label ID	Residential SUEs	Equivalent Population	TSZ ID	2000-2027 TSZ Pop. Total Growth *	2000-2027 Service Pop. Growth
Shelacy	22	6,600	15,246	781	861	535
				790	798	798
Cottonwood Creek	13	2,886	6,670	778	2,363	2,244
				779	2,549	2,160
Galisteo Ranch Subdivision	14	2,577	5,950	789	4,456	4,456
Smith Tract	24	2,088	4,825	772	1,672	1,672
				773	1,380	1,380
3 x 100 ac Posey Road Tracts	23	1,800	4,158	781	861	535
Bennet Realty Tract	6	1,300	3,000	823	1,527	700
Camino Real	12	1,264	2,920	775	2,186	2,186
McKinley Place Sec. 2 & 3	7	587	1,350	802	3,753	3,753
Holt Property	1	520	120	835	1,428	1,357
Hunter's Hollow	3	358	825	741	2,510	2,510
Cottonwood Crossing	11	269	620	802	3,753	3,753
Hunter's Hill	15	250	575	787	631	631
Berry Tract	5	190	440	762	1,441	1,441
Park Hill	9	183	420	776	658	658
Vellagio	20	155	360	724	959	959
Melrose	21	135	310	724	959	959
Bishop's Crossing Sec. 2	10	92	210	737	846	846
Willow Creek Sec. 11 & 12	17	89	205	670	622	622
				738	823	516
Greenpointe	16	16	35	683	0	0
Lyendecker	18	Commercial				
Widelights	19	Commercial				
Nash Subdivision	4	Commercial				
Perry Financial Tract	2	Outside of Water Service Area				
Highway 123 Business Park	8	Commercial				

* 2000-2027 TSZ Population Growth Values Utilized for Planning Purposes

boundaries regulate which entity can provide service to a customer. Previously, TCEQ created CCN boundaries that were allowed to “overlap”, creating dually certified areas, which permitted customers to choose between providers. There is a portion of the City’s service area that is dually certified to Crystal Clear WSC. Additionally, private individuals, businesses, or entities such as SWTSU can produce their own water for consumption, irrigation, cooling tower blow down, or other required uses without applying for a CCN. The current CCN boundaries in and around the City are shown in Figure IV-3.

The growth of the future water service area is limited by existing CCN boundaries to the north, east, and south. Therefore, the expected growth in new areas to be served and incorporated into the CCN by the City is expected on the western edge of the existing CCN. The anticipated boundaries for the future water service area are shown in Figure IV-4.

The ArcView GIS tool was utilized to evaluate the current and future service area populations based upon the defined service areas and TSZ boundaries. First, the population density within the TSZ was determined by dividing the residential population by the land area within the TSZ. Second, these two thematic data sources were manipulated by “intersecting” the TSZ records with the current and future service area records to determine the appropriate land area within the TSZ to be served. Finally, the land area for the portion of the TSZ within the current and future service areas were multiplied by the population density to obtain the TSZ population within the service area. Figure IV-5 illustrates the steps in this process.

Once the 2007, 2017, and 2027 water service area populations were determined in the GIS analysis, intermediate year populations were estimated based upon a constant annual growth rate necessary to achieve the population benchmark years. 2001 through 2003 water service area populations were estimated based upon the building permit data previously described. Table IV-2 and Figure IV-6 contain the water service area population projections.

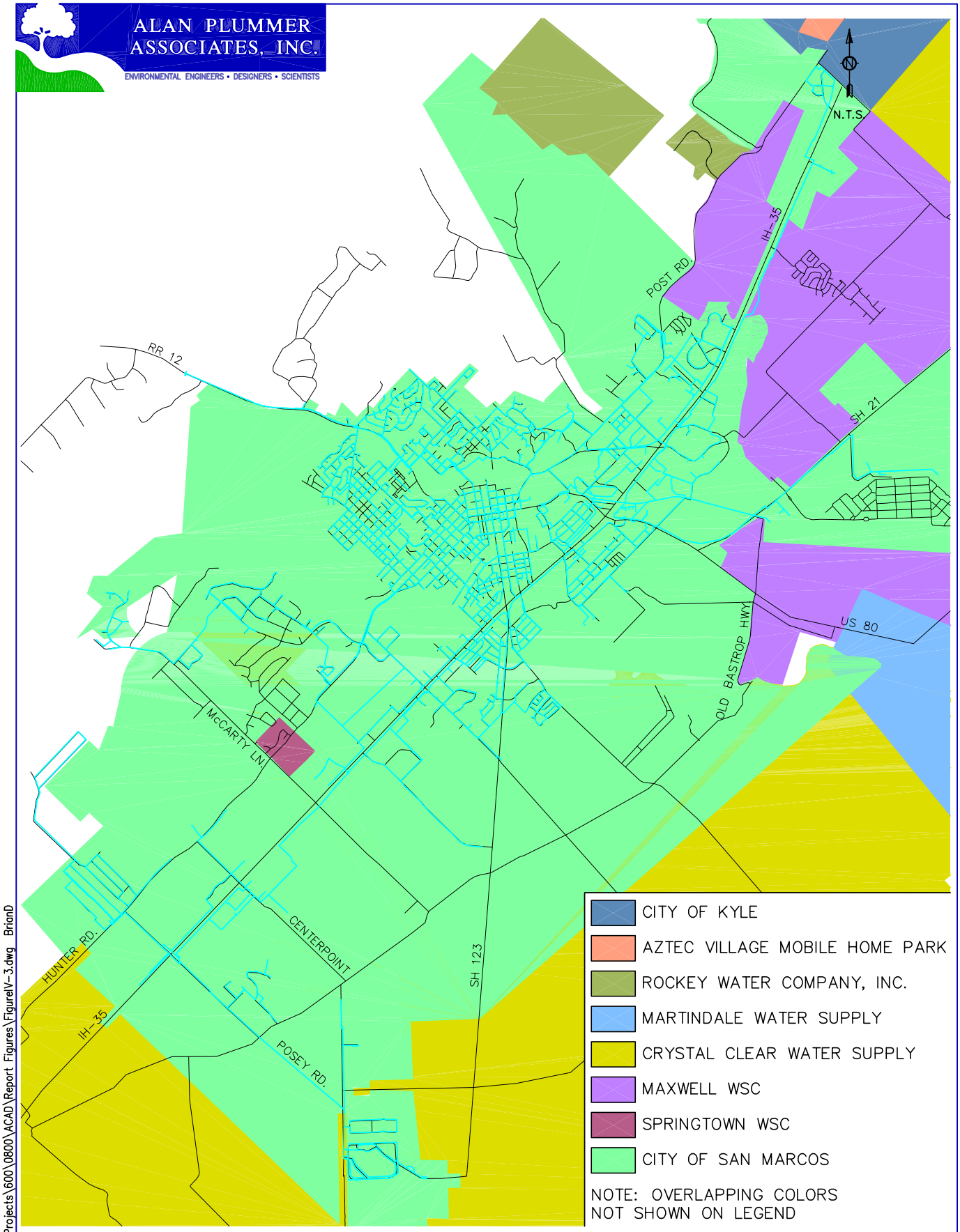

FIGURE IV-3
CITY OF SAN MARCOS
SAN MARCOS AREA CCN BOUNDARIES

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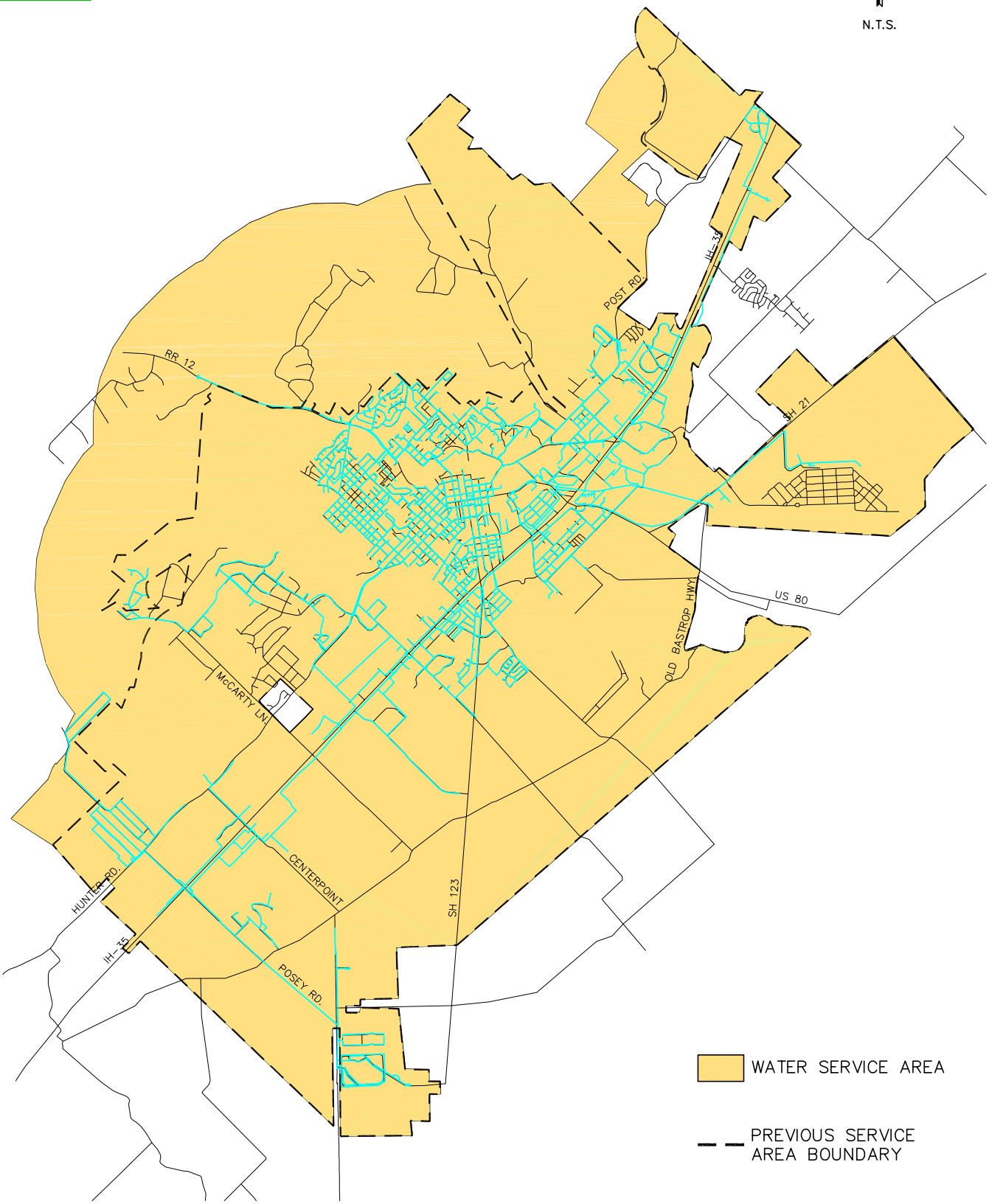

FIGURE IV–4
CITY OF SAN MARCOS
ANTICIPATED FUTURE WATER SERVICE AREA

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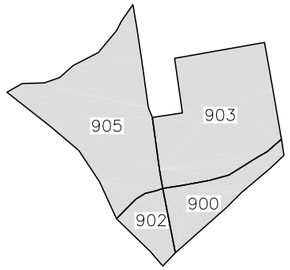
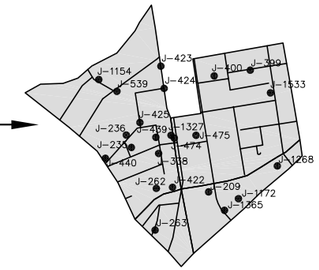


TSZ	Population
900	6
902	73
903	311
905	311

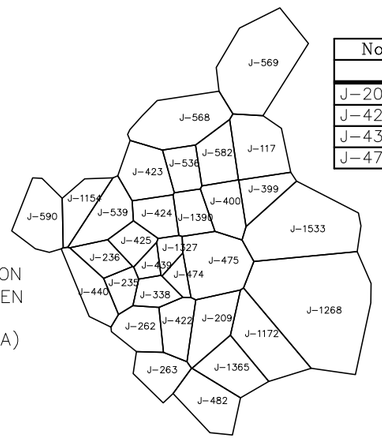
DATABASE MANIPULATION (DETERMINE AREA AND POPULATION DENSITY)

TSZ	Population	Area	Population Density
		(Acres)	(People/Acre)
900	6	16.76	0.36
902	73	9.70	7.53
903	311	52.66	5.91
905	311	55.94	3.56



Node	Elevation	Area	Demand
	(ft)	(Acres)	(gpm)
J–209	577.56		
J–422	570.00		
J–439	570.00		
J–474	570.00		

GIS MANIPULATION (CREATE THIESSEN POLYGONS & DETERMINE AREA)

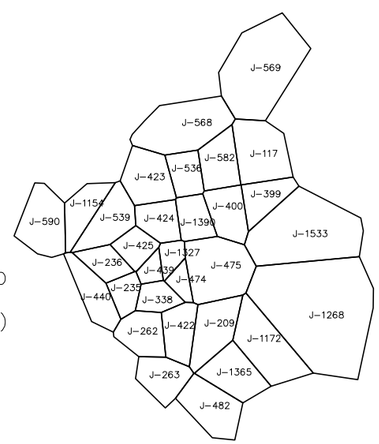


Node	Elevation	Area	Demand
	(ft)	(Acres)	(gpm)
J–209	577.56	9.62	
J–422	570.00	6.85	
J–439	570.00	2.31	
J–474	570.00	2.56	

GIS MANIPULATION (INTERSECT THIESSEN POLYGONS & TS BOUNDARIES)

Intersection:					
Node	TSZ	Area	Density	Population	Demand
		(Acre)	(People/Acre)	(People)	(gpm)
J–209	900	8.14	0.36	2.93	0.33
J–209	903	1.48	5.91	8.75	0.99
J–422	900	2.74	0.36	0.99	0.11
J–422	902	2.63	7.53	19.80	2.24
J–422	903	1.02	5.91	6.03	0.68
J–422	905	0.46	3.56	1.64	0.19
J–439	905	2.31	3.56	8.22	0.93
J–474	903	2.45	5.91	14.48	1.64
J–474	905	0.11	3.56	0.39	0.04

GIS MANIPULATION (DISSOLVE FEATURES TO DETERMINE JUNCTION POPULATION & DEMAND)



Node	Population	Demand
		(gpm)
J–209	11.68	1.32
J–422	28.46	3.22
J–439	8.22	0.93
J–474	14.87	1.68

FIGURE IV–5
CITY OF SAN MARCOS
GIS DATA PROCESSING

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TABLE IV-2

CITY OF SAN MARCOS
POPULATION PROJECTIONS

Year	Approximate Population Served	% Growth	Total Growth
2000	35,368 [1]		
2001	37,946	7.29%	2,578 [2]
2002	41,255	8.72%	3,308 [2]
2003	44,951	8.96%	3,696 [2]
2004	46,695	3.88%	1,744
2005	48,507	3.88%	1,812
2006	50,390	3.88%	1,882
2007	52,345 [3]	3.88%	1,955
2008	54,271	3.68%	1,926
2009	56,269	3.68%	1,997
2010	58,340	3.68%	2,071
2011	60,487	3.68%	2,147
2012	62,713	3.68%	2,226
2013	65,021	3.68%	2,308
2014	67,414	3.68%	2,393
2015	69,895	3.68%	2,481
2016	72,467	3.68%	2,572
2017	75,134 [3]	3.68%	2,667
2018	77,264	2.84%	2,130
2019	79,455	2.84%	2,190
2020	81,707	2.84%	2,253
2021	84,023	2.84%	2,316
2022	86,406	2.84%	2,382
2023	88,855	2.84%	2,450
2024	91,374	2.84%	2,519
2025	93,965	2.84%	2,590
2026	96,629	2.84%	2,664
2027	99,368 [3]	2.84%	2,739

[1] U.S. Census Bureau data
[2] Growth based on City of San Marcos building permit data
[3] Based on Capitol Area Metropolitan Planning Organization data

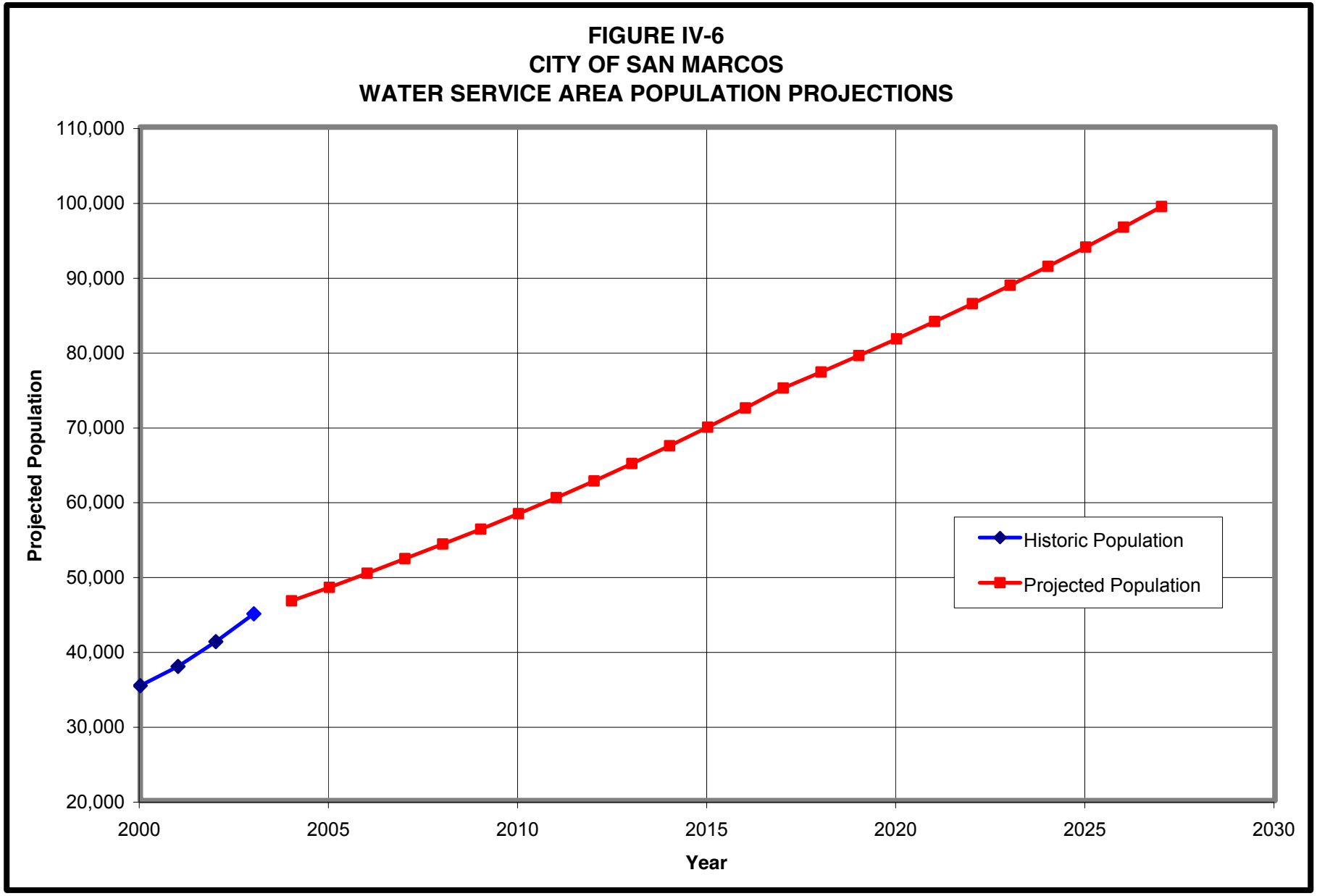
FIGURE IV-6
CITY OF SAN MARCOS
WATER SERVICE AREA POPULATION PROJECTIONS
110,000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
Projected Population
2000
2005
2010
2015
2020
2025
2030
Year
Historic Population
Projected Population

CHAPTER V

EXISTING SYSTEM MODEL DEVELOPMENT

A representative computer model of the City's water distribution system was developed to aid in the evaluation of the existing water distribution system, including water mains, storage facilities, and pumping stations. This tool was also utilized to evaluate and optimize necessary improvements required to provide adequate service to future growth areas that are currently anticipated through 2027 according to the CAMPO population projections.

The modeling software used to conduct these evaluations was WaterCAD Version 6.0103b, which operates in a stand-alone or AutoCAD environment. WaterCAD was developed and is sold commercially by Haestad Methods, Inc of Waterbury, Connecticut. The model uses the hydraulic computational algorithms developed by the U.S. Environmental Protection Agency (EPA) Drinking Water Research Division, Risk Reduction Engineering Laboratory.

The development of a computer model requires two basic types of information. First, information concerning the physical make-up of the system, including pumping, storage, and distribution piping must be identified. Second, information concerning the demands for water placed on the system must be identified. These two major components are discussed in the following sections.

Physical System

The City recently digitized their distribution system into a GIS database. Since a significant level of effort and quality control was provided for the digitizing project, City staff directed APAI to utilize the GIS information in building the new model. In addition, the following sources of information were utilized in the development of the model: hard copy map of water utility system showing existing (2002) improvements; electronic copy of the current system operational set points; electronic copy of GIS base files (i.e. streets, meter boxes, CCN, etc.); and electronic copy of an existing model for the Oak Ridge system developed by Carter & Burgess, Inc.

This information was evaluated and a digital representation of the water distribution system was created. The computer model of the distribution system contains physical characteristics such as pipe diameters, pipe lengths, pump operating curves, tank heights and diameters. These characteristics are represented by interrelated graphical elements. The model node elevations were electronically determined utilizing a three dimensional model of the City's ground elevations created from US Geological Survey (USGS) 10-ft. topographic contours. A graphical representation of the distribution system on January 1, 2003 is shown in Figure V-1.

Water Demands

Determination of water demand, physical demand distribution, and diurnal demand distribution are generally the most difficult aspects of water distribution system modeling. Water system demands are generated by, but not limited to, individuals using water at their homes, offices, schools, commercial establishments, industrial facilities, or recreational facilities.

Existing Demand Distribution

System-wide demand is typically calculated based upon operational metering records for point of entry locations, such as wells or treatment plants. These data are used to generate per capita demands for various demand scenarios, including average day, maximum day, and peak hour. However, physical demand distribution of the system-wide data has historically been difficult to determine.

The City provided APAI with historic monthly water usage between May 2000 and April 2002 from the City's Maximo billing system. In addition, meter account locations for customers were provided as a GIS theme linking usage with physical meter location. Since the data completely covered the 2001 calendar year, the 2001 annual average water usage was calculated for each account. The annual average water data was then manipulated with the MD/AD factors that were calculated from the water production data to generate the maximum day demands.

In order to assign water demands to individual nodes within the system, node service areas were defined by creating Thiessen polygons to delineate the area served by each model node. GIS intersection analysis of the Thiessen polygons and the water meter account information was performed to assign observed demands to the node service area. Since the demands were

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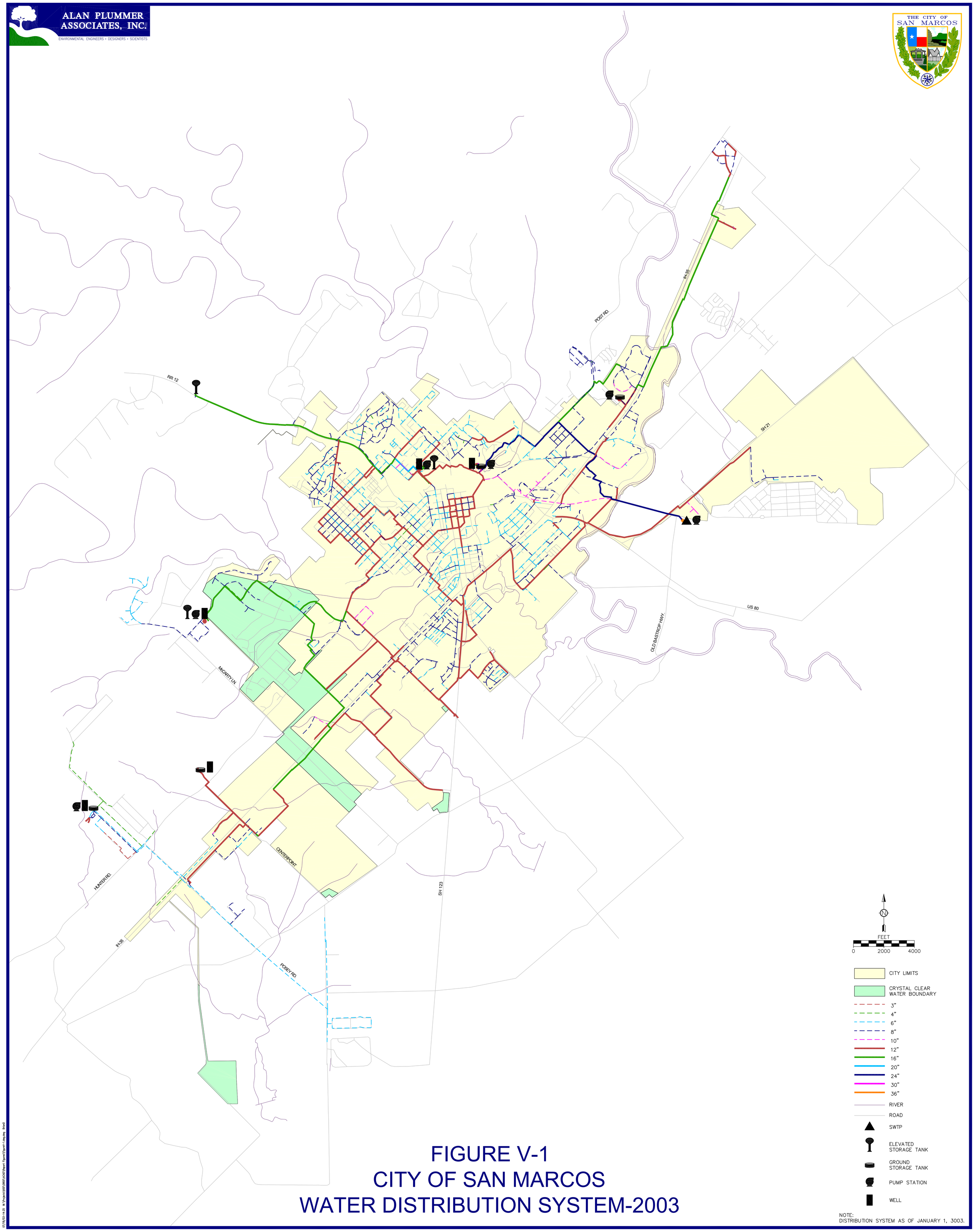

NOTE:
DISTRIBUTION SYSTEM AS OF JANUARY 1, 3003.

FIGURE V-1
CITY OF SAN MARCOS
WATER DISTRIBUTION SYSTEM-2003

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assigned using observed data, it was determined that per capita demands and population distributions were not necessary to analyze the current system.

Future Population

Estimates and distribution of 2007, 2017, and 2027 TSZ populations prepared by CAMPO were utilized in ArcView to determine future population distribution throughout the water supply service area. In order to assign water demands to individual nodes within the system, node service areas were defined by creating Thiessen polygons to delineate the area served by each model node. GIS intersection analysis of the Thiessen polygons and the TSZ polygons was performed to assign population to demand nodes as described in Chapter IV.

Per Capita Water Demands

Water demands are typically discussed in terms of per capita water demands on an annual average, maximum day, and peak hour basis. This is generally accomplished by observing citywide demands during these conditions, and dividing by the total population.

Based upon the population data analysis previously described, the approximate population served in 2001 was 37,946. This population includes the SWTSU population, but does not include the dually certified Crystal Clear Service Area, nor does it include any population outside of Hays County. However, SWTSU only needed water for approximately one month according to the 2001 meter records, therefore deleting SWTSU would result in a population served of approximately 33,668. This population translates to a population density of 4.16 people/connection. This number is higher than typical values used in residential planning because it includes apartment complexes, which generally have one connection. The average daily demand in 2001 was 5.485 MGD, yielding a daily per capita consumption of 162.9 gallons. This per capita consumption includes all unaccounted water, commercial, industrial, and various maintenance uses.

Review of the system-wide historical MD/AD ratio indicated that the historical high MD/AD factor is 1.66. It is more difficult to determine the maximum hour to maximum day ratio. Current PH/MD peaking factors of 1.66 and 1.35 were determined for the SWTP Upper Plane and SWTP Lower Plane, respectively, during the model calibration effort.

The per capita consumption data were not utilized in the current system analysis; however, the information is necessary for the 2007, 2017, and 2027 system analyses. The water demand distribution based upon the per capita consumption for the future planning periods was also compared to the current demand distribution based upon metered accounts. Those areas that had significantly higher demand in the current model than in the future models were assumed to continue the elevated demand rate. The higher demand based upon metered data is most likely attributed to non-residential demands, such as industrial or commercial type customers. Therefore, additional demands were added to per capita consumption demand data for approximately a dozen nodes to reflect the concentrated non-residential demands that currently exist within the distribution system.

The use of the current system-wide per capita demand for the future scenarios incorporates the assumption that future growth will include approximately the same mix of residential, commercial, industrial, and unaccounted water. The mix of future growth should be periodically evaluated and adjustments to the per capita demands should be performed. In addition, the effects of water conservation efforts should be evaluated in future updates to the Master Plan.

CHAPTER VI

MODEL CALIBRATION

The goal of utilizing a computer model to simulate a water distribution system is to replicate the actual water distribution system as closely as possible. Once the physical components of the distribution system have been entered into the computer model, it is important to establish reasonable estimates of model variables. This process is often referred to as "Model Calibration". It is essential that the model be calibrated to establish that the model reasonably simulates actual conditions in the distribution system since decisions concerning implementation of capital improvement projects will be based on this information.

In general, there are four components that can be changed in a computer model to simulate the actual water system. These four components are the tank level and pump station operation, the pipe roughness, the physical system demand distribution, and the diurnal demand distribution. There are different calibration methods utilized to establish reasonable estimates of each of these items, which are discussed in the following sections.

Tank Level and Pump Station Operation

The water level within the elevated storage tanks and the status of each pump within the booster pump stations are important operational data in model calibration. If the operational status of these facilities is unknown, hydraulic grades can be significantly different, causing excessive discrepancies in calibration attempts. However, since the tank levels and pump station operational status was provided to APAI, there was no additional modification to achieve calibration

Pipe Roughness

Pipe roughness is typically a function of pipe material, pipe age, and potable water chemistry. Since a large portion of the City's water distribution system is of unknown age and pipe material, two methods of dynamic field-testing procedures were conducted on twelve pipe segments throughout the City to determine "C" values for pipe roughness. The locations of the dynamic field tests are shown on Figure VI-1. Additionally, fire flow tests were conducted at 10 locations

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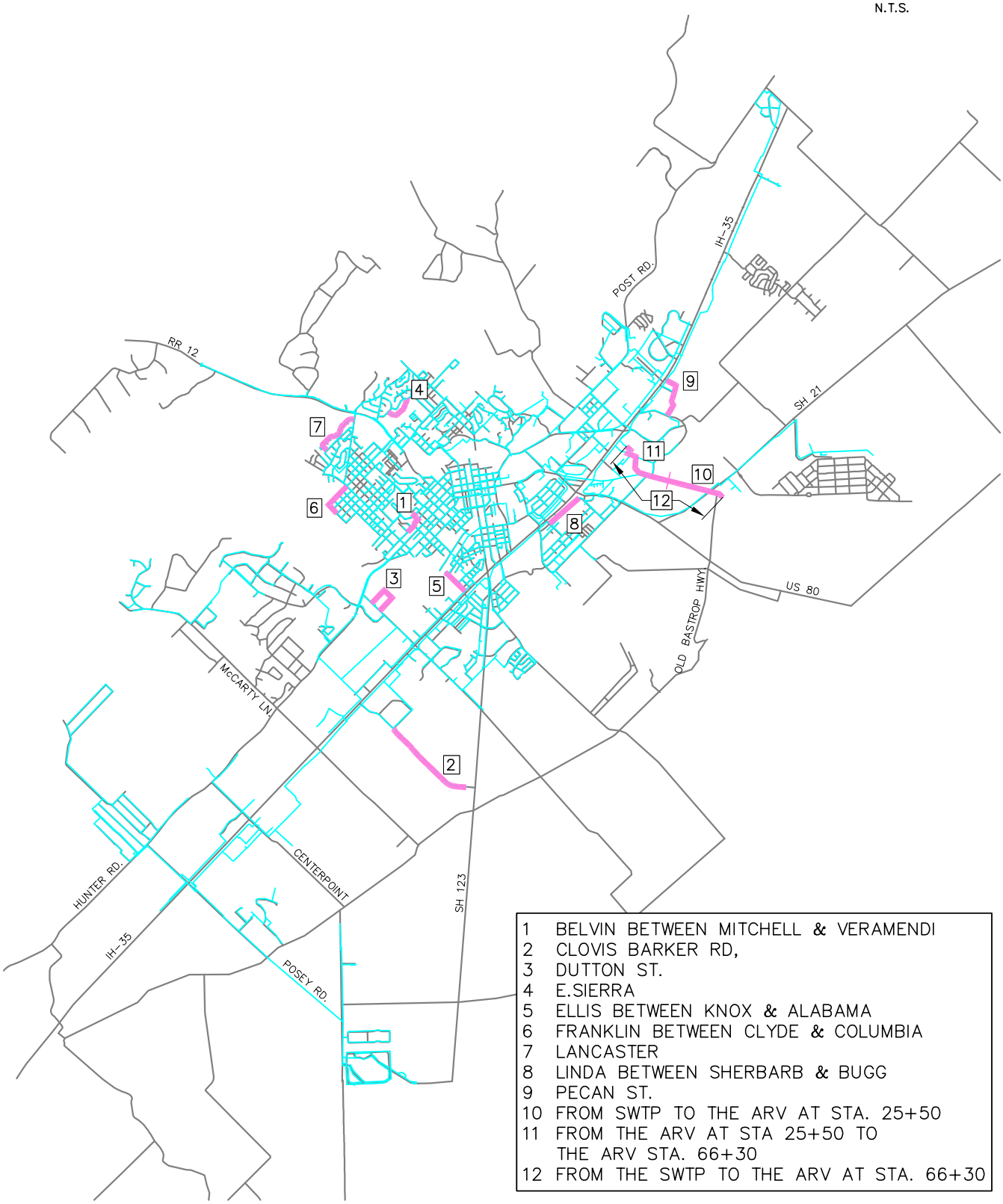

1 BELVIN BETWEEN MITCHELL & VERAMENDI
2 CLOVIS BARKER RD,
3 DUTTON ST.
4 E.SIERRA
5 ELLIS BETWEEN KNOX & ALABAMA
6 FRANKLIN BETWEEN CLYDE & COLUMBIA
7 LANCASTER
8 LINDA BETWEEN SHERBARB & BUGG
9 PECAN ST.
10 FROM SWTP TO THE ARV AT STA. 25+50
11 FROM THE ARV AT STA 25+50 TO THE ARV STA. 66+30
12 FROM THE SWTP TO THE ARV AT STA. 66+30

FIGURE VI–1
CITY OF SAN MARCOS
DYNAMIC FIELD TEST LOCATIONS

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throughout the City and static pressure measurements were taken at 20 locations throughout the City as shown on Figure VI-2 and VI-3 respectively.

The field-testing of selected pipes throughout the system was performed to determine a reasonable range of roughness coefficients for pipes in the model. The pipes that were evaluated were considered to be a representative mixture of old and new pipelines, as well as large and small diameter pipelines.

The first loss of head test method is called a Parallel Hose Test, which involves a direct measurement of the head loss by use of a parallel hose running between the test inlet and outlet. The inlet and outlet water levels are balanced directly through a pressure differential transmitter. The flow can be measured either with a Pitometer rod meter or hydrant pitot tube. This test is popular for short sections of pipe, but is limited by the length of hose required for the parallel hose connection. This method was used for all locations except segments 10-12, which were on the SWTP treated water transmission main. The results of the dynamic field tests are shown in Table VI-1.

The second loss of head test method is called a Standard Gauge Test. This method utilizes a pressure recorder or data logger to measure the inlet and outlet pressures of a pipeline section. The pressures are then converted to head in ft., which is in turn added to the gauge elevation to determine inlet and outlet hydraulic grade levels. The difference in the hydraulic grade levels is the friction loss in the pipe over the distance tested. This type of test has the advantage of testing much longer sections of pipe but has the disadvantage of requiring accurate gauge survey elevations at the inlet and outlet test locations. The 24-in. diameter transmission pipeline was analyzed utilizing this testing method and is included in the results of the dynamic field tests shown in Table VI-1.

The static pressure measurements and fire hydrant flow test are also used to assist in the model calibration. A fire hydrant flow test involves measuring the static pressure at one or more locations in the distribution system. A fire hydrant is then opened and allowed to flow freely. The increased flows in the pipes supplying the hydrant result in increased head losses and a decrease in the observed pressure. The amount of flow at the hydrant is measured or calculated so that this condition can be simulated using the model. Ideally, information concerning the tank elevations and status of each of the pumps in a system should be recorded.

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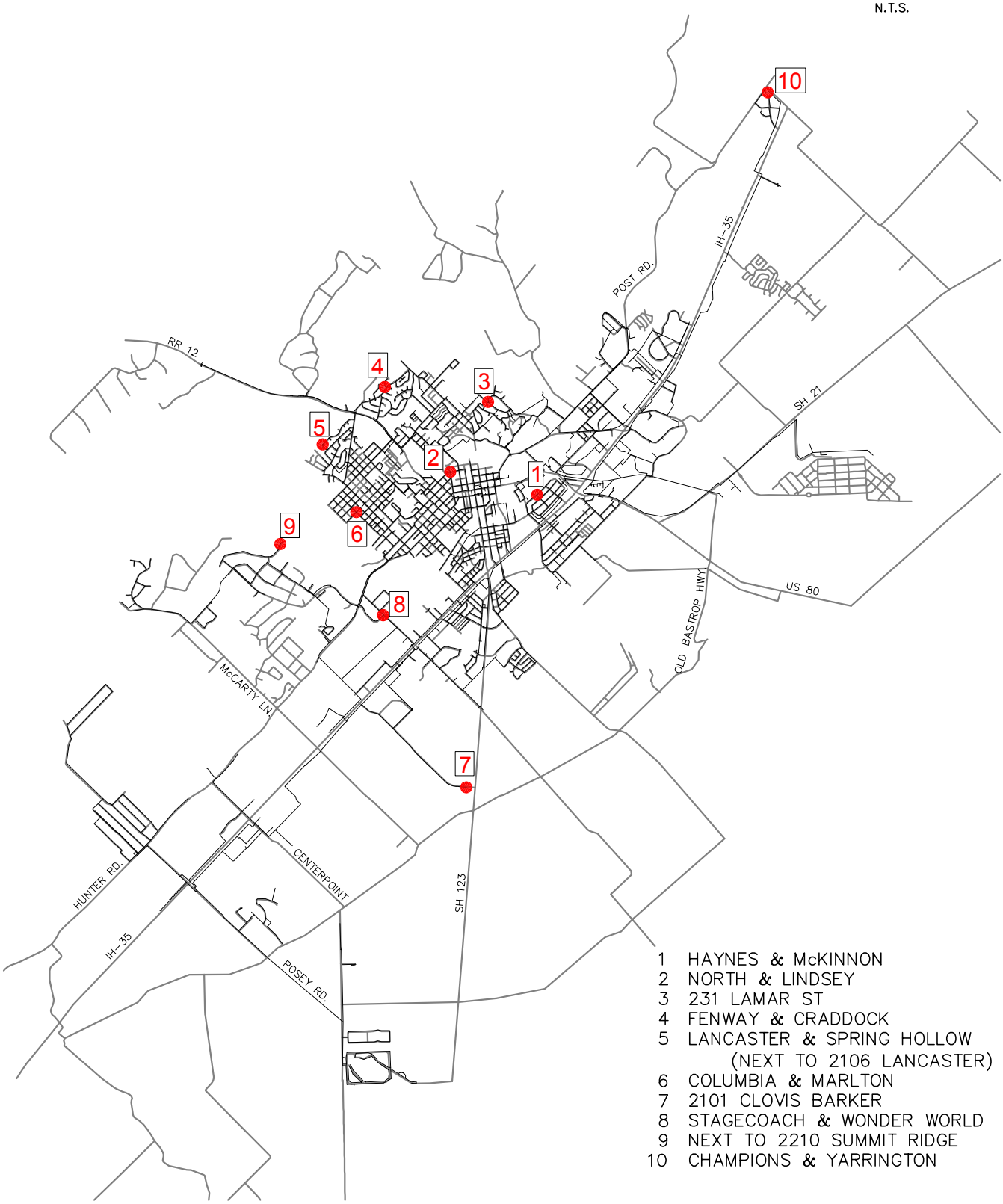

1 HAYNES & McKINNON
2 NORTH & LINDSEY
3 231 LAMAR ST
4 FENWAY & CRADDOCK
5 LANCASTER & SPRING HOLLOW (NEXT TO 2106 LANCASTER)
6 COLUMBIA & MARLTON
7 2101 CLOVIS BARKER
8 STAGECOACH & WONDER WORLD
9 NEXT TO 2210 SUMMIT RIDGE
10 CHAMPIONS & YARRINGTON

FIGURE VI-2
CITY OF SAN MARCOS
FIRE FLOW TEST LOCATIONS

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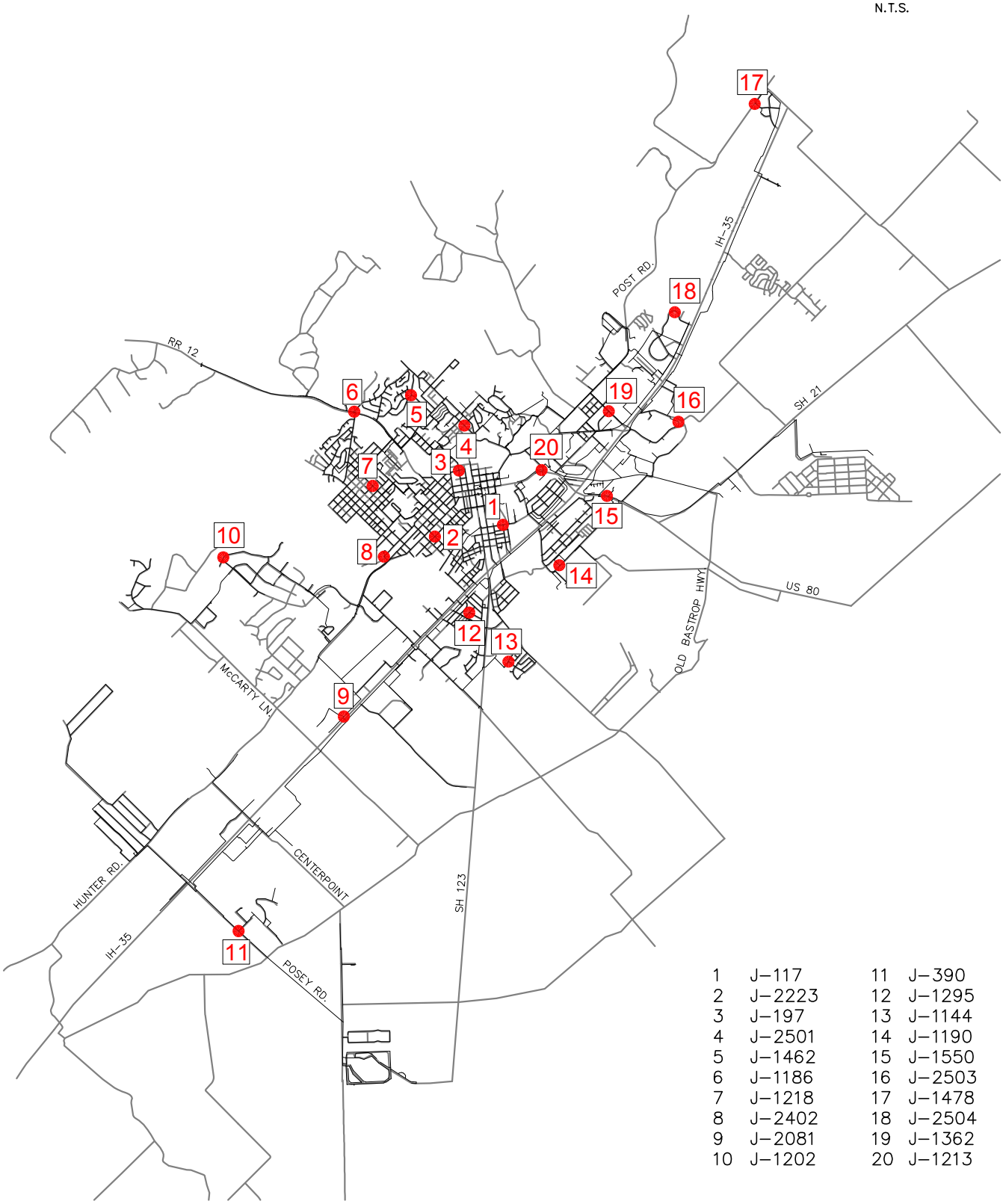

1	J-117	11	J-390
2	J-2223	12	J-1295
3	J-197	13	J-1144
4	J-2501	14	J-1190
5	J-1462	15	J-1550
6	J-1186	16	J-2503
7	J-1218	17	J-1478
8	J-2402	18	J-2504
9	J-2081	19	J-1362
10	J-1202	20	J-1213

FIGURE VI-3
CITY OF SAN MARCOS
STATIC PRESSURE MEASUREMENT LOCATIONS

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TABLE VI-1

CITY OF SAN MARCOS
SUMMARY OF HAZEN-WILLIAMS "C" FACTOR TEST RESULTS

Test No.	Test Location	Pipe Size (in.)	Hazen-Williams Coefficient
1	Belvin between Mitchell and Veramendi	6	70
2	Clovis Barker Rd.	12	90
3	Dutton St.	10	102
4	E. Sierra	8	85
5	Ellis Between Knox and Alabama	6	134
6	Franklin between Clyde and Columbia	12	96
7	Lancaster	6	117
8	Linda between Sherbarb and Bugg	6	136
9	Pecan St.	8	143
10	From the SWTP to the ARV at STA 25+50	24	140
11	From the ARV at STA 25+50 to the ARV at STA 66+30	24	104
12	From the SWTP to the ARV at STA 66+30	24	116

Note: A Hazen-Williams Coefficient of 150 is representative of new PVC pipe.
A Hazen-Williams Coefficient of 80 is representative of aged (30+ years) cast iron pipe.

However, the observed difference in pressure is due to the flow at the fire hydrant and is usually not impacted by changing conditions in the system since the tests usually last a matter of minutes. As a result, it is not critical to know the exact system conditions at the time of the test.

The fire hydrant flows were put into the model and the resultant drop in pressure at the given node was compared to the drop in pressure observed during the actual fire hydrant flow test. The Hazen-Williams friction coefficients (C factor) for pipes in the system were changed in an attempt to match the observed pressure difference. This process was repeated iteratively until the pressure differences were matched for each of the fire hydrant flow tests within approximately 2 psi. The fire flow calibration results are shown in Table VI-2.

System Demand Distribution

The physical distribution of system demands can have a significant impact upon the distribution system response. Concentrated demands, such as large water users, have historically been evaluated and included as high volume users in modeling efforts. This evaluation would typically identify a fraction of the largest water users, but did not always identify multiple moderate quantity users near the same location. Because of the inaccuracies created in this type of evaluation, it was determined that a more precise method of demand distribution would be conducted for the project.

The City provided APAI with historic monthly water usage between May 2000 and April 2002 from the City's Maximo billing system. In addition, meter account locations for customers were provided as a GIS theme linking usage with physical meter location. Since the data completely covered the 2001 calendar year, the 2001 annual average water usage was calculated for each account. The annual average water data was then manipulated with the MD/AD factors that were calculated from the water production data to generate the maximum day demands. Since the physical demand distribution was based upon measured data, there was no additional modification to achieve calibration.

Diurnal Demand Distribution

The daily demand fluctuations, also referred to as the diurnal demand pattern, can also have a significant impact upon the water distribution system response. The short duration of high

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	Test Location #1			Test Location #2			Test Location #3			Test Location #4 Ⓐ			Test Location #5			Test Location #6			Test Location #7			Test Location #8			Test Location #9			Test Location #10		
	ΔP_{obs}	ΔP_{model}	Diff	ΔP_{obs}	ΔP_{model}	Diff	ΔP_{obs}	ΔP_{model}	Diff	ΔP_{obs}	ΔP_{model}	Diff	ΔP_{obs}	ΔP_{model}	Diff	ΔP_{obs}	ΔP_{model}	Diff	ΔP_{obs}	ΔP_{model}	Diff	ΔP_{obs}	ΔP_{model}	Diff	ΔP_{obs}	ΔP_{model}	Diff	ΔP_{obs}	ΔP_{model}	Diff
A	8.97	8.66	−0.31																											
B				6.10	4.98	−1.12																								
C				4.91	4.40	−0.51																								
D							13.26	14.96	1.70																					
E							7.90	8.09	0.19	12.75	14.13[1]/13.14[2]	1.38[1]/0.39[2]	16.71	16.81	0.10															
F										6.50	6.14[1]/5.98[2]	−0.36[1]/−0.52[2]	15.86	15.67	−0.19															
G													17.87	18.69	0.82	21.74	23.89	2.15												
H																						20.15	18.55	−1.60						
I																														
J																									4.16	4.44	0.28			
K																														
L																														
M																			10.79	9.94	−0.85									
N	9.13	10.22	1.09																											
O																														
P																														
Q																												23.38	24.29	0.91
R																														
S																														
T	11.18	12.01	0.83																											

Ⓐ PUMP STATION CHANGED DURING FIRE FLOW TEST

[1] COMANCHE PUMP 1 ON

[2] COMANCHE PUMP 1 AND 2 ON

TABLE VI-2
CITY OF SAN MARCOS
FIRE FLOW TEST CALIBRATION COMPARISON

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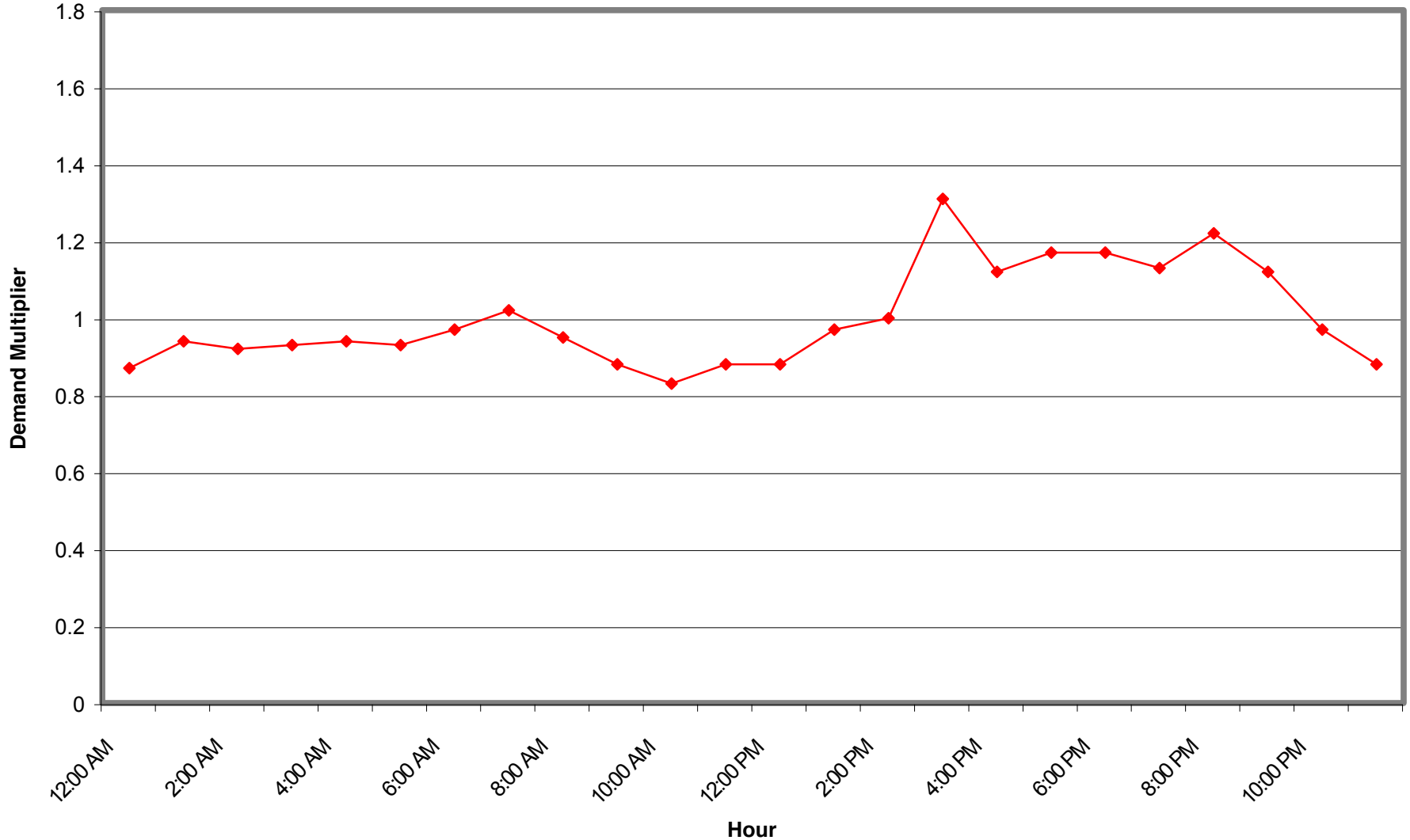
demand periods, also known as peaks, can strain a distribution system's ability to provide adequate service to customers.

The diurnal demand pattern for the City of San Marcos was calculated for the SWTP Lower and Upper pressure planes based upon observed data measured on June 12, 2002. The City used 6.984 million gallons of water throughout the system on that day. At the time, this usage was one of the highest observed daily totals in 2002. These patterns were used in the future condition models. Peak hour to max day (PH/MD) multipliers for the SWTP lower and SWTP upper pressure planes are 1.33 and 1.66 respectively.

The SWTP Lower and Upper diurnal demand patterns are presented in Figures VI-4 and VI-5. The diurnal demand patterns for the SWTP Upper pressure plane were used for the McCarty, Soyars, and Oak Ridge pressure planes since the customer configuration for these planes more closely resembles the SWTP Upper plane. The Extended period calibration results for June 12, 2002 illustrating the Comanche and Ranch Road 12 tank levels are presented in Figure VI-6. The Extended period calibration results for June 12, 2002 illustrating the City's Care Inn and Highway 123 pressure data-logger readings are presented in Figure VI-7. It should be noted that the general shape of the EPS calibration and pressure readings are similar but slightly shifted. The relatively small differences between the modeled and observed pressures (~ 5 psi) could be due to differences between the assumed mode elevation based on the UGS 10-foot contours and the actual recorder elevation, or drift in the data logger calibration. These differences were not considered to be significant.

A fire flow availability analysis was conducted using the calibrated model. This static model evaluation added a fire demand to the maximum day water demand for individual model nodes to determine the systems ability to convey the fire demand while maintaining 20 psi residual pressure in the distribution system. Results of the fire flow availability analysis are presented in Figure VI-8. Improvements identified in Chapter IX will increase fire flow availability system-wide.

FIGURE VI-4
CITY OF SAN MARCOS
SWTP LOWER DIURNAL DEMAND PATTERN



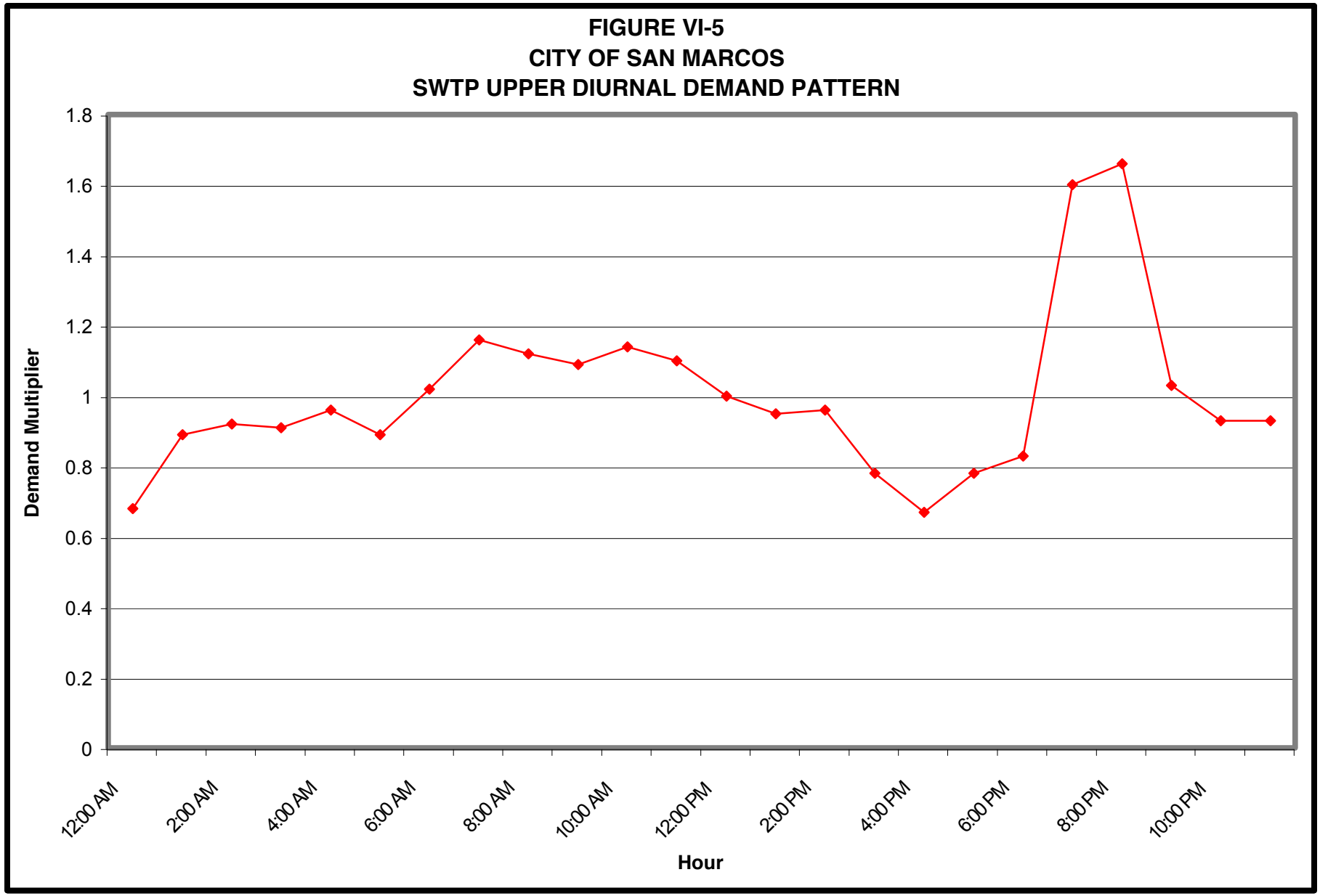


FIGURE VI-5
CITY OF SAN MARCOS
SWTP UPPER DIURNAL DEMAND PATTERN
Demand Multiplier
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
12:00 AM
2:00 AM
4:00 AM
6:00 AM
8:00 AM
10:00 AM
12:00 PM
2:00 PM
4:00 PM
6:00 PM
8:00 PM
10:00 PM
Hour

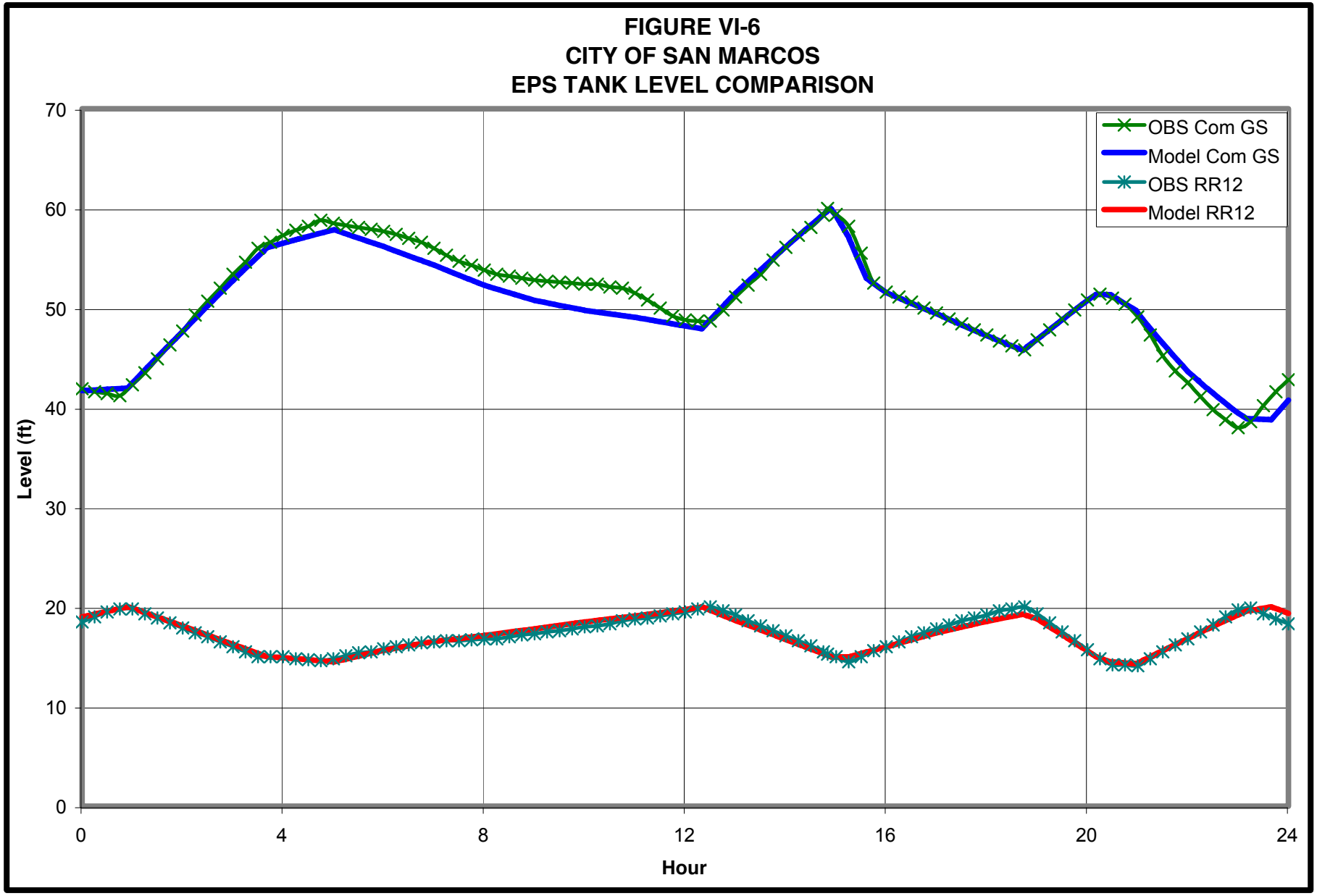


FIGURE VI-6
CITY OF SAN MARCOS
EPS TANK LEVEL COMPARISON
OBS Com GS
Model Com GS
OBS RR12
Model RR12
Level (ft)
Hour
0
10
20
30
40
50
60
70
0
4
8
12
16
20
24

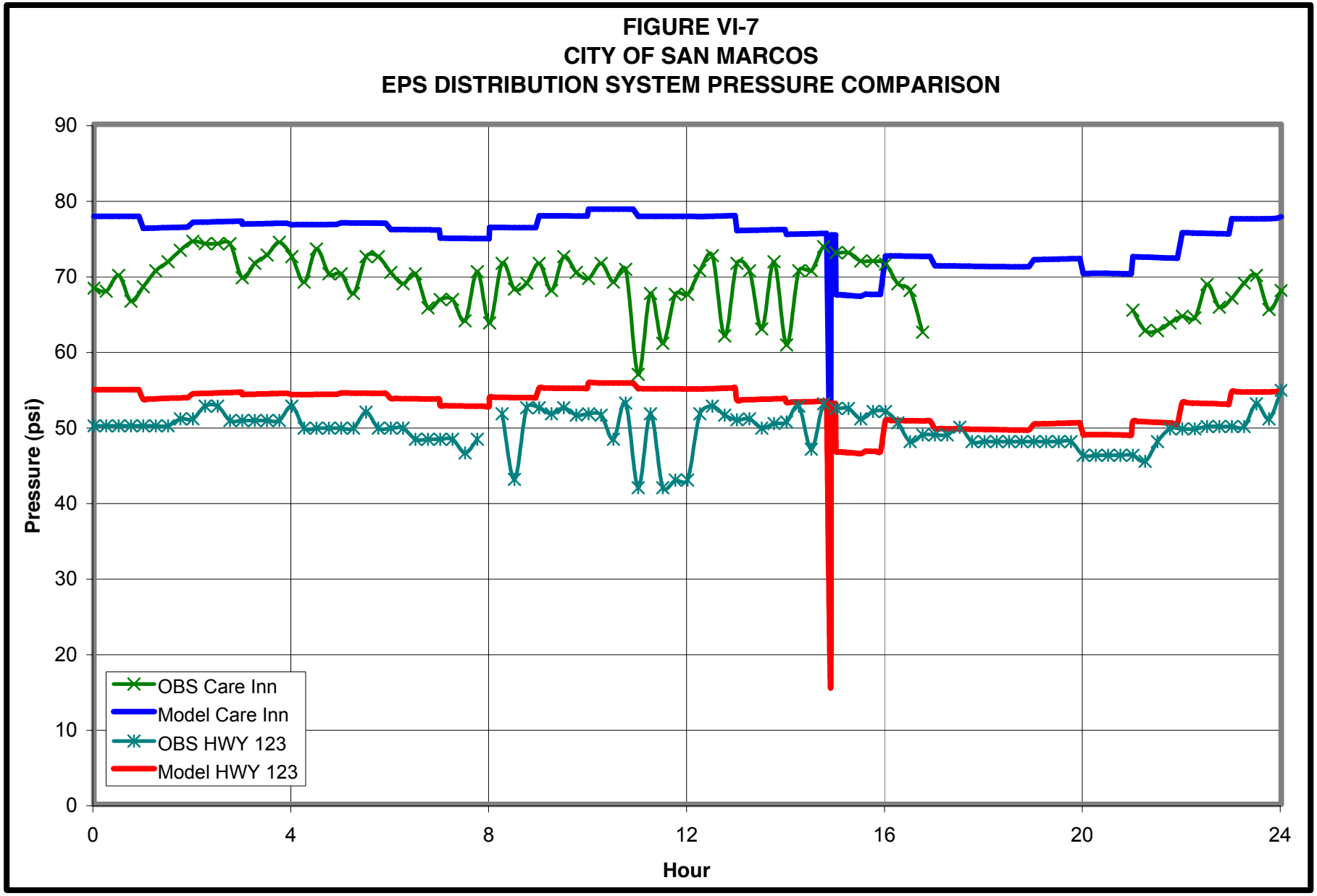


FIGURE VI-7
CITY OF SAN MARCOS
EPS DISTRIBUTION SYSTEM PRESSURE COMPARISON
Pressure (psi)
90
80
70
60
50
40
30
20
10
0
0
4
8
12
16
20
24
Hour
OBS Care Inn
Model Care Inn
OBS HWY 123
Model HWY 123

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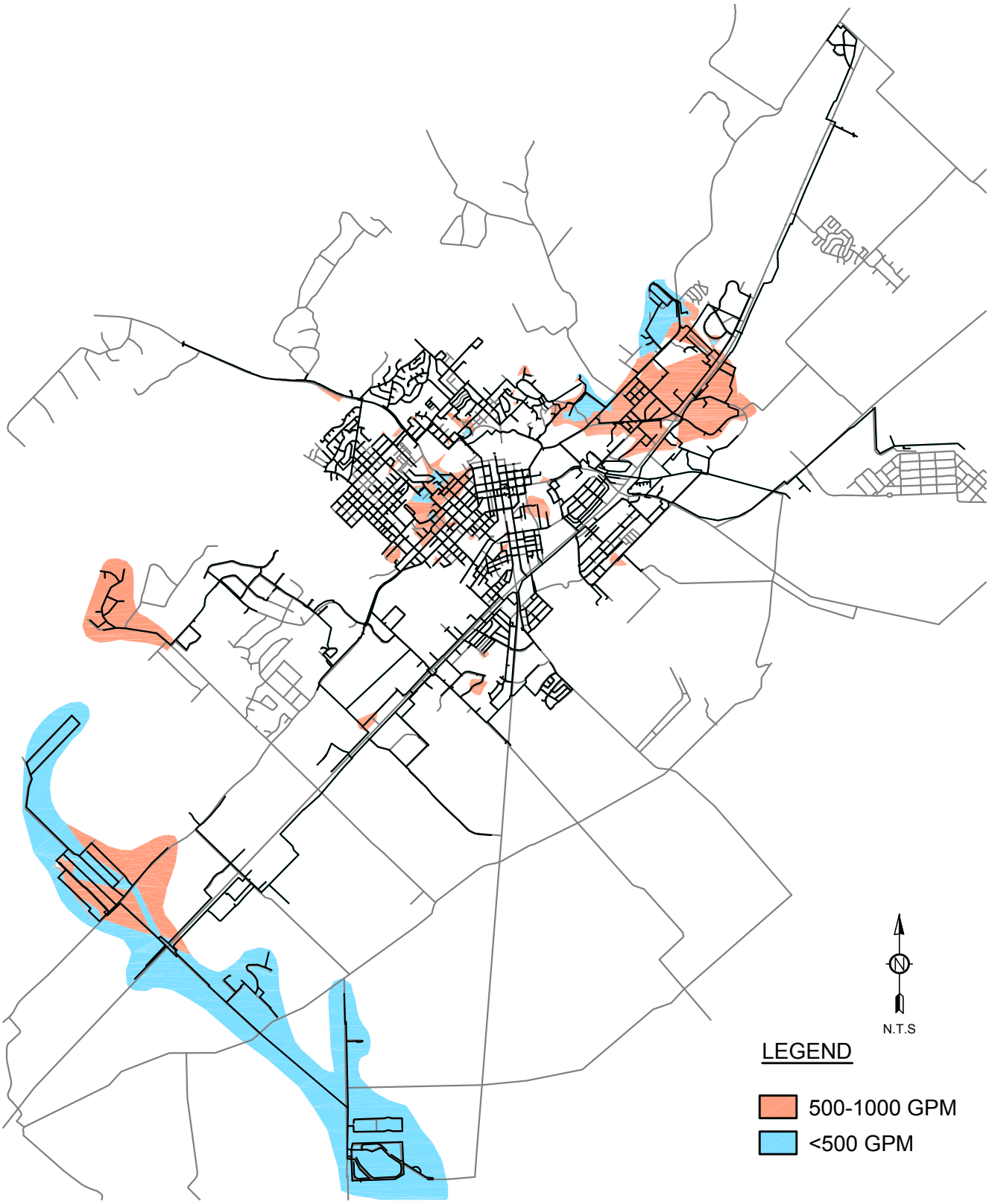

FIGURE VI–8
CITY OF SAN MARCOS
FIRE FLOW AVAILABILITY ANALYSIS

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CHAPTER VII

WATER QUALITY ISSUES

The quality of water in a municipal distribution system is increasingly becoming more regulated. The Stage II Disinfection By-Products Rule recently took affect, requiring operators of systems to monitor and report disinfection by-product concentrations in the distribution system. This monitoring is in addition to the bacteriological and disinfection residual monitoring previously required.

The quality of water in the distribution system depends on several factors.

- Quality of the source water;
- Level/type of treatment provided;
- Characteristics of the treated water; and
- Changes in water characteristics due to chemical reactions or bacteriological regrowth within the distribution system.

The first three factors are well documented through detailed monitoring at the treatment plant. The final factor is difficult to monitor due to the continually varying conditions across the distribution system. Frequently, the age of water within a system is used as a potential indicator of water quality issues. The longer water stays in a distribution system, the more time is available for chemical reactions or regrowth to take place. The following section discusses water age within the San Marcos distribution system.

System Water Age

The age of water within a given distribution system can vary dramatically from one location to the next. The age is generally impacted by the physical characteristics of the distribution system and the relative location of water sources and water demands. Since water in a system will move rapidly to those areas with the highest demands, areas of low demands tend to have higher water ages. In addition, areas with poor circulation, such as dead-end lines, have higher water ages since water is not passing through the area to get to a high-demand area.

In addition to the pipe system configuration, the operation of storage tanks can have a significant impact on water age. The purpose of a storage tank is to hold water for use at a later time, when the supply of water from the source is not able to keep up with the demand. This can result in aging water in tanks more than desired during periods of low demand.

The age of water within the San Marcos distribution system was evaluated using an elapsed period simulation of the computer model. Average day conditions were modeled over a period of several days to determine the average water age. Based on this analysis, the median water age in the City's distribution system is 30 hours. The age varied from a low of 1 hour near the SWTP to a high of greater than 100 hours near Champions Crossing. Figure VII-1 contains an illustration of water age throughout the system. This analysis was completed assuming that the City of Kyle is taking water at a constant rate of 0.5 MGD.

Dead-End Lines

As previously indicated, dead-end lines in a distribution system can impact the age and quality of water in a system. The City of San Marcos' water distribution system is generally well looped within the main environs of the City. However, there are several small diameter, 4-in. and smaller, lines with long dead-ends in the older portions of town. In addition, there are numerous dead-ends located around the edges of the City's system, particularly where the City has acquired rural systems. Where feasible, the City should remove these dead-ends from the system. In addition to addressing potential water quality issues, elimination of these dead-end lines will reduce system maintenance since the City is required to flush these lines on a monthly basis in accordance with 30 TAC 290.46. Figure VII-2 illustrates the dead-end pipelines identified in the model. It should be noted that these pipelines could be connected to small diameter pipes that are not included in the model.

System Monitoring

The City is required to monitor the distribution system for bacteriological contamination, chlorine residuals, and disinfection by-product concentrations. The City has been monitoring bacteriological and chlorine residuals at 60 locations within the system. These locations are included in Table VII-1 and are considered representative of the distribution system.

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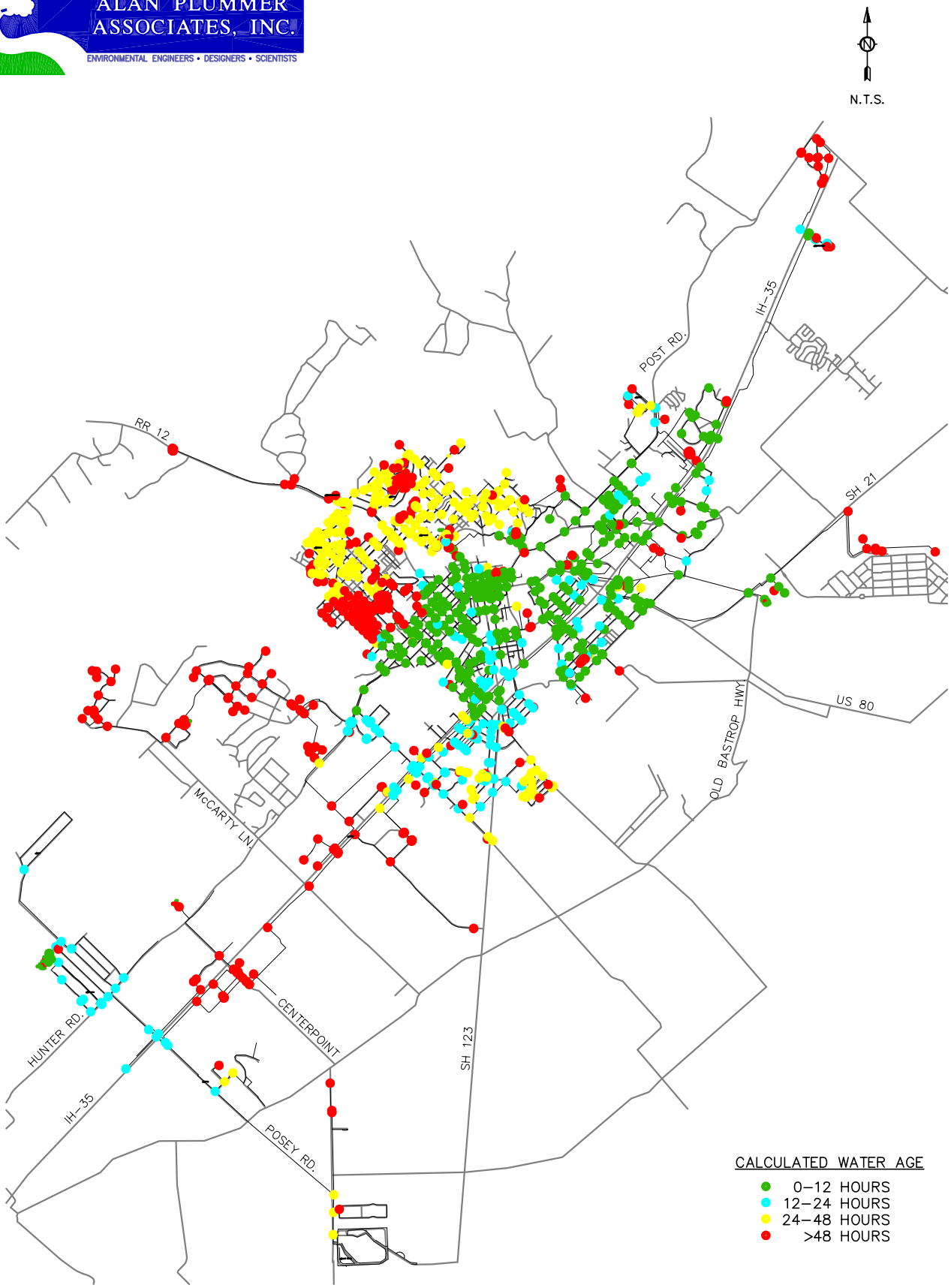

FIGURE VII-1
CITY OF SAN MARCOS
CALCULATED WATER AGE

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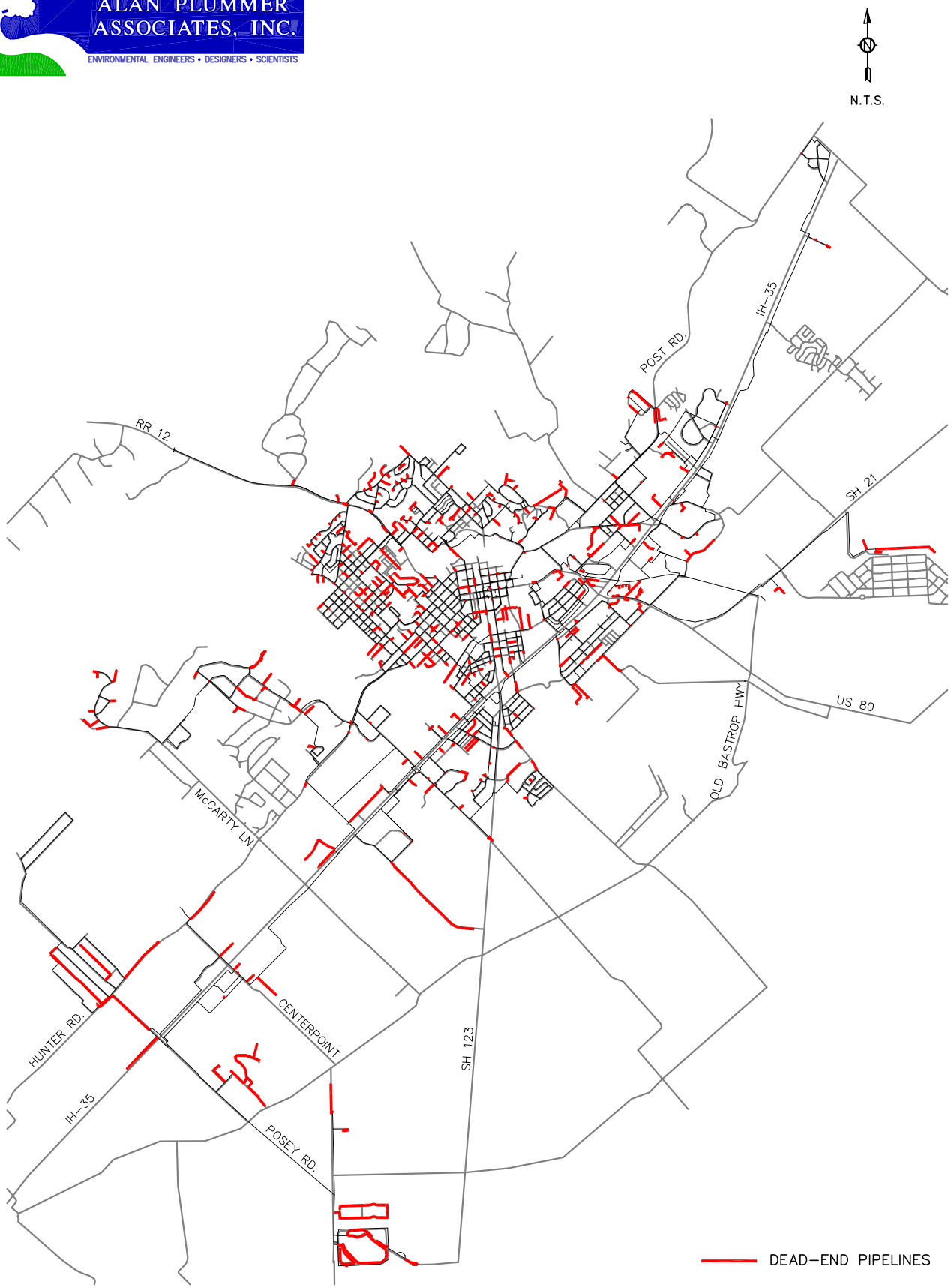

FIGURE VII-2
CITY OF SAN MARCOS
DEAD-END PIPELINES

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TABLE VII-1

CITY OF SAN MARCOS
BACTERIOLOGICAL AND CHLORINE RESIDUAL MONITORING LOCATIONS

Number	Location	Number	Location
1	Grease Monkey	31	Goodnight School
2	Field 1127	32	Patricia 816
3	Harper 1439	33	Durango 215
4	Conway 630	34	Lago Vista 800
5	Pecan St 1909	35	DeZavala School
6	Grande Comm	36	SanMarcos High School
7	Uhland 602	37	Bowie School
8	Travis School	38	Lacy Lane
9	Allenwood	39	CTMC
10	Norcrest 210	40	Nations Bank
11	Ridgeway 111	41	Gulf Business
12	Harvard 200	42	Post Road 1642
13	Oakridge 104	43	Briarwood #14
14	Sierra 203	44	Harmons Way 205
15	Cedargrove 100	45	Pauls Drive 101
16	Ramona 1928	46	Tanger Mall-1
17	Crockett School	47	Factory Mall-1
18	Rodgers 517	48	Tanger Mall-2
19	Hernandez School	49	Factory Mall-2
20	Miller School	50	Tanger Mall-3
21	McGehee 519	51	Factory Mall-3
22	Bonham School	52	Tanger Mall-4
23	Central Fire Station	53	Factory Mall-4
24	Columbia 1302	54	Booth Drive
25	Belvin 1215	55	River rd 2223
26	San Antonio	56	Airport
27	Valley 715	57	Cfan
28	Ellis 208	58	RR-12 217
29	Mountain High 2110	59	Franklin 505
30	Great Oaks 2904	60	Posey 1647

The disinfection by-product monitoring must be completed in accordance with 30 TAC 290.113, which requires four samples per quarter for each water treatment plant. The City has been monitoring a total of twelve sites, four for the Oakridge well plant, four for the Comanche wells, and four for the SWTP. The locations of these sites are included in Table VII-2. The requirement for the monitoring sites indicates that twenty-five percent of the samples must be taken from a site with the maximum water age while the other sites must be taken from sites where the water age is at least the average age. Based on this criterion, it is recommended that the monitoring site at 1000 Tech Way be moved to the vicinity of Champions Crossing. The monitoring site at 2525 IH 35 should be relocated to Wonder World and IH-35.

TABLE VII-2

CITY OF SAN MARCOS DISINFECTION BYPRODUCT MONITORING LOCATIONS

Number	Location
1	303 Lazy Lane
2	205 Harmons Way
3	1642 Posey
4	151 Crest Circle
5	315 Harvard
6	203 Sierra Circle
7	2003 Ramona
8	1800 RR-12
9	205 Booth
10	1520 Rancho Rd. 12
11	2525 IH-35 (Uniform Shop)
12	1000 Technology Way (CFAN)

CHAPTER VIII

WATER SUPPLY

The required water supply capacity for a water system is regulated based on the total number of connections served. The requirements for water supply capacity are regulated by TCEQ criteria set forth in 30 Texas Administrative Code (TAC) Chapter 290.45 Subchapter D. The City currently has four distinct supply systems that include the upper and lower pressure planes for the SWTP, McCarty Oaks, Soyars, and Oak Ridge. Table VIII-1 presents the current connection count and supply capacity for each of these major supply systems.

The City of San Marcos owns a 6 MGD surface water treatment plant that began operation on January 5, 2000. The City purchases raw water from GBRA, which owns and operates the raw water facilities in addition to operating the SWTP under contract for the City. The raw water source for the treatment plant is Lake Dunlap, which receives water from Canyon Lake via the Guadalupe River. The raw water intake and pump station are located at the GBRA Hydro canal. Water is pumped through a 30-in. pipeline to the SWTP approximately twenty miles away.

The SWTP consists of a solids contact clarifier, high rate dual media filters, a clearwell, and a high service pump station. The plant was originally rated for a maximum flow of 6 MGD. However, historic plant performance indicated that a higher capacity was possible with minor modifications. Therefore, the City is currently seeking a 9 MGD uprating for the plant from TCEQ.

In developing the SWTP, the City and GBRA entered an agreement to develop the plant as a regional facility. Accordingly, the City reserved 1.5 MGD of the plant capacity for use by GBRA to serve regional customers for a period of five years. By this time, it was assumed that GBRA would have sufficient customers to warrant a plant expansion. GBRA would own the expanded capacity and the 1.5 MGD reserve would revert to the City.

TABLE VIII-1

CITY OF SAN MARCOS
TCEQ SUPPLY EVALUATION

Service Area	No. of Connections	Required Storage Capacity (gpm)	Supply Source	Source Capacity (gpm)	Provideded Supply Capacity (gpm)	Deficit (-) /Surplus (+)
SWTP	7,246	4,348	SWTP Spring Lake Wells Comanche Well	3,125 6,480 2,700	12,305	7,957
McCarty Oaks	260	156	McCarty Oaks Well	1,428	1,428	1,272
Soyars	6	4	Soyars Well	400	400	396
Oak Ridge	572	344	Oak Ridge Wells	700	700	356

In addition to obtaining water from the SWTP, the city also obtains water from wells throughout the system. Each of these wells obtains groundwater from the Edwards Aquifer. The EAA regulates pumping rates to prevent damaging the critical habitat that rely upon the springs fed by the Aquifer.

The EAA was created by the Texas Legislature in 1993 with the passage of the Edwards Aquifer Authority Act to preserve and protect the groundwater resource. The EAA sets policy to manage, conserve, preserve and protect the aquifer, and works to increase the recharge and prevent waste or pollution of the aquifer. As part of this policy, the EAA issues pumping permits that authorize specific quantities of groundwater to be pumped from the aquifer. As part of the planning evaluation, APAI reviewed the 2000 Black & Veatch (B&V) report titled "Well Investigation Report". In 2000, San Marcos was authorized to pump 7,615.18 acre-feet (ac-ft.) of groundwater per year based upon data presented in the report. This amount is equivalent to 6.8 mgd. However, recent discussions with EAA indicated that the City currently has a permit that authorizes pumping based upon an annual limit of 5,426.229 ac-ft. of groundwater per year, or 4.8 mgd. APAI understands that the City currently has a permit from EAA that authorizes maximum pumping rates based upon historical groundwater pumping rates prior to the commencement of the SWTP. The groundwater pumping rates since the SWTP began operations in January 2000 are significantly different than rates prior to 2000. It is recommended that the City and EAA reevaluate the quarterly permitted pumping rates based upon current usage trends. Since the City uses very little water from the Edwards during the winter, higher pumping rates during the summer months should be considered.

The EAA has additional restrictions during periods of decreased aquifer water levels at specific gauging locations. During the most restrictive conservation periods, Stage III conservation is initiated, which reduces the pumping to 85% of the authorized rate. Based upon information presented in the 2000 B&V report, it appears that the peak factor for the summer (August) pumping rate with Stage III conservation is 1.28 times the annual Stage III conservation average of 4.1 mgd. This peak monthly rate would then equate to 5.3 mgd. However, as previously stated, the City has significantly changed the groundwater usage pattern since the SWTP started production.

For planning purposes, APAI applied the MD/AD factor of 1.66 to the annual average day withdrawal rate of 4.843 MGD to determine the available water during maximum demand conditions. Since the City is only obtaining 30% of the total water supplied from groundwater, it is anticipated that a revised EAA groundwater pumping schedule would allow for a higher maximum month/average month pumping factor than the schedule presented in the 2000 B&V report. It is likely that summer pumping rates will be similar to the current pumping schedule since the winter pumping has been drastically reduced.

For planning purposes, the population growth data distributed by CAMPO and per capita demand rates, including maximum day and peak hour factors, will be used as the basis for determining water demand. Since TCEQ regulates based upon the number of connections, the estimated number of connections are presented in the scenarios below based upon the population growth data and the current connection density of 4.16 people/connection as previously indicated.

SWTSU currently obtains most of its potable water from their wells. However, the University also has water service from the City. It is possible that the University's wells could be determined to be under the influence of groundwater in the future, since one of the Comanche wells was recently given this classification. From a planning perspective, it is recommended that impact of the University becoming a "full-time" customer be considered. Table VIII-2 and Figure VIII-1 present the water system future demand and implementation timing of water production improvements that includes providing "full-time" service to SWTSU. Table VIII-3 and Figure VIII-2 present the water system future demand and implementation timing of water production improvements that excludes providing service to SWTSU.

The City of San Marcos Water Treatment Plant (WTP) capacity is split with GBRA. Currently the City has a contractual agreement with GBRA, which allows GBRA to utilize up to 1.5 mgd of the treatment plant capacity. This agreement is scheduled to expire in January 2005. However, it is expected that this agreement, or some modified form of it, will be continued. If the agreement is not continued, the City's treatment plant capacity will be increased in 2005. Table VIII-4 and Figure VIII-3 present the water system future demand and implementation timing of water production improvements if the GBRA contract is not continued.

TABLE VIII-2

CITY OF SAN MARCOS
RECOMMENDED WATER SYSTEM FUTURE DEMANDS

Year	Approximate Pop Served	% Growth	Total Growth	Average Day Demand (MGD)	Maximum Day Demand (MGD)	Water Production Capacity (MGD)
2000	35,368 [1]			5.6 [4]	9.3 [4]	12.5 [6]
2001	37,946	7.29%	2,578 [2]	5.5 [4]	7.8 [4]	12.5
2002	41,255	8.72%	3,308 [2]	5.6 [4]	7.7 [4]	12.5
2003	44,951	8.96%	3,696 [2]	7.3 [5]	12.2	15.5 [7]
2004	46,695	3.88%	1,744	7.6 [5]	12.6	15.5
2005	48,507	3.88%	1,812	7.9 [5]	13.1	15.5
2006	50,390	3.88%	1,882	8.2 [5]	13.6	15.5
2007	52,345 [3]	3.88%	1,955	8.5 [5]	14.2	15.5
2008	54,271	3.68%	1,926	8.8 [5]	14.7	15.5
2009	56,269	3.68%	1,997	9.2 [5]	15.2	15.5
2010	58,340	3.68%	2,071	9.5 [5]	15.8	24.5 [8]
2011	60,487	3.68%	2,147	9.9 [5]	16.4	24.5
2012	62,713	3.68%	2,226	10.2 [5]	17.0	24.5
2013	65,021	3.68%	2,308	10.6 [5]	17.6	24.5
2014	67,414	3.68%	2,393	11.0 [5]	18.2	24.5
2015	69,895	3.68%	2,481	11.4 [5]	18.9	24.5
2016	72,467	3.68%	2,572	11.8 [5]	19.6	24.5
2017	75,134 [3]	3.68%	2,667	12.2 [5]	20.3	24.5
2018	77,264	2.84%	2,130	12.6 [5]	20.9	24.5
2019	79,455	2.84%	2,190	12.9 [5]	21.5	24.5
2020	81,707	2.84%	2,253	13.3 [5]	22.1	24.5
2021	84,023	2.84%	2,316	13.7 [5]	22.7	24.5
2022	86,406	2.84%	2,382	14.1 [5]	23.4	24.5
2023	88,855	2.84%	2,450	14.5 [5]	24.0	24.5
2024	91,374	2.84%	2,519	14.9 [5]	24.7	33.5 [9]
2025	93,965	2.84%	2,590	15.3 [5]	25.4	33.5
2026	96,629	2.84%	2,664	15.7 [5]	26.1	33.5
2027	99,368 [3]	2.84%	2,739	16.2 [5]	26.9	33.5

[1] U.S. Census Bureau data
[2] Growth based on City of San Marcos building permit data
[3] Based on Capitol Area Metropolitan Planning Organization data
[4] Historical water production
[5] Includes SWTSU on campus population of 4278 people. SWTSU currently provides potable water, however, they have an agreement with the City to provide supplemental and/or emergency water
[6] 4.5 MGD SWTP (COS portion of 6 MGD plant) capacity plus 1.66*4.843 MGD EAA permitted capacity
[7] SWTP uprated to 7.5 MGD (COS portion of 9 MGD plant)
[8] Parallel 9.0 MGD train constructed at SWTP
[9] Third 9.0 MGD train constructed at SWTP

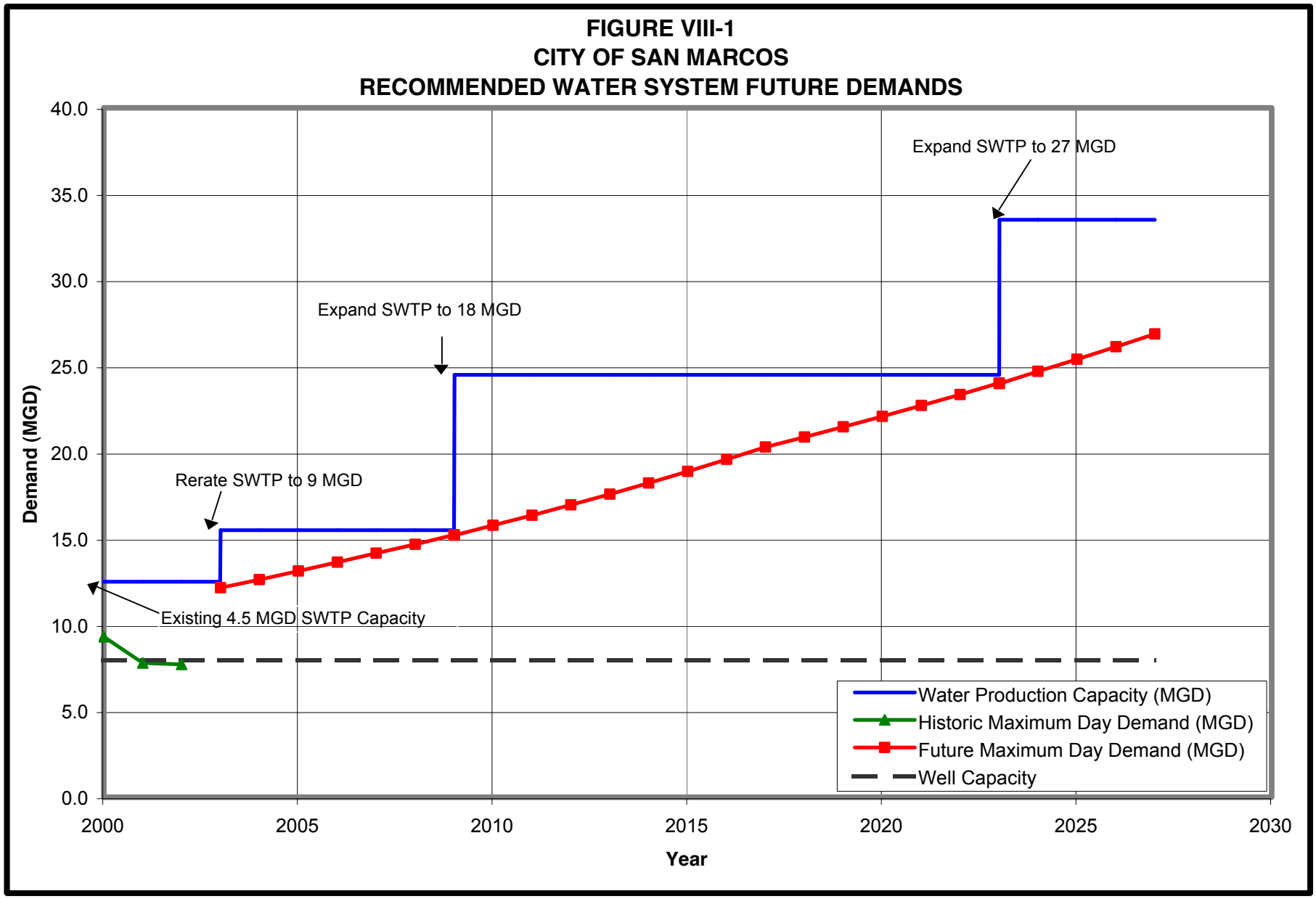


FIGURE VIII-1
CITY OF SAN MARCOS
RECOMMENDED WATER SYSTEM FUTURE DEMANDS
Expand SWTP to 27 MGD
Expand SWTP to 18 MGD
Rerate SWTP to 9 MGD
Existing 4.5 MGD SWTP Capacity
Demand (MGD)
Year
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
2000
2005
2010
2015
2020
2025
2030
Water Production Capacity (MGD)
Historic Maximum Day Demand (MGD)
Future Maximum Day Demand (MGD)
Well Capacity

TABLE VIII-3

CITY OF SAN MARCOS
ALTERNATE 1 WATER SYSTEM FUTURE DEMANDS
(EXCLUDES SWTSU POPULATION)

Year	Approximate Pop Served	% Growth	Total Growth	Average Day Demand (MGD)	Maximum Day Demand (MGD)	Water Production Capacity (MGD)
2000	31,090 [1]			5.6 [4]	9.3 [4]	12.5 [5]
2001	33,668	8.29%	2,578 [2]	5.5 [4]	7.8 [4]	12.5
2002	36,977	9.83%	3,308 [2]	5.6 [4]	7.7 [4]	12.5
2003	40,673	10.00%	3,696 [2]	6.6	11.0	15.5 [6]
2004	42,417	4.29%	1,744	6.9	11.5	15.5
2005	44,229	4.27%	1,812	7.2	12.0	15.5
2006	46,112	4.26%	1,882	7.5	12.5	15.5
2007	48,067 [3]	4.24%	1,955	7.8	13.0	15.5
2008	49,993	4.01%	1,926	8.1	13.5	15.5
2009	51,991	4.00%	1,997	8.5	14.1	15.5
2010	54,062	3.98%	2,071	8.8	14.6	15.5
2011	56,209	3.97%	2,147	9.2	15.2	15.5
2012	58,435	3.96%	2,226	9.5	15.8	24.5 [7]
2013	60,743	3.95%	2,308	9.9	16.4	24.5
2014	63,136	3.94%	2,393	10.3	17.1	24.5
2015	65,617	3.93%	2,481	10.7	17.7	24.5
2016	68,189	3.92%	2,572	11.1	18.4	24.5
2017	70,856 [3]	3.91%	2,667	11.5	19.2	24.5
2018	72,986	3.01%	2,130	11.9	19.7	24.5
2019	75,177	3.00%	2,190	12.2	20.3	24.5
2020	77,429	3.00%	2,253	12.6	20.9	24.5
2021	79,745	2.99%	2,316	13.0	21.6	24.5
2022	82,128	2.99%	2,382	13.4	22.2	24.5
2023	84,577	2.98%	2,450	13.8	22.9	24.5
2024	87,096	2.98%	2,519	14.2	23.6	24.5
2025	89,687	2.97%	2,590	14.6	24.3	24.5
2026	92,351	2.97%	2,664	15.0	25.0	33.5 [8]
2027	95,090 [3]	2.97%	2,739	15.5	25.7	33.5

[1] U.S. Census Bureau data
[2] Growth based on City of San Marcos building permit data
[3] Based on Capitol Area Metropolitan Planning Organization data
[4] Historical water production
[5] 4.5 MGD SWTP (COS portion of 6 MGD plant) capacity plus 1.66*4.843 MGD EAA permitted capacity
[6] SWTP uprated to 7.5 MGD (COS portion of 9 MGD plant)
[7] Parallel 9.0 MGD train constructed at SWTP
[8] Third 9.0 MGD train constructed at SWTP

FIGURE VIII-2
CITY OF SAN MARCOS
ALTERNATE 1 WATER SYSTEM FUTURE DEMANDS (EXCLUDES SWTSU POPULATION)

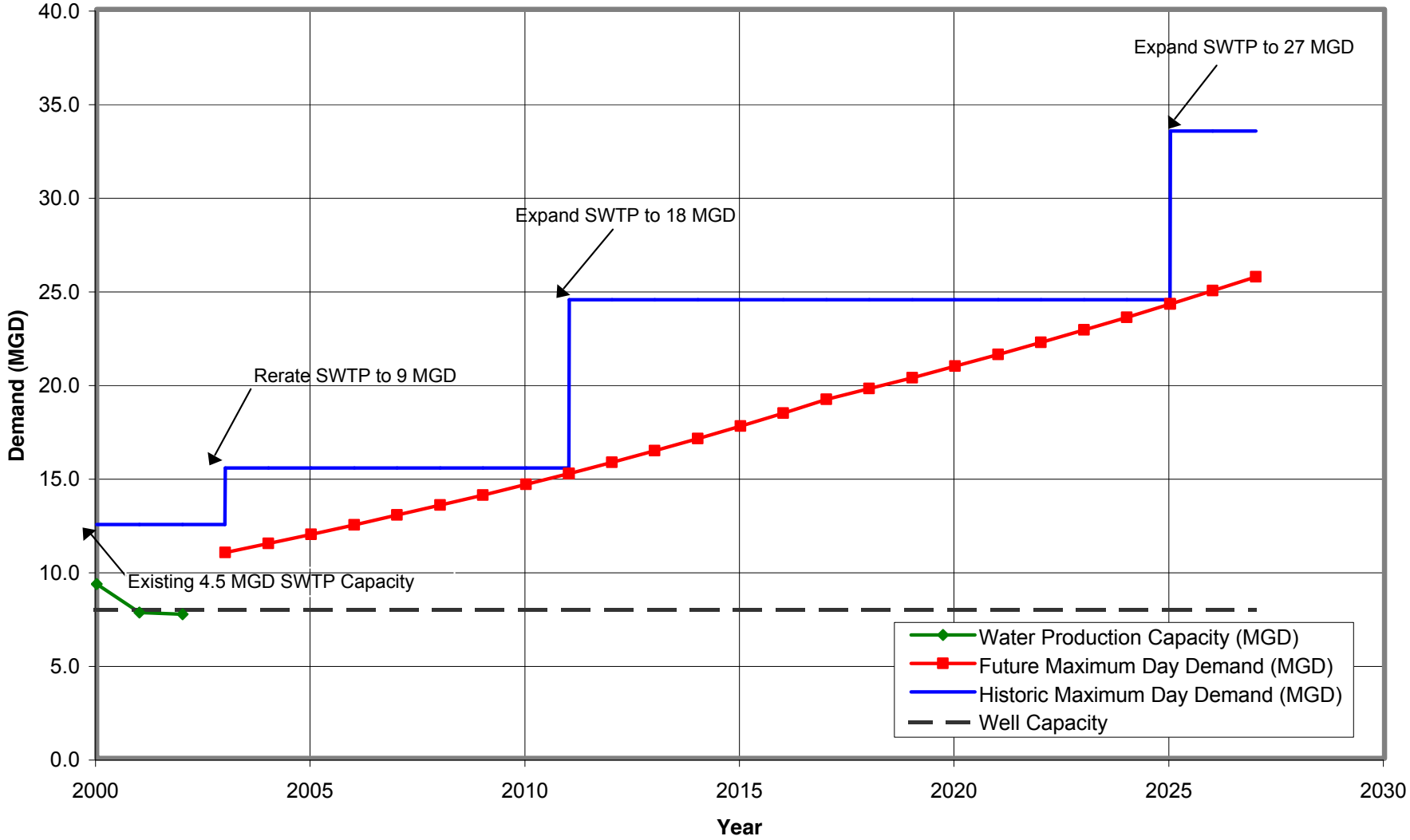


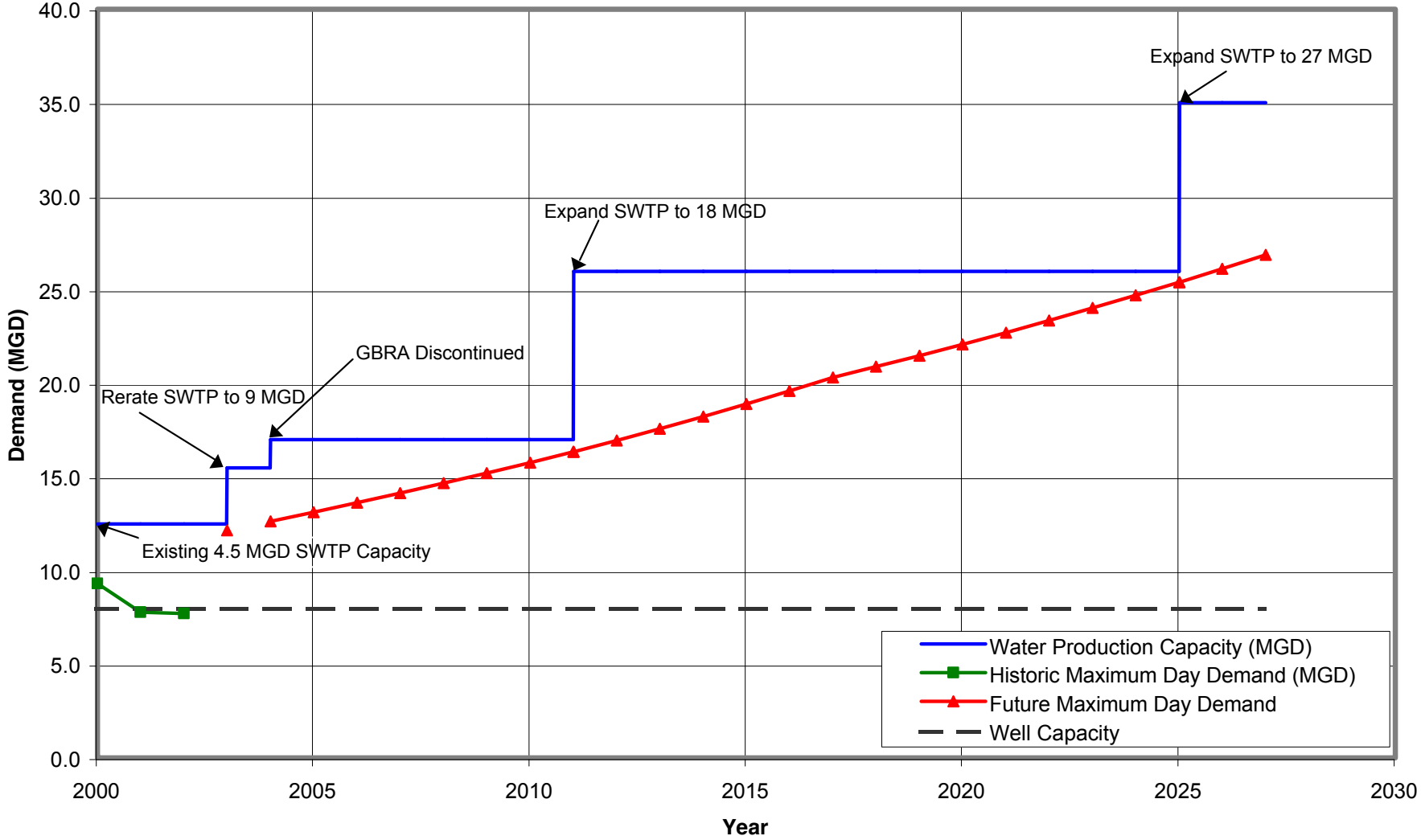
TABLE VIII-4

CITY OF SAN MARCOS
ALTERNATE 2 WATER SYSTEM FUTURE DEMANDS
(GBRA CONTRACT DISCONTINUED)

Year	Approximate Pop Served	% Growth	Total Growth	Average Day Demand (MGD)	Maximum Day Demand (MGD)	Water Production Capacity (MGD)
2000	35,368 [1]			5.6 [4]	9.3 [4]	12.5 [6]
2001	37,946	7.29%	2,578 [2]	5.5 [4]	7.8 [4]	12.5
2002	41,255	8.72%	3,308 [2]	5.6 [4]	7.7 [4]	12.5
2003	44,951	8.96%	3,696 [2]	7.3 [5]	12.2	15.5 [7]
2004	46,695	3.88%	1,744	7.6 [5]	12.6	17.0 [8]
2005	48,507	3.88%	1,812	7.9 [5]	13.1	17.0
2006	50,390	3.88%	1,882	8.2 [5]	13.6	17.0
2007	52,345 [3]	3.88%	1,955	8.5 [5]	14.2	17.0
2008	54,271	3.68%	1,926	8.8 [5]	14.7	17.0
2009	56,269	3.68%	1,997	9.2 [5]	15.2	17.0
2010	58,340	3.68%	2,071	9.5 [5]	15.8	17.0
2011	60,487	3.68%	2,147	9.9 [5]	16.4	17.0
2012	62,713	3.68%	2,226	10.2 [5]	17.0	26.0 [9]
2013	65,021	3.68%	2,308	10.6 [5]	17.6	26.0
2014	67,414	3.68%	2,393	11.0 [5]	18.2	26.0
2015	69,895	3.68%	2,481	11.4 [5]	18.9	26.0
2016	72,467	3.68%	2,572	11.8 [5]	19.6	26.0
2017	75,134 [3]	3.68%	2,667	12.2 [5]	20.3	26.0
2018	77,264	2.84%	2,130	12.6 [5]	20.9	26.0
2019	79,455	2.84%	2,190	12.9 [5]	21.5	26.0
2020	81,707	2.84%	2,253	13.3 [5]	22.1	26.0
2021	84,023	2.84%	2,316	13.7 [5]	22.7	26.0
2022	86,406	2.84%	2,382	14.1 [5]	23.4	26.0
2023	88,855	2.84%	2,450	14.5 [5]	24.0	26.0
2024	91,374	2.84%	2,519	14.9 [5]	24.7	26.0
2025	93,965	2.84%	2,590	15.3 [5]	25.4	26.0
2026	96,629	2.84%	2,664	15.7 [5]	26.1	35.0 [#]
2027	99,368 [3]	2.84%	2,739	16.2 [5]	26.9	35.0

[1] U.S. Census Bureau data
[2] Growth based on City of San Marcos building permit data
[3] Based on Capitol Area Metropolitan Planning Organization data
[4] Historical water production
[5] Includes SWTSU on campus population of 4278 people. SWTSU currently provides potable water, however, they have an agreement with the City to provide supplemental and/or emergency water
[6] 4.5 MGD SWTP (COS portion of 6 MGD plant) capacity plus 1.66*4.843 MGD EAA permitted capacity
[7] SWTP uprated to 7.5 MGD (COS portion of 9 MGD plant)
[8] GBRA contract discontinues 12/31/03
[9] Parallel 9.0 MGD train constructed at SWTP
[10] Third 9.0 MGD train constructed at SWTP

FIGURE VIII-3
CITY OF SAN MARCOS
ALTERNATE 2 WATER SYSTEM FUTURE DEMANDS (GBRA CONTRACT DISCONTINUED)



The combination of the previous two scenarios that exclude service to SWTSU and expiration of the GBRA reserve capacity provides the City with the longest schedule for timing of water treatment plant improvements. This scenario is presented in Table VIII-5 and Figure VIII-4.

The 10-year, 20-year, and 25-year Capital Improvement Project schedule and opinion of probable cost for improvements based upon the first demand scenario, which was viewed as the best alternative for planning, are presented in Table VIII-6.

TABLE VIII-5

CITY OF SAN MARCOS
ALTERNATE 3 WATER SYSTEM FUTURE DEMANDS
(EXCLUDES SWTSU POPULATION & GBRA CONTRACT DISCONTINUED)

Year	Approximate Pop Served	% Growth	Total Growth	Average Day Demand (MGD)	Maximum Day Demand (MGD)	Water Production Capacity (MGD)
2000	31,090 [1]			5.6 [4]	9.3 [4]	12.5 [6]
2001	33,668	8.29%	2,578 [2]	5.5 [4]	7.8 [4]	12.5
2002	36,977	9.83%	3,308 [2]	5.6 [4]	7.7 [4]	12.5
2003	40,673	10.00%	3,696 [2]	6.6 [5]	11.0	15.5 [7]
2004	42,417	4.29%	1,744	6.9 [5]	11.5	17.0 [8]
2005	44,229	4.27%	1,812	7.2 [5]	12.0	17.0
2006	46,112	4.26%	1,882	7.5 [5]	12.5	17.0
2007	48,067 [3]	4.24%	1,955	7.8 [5]	13.0	17.0
2008	49,993	4.01%	1,926	8.1 [5]	13.5	17.0
2009	51,991	4.00%	1,997	8.5 [5]	14.1	17.0
2010	54,062	3.98%	2,071	8.8 [5]	14.6	17.0
2011	56,209	3.97%	2,147	9.2 [5]	15.2	17.0
2012	58,435	3.96%	2,226	9.5 [5]	15.8	17.0
2013	60,743	3.95%	2,308	9.9 [5]	16.4	17.0
2014	63,136	3.94%	2,393	10.3 [5]	17.1	26.0 [9]
2015	65,617	3.93%	2,481	10.7 [5]	17.7	26.0
2016	68,189	3.92%	2,572	11.1 [5]	18.4	26.0
2017	70,856 [3]	3.91%	2,667	11.5 [5]	19.2	26.0
2018	72,986	3.01%	2,130	11.9 [5]	19.7	26.0
2019	75,177	3.00%	2,190	12.2 [5]	20.3	26.0
2020	77,429	3.00%	2,253	12.6 [5]	20.9	26.0
2021	79,745	2.99%	2,316	13.0 [5]	21.6	26.0
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2024	87,096	2.98%	2,519	14.2 [5]	23.6	26.0
2025	89,687	2.97%	2,590	14.6 [5]	24.3	26.0
2026	92,351	2.97%	2,664	15.0 [5]	25.0	26.0
2027	95,090 [3]	2.97%	2,739	15.5 [5]	25.7	26.0

[1] U.S. Census Bureau data
[2] Growth based on City of San Marcos building permit data
[3] Based on Capitol Area Metropolitan Planning Organization data
[4] Historical water production
[5] Includes SWTSU on campus population of 4278 people. SWTSU currently provides potable water, however, they have an agreement with the City to provide supplemental and/or emergency water
[6] 4.5 MGD SWTP (COS portion of 6 MGD plant) capacity plus 1.66*4.843 MGD EAA permitted capacity
[7] SWTP uprated to 7.5 MGD (COS portion of 9 MGD plant)
[8] GBRA contract discontinues 12/31/03
[9] Parallel 9.0 MGD train constructed at SWTP

FIGURE VIII-4
CITY OF SAN MARCOS
ALTERNATE 3 WATER SYSTEM FUTURE DEMANDS (EXCLUDES SWTSU POPULATION & GBRA CONTRACT DISCONTINUED)

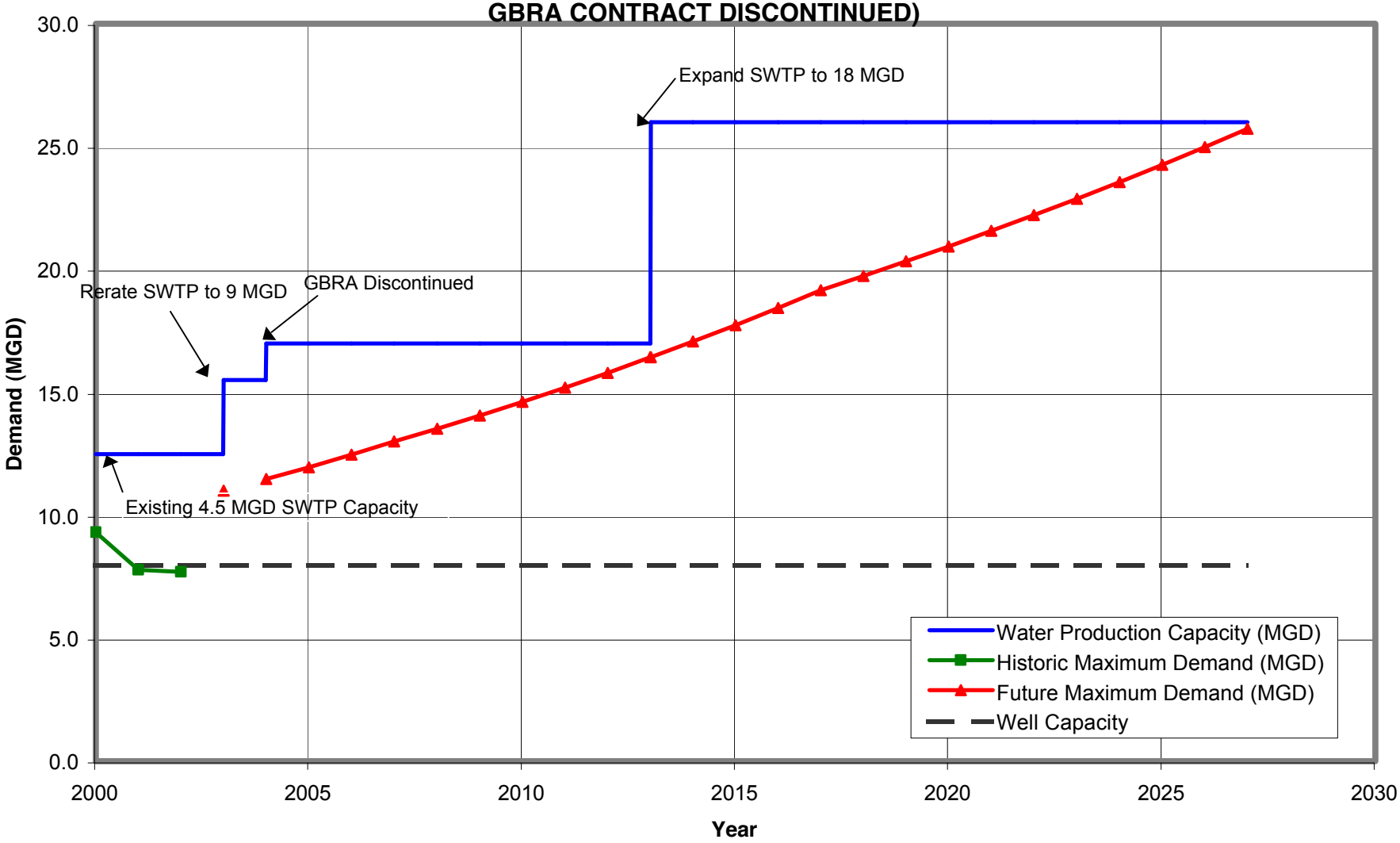

TABLE VIII-6

CITY OF SAN MARCOS
SWTP IMPROVEMENT SCHEDULE AND
OPINION OF PROBABLE COSTS

Facility	Facility Capacity	Capital Improvement Cost	Schedule
3 MGD Uprating	3 MGD	$600,000	10 year
1st 9 MGD Plant Train	9 MGD	$8,500,000	10 year
2nd 9 MGD Plant Train	9 MGD	$10,000,000	25 year

CHAPTER IX

DISTRIBUTION SYSTEM EVALUATION AND IMPROVEMENTS

The water distribution system evaluation for the 2007, 2017, and 2027 population projection planning years and recommended improvements are the primary products of the water master plan. The Capital Improvement Projects list was developed for 10-year (2012), 20-year (2022), and 25-year (2027) timeframes to coincide with the City's CIP process. Each of the major components for the distribution system was evaluated for existing and anticipated conditions in the incremental planning years utilizing TCEQ criteria for water systems as stated in 30 Texas Administrative Code (TAC) Chapter 290 Subchapter D. The following sections describe the current facilities in relation to the TCEQ criteria and the recommendations of necessary improvements to the existing water distribution system and operational changes suggested to meet projected water demands.

Current System

The City's existing water distribution system is composed of seven pressure planes with five pressure plane booster pump stations, eight operational water storage tanks, and over 1,000,000 linear ft. of pipeline. The TCEQ regulated capacity requirements for the distribution system facilities are described in the following sections.

Pressure Planes/Booster Pump Stations

The required pumping capacity for a water system is based upon TCEQ criteria that require systems to provide a minimum capacity of 2.0 gpm per connection with two or more pumps (for reliability), or, provide a total capacity of at least 1,000 gpm and the ability to meet the maximum day demands of the system with the largest pump out of service, whichever is less. The City currently has seven pressure planes that operate with five booster pump stations. Table IX-1 presents the current connection count and pumping capacity for each of the five pump stations. According to the TCEQ criteria, the Oak Ridge Lower and Upper Pressure planes need additional pumping capacity. Recommended improvements are included in the 2007 System Improvements.

TABLE IX-1

CITY OF SAN MARCOS
TCEQ PUMP STATION EVALUATION

Service Area	No. of Connections	Required Pumping Capacity (gpm)[1]	Required Pumping Capacity (gpm)[2]	Firm Pumping Capacity (gpm)	Deficit (-) /Surplus (+)
SWTP Lower	4,532	9,064	2,133	8,800 [3]	6,667
SWTP Upper	2,714	5,428	1,277	1,800 [4]	523
McCarty Oaks Upper	97	194	N/A	400 [5]	206
Oak Ridge Lower	489	978	N/A	300 [6]	-678
Oak Ridge Upper	83	166	N/A	0 [7]	-166

[1] Based upon 2.0 gpm / connection
[2] Based upon supplying historic maximum day demands (162.9 gpcd x 4.16 people/connection)
[3] Excludes one 4,200 gpm high service pump
[4] Excludes 1,200 gpm Comanche pump
[5] Excludes one 200 gpm McCarty pump
[6] Excludes 450 gpm Oak Ridge Lower pump
[7] Excludes 100 gpm Oak Ridge Upper pump.

Storage Facilities

The required storage capacity for a water system is also regulated based on the total number of connections served. The City has eight storage tanks distributed throughout the upper and lower pressure planes of the SWTP, McCarty Oaks, Soyars, and Oak Ridge systems. Table IX-2 presents the current connection count and total storage capacity for each applicable system. Table IX-3 presents the current connection count and elevated storage capacity for each applicable system. According to the TCEQ criteria, the Oak Ridge Pressure Planes need additional ground storage capacity. Recommended improvements to address the Oak Ridge deficiencies are included in the 2007 System Improvements.

Distribution System

The distribution system capacity is regulated by TCEQ based upon minimum main sizing and delivery pressures. TCEQ criteria indicate that the system should be capable of maintaining 35 psi at all customer connections during peak hour demands and should maintain 20 psi at customer connections during emergency situations that occur during maximum day demands. Based upon modeled and observed data it appears that the distribution system provides adequate service to all customer connections.

2007 System

Water distribution systems typically require significant improvements as population grows and demands increase. The City of San Marcos is no different. As indicated in Chapter IV, the City's service area population is estimated to increase almost 50 percent between 2000 and 2007 growing from 35,368 to 52,345 and maximum day demand is projected to increase from 9.3 MGD to 14.2 MGD over that same timeframe. This growth will require significant improvements to the water distribution system to supply water to new population hubs.

The water distribution system facilities will include new pumping, storage, and significant pipeline improvements in the 2007 planning period. The system will operate similar to the current operation with the exception of the SWTP Lower Pressure Plane. The SWTP Lower Pressure Plane is recommended to be lowered to an operational grade of 810 ft. msl due to the

TABLE IX-2

CITY OF SAN MARCOS
TCEQ TOTAL STORAGE EVALUATION

Service Area	No. of Connections	Required Storage Capacity (gal)[1]	Tank Name	Tank Capacity (gal)	Provideded Storage Capacity (gal)	Deficit (-) /Surplus (+)
SWTP	7,246	1,449,200	SWTP Clearwell	1,000,000	4,700,000	3,250,800
			Spring Lake	1,500,000		
			Butler	200,000		
			Ranch Road 12	1,000,000		
			Comanche	1,000,000		
McCarty Oaks	260	52,000	McCarty Oaks	500,000	500,000	448,000
Soyars	6	1,200	Soyars	500,000	500,000	498,800
Oak Ridge	572	114,400	Oak Ridge	50,000	50,000	-64,400

[1] Based upon 200 gal / connection

TABLE IX-3

CITY OF SAN MARCOS
TCEQ ELEVATED STORAGE EVALUATION

Service Area	No. of Connections	Required Storage Capacity (gal)[1]	Tank Name	Tank Type	Tank Capacity (gal)	Deficit (-) /Surplus (+)
SWTP Lower	4,632	463,200	Comanche	Standpipe	510,000 [2]	46,800
SWTP Upper	2,714	271,400	Ranch Road 12	Elevated Ground	1,000,000	728,600
McCarty Oaks Lower	163	16,300	McCarty Oaks	Standpipe	215,000	198,700
McCarty Oaks Upper	97	9,700	None		N/A	N/A[3]
Soyars	6	600	Soyars	Standpipe	74,000	73,400
Oak Ridge Lower	489	9780 [4]	Oak Ridge Lower	Pressure	10,000	220
Oak Ridge Upper	83	1660 [4]	Oak Ridge Upper	Pressure	2,000	340

[1] Based upon 200 gal / connection
[2] Calculated based upon volume above 795 ft. msl which is required to maintain 35 psi in lower plane.
[3] System operates with VFD Pumps
[4] Based upon 20 gal / connection for pressure tanks

increased conveyance efficiency to the southeastern portion of the SWTP Lower Pressure Plane distribution system. Because the distribution system was designed around the Spring Lake wells and booster pumps, water traveled from the north central part of the system through the grid network to the southeastern part of the system, incurring significant head loss. However, upon completion of the proposed 2007 improvements, the conveyance to the southeast part of the system will be more efficient. Due to the better conveyance efficiency, the system operation grade elevation can be reduced from 826 ft. msl to 810 ft. msl while still providing adequate pressure for the customers in the distribution system and reducing most areas of high pressure in the lower pressure plane. The reduction in operational grade will reduce the pumping head for the lower pressure plan, but will increase the head for the upper pressure plane. The head reduction in the lower plane will reduce the power requirements at the SWTP, but will require additional power for pump stations serving the upper pressure plane. There will be an overall reduction in power costs as a result of the operational grade change.

Maintenance Projects

City staff in the Operations and Engineering Departments have identified several capital improvement projects necessary to enhance system reliability and reduce maintenance requirements for problem areas. These projects are required to maintain a satisfactory level of service and water quality throughout the distribution system.

Several projects are proposed to strengthen distribution system security, monitoring ability, and improve fire protection. Project 49 will assess security vulnerabilities of the water system and implement recommendations for security enhancements to facilities and procedures. Project 51 consists of adding 12 pressure monitoring stations at key locations throughout the City's water distribution system to assist in monitoring water pressure in the City. Water production and distribution personnel will monitor the new locations through the Supervisory Control and Data Acquisition (SCADA) control system, which will allow operators to make appropriate adjustments and/or repairs to insure continued and uninterrupted water service to customers. Project 56 consists of the installation of fire hydrants and modification of the distribution system in recently annexed areas to improve fire protection.

Most projects are proposed to address areas of the distribution system that are routine maintenance problems. Projects 54, 57, 65, 69, 71, 72, 73, 74, and 75 will upgrade and replace

a total of approximately 128,000 linear ft. of aging water lines in the Heritage, Rio Vista Terrace, Victory Gardens, Deerwood Estates, Sleepy Hollow, Red Sky, Wallace Addition, Dunbar, Green Haven, and Southridge Estates Neighborhoods respectively. The aging waterlines in these neighborhoods have a history of line breakage and do not meet current City standards. Project 50 will replace deteriorating 8-in. asbestos cement pipe in Craddock between Franklin and Ranch Road 12 with a 12-in. pipeline. Project 52 consists of constructing approximately 3,800 linear ft. of 8-in. water line along River Road from Davis Lane to Uhland Road to replace an existing 2" water line, which in turn will provide for increased pressure, additional fire protection, and eliminate a dead end line. Project 53 will replace approximately 3,100 linear ft. of existing 2-in. and 6-in. waterlines in North LBJ from Sessom Drive to Holland Street with 1 2-in. waterlines to strengthen the distribution grid and provide better service to the apartment complexes in this area. Project 55 consists of constructing 1,800 linear ft. of 8-in. water line along the extension of Gravel Street to the proposed intersection with S Bishop, which will close the loop for the existing dead end waterline in Gravel. Street. Project 59 will replace the failing asbestos cement waterline along Post Road between Lime Kiln Road and north City Limits line during the reconstruction and widening of Post Road. Project 60 will address some maintenance issues and strengthen the distribution grid by replacing and extending water lines in Del Sol Drive and Lockwood Street. Project 67 consists of constructing a 2,000 linear ft. of 12-in. water line along Staples Road from Broadway to DeZavala to close the gap between two existing 12-in. water lines along Staples Road. Project 70 will replace the existing 12-in. asbestos cement waterline along Hwy 123 between Wonder World and IH 35. Project 76 consists of replacing 5,300 linear ft. of existing 8-in. water main along the west side of IH-35 between Marshall Street and Wonder World Drive with a 12-in. line.

Several general maintenance projects are identified to repair or replace distribution system infrastructure as the need arises. These projects include: Project 58, which will replace waterlines identified through leak detection and maintenance records; Project 61, which will be used to replace, repair and add water valves and fire hydrants throughout the water system; Project 62, which will be used to systematically repair, replace, and upgrade existing water pump stations; Project 63, which will be used to inspect and upgrade water well facilities to insure the integrity of water production; and Project 68, which will be to update the City's Water Distribution Master Plan.

Other distribution system projects include Project 64, which is the dismantling of the Franklin and Midway storage tanks, and Project 66, which will encase water lines crossing Union Pacific Railroad Tracks at 9 locations to comply with current railroad utility agreement requirements. In addition, the encasement will provide additional protection for the pipeline and will allow for faster repairs at these crossings should they be warranted.

Pressure Planes/Booster Pump Stations

The water distribution system pressure planes and booster pump station facilities in the 2007 planning period will look similar to the current configuration with one exception. A Soyars booster pump station will be added at the Soyars Standpipe. This pump station will boost water to the same elevation as the McCarty Tank and will be a redundant supply source of water for the McCarty Lower pressure plane. The pump station capacity is proposed to be 600 gpm at 65 ft. Total Discharge Head (TDH). In addition, customers east of IH-35 that are currently served by the Oak Ridge Lower Pressure Plane should be moved to the McCarty Lower Pressure Plane to relieve some demand on the Oak Ridge Lower Pressure Plane. The proposed 2007 pressure plane boundaries are shown on Figure IX-1. The proposed booster pump station improvement is identified as project 124 on Figure IX-2.

Additional pumping capacity should also be added to the Oak Ridge Upper Pressure Planes by 2007. Currently, both of the Oak Ridge Pressure Planes do not have adequate pumping capacity to meet the TCEQ requirements. The proposed pump station improvements for the Oak Ridge booster pump station are identified as project 125 on Figure IX-2. As of April 2003, the Oak Ridge lower Pressure Plane east of IH-35 has been switched to the McCarty Lower Pressure Plane.

Storage Facilities

The water distribution system storage facilities in the 2007 planning period will look similar to today's configuration with two exceptions. The first is the construction of a new elevated storage tank located near the proposed Cottonwood Creek subdivision along SH 130 south. The new Cottonwood Creek elevated storage tank is currently proposed as a 1 million gallon (MG) tank with an overflow elevation of 810 ft. This tank would be fed with the currently proposed 18-in. Clovis Barker to Cottonwood Creek pipeline that will be connected to the proposed 24-in. Camino Real Transmission pipeline. The tank would increase the elevated

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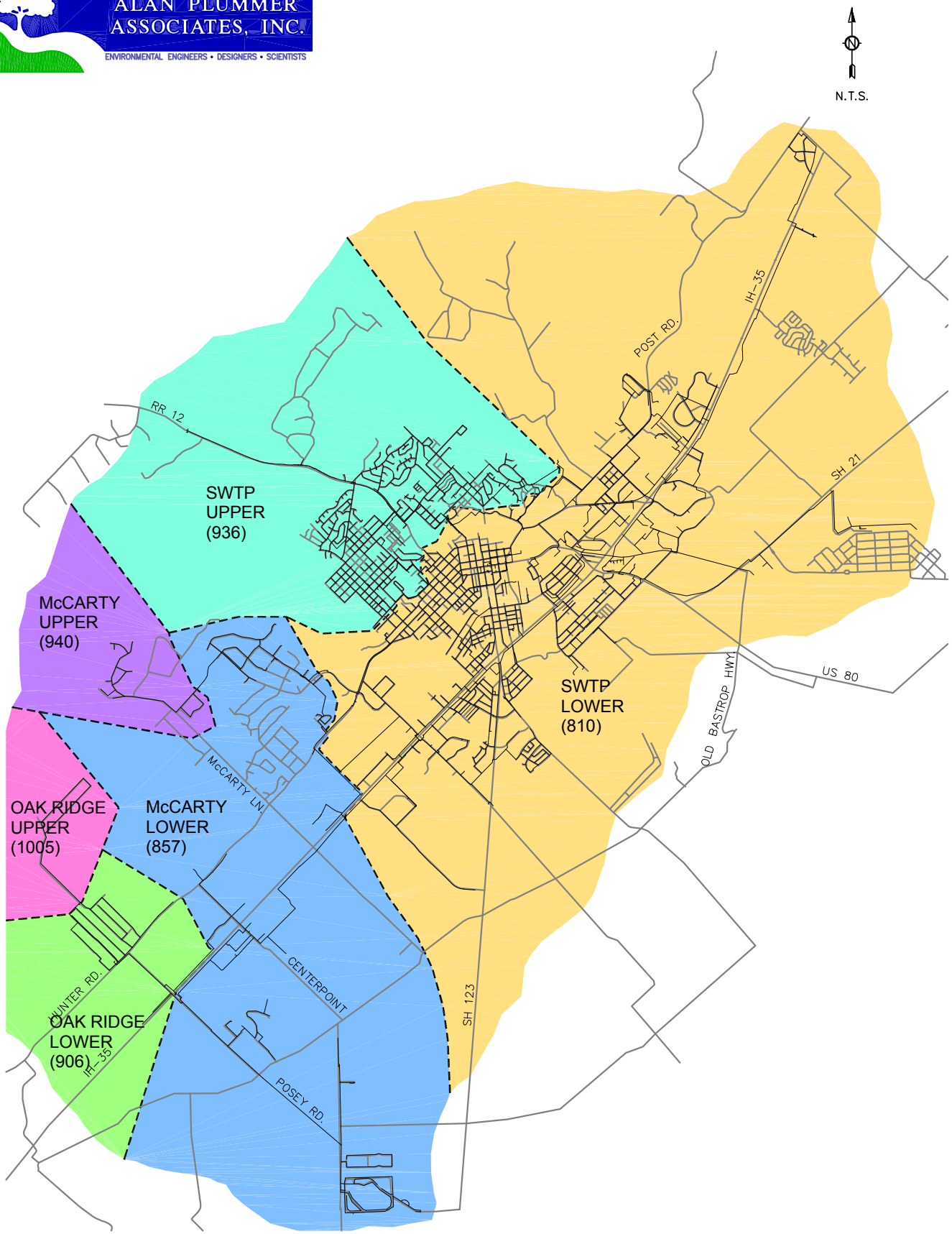

FIGURE IX–1
CITY OF SAN MARCOS
2007 PRESSURE PLANE BOUNDARIES

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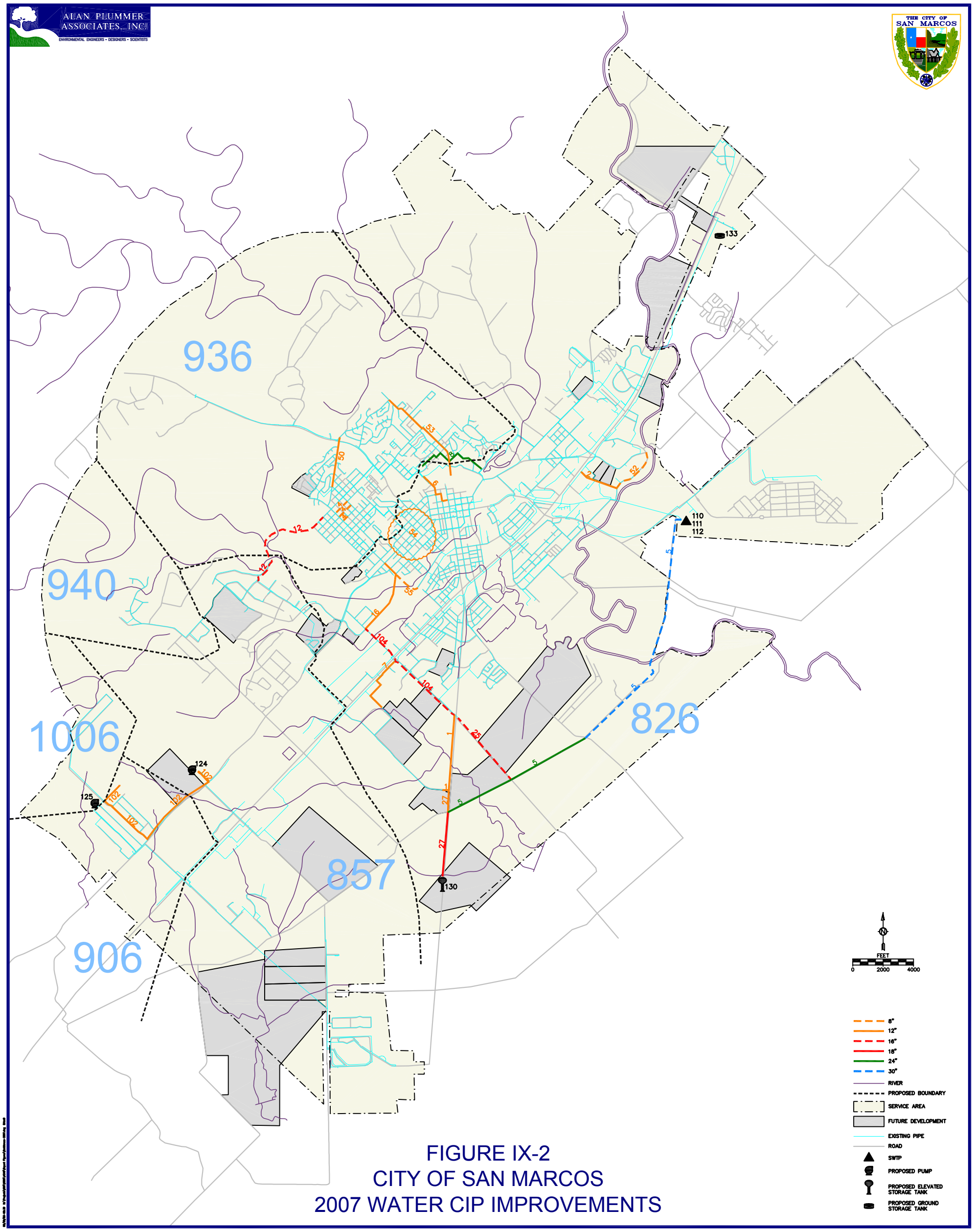

FIGURE IX-2
CITY OF SAN MARCOS
2007 WATER CIP IMPROVEMENTS

storage capacity in the SWTP Lower pressure plane to 1.5 MG, which would allow for 15,000 total connections. This storage tank will provide additional elevated storage in a strategic location to serve the southeast portion of the SWTP Lower Pressure Plane. The proposed Cottonwood Creek elevated storage tank is identified as project 130 on Figure IX-2.

The second storage facility improvement is the relocation of the Butler ground storage tank and pump station to the industrial park on Technology Way. The relocation of the Butler ground storage tank and pump station to the industrial park on Technology Way would allow the City to provide fire protection service consistent with current commitments. The agreement requires the City to provide 3,000 gpm with a residual pressure of 75 psi to the industrial park. It was because of this agreement that Butler Tank was originally constructed. The current location for the booster pump station will not provide adequate service as the system infrastructure changes. The proposed relocation of the Butler ground storage tank and pump station is identified as project 133 on Figure IX-2.

Distribution System

The water distribution system will have significant improvements by 2007. The most significant improvements include the El Camino Real Transmission Main, Highway 123 Transmission Main, Comanche Transmission Main, and Purgatory Creek Transmission Main. Each of the eighteen projects currently scheduled to be completed by 2007 are described in detail in the following paragraphs. Improvements described in the following paragraphs are shown on Figure IX-2.

The City is currently in the process of completing construction of a 12-in. waterline between Wonder World Drive and Clovis Baker Road. This waterline will close a loop allowing for better service to customers along Clovis Barker. This improvement is identified as project 1.

The City is currently planning or designing several miscellaneous distribution system improvements. These are projects in which the City is reconstructing pipelines because of maintenance issues, reconstructing the roadways requiring utility relocation, or simply increasing the distribution grid to improve service. The 12-in. Davis Lane waterline between IH-35 and River Road, identified as project 2, is being relocated because of road construction.

The 8-in. waterlines in the Westover Neighborhood along Clyde Street, Delmar Street, and Earl Street, identified as project 4, will improve the grid in this area of the distribution system.

The 12-in. pipeline along Comanche from the Liveoak to University, project 6, will remove an existing bottleneck and allow for more efficient transfer of water from the tank to the downtown area and ultimately the southern portions of the distribution system. The 12-in. pipeline along IH-35 from Civic Center to FM 3407, identified as project 7, will complete a project to enhance the distribution systems ability to convey water to the south. The 12-in. South Bishop pipeline, project 16, will connect the network between Belvin Street and Wonder World Drive upon completion of the roadway construction.

Phase I and II of the El Camino Real Transmission Main, identified as project 5, will provide the ability to convey treated water to the south side of the City. Based upon development applications, the general trend in growth for the City is to the south and east. This transmission main will begin at the SWTP and generally follow County Line Road to the south, crossing the San Marcos River, and continuing south along Old Bastrop Highway to the intersection of SH 123. The Phase I and II portions of the El Camino Real pipeline are approximately 5.2 miles in length and range in diameter from 24-in. to 30-in.

The 24-in. Comanche Transmission Main extension, identified as project 8, will allow the current 24-in. SWTP transmission main to continue from the Spring Lake Pump Station to the Comanche Standpipe and will allow the 12-in. waterline in Sessom Drive to be abandoned. This project will allow for water to be transferred from the SWTP to the tank at lower hydraulic gradients, thus eliminating the need for two of the three PRVs currently installed along the transmission main. It is recommended that the PRV at the intersection of the existing 24-in. SWTP transmission main and SH 21 remain to control pressures near the discharge of the high service pumps.

The Purgatory Creek pipeline will allow treated surface water to be the primary supply for the McCarty Pressure Planes. This project, identified as project 12, consists of a PRV connected to the SWTP Upper Pressure Plane that induces head loss and reduces the hydraulic grade of the water entering the McCarty Pressure Plane, then passes through 8,000 linear ft. of 16-in. pipe and connects to an existing 16-in. pipeline along Stagecoach Road.

The 16-in. Redwood Road pipeline will be a major arterial that connects the distribution system south of the San Marcos River and East of the Interstate to the proposed El Camino Real Transmission Main. This project, identified as project 25, will generally follow Redwood Road from Old Bastrop Highway to SH 123 and is approximately 1 mile long.

The 18-in. waterline along SH 123 from Clovis Barker to the Cottonwood Creek Development is identified as project 27. This pipeline will supply the Cottonwood Creek Development and connect the proposed Cottonwood Creek elevated storage tank to the system. It is anticipated that this project will be constructed by the Cottonwood Creek developer and will be partially funded by the City.

The Hunter Road 12-in. pipeline between the Soyars booster pump station and the Oak Ridge ground storage tank will allow treated surface water to be conveyed to the Oak Ridge Pressure Planes. This project, identified as project 102, will be constructed in the McCarty Lower Pressure plane and will generally follow Hunter Road between Centerpoint Road and Quail Run, then head west along Quail Run to the Oak Ridge ground storage tank where a PRV and rate of flow control (RFC) valve will be installed.

The Wonder World Drive 16-in. waterline, project 104, will generally be a continuation of the 16-in. Redwood Road project and will allow water to be conveyed west of IH-35 in the southern portions of the City. This project will also replace a 12-in. waterline in Wonder World Drive west of IH-35 that will need to be abandoned due to a new railroad overpass being constructed. The existing 12-in. waterline along Wonder World Drive east of IH-35 should remain in service upon completion of construction.

2017 System

By the year 2017, the City will have an estimated population of 75,134. This represents a population growth of over 100 percent from the 2000 Census. It is also projected that the maximum day demand will exceed 20.0 MGD by 2017. This growth will require significant improvements to the water distribution system to supply water to new population hubs.

Pressure Planes/Booster Pump Stations

The water distribution system will operate significantly different in the 2017 planning period than the current operation and will include new pumping, storage, and considerable pipeline improvements. The primary objective for the 2017 planning period is to have the capability to provide treated surface water to all customers. To achieve this objective, the distribution system will be transformed into three operational pressure planes, the SWTP Lower (810 ft. msl), SWTP Upper (936 ft. msl), and Sleepy Hollow (1,005 ft. msl).

This significant change in pressure plane boundary delineation will require the installation of a new booster pump station and the modification of two existing pump stations to provide service to customers in these three pressure planes. The proposed 2017 pressure plane boundaries are shown on Figure IX-3. Proposed improvements are illustrated on Figure IX-4.

A new pump station to provide service to the Sleepy Hollow 1,005 ft msl plane will be located at the proposed Trunk Hill storage tank that is described in the following section. The Sleepy Hollow Pump Station is proposed to be 350 gpm at 100 ft TDH and will draw water from the SWTP Upper Pressure Plane, 936 ft msl, and lift it to the 1,005 ft msl Sleepy Hollow Pressure Plane. The proposed Sleepy Hollow Pump Station improvements are identified as project 123 on Figure IX-4.

Pump station modifications will be required at the McCarty Pump Station and the proposed Soyars Pump Station that was previously presented in the 2007 System Improvements section. The McCarty pump station and the modified Soyars pump station will require new pumps to boost from the 810 ft. msl plane to the 936 ft. msl plane. The modified McCarty pump station capacity is proposed to be 2,000 gpm at 155 ft. TDH and is identified as project 121 on Figure IX-4. The modified Soyars pump station capacity is proposed to be 1,100 gpm at 155 ft. TDH and is identified as project 120 on Figure IX-4.

Storage Facilities

The water distribution system storage facilities will look similar to today's configuration but will operate quite differently in the 2017 planning period. The significant change in pressure plane boundary delineation will require the installation of one new elevated storage tank in the upper

pressure plane and the transition of two existing tanks into the lower pressure plane. A new SWTP upper elevated tank would be installed on or near Trunk Hill, which is near the existing Oak Ridge ground storage. Operation of the McCarty and Soyars standpipe tanks would be modified so that they could be incorporated into the SWTP lower pressure plane.

The Trunk Hill tank would be a 0.5 MG tank with an overflow elevation of 936 ft. msl. This tank would be fed from the previously described Soyars Pump Station and associated pipelines. The tank would increase the elevated storage capacity in the SWTP Upper pressure plane to 1.5 MG, which would allow for 15,000 total connections. The proposed Trunk Hill Tank is identified as project 132 on Figure IX-4.

The change in operation of the McCarty standpipe from the McCarty Lower pressure plane to the SWTP Lower pressure plane will require the installation of a 16-in. waterline from the tank to the intersection of Snyder Hill and Willow Arbor. The tank level would be lowered from the 857 ft. msl McCarty Lower operation to the SWTP Lower 810 ft. msl hydraulic grade. This tank would float off of the SWTP Lower pressure plane during average day conditions, but could be fed with McCarty well water during higher demand conditions. The tank would increase the elevated storage capacity in the SWTP Lower pressure plane by 0.2 MG.

The change in operation of the Soyars standpipe from the Soyars pressure plane to the SWTP Lower pressure plane only requires the installation of an altitude valve to prevent the tank from overflowing during low demand conditions. The tank overflow level would remain the same at 805 ft. after being connected to the SWTP Lower 810 ft. hydraulic grade. This tank would float off of the SWTP Lower pressure plane during average day conditions, but could be fed with Soyars well water during higher demand conditions. Constant flow through the tank would be maintained because the Soyars pump station would use this tank as its supply. The tank would increase the elevated storage capacity in the SWTP Lower pressure plane by 75,000 gallons. The total elevated storage capacity in the SWTP Lower pressure plane would increase to 1.8 MG, which would allow for a total of 18,000 connections.

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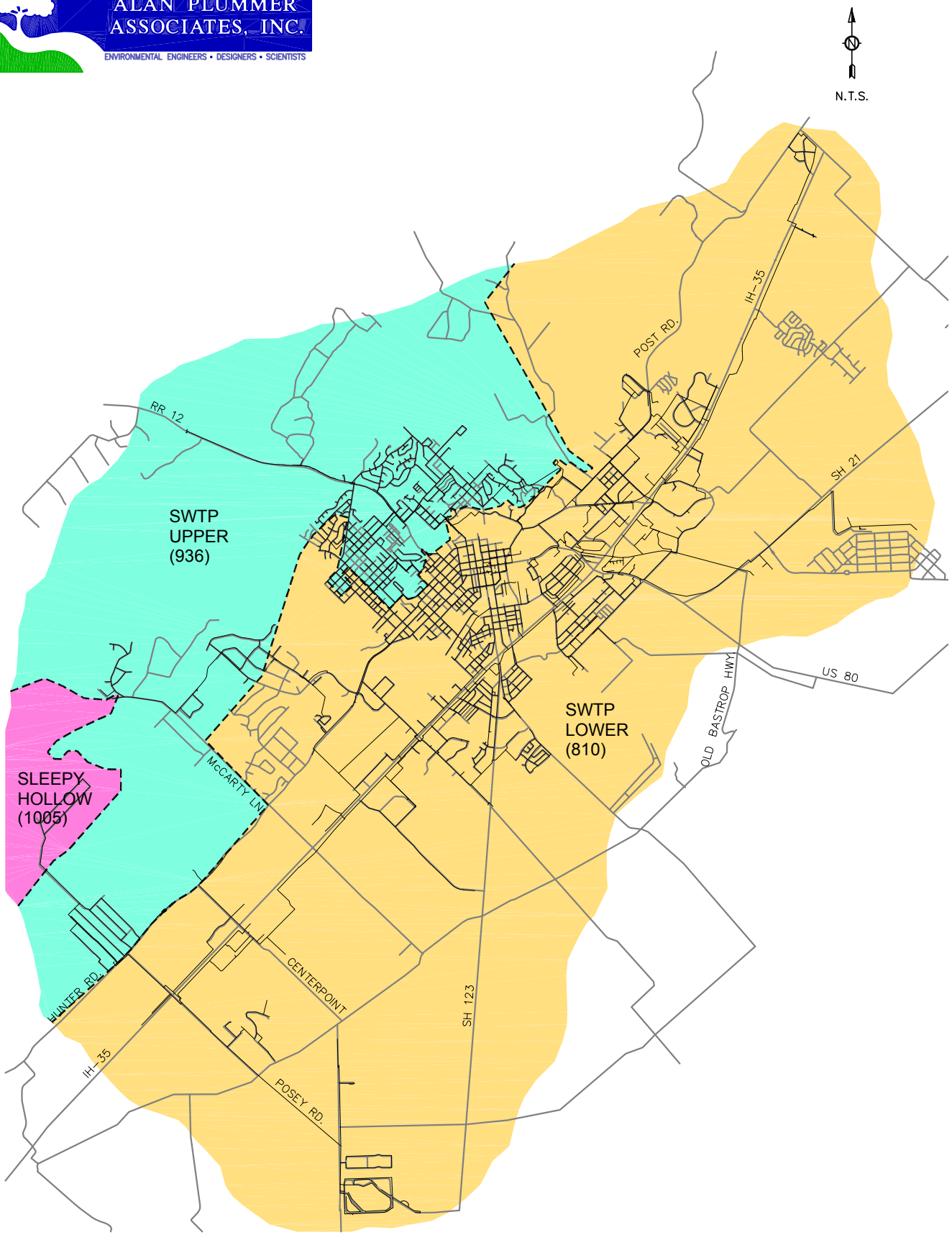

FIGURE IX-3
CITY OF SAN MARCOS
2017 PRESSURE PLANE BOUNDARIES

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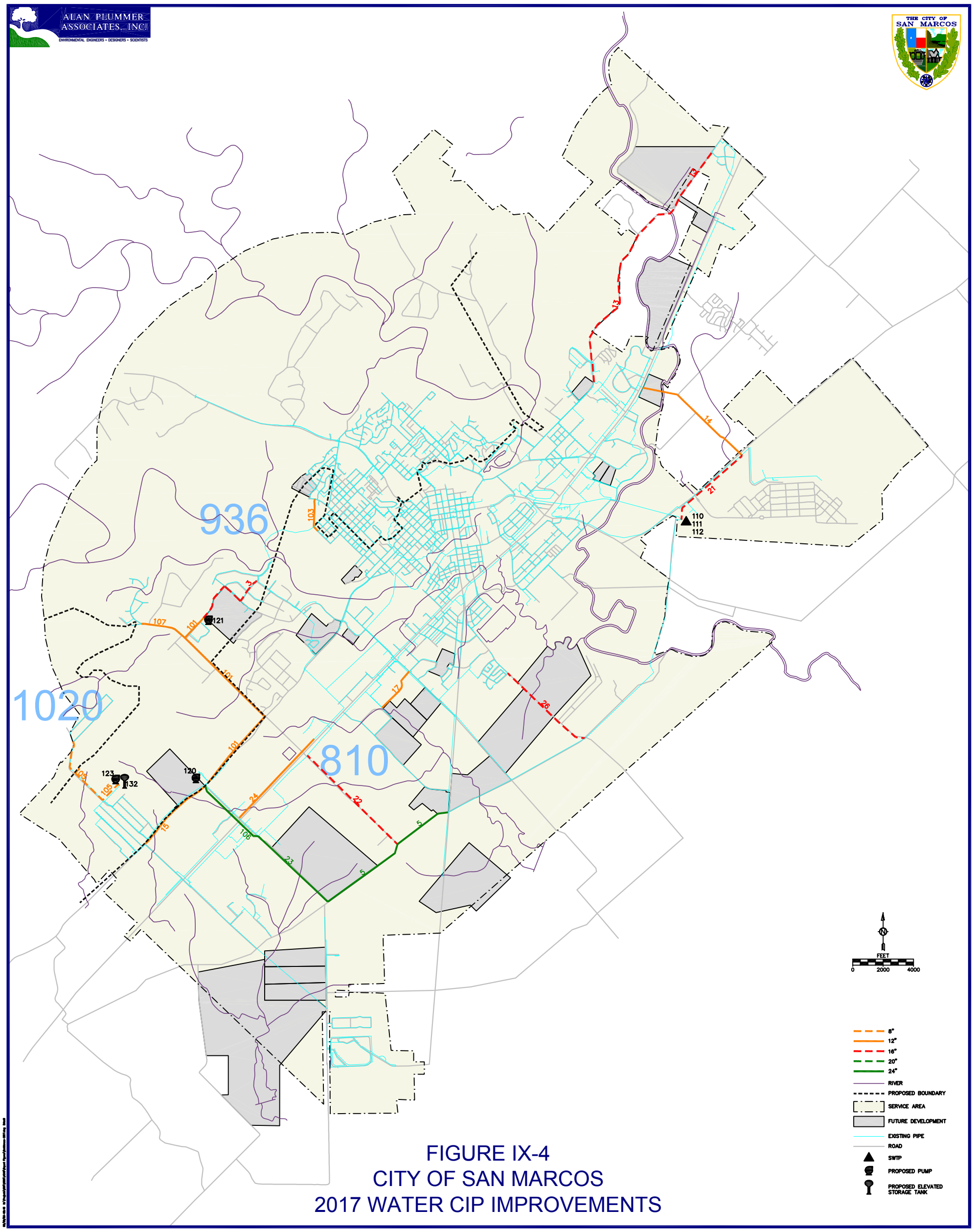

FIGURE IX-4
CITY OF SAN MARCOS
2017 WATER CIP IMPROVEMENTS

Distribution System

The water distribution system will have a considerable number of improvements by 2017. The most significant improvements include the continuation of the El Camino Real Transmission Main, Post Road Pipeline, and the McCarty to Trunk Hill Transmission Main. Each of the sixteen projects currently scheduled to be completed by 2017 are described in the following paragraphs. Improvements described in the following paragraphs are shown on Figure IX-4.

Phase III of the El Camino Real Transmission Main, identified as project 5, will be a continuation of Phase I and II as described in the 2007 distribution system improvements to provide the much-needed conveyance of treated water to the south side of the City. Phase III of this transmission main will begin at the intersection of SH 123 and Bastrop Highway and continue south along Old Bastrop Highway to the intersection of Centerpoint Road. Phase III of the El Camino Real Transmission Main is approximately 1.9 miles in length of 24-in. diameter waterline.

The Centerpoint Road Phase I and II pipelines are basically the continuation of the El Camino Real Transmission Main in the 2017 planning period. This pipeline will begin at the intersection of Centerpoint Road and Old Bastrop Highway and follow Centerpoint Road to the intersection of the existing 12-in. waterline that currently provides service to the Tanger Outlet Mall. This pipeline is identified as project 23 and is approximately 1.2 miles of 24-in. diameter waterline. Phase II of this pipeline begins at the termination point of the Phase I project and continues northwesterly along Centerpoint Road to the intersection of Hunter Road. This pipeline is identified as project 106 and is approximately 1 mile of 24-in. diameter waterline.

A 12-in. pipeline is proposed along the southbound frontage of IH-35 from the current terminus of the 12-in. waterline near McCarty and IH-35 to the previously described Centerpoint pipeline. This pipeline is identified as project 24 and is approximately 1.4 miles of 12-in. diameter waterline.

The 16-in. FM 621 pipeline will be a major pipeline that connects the distribution system south of the San Marcos River and East of the Interstate to the proposed El Camino Real Transmission Main. This project, identified as project 26, will generally follow FM 621 from Old Bastrop Highway to Hilltop Drive and is approximately 1.3 miles long. In addition, the 16-in.

McCarty Road pipeline and 12-in. Railroad pipeline will be a major pipeline that provides service to the distribution system from the El Camino Real Transmission Main. The projects, identified as project 22 and 108 respectively, will generally follow McCarty Road from Old Bastrop Highway to Hunter Road and will parallel the railroad tracks from McCarty Road to the 16-in. cross-country waterline between Hunter Road and IH-35.

A 16-in. pipeline is proposed along Post Road from the existing 16-in. waterline along Post Road near the city limit boundary to the Champions Crossing Development at the northern extents of the City's CCN. This project, identified as project 13, is approximately 3.5 miles long and will close the loop in this area.

A transmission main to the northern portion of the distribution system is composed of 1.1 mile 16-in. pipeline along SH 21 from the SWTP to River Ridge and a 1.5 mile 12-in. pipeline along River Ridge from SH 21 to IH-35. These projects are identified as 21 and 14, respectively. The existing 12-in. pipeline along SH 21 should remain in service upon completion of the proposed 16" waterline.

Two relatively small improvements in the 2017 planning period are the 0.6 mile 12-in. Leah Drive pipeline, project 17, and the 0.4 mile 12-in. Bishop's Crossing pipeline, project 103. The Leah Drive pipeline will increasing the distribution grid to improve service. This improvement, which begins at Cottonwood Parkway, generally follows Leah Drive and ends at Civic Circle. The Bishop's Crossing pipeline will provide service from the SWTP Lower Pressure Plane to connections in the Bishop's Crossing neighborhood that are below 700 ft. msl. It is not recommended that customers below 700 ft. msl be served by the SWTP Upper Pressure Plane because of the excessive pressures that would be observed.

A pipeline from the McCarty Standpipe to the 16-in. waterline along Stagecoach Trail and will connect the McCarty Standpipe to the SWTP Lower Pressure Plane will allow the tank to serve as elevated storage for the SWTP Lower Pressure Plane. This 1.1 mile 16" pipeline is identified as project 3.

A new transmission line between the previously described McCarty Pump Station and the Soyars Pump Station will connect the two pump stations to the SWTP Upper Pressure Plane.

This transmission main will allow these two booster pump stations to provide service to the Ranch Road 12 Tank or the Trunk Hill Tank in the Upper Plane from their respective supply tanks in the SWTP Lower Pressure Plane. This 2.8 mile 12-in. pipeline is identified as project 101.

As development occurs in the western part of the service area along McCarty Lane, it will be necessary to increase the capacity of the existing 8" waterline that provides service to this area. A 0.6 mile 12-in. pipeline is proposed to be built from the project 101 pipeline, McCarty to Soyars Transmission Pipeline, to the development to the west. This project is identified as project 107.

Project 15 is proposed to increase the distribution grid to improve service along Hunter Road between Posey Road and Centerpoint Road. This 1.2 mile 12-in. pipeline project will also provide service from the SWTP Lower Pressure Plane to customers along Hunter Road that are below 700 ft. msl.

A pipeline project to connect the previously described Trunk Hill Tank to the Sleepy Hollow Pressure Plane is identified as project 105. This 1.2 mile 12-in. pipeline will begin at the Trunk Hill pump station and will connect to the existing distribution network that supplies the Sleepy Hollow Subdivision.

2027 System

The City will have an estimated population of 99,368 by the year 2027. This represents a population growth of almost 200 percent from the 2000 Census. It is also projected that the maximum day demand will be approximately 27.0 MGD by 2027. This growth will require improvements to the water distribution system.

The water distribution system will operate similarly to the 2017 planning period, and will require the addition of new pumping, storage, and pipeline improvements. There are no significant operational changes. A new pressure plane boundary will be created to serve developments around and west of the Ranch Road 12 Tank.

Pressure Planes/Booster Pump Stations

It will be necessary to construct and operate a booster pump station to serve the western edge of the service area as development occurs along Ranch Road 12. This pressure plane would operate on the same grade as the Sleepy Hollow 1,005 ft. msl. The new pump station capacity is proposed to be 700 gpm at 100 ft. TDH. The proposed 2027 pressure plane boundaries are shown on Figure IX-5. The proposed Ranch Road 12 Pump Station improvements are identified as project 122 on Figure IX-6.

Storage Facilities

The addition of the Northside elevated tank is the only planned change in water storage facilities between 2017 and 2027. The proposed 0.5 MG Northside elevated tank would increase the elevated storage capacity in the SWTP Lower pressure plane to 2.3 MG, which would allow for a total of 23,000 connections. The location for the proposed Northside elevated storage tank is shown as project 31 on Figure IX-6.

Distribution System

The 2027 improvements to the water distribution system build upon the significant improvements completed in the previous planning periods. The most significant improvements include the continuation of the El Camino Real Transmission Main, Posey Road Pipeline, and the SH 21 Pipeline. Each of the six projects currently scheduled to be completed by 2027 are described in the following paragraphs. Improvements described in the following paragraphs are shown on Figure IX-6.

Phase IV and V of the El Camino Real Transmission Main, identified as projects 10 and 19 respectively, will be a continuation of previous El Camino Real Transmission Main phases described in the 2007 and 2017 distribution system. Phase IV of the transmission main will begin at the intersection of Centerpoint Road and Bastrop Highway and continue south along Old Bastrop Highway to the intersection of Posey Road. Phase IV of the El Camino Real Transmission Main is approximately 1.1 mile in length of 16-in. diameter waterline. Phase V of the transmission main will begin at the intersection of Posey Road and Bastrop Highway and continue south along Old Bastrop Highway to the Francis Harris Overpass. Phase V of the El Camino Real Transmission Main is approximately 0.8 miles in length of 12-in. diameter waterline.

The Centerpoint Road to Southridge pipeline will serve the developments along Centerpoint Road south of Old Bastrop Highway. This pipeline will begin at the intersection of Centerpoint Road and Old Bastrop Highway and generally follow Centerpoint Road to the intersection of the Centerpoint Road and Paul's Drive. This pipeline is identified as project 11 and is approximately 1.7 miles of 12-in. diameter waterline. This project will allow the existing cross-country 6-in. diameter waterline to be abandoned.

The IH-35 Corridor Loop south of Posey Road will provide service to developments along the Interstate. This pipeline loop will begin at the intersection of Posey Road and IH-35 along the western frontage road and follow IH-35 southward for approximately 0.5 mile, then cross IH-35 to the eastern frontage road and follows IH-35 northward back to Posey Road. This pipeline is identified as project 20 and is approximately 1 mile of 12-in. diameter waterline.

The SH 21 Pipeline from Airport Drive to William Pettus Road will provide service to developments along the SH 21 in the northeastern part of the City's service area. This pipeline is identified as project 18 and is approximately 1.8 miles of 12-in. diameter waterline.

The CIP list was developed for 10-year (2012), 20-year (2022), and 25-year (2027) timeframes to coincide with the City's CIP process. The 10-year, 20-year, and 25-year CIP opinion of probable cost in 2003 dollars (ENR Index #6581) for the previously described 2007, 2017, and 2027 Systems, including water supply, are presented in Table IX-4, Table IX-5, and Table IX-6, respectively.

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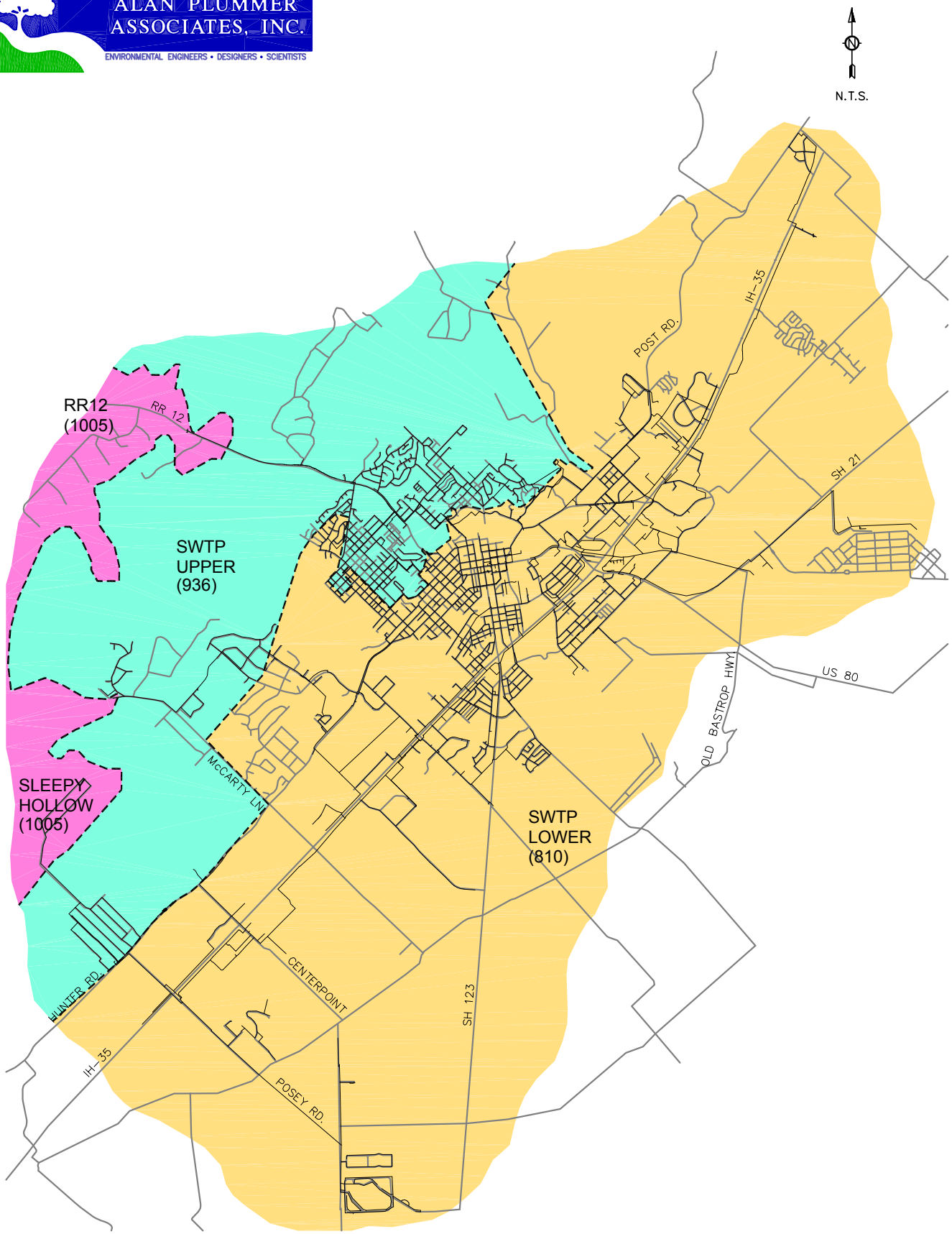

FIGURE IX-5
CITY OF SAN MARCOS
2027 PRESSURE PLANE BOUNDARIES

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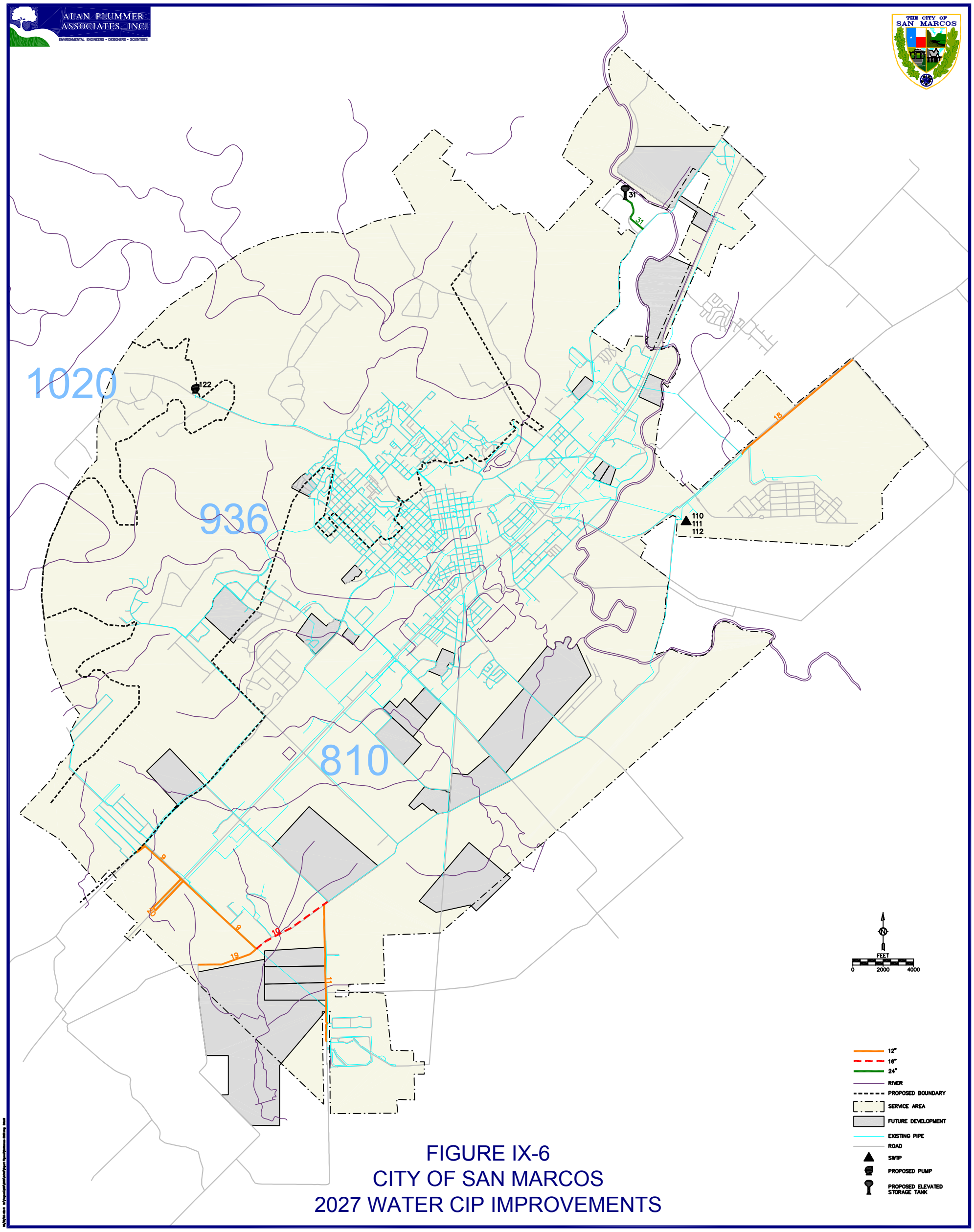

FIGURE IX-6
CITY OF SAN MARCOS
2027 WATER CIP IMPROVEMENTS

TABLE IX-4

CITY OF SAN MARCOS
10-YEAR CIP IMPROVEMENTS (2003-2012)

Project Number	Project Description	Line Size or Facility Capacity	Number of Units	Opinion of Construction Cost
Water Distribution Lines (Units are Linear Feet)				
1	Hwy 123 12" Line	12"	5,400	$510,000
2	Davis Ln. 12" Line	12"	2,700	$253,000
4	Westover Water Imp.	8"	2,500	$269,000
5	El Camino Real Transmission Ph 1	30"	16,900	$3,984,000
5	El Camino Real Transmission Ph 2	24"	10,500	$1,593,000
6	12" Comanche to University	12"	2,800	$667,000
7	IH 35 12" from FM 3407 to Civic Center	12"	6,800	$780,000
8	Comanche Transmission Main (24")	24"	5,200	$1,040,000
12	Purgatory Creek Park	16"	8,000	$918,000
16	S Bishop-Belvin to FM 3407 12"	12"	5,400	$506,000
17	Leah Drive 12" Cottonwood Pkwy to Civic Center	12"	3,100	$294,000
24	IH35-N of McCarty to Centerpoint	12"	7,200	$678,000
25	Redwood- Hwy 123- FM 621	16"	5,400	$782,000
26	FM 621- Old Bastrop-DeZavala	16"	6,800	$732,000
27	Hwy 123S Transmission Main - 12" Portion	12"	1,500	$138,000
27	Hwy 123S Transmission Main - 18" Portion	18"	4,200	$515,000
49	Water System Security			$386,284
50	Craddock 12" AC Replacement (Allen to RR12)	12"	4,000	$300,000
51	Pressure Monitoring Locations		12	$150,000
52	River Road W.L. from Davis to Uhland	8"	3,800	$380,000
53	N. LBJ W.L. from Sessom to Craddock	12"	6,300	$630,000
54	Replace multiple waterlines in Heritage Neighborhood	4",6",8"	13,000	$1,800,000
55	Gravel Road W.L. extension	8"	1,800	$180,000
56	Southwest Fire Hydrant Improvements			$100,000
57	Rio Vista Water System Improvements		16,000	$1,495,000
58	Main Extensuions / Replacements			$2,130,000
59	Post Road 8 Inch water Line Replacements	8"		$370,000
60	Lockwood - Del Sol Water Replacements			$125,000
61	Water Distribution Improvements			$1,474,494
65	Victory Gardens Water Improvements	2",6"	8,450	$545,000
66	Railroad Water Line Encasements			$438,900
67	Staples Road 12 Inch Water - Broadway to Zavala	12"	2,033	$205,000
68	Water Master Plan			$950,000
69	Deerwood Estates - Sleepy Hollow Water Line Replacement		40,900	$3,500,000
70	Highway 123 AC Replacement	12"		$950,000
71	Red Sky Subdivision Water Line Replacement	8"	7,800	$530,000
72	Wallace Addition Water Improvements	2",6",8"		$800,000
73	Dunbar Water Replacement	8"	11,400	$1,000,000
74	Green Haven & Briarwood Water Improvements	8"	6,450	$600,000
75	Southridge Estates Water Line Replacements	8"	23,650	$2,000,000
76	IH 35 S 12" Water - Marshall to Wonder World	12"	5,315	$530,000
102	Middle Plane Booster & Pipeline to Trunk Hill Tank	12"	12,100	$1,140,000
104	Wonder World Overpass Utilities	16"	8,300	$1,908,000
Water Distribution Sub-Total				**$38,276,678**

2003 Dollars (ENR Index #6581)

TABLE IX-4 (Cont.)

CITY OF SAN MARCOS
10-YEAR CIP IMPROVEMENTS (2003-2012)

Project Number	Project Description	Line Size or Facility Capacity	Number of Units	Opinion of Construction Cost
Water Supply				
63	Water Well Improvements			$460,000
110	3 MGD Uprating	3 MGD		$600,000
111	SWTP first 9 MGD plant train	9 MGD		$8,500,000
Water Supply Sub-Total				**$9,560,000**
Pumping Station				
62	Water Pump Station Improvements			$1,452,525
124	Soyars Pumping to McCarty	600 gpm		$300,000
125	Oak Ridge Capacity Improvements	500 gpm		$130,000
Pumping Station Sub-Total				**$1,882,525**
Storage Tank				
64	Water Storage Tank Improvements			$270,000
130	Cottonwood Tank	1 MG		$2,363,000
133	Technology Way Ground Storage w/ Fire Pumps	.200 MG		$500,000
Storage Tank Sub-Total				**$3,133,000**
			Cumulative Total	**$52,852,203**

2003 Dollars (ENR Index #6581)

TABLE IX-5

CITY OF SAN MARCOS
20-YEAR CIP IMPROVEMENTS (2013-2022)

Project Number	Project Description	Line Size or Facility Capacity	Number of Units	Opinion of Construction Cost
Water Distribution Lines (Units are Linear Feet)				
3	Stagecoach Trail- McCarty Tank	16"	5,800	$626,000
5	El Camino Real Transmission Ph 3	24"	9,800	$1,459,000
10	Old Bastrop Hwy - Posey to Cntr Pt.	16"	5,700	$610,000
11	Centerpoint to Southridge 12"	12"	9,100	$864,000
13	Post Road - City Limits to Champions	16"	18,400	$2,663,000
14	River Ridge IH 35- Hwy 21	12"	8,100	$767,000
15	Hunter Road 12" Waterline	12"	6,400	$603,000
21	Hwy 21 - SWTP to River Ridge	16"	6,100	$656,000
22	McCarty Rd - IH 35 to Old Bastrop Ovr.	16"	12,300	$1,350,000
23	Center Point Rd - IH 35 to Old Bastrop Ovr.	24"	6,300	$934,000
101	McCarty to 936 Pressure Plane 12"	12"	14,900	$1,404,000
103	Connection of Bishops Crossing to Lower Plane	12"	2,200	$212,000
105	Sleepy Hollow Upper Pipe 1	8"	6,400	$430,000
106	Center Point Rd - Hunter to IH 35	24"	5,000	$743,000
107	McCarty Rd to San Marcos Estates	12"	3,100	$293,000
108	Railroad Water Line	12"	5,000	$475,000
Water Distribution Sub-Total				**$14,089,000**
Water Supply				
Water Supply Sub-Total				**$0**
Pumping Station				
120	Soyars to 936 Plane (Pump Replacement Only)	1100 gpm		$150,000
121	Modify McCarty to 936 Plane	2000 gpm		$613,000
123	Sleppy Hollow 936 to 1,005 Plane	350 gpm		$138,000
Pumping Station Sub-Total				**$901,000**
Storage Tank				
132	Trunk Hill (936)	0.5 MG		$675,000
Storage Tank Sub-Total				**$675,000**
			Cumulative Total	**$15,665,000**

2003 Dollars (ENR Index #6581)

TABLE IX-6

CITY OF SAN MARCOS
25-YEAR CIP IMPROVEMENTS (2023-2027)

Project Number	Project Description	Line Size or Facility Capacity	Number of Units	Opinion of Construction Cost
Water Distribution Lines (Units are Linear Feet)				
9	Posey Rd - Hunter Rd to Old Bastrop	12"	10,700	$2,359,000
18	Airport - River Ridge to William Petus	12"	9,600	$911,000
19	Old Bastrop - Posey to Fransis Harris Ovr.	12"	4,100	$387,000
20	IH 35 - Posey to CCN Oversize	12"	5,500	$1,062,000
Water Distribution Sub-Total				**$4,719,000**
Water Supply				
112	2nd 9 MGD Plant Train	9 MGD		$10,000,000
Water Supply Sub-Total				**$10,000,000**
Pumping Station				
122	936-1020 North (middle-high)	700 gpm		$233,000
Pumping Station Sub-Total				**$233,000**
Storage Tank				
31	Northside Tank	0.5 MG		$1,053,000
Storage Tank Sub-Total				**$1,053,000**
			Cumulative Total	**$16,005,000**

2003 Dollars (ENR Index #6581)