Flahavan Estates Water and Wastewater Analysis

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FINAL / November 2023

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Abbreviations

2011 Master Plans	Water Distribution and Sewer Collection System Master Plan
ADD	average day demand
ADWF	average dry weather flow
Carollo	Carollo Engineers, Inc.
City	City of Cotati
d/D	flow depth to pipe diameter ratio
ft/sec	feet per second
gpd	gallons per day
gpd/ac	gallons per day per acre
gpm	gallons per minute
I/I	infiltration and inflow
MDD	maximum day demand
MG	million gallons
mgd	million gallons per day
NL	Neighborhood Low Density
PDWF	peak dry weather flow
PHD	peak hour demand
Project	Flahavan Estates residential development
psi	pounds per square inch
PWWF	peak wet weather flow
SCSMP	2017 Sewer Collection System Master Plan Update
Sonoma Water	Sonoma County Water Agency
WDSMP	2011 Water Distribution System Master Plan

SECTION 1 INTRODUCTION

The City of Cotati (City) contracted with Carollo Engineers, Inc. (Carollo) to conduct analyses related to the Flahavan Estates residential development (Project). The City's hydraulic models were used to evaluate the impacts of construction of the Project on the City's existing water distribution and wastewater collection systems. This project memorandum summarizes the analyses performed and documents the findings and recommendations that result from the analyses.

SECTION 2 PROJECT SCOPE

This evaluation includes the following scope of services:

- Develop water demands and wastewater flows attributed to the development of the Project.
- Update the City's hydraulic model to reflect the Project's wastewater flows and water demands.
- Evaluate the Project's impact to the existing water and wastewater systems.

SECTION 3 BACKGROUND

The Project is proposed to be constructed at 8841 Old Redwood Highway at the southern edge of the City, as shown in Figure 1. The Project will occupy 7.10 acres, which currently contains 5 structures including 3 single family residences. The existing use is supplied by a City water hookup and a private septic system. The Project consists of thirty-five (35) single family residential units.

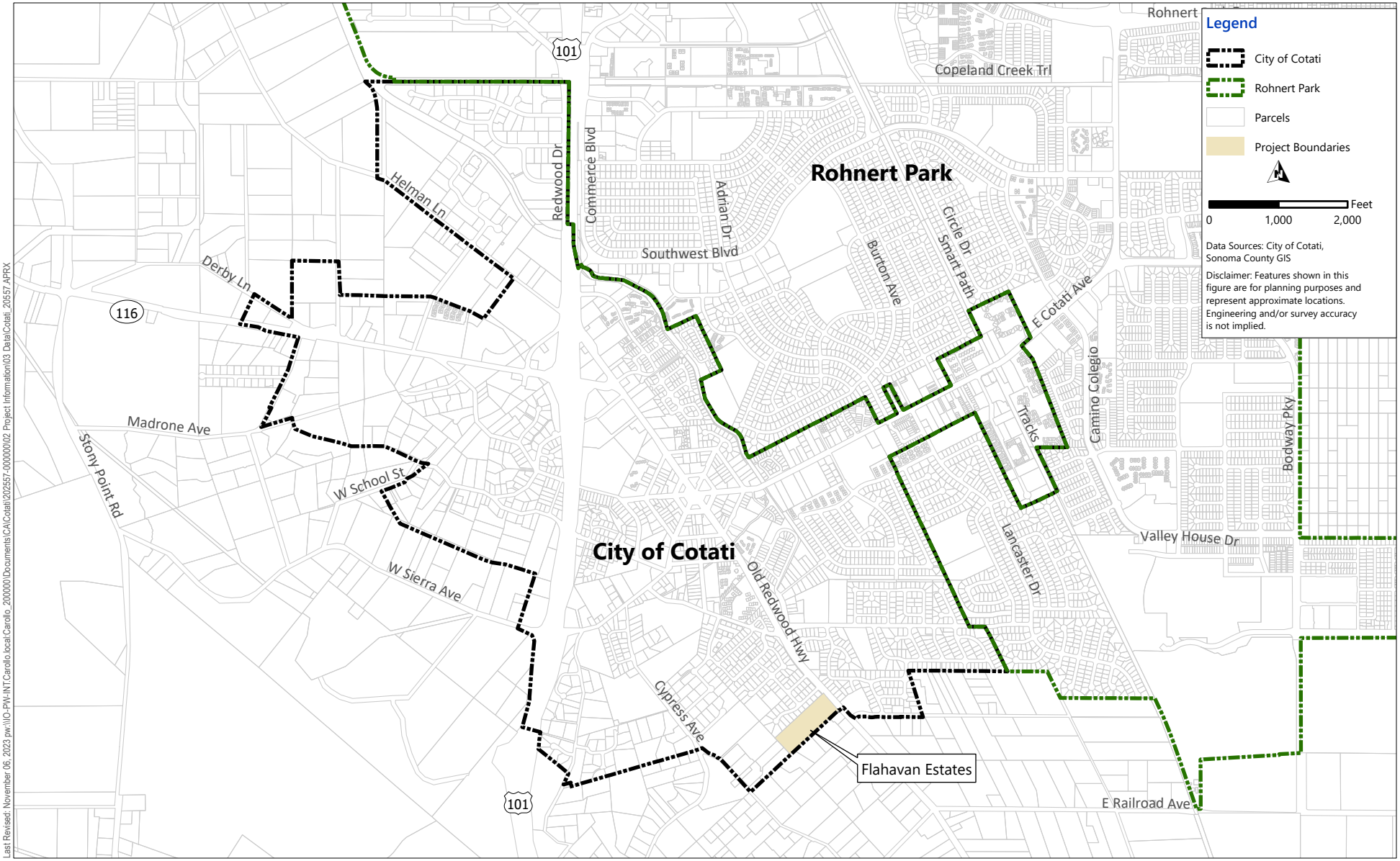


Figure 1 Study Area
CITY OF COTATI
FLAHAVAN ESTATES WATER AND WASTEWATER ANALYSIS

3.1 Wastewater System

The City's wastewater collection system includes approximately 32 miles of sewer pipeline ranging in diameter from 4 inches to 24 inches, and 4 lift stations. Ultimately, all wastewater flow is conveyed to the City of Santa Rosa's Laguna Wastewater Treatment Plant via the Helman Interceptor.

The existing average sewer flow generated within the City's service area is approximately 0.74 million gallons per day (mgd) based on 2023 data. Figure 2 shows the existing configuration of the City's wastewater collection system. Figure 3 is a close-up of the Project's location and shows the configuration and pipe diameter of the sewers in the vicinity of the Project. Sewer flows generated by the Project will be served by the existing 6-inch pipeline in Old Redwood Highway.

3.2 Water System

The City's water supply system consists of 30 miles of potable water distribution lines. The City water sources consist of wholesale water purchased from the Sonoma County Water Agency (Sonoma Water). The City has two Sonoma Water turnouts. The City's 2022 average day demand (ADD) was 0.64 mgd with approximately 60 percent from Sonoma Water and 40 percent from City wells. The ADD is defined as the total water delivered over the entire year divided by the number of days in the year.

The distribution system includes two City-owned water storage facilities totaling 1.1 million gallons (MG). However, the 100,000-gallon Cypress Tank is currently out of service.

Figure 4 illustrates the layout of the City's water distribution system. Figure 3 is a close-up of the Project's location and shows the configuration and pipe diameters of the water distribution system in the proximity of the Project. The Project will be served by the existing 8-inch diameter main in Old Redwood Highway.

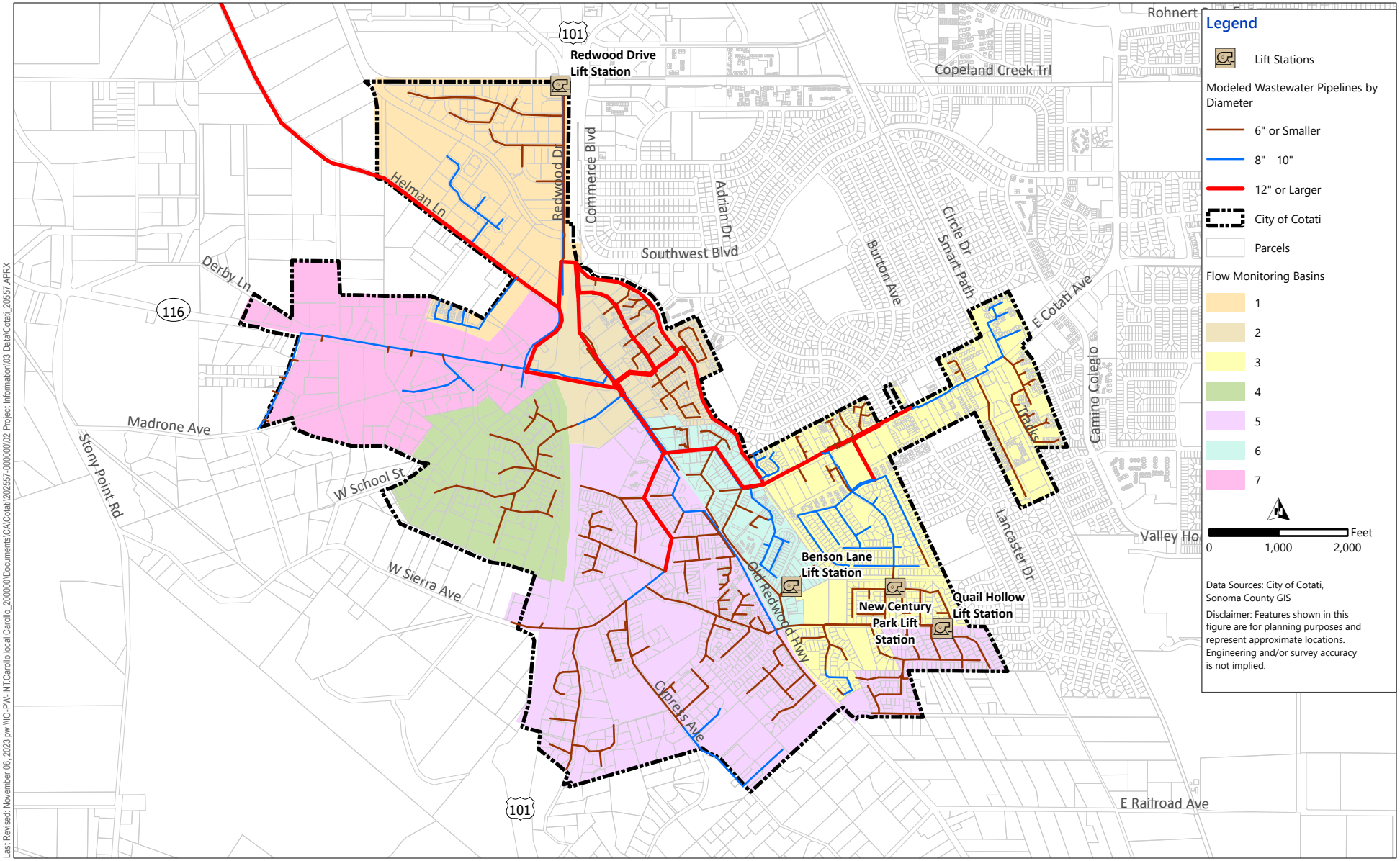


Figure 2 Existing Wastewater System
CITY OF COTATI
FLAHAVAN ESTATES WATER AND WASTEWATER ANALYSIS

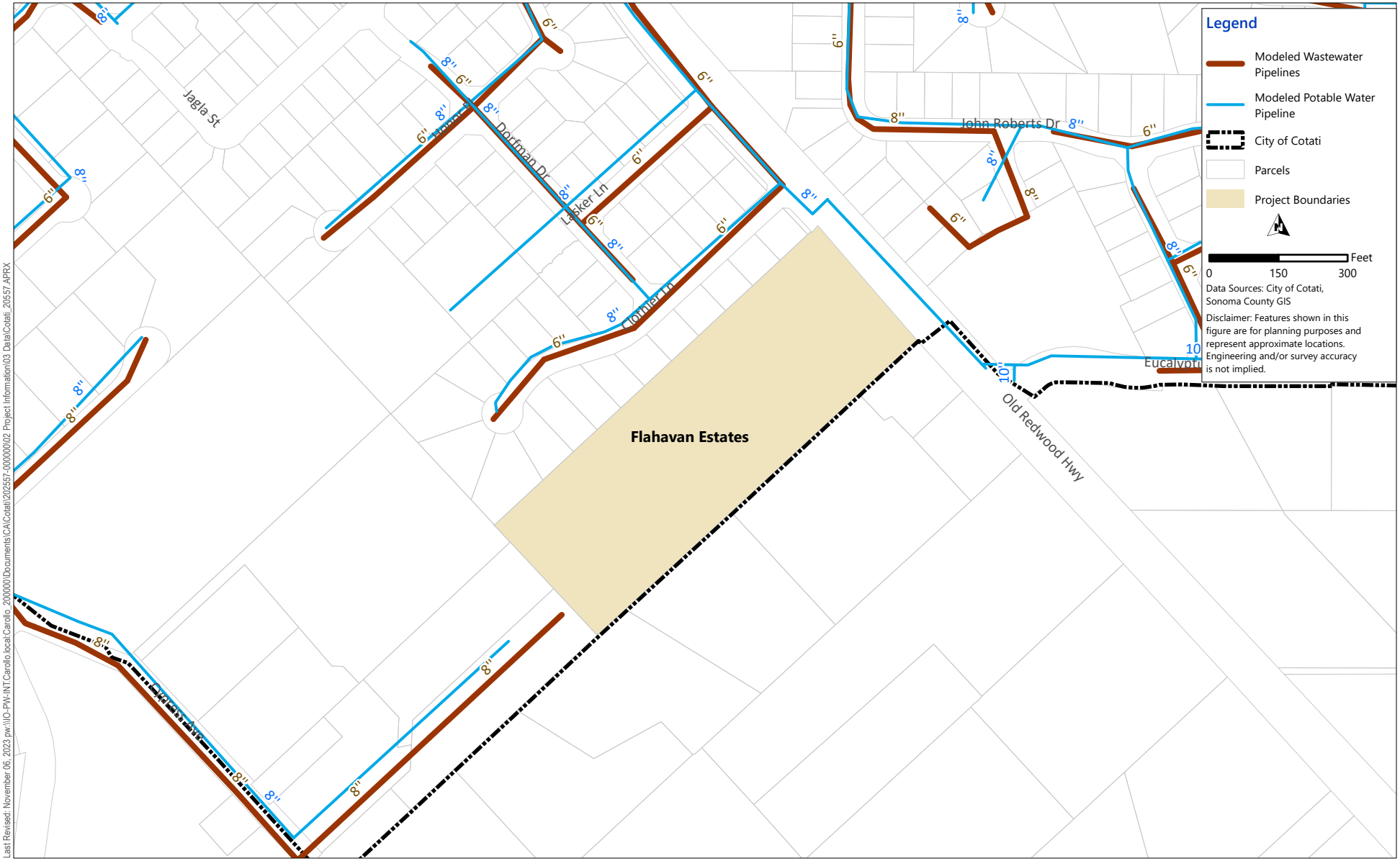


Figure 3 Project Site
CITY OF COTATI
FLAHAVAN ESTATES WATER AND WASTEWATER ANALYSIS

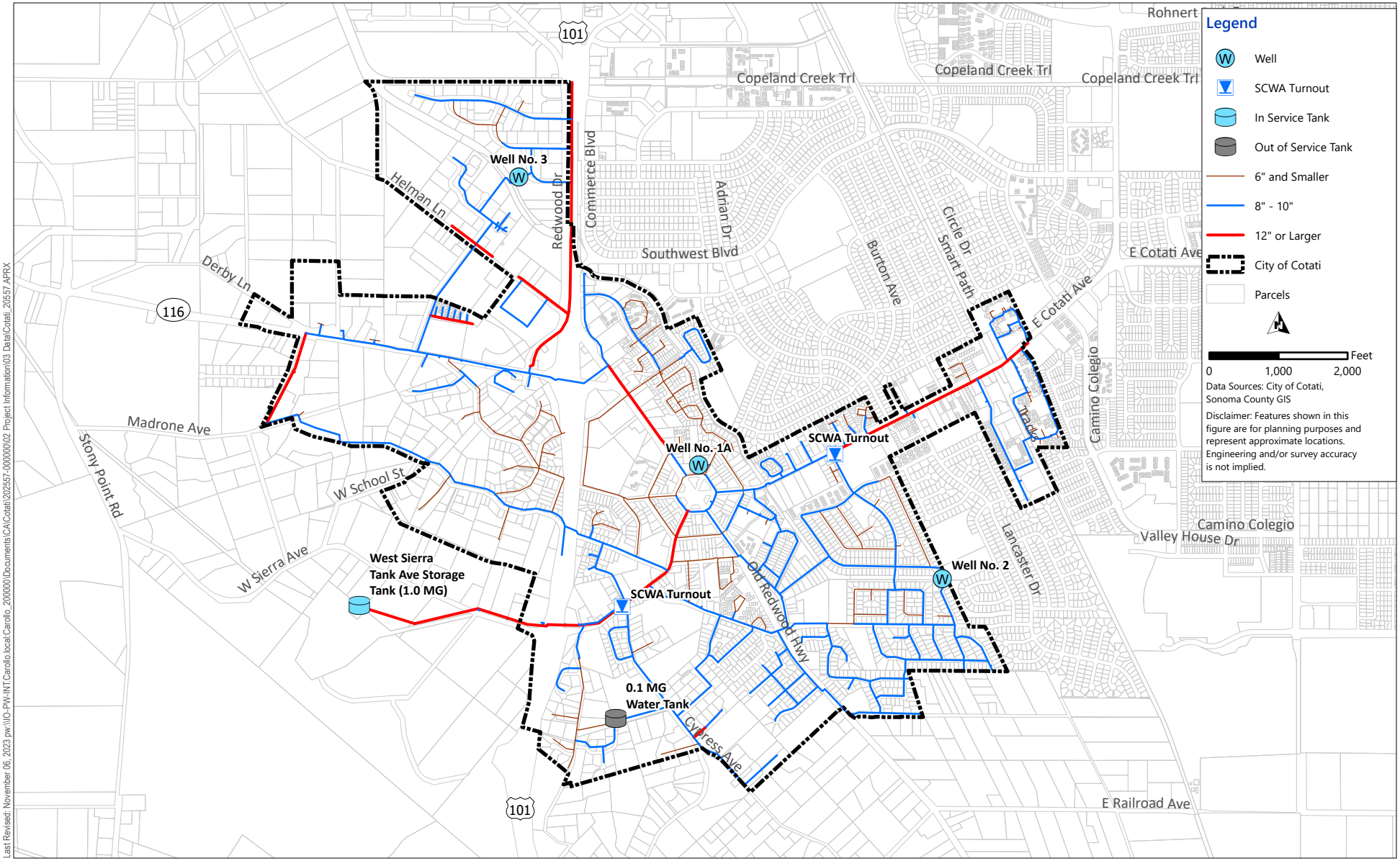


Figure 4 Existing Potable Water System
CITY OF COTATI
FLAHAVAN ESTATES WATER AND WASTEWATER ANALYSIS

3.3 Previous Studies

The City contracted with Carollo in 2010 to develop a Water Distribution and Sewer Collection System Master Plan (2011 Master Plans). As part of the 2011 Master Plans, Carollo developed a hydraulic model in Innovyze's InfoWater and InfoSWMM, modeling software. The models were calibrated to flow monitoring data and pressure logger data collected by a consultant and City staff under direction of Carollo. The models were used to evaluate the existing water distribution system and collection system's capacity and to determine if adequate capacity exists to provide adequate supply and pressure for the water system and to determine if the wastewater collection system could convey peak flows that occur during wet weather events.

In 2016 Carollo completed a wastewater system capacity analysis for the Kessing Ranch development located in the southern portion of the service area where Valparaiso Avenue meets Old Redwood Highway. The analysis found that flow from the development exacerbated the existing capacity deficiencies downstream of the development. Ultimately an overflow was constructed at Valparaiso Avenue and Fehler Lane so that flow could be split west toward the main in W Sierra Avenue or east towards the main in Old Redwood Highway with the pipe invert to the east set three inches higher.

In 2017, Carollo completed a 2017 Master Plan Update which recommended several improvement projects to address existing and future deficiencies. Since the 2017 Master Plan, projects P-1, P-3, P-4, P-8 and P-9 have been constructed. The construction of project P-1 was completed in 2019. Project P-1 includes the installation of a 21-inch diameter gravity main along Old Redwood Highway (starting at Saint Joseph Way), continuing along Highway 116, and finally continuing along Redwood Drive to Helman Lane. Project P-9 (upsize the 6-inch diameter pipeline on Saint Joseph Way to an 8-inch diameter pipeline) was constructed in approximately 2018. The City completed project P-3 (portion in Olof St) and P-8 in 2020 and P-3 (portion in W Sierra Avenue) and P-4 in 2022. The City completed sewer repairs, including laterals in W Sierra Avenue from Cypress Avenue to Water Road in 2022, and is planning to complete repairs to the existing 6-inch sewer in Cypress in Fall/Winter 2023 (no increase to pipe size). Carollo has performed various sewer and water assessments for proposed developments since the 2011 Master Plans.

In October 2023 Carollo updated the wastewater collection and water distribution hydraulic models to reflect the current systems including recently completed projects, water demands, and wastewater flows. The revised models did not have any impacts on the recommended projects in the 2011 Water Distribution System Master Plan (WDSMP) or the 2017 Sewer Collection System Master Plan Update (SCSMP), though some of the projects recommended in those master plans have been implemented and are now reflected in the existing conditions model. The October 2023 study also included an analysis of the Cotati Village 1 and Cotati Village 2 developments impact on the water and wastewater systems. This analysis does not include the Cotati Village 1 and Cotati Village 2 development wastewater flows and water demands.

SECTION 4 EVALUATION CRITERIA

Hydraulic design criteria outlined in the City's 2017 SCSMP Update and 2011 WDSMP were used to evaluate the impact of the proposed development on the existing systems. This section summarizes the relevant evaluation criteria from the Master Plans.

4.1 Wastewater

Gravity sewer pipe capacities are dependent on many factors. These factors include roughness of the pipe, maximum allowable depth of flow downstream, and limiting velocity and slope. Table 1 summarizes the evaluation criteria used for the analysis of the wastewater collection system as part of this study.

The criteria that typically has the greatest impact on the system is the maximum flow depth for existing sewers. During the preparation of the SCSMP, it was decided that the existing collection system sewers would be allowed to surcharge to three feet below the manhole rim during peak wet weather flows (PWWF).

Table 1 Wastewater System Evaluation Criteria

Wastewater System Evaluation Criteria	
Manning's "n" Coefficients	
n = 0.013	
Maximum Flow Depth for Existing Sewers	
PWWF:	3 Feet Below Manhole Rim
Maximum d/D for New Sewers	
Pipe Diameter (inches)	Maximum d/D Ratio (During Peak Flows)
Less than or equal to 12	0.50
12 to 18	0.67
Larger than 18	0.75
Design Velocity	
Minimum Velocity = 2 ft/sec	
Sewer Main Diameter	
Minimum Public Main = 8 inches	

d/D - flow depth to pipe diameter ratio; ft/sec - feet per second

4.2 Potable Water

The City's water system was evaluated under a range of normal and emergency operating conditions, and includes:

- Peak hour demand (PHD).
- Maximum day demand (MDD).
- MDD plus fire flow.

Distribution system evaluation criteria are required to determine the performance of the City's water system under a wide range of operating conditions to identify system deficiencies. The evaluation criteria for this study are consistent with the WDSMP and are summarized in Table 2. The criteria include allowable pressures, pipeline velocities, allowable headloss, as well as fire flow and storage criteria.

Table 2 Potable Water System Evaluation Criteria

Description	Value	Units
Service Pressures		
Maximum Pressure (During ADD)	90	psi
Minimum Pressure (During MDD)	40	psi
Minimum Pressure (PHD)	35	psi
Minimum Residual Pressure (MDD + Fire)	20	psi
Pipeline Criteria		
Maximum Velocity with MDD	8	ft/sec
Maximum Velocity with PHD	10	ft/sec
Water Use Peaking Factors		
MDD	2.4 x ADD	
PHD	3.6 x ADD	
Fire Flow Requirements		
Residential Fire Flow	1,500	gpm for 2 hours
Commercial Fire Flow	1,500	gpm for 2 hours
Industrial Fire Flow	2,500	gpm for 2 hours
Ag/Rural Residential/Parks Fire Flow	1,500	gpm for 2 hours
Storage Volume		
Operational	25 percent of MDD	
Fire Fighting Storage	0.30 MG (2,500 gpm for 2 hours)	
Emergency Storage	100 percent ADD	

gpm - gallons per minute; psi - pounds per square inch

SECTION 5 PROJECTED WATER DEMANDS AND WASTEWATER FLOWS

This section describes the methodology used to calculate the water demand and wastewater loads associated with the Project. Details of the Project, including number of residential units, proposed connection to the existing system, and estimated sewer generation, were provided in the Flahavan Estates drawings dated November 29, 2022.

5.1 Average Dry Weather Wastewater Flow

This study utilized the wastewater flow coefficients established in the City's SCSMP which allowed for the transformation of land use acreage into a corresponding average wastewater flow. The flow coefficients, expressed in gallons per day per acre (gpd/ac), for the SCSMP range from 200 gpd/ac to 1,600 gpd/ac. The Project falls within the Neighborhood Low Density (NL) land use designation which has a flow coefficient of 900 gpd/ac. Based on the SCSMP approach, the project will generate 6,390 gallons per day (gpd). The wastewater generation coefficients in the SCSMP were developed based on data from the City's temporary flow monitoring program and provide a realistic estimate of the flow generated by specific land use categories citywide. Hourly multipliers within a diurnal curve are used to generate peak flows. Based on the analysis of peak flows from the flow monitoring data, a peaking factor of 1.52 was used to simulate peak dry weather flow conditions (PDWF) for the Project estimated flow.

For comparison, sewer generation is estimated to be 14,219 gpd according to the drawings dated November 29, 2022. This is based on a density of 3.25 persons per dwelling unit and a per capita sewer generation of 125 gpd. It should be noted that this estimate is higher than the land use-based approach and may not reflect reductions in water use, and associated sewer generation, which the City has experienced over the past two decades. The plans for this development, including number of units and density, were reviewed and found to align with the land use designation. Therefore, the land use-based approach which is consistent with the SCSMP was used for this analysis and no changes were made to the flow coefficient for this analysis.

PWWF is the highest observed hourly flow that occurs following a storm event. PWWF is a combination of average dry weather flow (ADWF) and the peak infiltration and inflow (I/I). For the City's SCSMP, peak I/I rates for future development were derived using a peak I/I rate of 1,000 gpd/ac.

ADWF, PDWF, and PWWF for the Project is summarized in Table 3.

5.2 Potable Water Demands

This study utilized the WDSMP methodology to estimate water demand for the Project based on parcel acreage and water demand coefficients. The water demand coefficients, expressed in gpd/ac, range from 400 to 4,200 gpd/ac for existing, and 300 to 3,300 gpd/ac for future. Reduced coefficients for the future are based on projected water conservation and were used for this assessment. The NL demand coefficient is 1,300 gpd/ac. Similar to how wastewater flow was developed for the Project, the land use-based approach was used for the potable water demand and no changes were made to the demand coefficient developed as part of the WDSMP.

Table 4 summarizes water demands associated with the Project. Additionally, Table 4 compares the demands utilized to evaluate the supply, storage, and distribution system.

Table 3 Projected Wastewater Flows from Project

	Acreage	Units	Persons/Unit	Flow Coefficient	ADWF (gpd)	PDWF (gpd)	PWWF (gpd)
Flahavan Estates							
Land-use Based Approach(1)	7.10			900 gpd/ac	6,390	9,713	16,813
Per Capita Generation Approach from Drawings	7.10	35	3.25	125 gpd/capita	14,219	21,613	28,713

Notes:
(1) This analysis used the land-use based approach consistent with the Wastewater Master Plan. Per-capita sewer generation approach values were provided on the drawings provided by the City and are shown for comparison only.

Table 4 Projected Water Demands from Project

	Area (acres)	Units	Persons/Unit	Demand Coefficient (gpd/ac)	ADD (gpd)	MDD (gpd)	PHD (gpd)
Flahavan Estates							
Land-use Based Approach	7.10			1,300	9,230	22,152	33,228

SECTION 6 SYSTEM CAPACITY EVALUATION

To evaluate the impacts of the Project on the existing water distribution and wastewater collection systems, the updated hydraulic models were run for two scenarios—existing system without the Project and existing system with the Project. This section describes the wastewater and water capacity analyses.

6.1 Wastewater Capacity Analysis

The City's wastewater hydraulic model was evaluated under PWWF conditions to determine the impact of the proposed Project on the existing system.

Evaluation of the existing system without the Project does not result in deficiencies downstream of the Project and does not require additional improvements. The maximum d/D ratio for peak projected flow in the existing 6-inch diameter pipe downstream of the Project is 0.19. The pipe slope is 0.51 percent.

Evaluation of the existing system with the Project shows that the additional flow from the proposed Project has minimal impact on the existing collection system and does not result in deficiencies or require additional improvements. The maximum d/D ratio for peak projected flow in the existing 6-inch diameter pipe downstream of the Project increased to 0.24 with the additional flow from the Project. Hydraulic profiles from the project site downstream before and after the Project are included as an appendix to this report.

6.2 Potable Water Analysis

6.2.1 Water Supply Analysis

The water supply requirements for the City were determined in the WDSMP by comparing the available water supplies with the water demand. The WDSMP indicated the City should maintain a firm capacity at a minimum equal to the MDD. The City's current firm capacity is approximately 2.96 mgd (assuming the largest well – Well #3 – is out of service and available supply from Sonoma Water is 50 percent of the allotted amount per the contractual agreement).

Based on data provided by City staff, the water demand from 2018 to 2022 was on average 0.74 mgd, with a MDD of 1.77 mgd. The Project will require a MDD of approximately 0.02 mgd, increasing the City's existing MDD to 1.79 mgd. Based on the firm capacity of 2.96 mgd, there is no deficiency in supply with the Project. Table 5 summarizes the results of the supply analysis.

Table 5 Potable Water Supply Analysis

Scenario	MDD (mgd)	Firm Capacity(1) (mgd)	Deficiency (-) / Excess Capacity (+) (mgd)
Updated Existing System Water Demand (2022)	1.77	2.96	
Updated Existing System Water Demand with Project (2023)	1.79	2.96	1.17 (+)

Notes:
(1) Firm capacity is the City's total supply capacity with the largest well (Well #3) out of service and Sonoma Water supply at 50%.

6.2.2 Water Distribution Capacity Analysis

The City's water model was evaluated under ADD, MDD, PHD, and fire flow scenarios to determine the impact of the Project on the existing system. The existing system without additional demand from the proposed Project has seven junctions with a minimum pressure below the minimum allowable pressure according to the evaluation criteria for MDD. Figure 5 shows the location of these junctions. There are a handful of additional junctions that do not meet the minimum pressure under a MDD with fire flow scenario as well.

The existing system with additional demand from the proposed Project has the same number of junctions with a minimum pressure below the minimum allowable pressure according to the performance criteria under MDD and MDD with fire flow scenarios. Figure 6 shows the location of junctions below the minimum allowable pressure under the MDD scenario with the Project demands. Therefore, the proposed Project does not create additional deficiencies or impact the operation of the system, and no additional improvements beyond any existing needs are required.

As shown in Table 6, the Project could increase the updated 2022 estimated ADD by 2 percent under existing conditions.

Table 6 Existing System Updated Water Demand

Year	ADD (mgd)	MDD (mgd)	PHD (mgd)	ADD Change from Previous (%)
Existing System Water Demand (2010) – Master Plan	0.98	2.36	3.54	
Existing System Water Demand (2013) – Update	0.90	2.16	3.24	92%
Existing System Water Demand (2022) – Update	0.64	1.96	2.95	71%
Existing System Water Demand with Project (2023)	0.65	1.98	2.98	102%

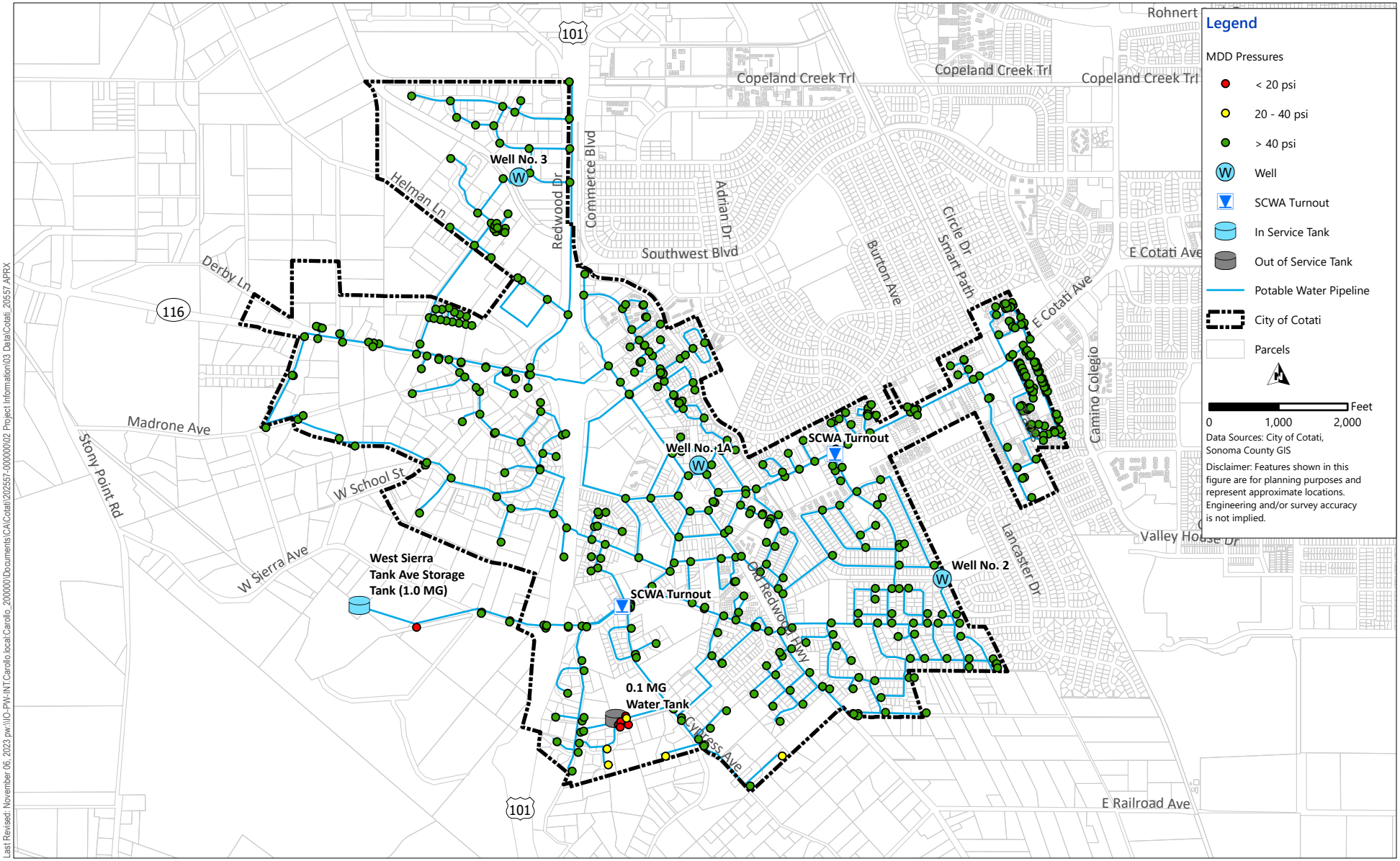


Figure 5 Existing System - Maximum Day Demand Pressure Results
CITY OF COTATI
FLAHAVAN ESTATES WATER AND WASTEWATER ANALYSIS

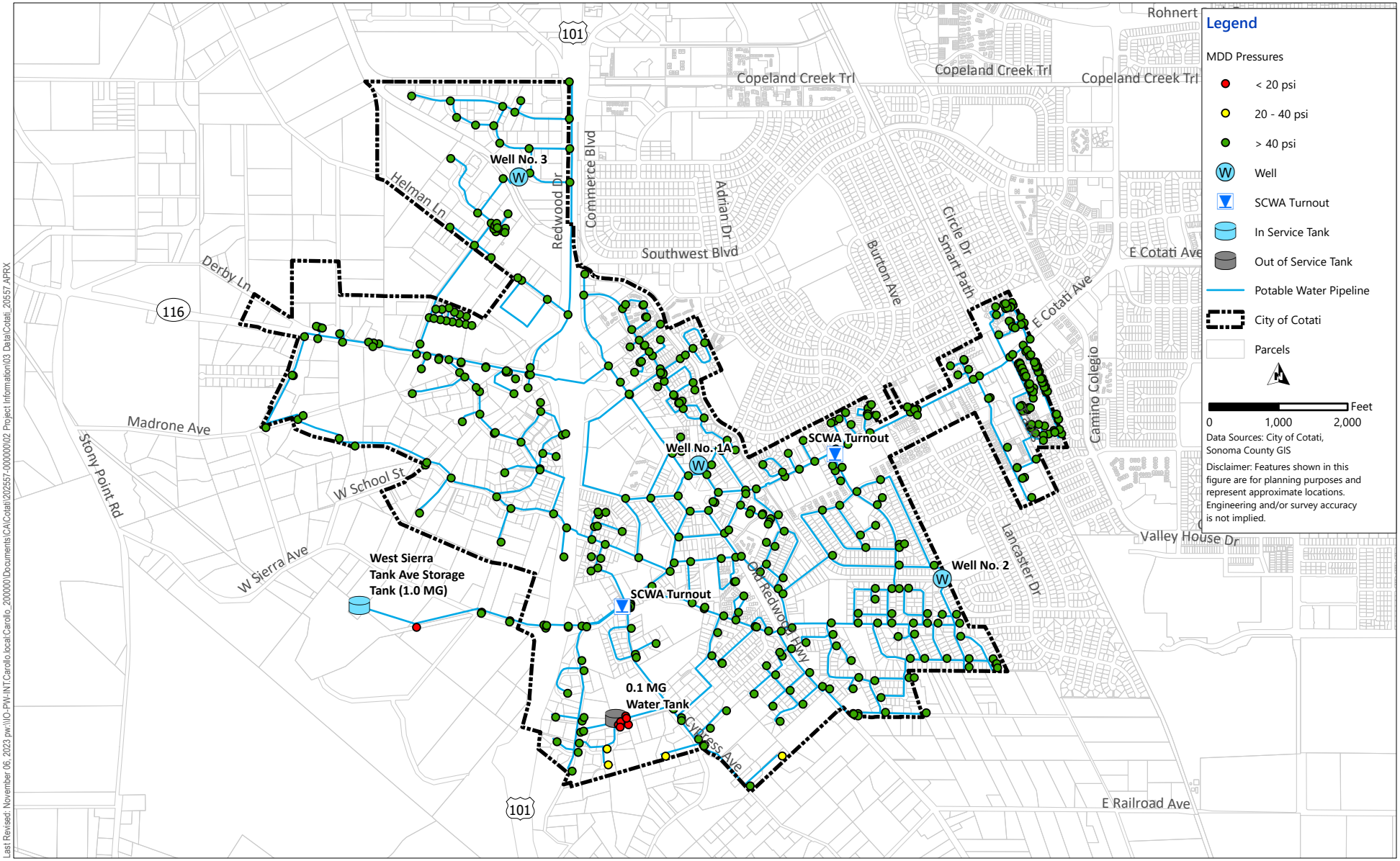


Figure 6 Existing System with Flahavan Estates - Maximum Day Demand Pressure Results

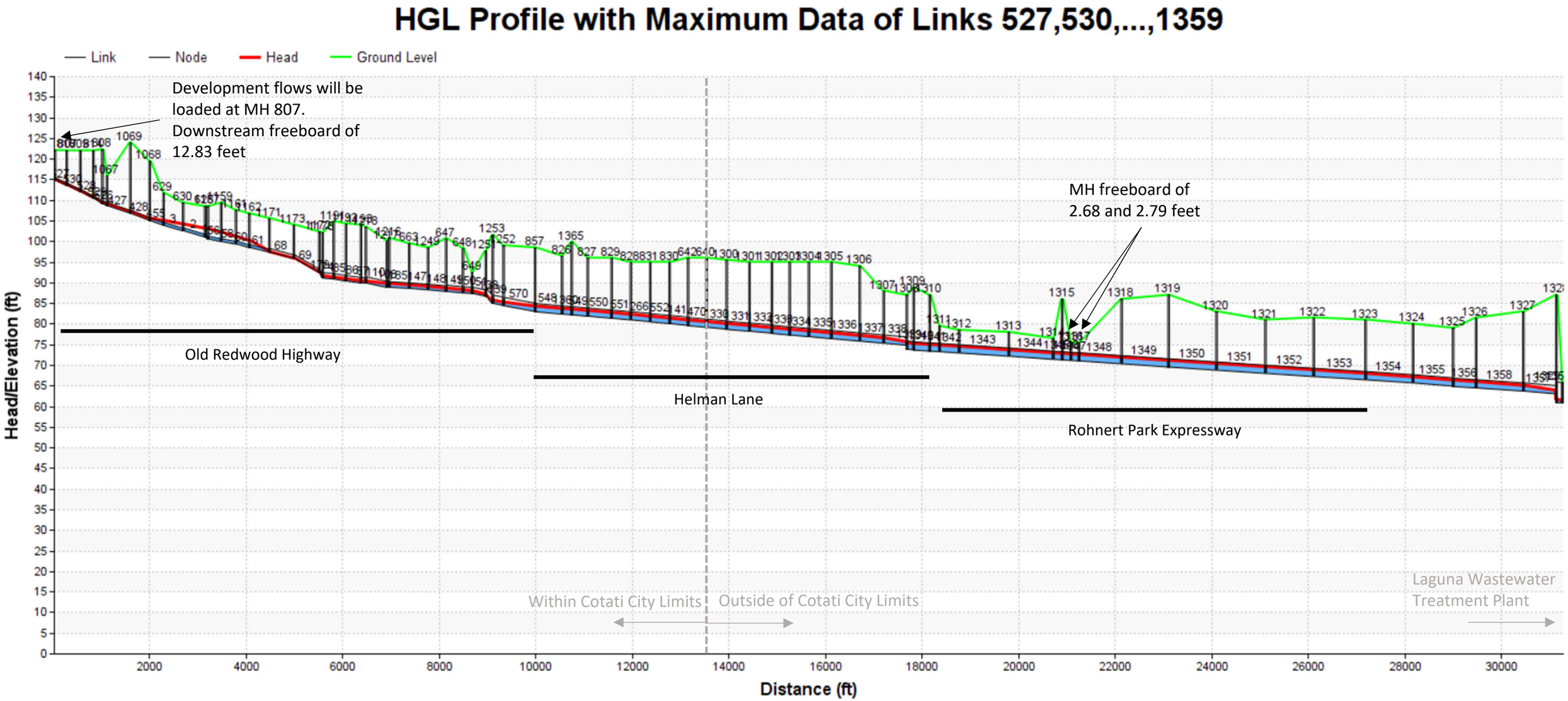
SECTION 7 SUMMARY OF FINDINGS

The objectives of this study were to determine the impact of the proposed Project on the existing sewer collection and water distribution systems. The following list highlights the findings of this study:

- The sewer model showed that the existing 6-inch gravity pipeline along Old Redwood Highway and downstream of it have sufficient capacity to convey existing PWWF.
- The additional flow from the proposed Project does not impact the collection system under existing PWWF conditions.
- The existing water system may have deficiencies related to low pressures, but the proposed Project does not exacerbate these issues or introduce any additional deficiencies.
- There are no recommended changes to the proposed improvements provided in the 2011 WDSMP or the 2017 SCSMP Update.

APPENDIX A HYDRAULIC PROFILES

Without Flahavan Estates



With Flahavan Estates