

Appendix K

Sewer System Analysis

DEXTER WILSON ENGINEERING, INC.

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SYSTEM ANALYSIS FOR THE FARM IN POWAY

March 2019

**SEWER SYSTEM ANALYSIS
FOR
THE FARM IN POWAY**

March 2019



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Job No. 1069-001

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CHAPTER 1

INTRODUCTION

This report provides a sewer system analysis for The Farm in Poway (The Farm) project. This report provides information on projected sewer flows, existing facilities, and recommended facilities associated with serving the project.

The Farm project is located in Poway along the north side of Espola Road, between Valle Verde Road and Cloudcroft Drive. Sewer service to the project will be provided by the City of Poway. Figure 1-1 provides a location map for the project.

LAND USE PLAN

The Farm project encompasses a total of approximately 117 acres with pad elevations ranging from approximately 597 feet to 773 feet. Figure 1-2 provides the development plan for the project. The plan includes redevelopment of the Stoneridge Golf-Course to include 160 single family residential lots and amenities.

PURPOSE OF STUDY

The purpose of this report is to establish the sewer facilities that will be required for the development of The Farm project. This study will be compatible with regional planning efforts of the City of Poway. A key facet of the study will be to analyze the hydraulics of the system to show how the proposed facilities will be integrated with the overall system and meet the operational requirements of the City.

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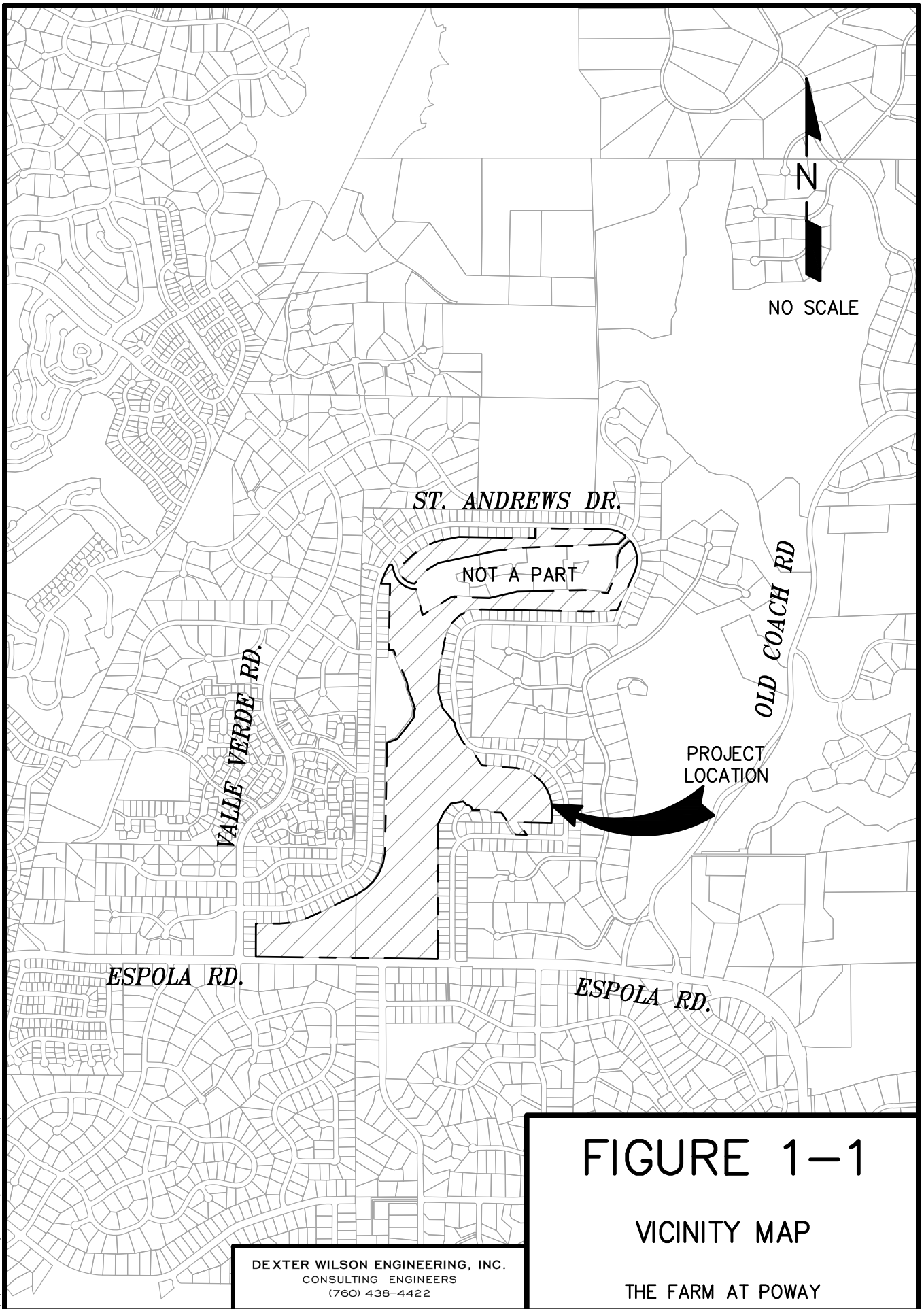
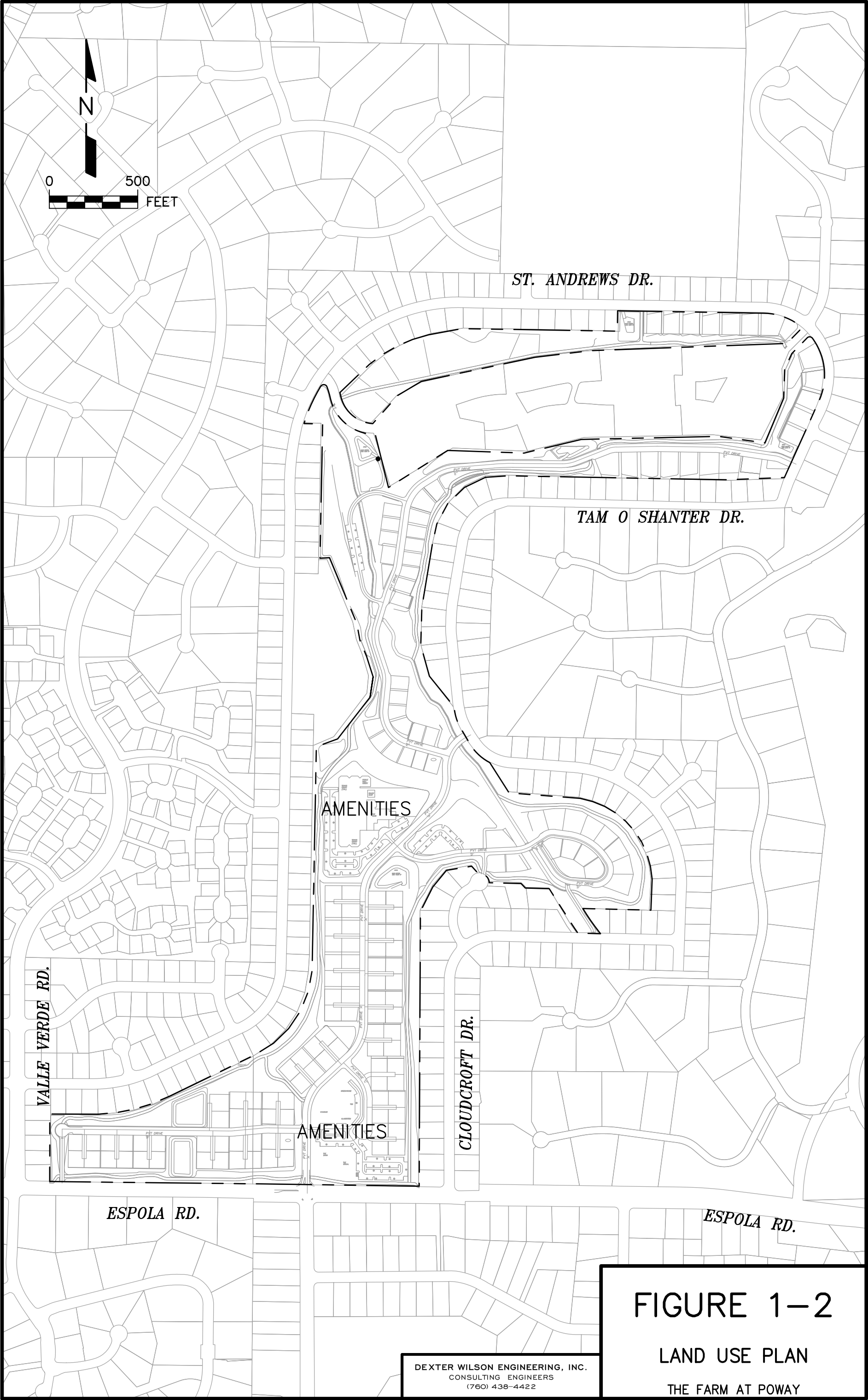


FIGURE 1-1

VICINITY MAP

THE FARM AT POWAY

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CHAPTER 2

PLANNING CRITERIA

This chapter presents the planning criteria used to evaluate sewer system requirements for The Farm project. Unless otherwise noted, planning criteria was taken from the City of Poway February 2013 Sanitary Sewer Master Plan. These criteria are used for evaluating the existing system as well as for sizing of proposed improvements to serve the project.

Sewer Generation and Peaking Factors

To convert proposed land uses to projected average sewer flows, sewer generation factors are used for the various land use types. Table 2-1 summarizes the sewer generation factors utilized in this study.

TABLE 2-1 SEWER GENERATION FACTORS	
Land Use	Water Duty Factor
SF Residential	215 gpd/du
Amenities	300 gpd/ac

To convert average day demands to peak demands, the City Master Plan does not have peaking factor curves, but instead evaluates peak flows based on inputs to the overall City hydraulic model. To convert average flows to peak flows in this report, the peaking factor chart from the City of San Diego 2016 Sewer Design Guide was utilized. A copy of this chart is provided in Appendix A for reference.

Gravity Sewers

Gravity sewer lines are to be 8-inch in diameter minimum and are to be designed for a minimum velocity of 2.0 feet per second at peak flow. Gravity sewer lines are evaluated using Manning's Equation with a roughness coefficient "n" of 0.013. Gravity sewers that are smaller than 18-inches in diameter are sized to convey peak flows with a maximum depth-to-diameter (d/D) ratio of 0.50.

Force Mains

Force mains from sewer lift stations are to be a minimum of 4-inch diameter. Force mains are to be sized for a minimum velocity of 2.5 feet per second and a maximum velocity of 8.0 feet per second. Headloss in force mains is based on a Hazen-Williams roughness coefficient of 130.

CHAPTER 3

PROJECTED SEWER FLOWS

This chapter presents the projected sewer flows for The Farm project.

The Farm Projected Sewer Flows

Table 3-1 provides the sewer flow projections for The Farm project. As shown, the projected average flow is 34,800 gpd (24 gpm). Using the peaking factor chart from Appendix A and assuming a per capita flow of 80 gpd, the projected peak flow is 112,060 gpd (78 gpm).

TABLE 3-1 THE FARM PROJECTED SEWER FLOWS			
Land Use	Quantity	Unit Flow Factor	Total Average Demand (GPD)
Residential	160 units	215 gpd/unit	32,250
Amenities	8.5 Ac	300 gpd/Ac	2,550
TOTAL			34,800

CHAPTER 4

EXISTING SEWER FACILITIES

Existing sewer facilities pertinent to The Farm project consist of local gravity sewer lines and the Saint Andrews Lift Station and force main. Figure 4-1 graphically shows the sewer facilities in the area and a brief description is provided below.

Gravity Sewers

There are existing 8-inch local gravity sewer lines all around and within The Farm property to serve existing development that surrounds the project. On the northern portion of the property, there are gravity sewer lines in Saint Andrews Road and Tam O' Shanter Drive that convey flow northerly to the Saint Andrews Lift Station.

The southern portion of the property includes existing gravity sewer lines that traverse the project. There is an existing 8-inch gravity sewer line in Saint Andrews Road that conveys sewer to a low point and then south through The Farm property in an easement. There are also gravity sewer lines in Tam O' Shanter Drive and Cloudcroft Drive to the east of the project. These lines convey flow south and they cross the project and connect with the flows from Saint Andrews Road. From this junction within the property, flows are conveyed south to an existing 12-inch line in Martincoit Road that was recently upgraded by the City as part of a capital improvement project.

Saint Andrews Lift Station

The Saint Andrews Lift Station is located on the south side of Saint Andrews Road, adjacent to the northern project boundary. This station was originally constructed in 1975 and was upgraded in 2011. The station includes three pumps, each rated for a design discharge of 100 gpm. The actual measured firm capacity of the station is 195 gpm. Existing peak wet weather flows to the station are 113 gpm. The force main from the lift station is a 4-inch PVC line that is approximately 1,925 feet long. This force main conveys flow from the lift station south through an easement and into Tam O' Shanter Drive. The force main discharges into an 8-inch gravity sewer line in Tam O' Shanter Drive that conveys flow south.

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CHAPTER 5

RECOMENDED SEWER FACILITIES

This chapter presents the results of the sewer system analysis performed to establish the sewer system improvements required to provide service to The Farm project. The onsite and offsite recommended sewer system improvements have been established based on the analyses contained in this report. Figure 5-1 graphically shows the proposed sewer system improvements for the project.

SEWER SYSTEM ANALYSIS

The sewer system analysis performed to determine sewer system requirements for The Farm consists of calculations that utilize Manning's Equation to evaluate the depth of flow in sewer lines at peak flow. Calculations were also performed to evaluate the impact of the project on the Saint Andrews Lift Station. Appendix B at the back of this report provides the calculations that were performed and a brief discussion is provided below.

Gravity Sewer System

There are four proposed residential lots in the northeast corner of the project that cannot flow by gravity north or south to connect to the existing sewer system. These lots are proposed to be served by constructing private individual grinder pump systems. Each lot would require a grinder pump force main to convey flows northerly to the existing gravity sewer system in Saint Andrews Road.

There are an additional 30 lots in the northern portion of the project that propose to connect to the existing gravity sewer system that conveys flow to the Saint Andrews Lift Station. Some of these lots are adjacent to an existing sewer line and will only require lateral connections while others lots will be served by extending 8-inch gravity sewer lines and connecting to the existing system. The impact that flows from these lots have on the existing Saint Andrews Lift Station is discussed in the next section of this report.

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There are 34 lots in the southwest corner of the project that propose to convey flow westerly and connect to an existing 8-inch gravity sewer line at the intersection of Espola Road and Valle Verde Road. This gravity sewer line conveys flow south in Valle Verde Road.

The remaining development in the southern portion of the project includes 92 units and amenity areas that will be served by constructing gravity sewer lines and re-aligning existing sewer lines that traverse the property into new street alignments for the project. These onsite sewer lines will be required to have capacity to convey flows from offsite areas, including flows to the Saint Andrews Lift Station. The gravity sewer lines on the very south end of the project will also convey flows from City Lift Station No. 1. Appendix B provides the calculations prepared for these gravity sewer lines along with the corresponding node diagram. The results of the analysis indicate that 8-inch gravity sewer lines are adequate with some sections of 12-inch line proposed upstream of the connection to the existing 12-inch sewer line in Martincoit Road.

The City of Poway recently replaced approximately 4,800 feet of gravity sewer starting at the intersection of Espola Road and Martincoit Road and going downstream. The replacement was a capital improvement project to relieve existing system deficiencies and involved replacement of 8-inch pipe with 12-inch pipe and 10-inch and 12-inch pipe with 15-inch pipe. Although the City did not specifically consider redevelopment of The Farm property when sizing these improvements, the additional flows from The Farm property will have a minimal impact on the offsite downstream system. Since the northern portion of the project flows to the Saint Andrews Lift Station and the capacity of this lift station is not proposed to change, the increase in peak flows in the downstream system as a result of the project will be limited to flows from the 126 lots and amenity areas in the southern portion of the project. Projected flow from this area represents approximately 3.0 percent of the design capacity (half full) of a 12-inch line constructed at a slope of 0.50 percent.

Saint Andrews Lift Station

The Saint Andrews Lift Station has a firm capacity of 195 gpm and existing peak wet weather flows to the station are 113 gpm. Based on the calculations in Appendix B, the additional 34 residences that are proposed to convey flow to the lift station will increase peak wet weather flows to an estimated 124 gpm. Thus, the Saint Andrews Lift Station has capacity to accommodate these additional units. These proposed units tributary to Saint

Andrews Lift Station will also not have an impact on the existing system downstream of the lift station discharge since the firm capacity of the lift station is not proposed to change.

SEWER SYSTEM SUMMARY

The Farm project can receive sewer service by connecting to the existing sewer system and re-aligning the existing sewers within the property to match the proposed development layout. Figure 5-1 graphically shows the proposed sewer system facilities for the project and a summary of recommended improvements is provided below.

1. There are four proposed lots in the northeast corner of the project that cannot gravity flow to the existing Saint Andrews Lift Station collection system. These lots are proposed to be served by constructing private individual grinder pumps. This would require constructing proposed private force mains within public right-of-way.
2. There are an additional 30 lots in the northern portion of the project that are tributary to the Saint Andrews Lift Station collection system. These lots can be served by extending 8-inch sewer lines and connecting to the existing system. The Saint Andrews Lift Station has available capacity to accommodate these additional units.
3. There are 34 lots in the southwest corner of the project that propose to convey flow by gravity to the existing 8-inch sewer line at the intersection of Espola Road and Valle Verde Road.
4. There are 92 lots and amenity areas in the southern portion of the project that are proposed to be served by constructing gravity sewers and connecting to the existing 12-inch gravity sewer line in Martincoit Road that was recently upgraded by the City of Poway. The gravity sewer system improvements will involve several connections to the existing gravity sewer system to re-route sewer lines that currently traverse the property. The onsite sewer system sizing takes into account offsite sewer flows that will be conveyed through the project.

APPENDIX A

PEAKING FACTOR CHART

PUBLIC UTILITIES DEPARTMENT
PEAKING FACTOR FOR SEWER FLOWS
(Dry Weather)

Ratio of Peak to Average Flow*
Versus Tributary Population

<u>Population</u>	<u>Ratio of Peak to Average Flow</u>	<u>Population</u>	<u>Ratio of Peak to Average Flow</u>
200	4.00	4,800	2.01
500	3.00	5,000	2.00
800	2.75	5,200	1.99
900	2.60	5,500	1.97
1,000	2.50	6,000	1.95
1,100	2.47	6,200	1.94
1,200	2.45	6,400	1.93
1,300	2.43	6,900	1.91
1,400	2.40	7,300	1.90
1,500	2.38	7,500	1.89
1,600	2.36	8,100	1.87
1,700	2.34	8,400	1.86
1,750	2.33	9,100	1.84
1,800	2.32	9,600	1.83
1,850	2.31	10,000	1.82
1,900	2.30	11,500	1.80
2,000	2.29	13,000	1.78
2,150	2.27	14,500	1.76
2,225	2.25	15,000	1.75
2,300	2.24	16,000	1.74
2,375	2.23	16,700	1.73
2,425	2.22	17,400	1.72
2,500	2.21	18,000	1.71
2,600	2.20	18,900	1.70
2,625	2.19	19,800	1.69
2,675	2.18	21,500	1.68
2,775	2.17	22,600	1.67
2,850	2.16	25,000	1.65
3,000	2.14	26,500	1.64
3,100	2.13	28,000	1.63
3,200	2.12	32,000	1.61
3,500	2.10	36,000	1.59
3,600	2.09	38,000	1.58
3,700	2.08	42,000	1.57
3,800	2.07	49,000	1.55
3,900	2.06	54,000	1.54
4,000	2.05	60,000	1.53
4,200	2.04	70,000	1.52
4,400	2.03	90,000	1.51
4,600	2.02	100,000+	1.50

*Based on formula: $\text{Peak Factor} = 6.2945 \times (\text{pop})^{-0.1342}$
(Holmes & Narver, 1960)

FIGURE 1-1

APPENDIX B

SEWER SYSTEM CALCULATIONS

Saint Andrews Lift Station Capacity Evaluation

Given:

Station Existing Firm Capacity = 195 gpm

Station Existing Peak Influent Flow = 113 gpm

Determine:

Impact that adding 34 units from The Farm project will have on existing peak flows

Determine Existing Average Flow

Using the peaking factor chart in Appendix A and assuming a per capita sewer generation rate of 80 gpcpd:

$$Q_{AVG} = Q_{PK}/PF$$

$$Q_{PK} = 113 \text{ gpm} = 162,720 \text{ gpd}$$

$$\text{By trial and error, } PF = 2.81 \text{ (724 people} \times 80 \text{ gpcpd} \times 2.81 = 162,755 \text{ gpd)}$$

$$\text{So, } Q_{AVG} = 162,720/2.81 = \mathbf{57,907 \text{ gpd}}$$

Determine Future Average Flow

Future Average Flow = Existing Average Flow + Flow from The Farm (34 Units)

$$\text{Future Average Flow} = 57,907 \text{ gpd} + (34 \text{ units} \times 215 \text{ gpd/unit})$$

$$\text{Future Average Flow, } Q_{AVG} = \mathbf{65,217 \text{ gpd}}$$

Determine Future Peak Flow

$$Q_{PK} = Q_{AVG} \times PF$$

$$PF = 2.73 \text{ based on chart in App. A and population} = 65,217 \text{ gpd}/80 \text{ gpcpd} = 815$$

$$Q_{PK} = 65,217 \text{ gpd} \times 2.73$$

$$Q_{PK} = 178,042 \text{ gpd}$$

$$Q_{PK} = \mathbf{124 \text{ gpm} < 195 \text{ gpm lift station capacity}}$$

DATE: 3/1/2019

SEWER STUDY SUMMARY

FOR: The Farm at Poway
JOB NUMBER: 1069-001
BY: Dexter Wilson Engineering, Inc.

SHT 1 OF 1
REFER TO PLAN SHEET:

LINE	FROM	TO	IN-LINE FLOW (gpd)	AVG DRY WEATHER FLOW (gpd)	EQUIV POP.	PEAKING FACTOR	PEAK WET WEATHER FLOW (gpd)	PEAK WET WEATHER FLOW (DESIGN FLOW)		LINE SIZE (inches)	DESIGN SLOPE (%)	DEPTH K ⁽¹⁾	dn (feet)	dn/D ⁽²⁾	C _a for Velocity ⁽³⁾	VELOCITY (f.p.s.)	Remarks
								M.G.D.	C.F.S.								
	24	22	53,750	53,750	672	2.86	153,725	0.15	0.24	8	1.50	0.074440	0.18000	0.27	0.1711	3.13	250 Existing Offsite Units
	22	20	19,105	72,855	911	2.81	204,723	0.20	0.32	8	0.40	0.191973	0.30000	0.45	0.3428	2.08	77 Units + Amenity Areas
	20	4	0	72,855	911	2.50	182,138	0.18	0.28	8	1.00	0.108020	0.22000	0.33	0.2260	2.81	
	12	10	11,825	11,825	148	4.00	328,100	0.33	0.51	8	2.00	0.137593	0.24667	0.37	0.2642	4.32	55 Existing Offsite Units+St. Andrews Lift Sta. (195 gpm)
	10	8	5,160	16,985	212	3.96	348,061	0.35	0.54	8	1.00	0.206424	0.31333	0.47	0.3627	3.34	15 Units + 9 Existing Offsite Units
	8	6	11,825	28,810	360	3.47	380,771	0.38	0.59	8	3.30	0.124311	0.23333	0.35	0.2450	5.41	55 Existing Offsite Units
	6	4	9,460	38,270	478	3.07	643,089	0.64	1.00	12	0.70	0.154614	0.40000	0.40	0.2934	3.39	44 Existing Offsite Units + LS-1 (170 gpm)
	4	2	72,855	111,125	1,389	2.38	790,078	0.79	1.22	12	1.00	0.158927	0.40000	0.40	0.2934	4.17	Flow from MH 20

Min Slope
0.40

Max dn/D
0.47

1 K' based on n = 0.013
2 dn/D using K' in Brater King Table 7-14
3 From Brater King Table 7-4, based on dn/D

