Appendix G

Utility Impact Study

Ravenswood/Four Corners Specific Plan Update SEIR

Ravenswood Business District Specific Plan Update
Utility Impact Study

Prepared for
Raimi & Associates

and

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Executive Summary

Schaaf & Wheeler has been retained by Raimi & Associates to determine impacts from the City of East Palo Alto (City) Ravenswood Business District Specific Plan Update (Project) on the public potable water, sanitary sewer, and storm drain systems that serve the Project area. The Project encompasses approximately 350 acres bounded by University Avenue at the west, the City boundary and a rail line at the north, the Bay at the east, and Weeks Street at the south (Figure A-1). The Project serves as a Specific Plan Update considering additional development above and beyond that studied in the 2013 Ravenswood/4 Corners TOD Specific Plan. The Specific Plan described a vision for a transit-oriented center, an improved multimodal transportation network, and a greater diversity of land uses. As a portion of this study, the levels of development proposed in the 2013 Specific Plan were considered along with two additional scenarios (Scenario 1 and 2) with land use densities above those studied in the 2013 Specific Plan.

Project impacts to the potable water system are analyzed for both Existing and Future Cumulative Condition. Hydraulic models simulating pre- and post-Project development scenarios are performed to examine hydraulic deficiencies. The Existing Condition and Future Cumulative Condition is based on the *2022 City of East Palo Alto Water System Master Plan* (WMP). The Future Cumulative Condition includes CIPs considered in the WMP and outlines the highest priority CIPs needed to serve the Project's increased demands while meeting the City's Standards.

Project impacts to the sanitary sewer system are analyzed for Existing and Future Cumulative Conditions. Hydraulic models simulating pre- and post-Project development scenarios are performed to examine hydraulic deficiencies. The Existing and Future Condition is based on the *2020 East Palo Alto Sanitary District (EPASD) Sewer Master Plan Update* (SMP). The Future Cumulative Condition includes CIPs considered in the Master Plan Update and outlines modified CIPs needed to serve the existing and proposed demands while meeting EPASD's standards. A portion of the Project area is served by West Bay Sanitary District (WBSD). S&W was not able to obtain detailed information from WBSD for this study. The majority of the planned development areas within the Project area are served by EPASD, and therefore this study focuses on EPASD impacts.

Project impacts to the storm drain system are analyzed for both Existing and Future Cumulative Condition. Hydraulic models simulating pre- and post-Project development scenarios are performed to examine hydraulic deficiencies. The Existing Condition and Future Cumulative Condition is based on the *2014 City of East Palo Alto Storm Drain Master Plan* (SDMP). The Project modeling assumes the SDMP Alternative 2 improvement program CIPs, as well as CIPs that were completed after the SDMP was published. The modeling also addresses modified parameters associated with the current San Francisquito Creek Joint Powers Authority (SFCJPA) SAFER Bay Project. The analysis discusses CIPs required to meet the City's standards and mitigate Project impacts.

Water System Project Impacts

The water system has deficiencies pre-project under peak hour demand (PHD) at Existing Condition. Similarly, there are many nodes that do not meet planning level fire flow requirements at Existing Condition. As a portion of this study, CIPs are identified that are required to meet the fire flow demands at the Project area and mitigate impacts on the fire flow availability due to increased water demands from the Project. The highest priority CIPs are outlined based on each level of development proposed.

The water system has sufficient capacity in the Future Cumulative Condition pre- and post-Project to meet the required fire flows in the Project area assuming the CIPs proposed in the WMP are constructed, however, multiple nodes across the City remain deficient. The Future Cumulative Condition meets the minimum pressure requirements under Peak Hour Demands (PHD) pre- and post-project. The actual fire flow requirements may change as the planning process continues and Project specific requirements are determined by the City Fire Marshal. If Project conditions require higher fire flow than what is analyzed, revised modeling should be conducted.

The water system for the City is primarily served with purchased water delivered through the SFPUC Supply Turnouts. Per the Water Supply Agreement between the City and SFPUC, the City has a total capacity of 3.56 million gallons per day (Average Daily Demand). As a portion of this study the total estimated demands in the

Future Cumulative Condition were compared to the City's supply capacity. The City has sufficient capacity to support the estimated demand increase associated with land uses proposed in the General Plan and the 2013 Specific Plan. With the proposed land uses of the Project, the City has sufficient capacity to support the land use levels proposed in Scenario 1 and Scenario 2 of the Project.

Sewer System Project Impacts

The sanitary sewer system does not have sufficient capacity in the Existing Condition nor the Future Condition with or without the estimated increase in incremental Project flow. In the pre-Project condition, model results indicate that many pipes within the Project boundary and the remainder of the City are surcharging. CIPs are developed to address existing deficiencies and future deficiencies pre- and post-project. CIPs outlined in this report are based on CIPs recommended in the 2020 SMP and further modified to ensure all pipes meet the performance criteria outlined in the 2020 SMP.

For the purposes of this study, CIPs were developed using the 2020 SMP recommended CIPs; however, the CIPs outlined in the 2020 SMP did not correct all of the deficiencies in the existing nor in the future conditions. Additional CIPs are outlined to address all deficiencies pre-Project in both the existing and future condition. The increase in flows for post-Project Scenarios both existing and future condition created additional deficiencies. CIPs were developed above and beyond those required pre-Project for each level of development and increased land use density proposed by the Project.

The sewer system collects sewage from East Palo Alto and conveys flows to the Regional Water Quality Control Plant in Palo Alto. The EPASD has a total treatment allocation of 2.9 million gallons per day (Average Dry Weather Flow). As a portion of this study, the total estimated sewer flows in the Future Cumulative Condition were compared to the EPASD treatment allocation. The EPASD has sufficient allocation to support the estimated sewer flow increase associated with land uses proposed in the General Plan and the 2013 Specific Plan. With the proposed land uses of the Project, the EPASD will not have sufficient treatment allocation. Additional treatment allocations will need to be secured in the future to support the level of development analyzed in the SP update.

Storm Drain System Project Impacts

The storm drain system does not have sufficient capacity in the Existing Condition nor the Future Condition with or without the estimated increase in storm water runoff due to Project development. The 2014 SDMP identifies storm drain performance is significantly affected by SF Bay tides and low-lying topography within the City boundaries. The storm drain system on the east side of the City is comprised of several local gravity outfalls that discharge directly to the SF Bay. The SDMP improvement program concept eliminates individual local gravity outfalls and conveys storm water south to the existing O'Connor Pump Station, thereby eliminating the influence of SF Bay tides on the storm drain system. The RBD SP envisions development in areas that currently do not drain to the City's storm drain system. In addition to new land development, the SFCJPA SAFER Bay project plans to protect the City from high tides by constructing a perimeter levee system along the eastern boundary of the City, which in turn results in increased storm water runoff to the City's storm drain system. The culmination of several factors requires modification to the SDMP findings. The 2014 SDMP-recommended CIPs are modified to include the construction of an additional storm drain pump station to be located adjacent to the existing Runnymede storm drain outfall and several pipe improvement project modifications.

Infrastructure Improvement Costs

Improvement costs for the public utility systems are outlined for the water, sewer, and storm drain systems. Costs are only included for CIPs in the RBD or downstream of the RBD. CIPs only include City or Municipal level improvements and do not include private property improvements needed to serve development projects. Water CIP costs include water conveyance improvements, storage improvement costs, and new supply connections. Sewer CIP costs include conveyance in the RBD and along the Project-affected flow path but do not include treatment capacity improvements or additional treatment capacity rights. Storm CIP costs include City conveyance improvement projects and pump stations but do not include any regional levee projects or individual development grading or onsite storm systems including LID, drainage, and trash capture systems. Table ES-1 represents CIP costs related to the RBD SP area for each utility system. The cost values are totals and do not differentiate cost sharing analysis for new RBD development.

Table ES-1: Infrastructure Improvement Costs Summary

Utility	2013 Specific Plan (Baseline)	Project Scenario 1	Project Scenario 2
Water	$9,628,200	$16,051,200	$16,051,200
Sewer	$16,677,950	$18,356,030	$21,226,450
Storm Drain	$22,800,000	$22,800,000	$22,800,000
Total	**$49,106,150**	**$57,207,230**	**$60,077,650**

Chapter 1. Introduction

1.1. Project Description

This report presents the results of the Utility Impact Study (UIS) prepared for the Ravenswood Business District Specific Plan Update (Project) in East Palo Alto (City), California. The Ravenswood Business District Specific Plan area encompasses approximately 350 acres, covering approximately 850 parcels bounded by University Avenue at the west, the City boundary and a rail line at the north, the Ravenswood Open Space Preserve and the Bay at the east, and Weeks Street at the south (Figure A-1). Currently, the area is distinguished by single-family residential, and general and light industrial uses. In addition to University Avenue, which is an important corridor within the City as well as the region, the Project area includes Bay Road, a major east-west corridor in East Palo Alto. Some small portions of the Project area are located outside these general boundaries.

The Ravenswood/4 corners TOD Specific Plan was adopted in 2013. The Specific Plan describes a vision for a transit-oriented center, an improved multi-modal transportation network, and a greater diversity of land uses. An Environmental Impact Report (EIR) was prepared to identify the impacts and mitigation measures associated with new development permitted under the Specific Plan as outlined in Table 1-1. The proposed Project has multiple Scenarios of proposed land use densities in consideration. The Project serves as an update to the previous Specific Plan. Levels of development considered in the previously approved Specific Plan are considered in the report along with the two additional levels of development proposed by the Project. Land use from the 2013 Specific Plan and the City's General Plan is used as baseline condition in the Future Cumulative Condition. The development level from the 2013 Specific Plan is studied in the Existing Condition to provide a comparison of the level of development proposed by the Project. Table 1-1 provides a summary of the three proposed levels of development.

Table 1-1: New Development Comparison of the 2013 Specific Plan and Specific Plan Update

Land Use	2013 Specific Plan Land Use (Base Scenario)	Specific Plan Update Scenario 1 Land Use	Specific Plan Update Scenario 2 Land Use
Residential	835 DU	1,350 DU	1,600 DU
Industrial – R&D	176,000 SF	988,000 SF	1,167,000 SF
Retail	112,473 SF	112,473 SF	112,473 SF
Office, Industrial, & Services	1,492,696 SF	2,276,743 SF	2,668,488 SF

The 2013 Ravenswood Business District Specific Plan EIR had two goals that outline the basis of this study. The EIR included multiple additional goals for each utility system discussed in further detail in the corresponding utility sections. Goal UTIL-3.4 outlines the goal to install or contribute proportionate share towards the CIPs required in the 2008 DEPLAN. As a portion of this study the required CIPs were compared to the most updated studies and Master Plans and a set of new CIPs required to be constructed as a portion of the development proposed by the Specific Plan Update is outlined in this report. Goal UTIL-3.7 outlines additional goals that coincide with UTIL-3.4 and require coordination between developers and the City to ensure the utility systems have sufficient capacity to meet demands in the City.

1.2. Water System Analysis Approach

Project impacts are analyzed using the City's water models developed as portion of the *2022 Water System Master Plan* (WMP) for two conditions: Existing and Future Cumulative. As a baseline for system performance, each condition is evaluated pre-Project for existing hydraulic deficiencies. The estimated incremental water demand resulting from Project development is added to the model and post-Project deficiencies are examined for each land use scenario. In total, seven model simulations of the water system are performed, as shown in Figure 1.

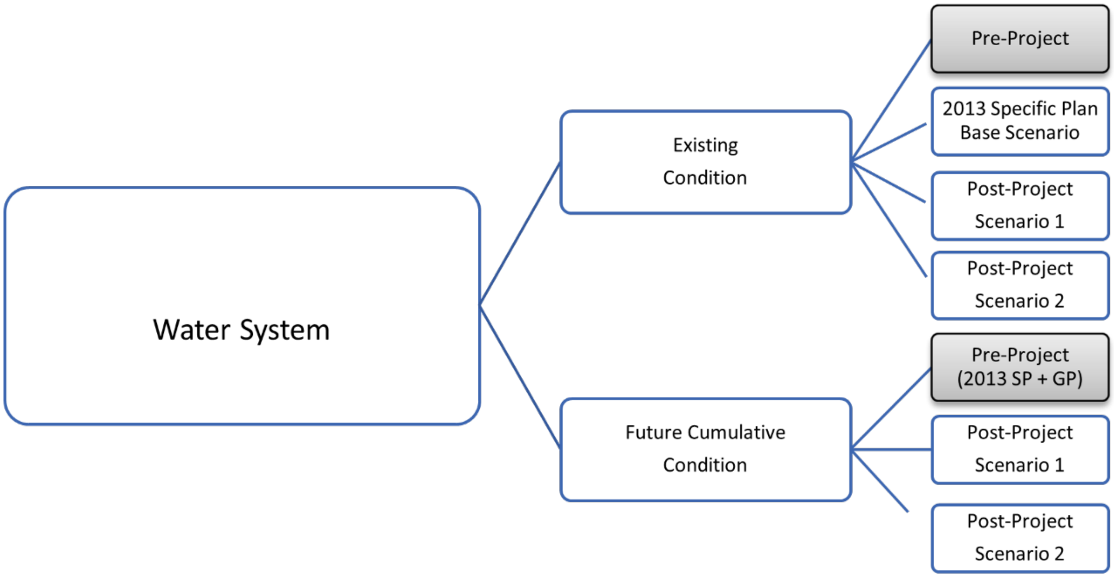


Figure 1. Water System Model Simulations

The Existing Condition model consists of the existing distribution system and operating parameters along with water demands based on existing land use from the WMP. Within the Specific Plan boundary, water demands are updated to be consistent with current land use based on information provided by the City. In the Existing Condition, the demands outlined in the 2013 Specific Plan are also considered to provide a comparison of system performance impact to the Project.

The Future Cumulative Condition water demand is based on the estimated demands from the 2035 General Plan and has since been revised to include the demands from the 2013 Specific Plan not accounted for or in exceedance of the 2035 GP projections. Post-Project demands are further revised to include demands proposed by this Project for each land use scenario.

1.3. Sewer System Analysis Approach

There are two distinct sewer collection system districts that serve the City, West Bay Sanitary District (WBSD) and East Palo Alto Sanitary District (EPASD). The majority of planned development within the RBD SP area flows to EPASD. WBSD was contacted multiple times during this study and was not responsive to allow inclusion of hydraulic modeling of their system. Given the majority of the RBD SP flows to EPASD and the lack of response from WBSD, this study focuses on the hydraulic impacts of the EPASD only.

Project impacts to the sanitary sewer system are analyzed using the EPASD's sewer models for two conditions: Existing and Future Cumulative. As a baseline for system performance, each condition is evaluated pre-Project for existing hydraulic deficiencies. CIPs are developed and considered to be installed for post-Project conditions. The estimated sewer flow resulting from Project development is added to the model and post-Project deficiencies are examined. In total, seven model simulations of the sewer system are performed, as shown in Figure 2.

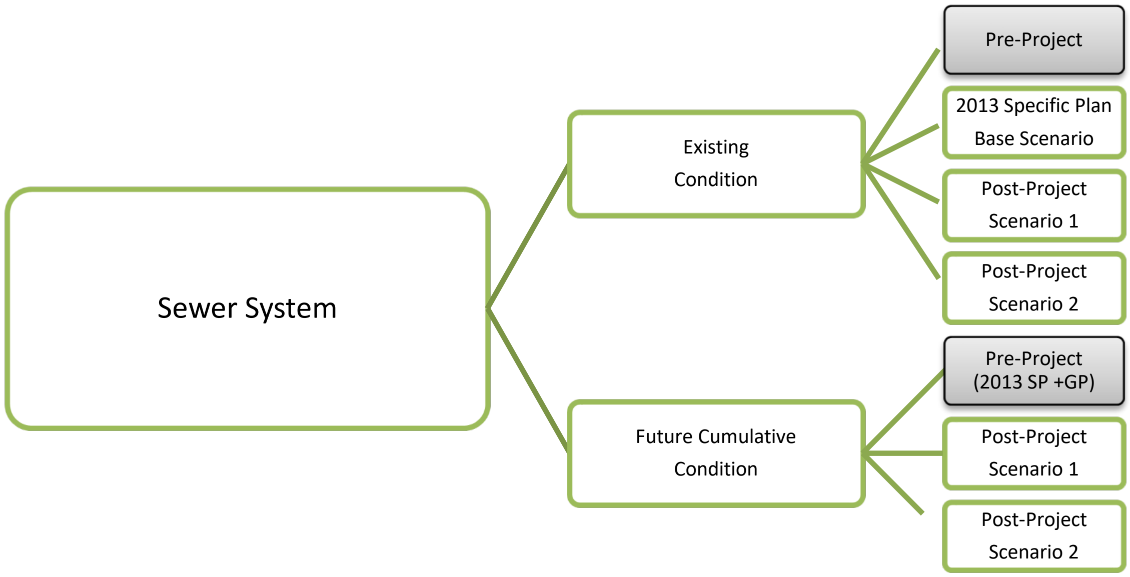


Figure 2. Sewer System Model Simulations

The Existing Condition model consists of the existing collection system and operating parameters along with demands from the *2020 EPASD Sewer Master Plan Update* (SMP). Within the Specific Plan boundary, sewer flows are updated to be consistent with current land use based on information provided by the City. In the Existing Condition, the demands outlined in the 2013 Specific Plan are also considered to provide a comparison of system performance to the Project.

The Future Cumulative Condition sewer flows are based on the 2035 General Plan land use and have since been revised to include demands from the 2013 Specific Plan not accounted for or in exceedance of the 2035 GP projections. Post-Project sewer flows are further revised to include demands proposed by this Project.

The modeling analysis builds upon itself starting with Existing Condition pre-Project. System improvements are then applied to meet EPASD performance criteria for the Existing Condition pre-Project. The upgraded sewer system to meet the previous scenario is the basis (or starting condition) for the next land use scenario. This stepping-stone approach is continued through the remaining modeled scenarios.

1.4. Storm Drain Analysis Approach

Schaaf & Wheeler updated the 2014 SDMP model to include infrastructure projects completed since 2014 and to reflect and analyze the impact of various conditions discussed in this report. Similar to the SDMP, the system is analyzed with a 10-year design storm. Existing conditions are analyzed on the assumption that gravity outfall boundary conditions are characterized by a constant water surface elevation equivalent to Mean Sea Level of San Francisco Bay in the vicinity of East Palo Alto.

For Future Cumulative Condition model, boundaries were altered to reflect the construction of new levees currently being planned by the SFCJPA. Once levees are constructed, gravity outfalls are ineffective during storm events due to the relative elevation between ground and SF Bay water elevations. Therefore, as discussed in the SDMP, gravity outfalls are removed from the model and interior drainage is conveyed by pump station to receiving waters. Storm drain system routing and configuration generally follows CIP Alternative 2 in the SDMP, with several modifications.

1.5. Report Organization

This report is organized into five chapters. Chapter 2 discusses the water demand estimates for the Project. Chapter 3 covers the impacts and capital improvement recommendations for the water system. Chapter 4 discusses the sewer flow estimates and Chapter 5 covers the capital improvements recommendations for the sewer system. Chapter 6 discusses storm drainage and the impacts and improvement recommendations for the storm drain system.

Chapter 2. Water Demand Projections

This chapter discusses the estimated water demand and required fire flow for the Project development. The proposed Project demand is added to the Existing and Future Cumulative Condition models as an incremental difference from the baseline water demand modeled within the Project area. The pre-Project baseline demand in the Existing Condition follows the methodology described in the 2022 WMP. Within the Project area, pre-Project baseline demand in the Existing Condition is set to match existing land use types and densities provided by the City. Pre-Project in the Future Cumulative Condition includes demands associated with the level of development proposed in the 2013 Specific Plan and the City's General Plan. The water unit duty factor for estimating Project demand is taken from the 2022 WMP to remain consistent with the City-wide demand projections used in the hydraulic models.

Water demand in this section represents Average Daily Demand (ADD). The ADD is an estimated daily average of water use patterns that varies by season and customer type.

2.1. Project Water Demand

Project water demand is estimated using proposed land use types and densities as provided by the City and water unit duty factors developed as a portion of the 2022 WMP. Development levels proposed in the 2013 Specific Plan and the two development Scenarios outlined in the Project are considered as a portion of this analysis. Table 2-1 provides the applicable water unit duty factors outlined in the 2022 WMP for the Project land uses. Table 2-2 provides the demand estimation for the Project area with proposed development types and densities.

Table 2-1: Water Unit Duty Factors

Use Type	Water Demand Factor	Units
Industrial Warehouse	110	GPD/1,000 SF
Industrial R&D/Lab	375	GPD/1,000 SF
Commercial – Office	110	GPD/1,000 SF
Retail/Restaurant	160	GPD/1,000 SF
Civic/Amenities	110	GPD/1,000 SF
Residential – Single Family	260	GPD/DU
Residential – Multi-family	160	GPD/DU

Table 2-2: Project Estimated Water Demand

Condition	Water Demand (gpd)		
	2013 Specific Plan Base Scenario	Development Scenario 1	Development Scenario 2
Project	381,792	854,937	1,110,790

2.1.1. Project Required Fire Flow

Anticipated fire flow requirements within the Project area are based on fire flow requirements developed as part of the 2022 WMP, shown in Table 2-3. Fire flow requirements are assigned based on land use types developed as part of the Specific Plan Update. Project fire flows are assumed to be 4,000 gpm based on the requirements outlined in the 2022 WMP and is representative of a planning-level fire flow requirement. Project-specific fire flows may deviate from what is studied due to project-specific building size and other building code variables not known at the time of this study.

Table 2-3: Anticipated Project Fire Flow Requirements

Land Use	Required Fire Flow Rate (gpm)
Single Family Residential	1,000
Multi-Family Residential	4,000
Non-Residential	4,000

2.2. Existing Condition

2.2.1. Pre-Project (Baseline) Demand

The pre-Project (baseline) condition is based on existing land use types and densities provided by the City and water unit duty factors developed for the City as part of the 2022 WMP. Table 2-4 provides the estimated demand for existing pre-Project conditions.

Table 2-4: Baseline Demand for Existing Condition

Condition	Water Demand (gpd)
Pre-Project	48,000

2.2.2. Post-Project Incremental Demand

For the Project impact analysis in the Existing Condition, Project demand is added to the Existing Condition model as an incremental difference from the pre-Project demand. This overall incremental demand is spread across the Project area given land use types and densities developed as part of the Specific Plan Update. The incremental Project demand in the Existing Condition is given in Table 2-5. Base Scenario demands are demands proposed as a portion of the 2013 RBD Specific Plan to provide a comparison of the Specific Plan Update proposed land use to the previously approved land use in the City. Scenarios 1 and 2 are demands proposed as a portion of the RBD Specific Plan Update Project.

Table 2-5: Incremental Project Demand for Existing Condition

	Water Demand (gpd)		
	2013 Specific Plan Base Scenario	Scenario 1	Scenario 2
Pre-Project (Baseline) Demand	48,000	48,000	48,000
Project Demand	381,792	854,937	1,110,790
Incremental Project Demand	*+333,792*	*+806,937*	*+1,062,790*

2.3. Future Cumulative Condition

2.3.1. Pre-Project (Baseline) Land Use and Demand

Future Cumulative baseline demand for the Project is adopted from the City's InfoWater model developed as part of the 2022 WMP. In the Future Cumulative Condition model, water demands are based on the 2035 General Plan (GP) land use and modified further based on the 2013 RBD Specific Plan. Table 2-6 presents the pre-project

Future Cumulative Condition demand including the proposed demands due to the approved land use from the 2013 RBD Specific Plan.

Table 2-6 – Baseline Demand for Future Cumulative Condition (Based on 2013 Specific Plan and General Plan)

Condition	Water Demand (gpd)
Pre-Project (2013 SP + GP)	381,792

2.3.2. Post-Project Incremental Demand

Project demand is added to the model as an incremental difference from the pre-Project demand. The incremental Project demand in the Future Cumulative Condition is given in Table 2-7. As with the Existing Condition model, this incremental demand is spread across the Project area following land use types and densities developed as part of the Specific Plan Update.

Table 2-7: Incremental Project Demand for Future Cumulative Condition

	Water Demand (gpd)	
	Scenario 1	Scenario 2
Pre-Project (Baseline) Demand	381,792	
Project Demand	854,937	1,110,790
Incremental Project Demand	*+473,145*	*+728,998*

Chapter 3. Water System Impact

Project impacts to water supply, water storage, hydraulic conveyance, and fire flow requirements are evaluated in this chapter to ensure the Project demand can be adequately met. Hydraulic conveyance and available fire flow are assessed for both Existing and Future Cumulative Conditions. Water supply and water storage are evaluated for the Future Cumulative Condition.

The 2013 Ravenswood Business District Specific Plan EIR had two specific goals relating to the water system. Goal UTIL-2.1 outlines the goal to study each development to ensure impacts on the water system including impacts to hydraulics, supply, and storage. Hydraulics, supply, and storage are all discussed in this section. Goal UTIL-2.2 outlines the goal to verify the City has sufficient water supply if demands increase by the Project. This study includes the analysis of the City's water supply and discusses the requirements of additional needed water supply.

3.1. Demand Scenarios and Performance Criteria

Hydraulic deficiencies within the water system are evaluated under two demand scenarios: Peak Hour Demand (PHD) and Maximum Day Demand with Fire Flow (MDD + FF). The MDD and PHD peaking factors from the 2022 Water System Mater Plan (WMP) are used for this analysis. As detailed in the 2022 WMP, MDD and PHD peaking factors are developed using hourly data from the City's SFPUC meters at each turnout from 2018 through 2021. The calculated peaking factors, presented in Table 3-1, are applied to Average Day Demand (ADD).

Table 3-1: Peaking Factors

Category	Peaking Factor
Maximum Day	1.3
Peak Hour	1.95

Established design criteria used to evaluate the Project impact for all scenarios are summarized in Table 3-2.

Table 3-2: Water System Performance Criteria

Criteria	PHD	MDD + FF
Minimum Allowable Pressure (psi)	40	20

3.2. Water Supply Analysis

The increased water demand from the Project development in the Future Cumulative Condition is compared with the City's supply turnouts and groundwater well capacities to ensure demand can be met. The East Palo Alto water system is supplied primarily by three SFPUC Turnouts. The current system does not have storage; however, two water storage tanks and associated booster pump stations are high priority CIPs in the 2022 Master Plan and are the basis of the storage analysis. Two additional tanks are being designed in coordination with the City and land developers.

Water demand versus supply capacity is given in Table 3-3. Demands throughout the City can be sufficiently supplied by the three SFPUC Turnouts based on the supply capacity provided in Table 4-9 of the *2022 WMP* for the Future Cumulative Condition. The City has sufficient supply to meet the demands for Scenario 1 and Scenario 2 development proposed in the Specific Plan Update.

Table 3-3: Future Cumulative Condition Demand versus Supply

Future Cumulative Demand			Total Capacity (mgd)*
Pre-Project (2013 SP + GP)	Post-Project ADD (mgd)		
ADD (mgd)	Scenario 1	Scenario 2	
2.47	2.95	3.10	3.46

** Total Capacity from Table 4-9 in the Water System Master Plan (EKI, 2022 Revised)*

3.3. Water Storage Analysis

Water storage volume requirements are evaluated according to the requirements outlined in the 2022 WMP. Storage requirements outlined in the 2022 WMP are comprised of equalization (25% MDD), fire flow, and emergency storage (100% of ADD). There is no existing storage in the City's system, however, multiple tanks are currently being designed to provide 1.65 million gallons (MG) of storage. The City has an existing groundwater well (groundwater credit of 0.16 MG) and proposes to construct an additional well in the future to increase the ground water credit to 0.7 MG. Table 3-4 outlines the total storage requirements across the City in the Future Cumulative Condition. The water storage requirement to serve the RBD alone is 1.5 MGD for the Base Scenario, 2.1 MGD for Scenario 1, and 2.3 MGD for Scenario 2.

Table 3-4: Storage Requirements

Project Scenario	Equalization Storage (MG)	Operational Active Storage (MG)	Fire Flow (MG)	Groundwater Credit (MG)	Total Required Storage (MG)
Base	0.80	2.47	0.96	0.7	3.54
1	0.96	2.95	0.96	0.7	4.17
2	1.01	3.10	0.96	0.7	4.37

Two additional tanks are proposed as high priority CIPs outlined in the WMP. The City has identified multiple potential sites for future tanks as discussed in the 2022 WMP to meet the City's storage requirements. One identified site in the WMP is located within the RBD Project area at the corner of Bay Road and University Avenue, based on the RBD Specific Plan planning efforts, this site is likely not feasible. Specific storage tank siting locations is not included in this study.

3.4. Existing Condition Results

3.4.1. Peak Hour Demand (PHD) – Pre and Post Project

System pressures are evaluated under Peak Hour Demand (PHD) pre-Project (Figure A-2) and post-Project (Figure A-3 & A-4). Under existing conditions, multiple nodes in the southern portion of the City do not meet the minimum pressure requirements.

Under existing conditions with Project demands, the system does not meet minimum pressure requirements at many of the southern nodes. Assuming the CIPs required to mitigate the MDD + FF deficiencies are constructed; the system meets the minimum pressure requirements for 2013 Specific Plan Baseline demands and demands for Scenarios 1 and 2 (Figure A-3 and A-4).

3.4.2. Maximum Day Demand with Fire Flow (MDD+FF) – Pre and Post Project

In the Existing Condition pre-Project, the system is not able to meet fire flow requirements at many nodes within the City and within the Project area, as shown on Figure A-5. As a portion of this study, the Existing Condition with Project was considered to ensure that the Project area fire flows are met and impacts to available fire flows around the City are mitigated. Mitigations include verifying post-Project fire flows are at minimum the same as pre-Project fire flows in the remainder of the City. In order to mitigate impacts of the incremental increase in Project demands, primary CIPs proposed in the 2022 WMP were investigated to determine the CIPs required to be installed prior to the development of each Scenario.

With the development levels proposed in the 2013 Specific Plan (Baseline), the portion of CIP P-3 in University that extends between O'Brien Drive and Bay Road and the in-tract pipes proposed in CIP P-5 are required to be installed to provide the required fire flows in the Project area and mitigate impacts through the rest of the City (Figure A-6).

With the development levels proposed as a portion of the Specific Plan Update in Scenario 1 and 2, both CIPs, P-3 and P-5, are required. In addition to the two CIPS outlined above, the fourth SFPUC supply turnout and associated 16-inch transmission main in Purdue Avenue proposed as a portion of CIP P-2, are required to be installed to provide the required fire flows in the Project area and mitigate impacts throughout the rest of the City (Figure A-7).

3.4.3. Deficiencies – Pre and Post Project

With Existing Conditions, the water system does not meet system design criteria at PHD conditions, nor does it meet fire flow requirements. For the purposes of this study, post-project PHD and MDD + FF were studied to determine the minimum required CIPs to provide the required fire flows, mitigate impacts through the remaining City, and to meet the minimum pressure requirements in the City. In the Base Scenario (2013 SP) condition, two CIPs including P-3 and P-5 are required to be installed prior to the levels of development proposed in the 2013 Specific Plan are developed (Figure A-6). For both development levels proposed by the Project, CIPs P-3 and P-5 are required along with one additional CIP, CIP P-2, that includes the new Purdue SFPUC Turnout and pipeline along Purdue Avenue (Figure A-7).

3.5. Future Cumulative Condition Results

3.5.1. Peak Hour Demand (PHD) – Pre and Post Project

The system has adequate pressure pre-Project (Figure A-8) and can satisfy post-Project demands while meeting the design criteria at PHD (Figure A-9) at Future Cumulative Condition assuming all the CIPs outlined in the 2022 WMP are constructed.

3.5.2. Maximum Day Demand with Fire Flow (MDD+FF) – Pre and Post Project

In the Future Cumulative Condition, the system can meet the fire flow requirements within the Project boundary pre- and post-Project as shown on Figures A-10 and A-11. Within the City, there are multiple deficient nodes, but they are independent of the Project. Many of the deficient nodes are located along dead-end mains and hydraulic model results may not be representative of the actual available flows. These nodes show minimal (<1%) impact due to Project development. No additional deficiencies occur due to Project development.

3.5.3. Deficiencies – Pre and Post Project

With the recommended CIPs proposed by the 2022 WMP, the City-wide system has adequate pressures pre- and post-Project and is able to meet the fire flow requirements within the Project area. Section 3.6 discusses the CIP needs of the Specific Plan Update.

3.6. Recommended CIPs

In order to have sufficient water supply for development within the Project area and alleviate fire flow deficiencies affected by the Project development, three CIPs from the 2022 WMP are recommended to be completed prior to Project development, as shown in Table 3-5. CIPs #2, 3, and 5 are localized near and in the Project area and are recommended at a minimum to meet the hydraulic requirements at the Project and to mitigate impact to the remainder of the City.

As part of the Specific Plan Update, new streets are proposed within the Project area and new water mains could be installed along these street alignments to improve connectivity within the Project area. These improvements align with the CIPs outlined in CIP P-5.

New water storage tanks are required to meet the City's water storage requirements outlined in the 2022 WMP. Water storage tanks and booster stations were included as a portion of the 2022 WMP CIP WS-03A.

Estimated Costs associated with the CIPs outlined above and in the 2022 WMP are summarized in Table 3-5 and 3-6. Costs are based on recent estimates developed as a portion of the master efforts. For future years costs should be adjusted for Construction Cost Escalation.

Table 3-5: Recommended CIPs from 2022 WMP Required for Existing Conditions with Project

Project Description	2022 WMP CIP #	Length (ft)	Existing Diameter (in)	CIP Diameter (in)	Cost ($)
New Purdue Turnout and Pipeline Along Purdue Avenue	P-2	1,240	N/A	16	$1,423,00
University between O'Brien Drive and Bay Road	P-3	1,800	N/A	12	$1,778,200
In-Tract Piping	P-5	8,180	6, 8, & 10	12 & 16	$7,850,000
New Tank	WS-03A	NA	NA	NA	$5,000,000

Table 3-6: Recommended CIPs from 2022 WMP Required for Future Conditions with Project

Project Description	2022 WMP CIP #	Length (ft)	Existing Diameter (in)	CIP Diameter (in)	Cost ($)
New Purdue Turnout and Pipeline Along Purdue Avenue	P-2	1,240	N/A	16	$1,423,000
University between O'Brien Drive and Bay Road	P-3	1,800	N/A	12	$1,778,200
In-Tract Piping	P-5	8,180	6, 8, & 10	12 & 16	$7,850,000
New Tank	WS-03A	NA	NA	NA	$5,000,000
CIPs Needed for RBD and Mitigation	**P-2, P-3, & P-5**	**11,220**	**Varies**	**12 & 16**	**$16,051,200**
Remaining CIPs recommended in the 2022 WMP	All Remaining	Varies	Varies	Varies	$65,099,800

Chapter 4. Sewer Flow Projections

This chapter discusses the sanitary sewer flow estimates for Project development and provides a comparison to pre-Project baseline conditions. The incremental Project flow is determined for the Existing and Future Cumulative Condition as discussed in the following sections. The pre-Project baseline sewer flow in the Existing and Future Cumulative Conditions follows the methodology described in the 2020 SMP. The sewer generation factor for estimating Project sewer flow is taken from previous technical studies to remain consistent with the District-wide flow projections used in the hydraulic models.

Three types of sewer flow loading are used to model the sewer system: base wastewater flow, groundwater infiltration (GWI), and rainfall-dependent infiltration/inflow (RDI/I). GWI includes base infiltration (BI) and pumped groundwater discharged to the sewer system. RDI/I is stormwater that enters the sewer system. GWI and RDI/I values are modeled as constant flows.

Base wastewater flow (BWF) is from residential, commercial, institutional, office, and industrial sources. As described in the 2020 Sewer Master Plan Update (SMP), BWF is developed based on land use information, aerial photography and District unit flow factors. Change in BWF throughout the day due to daily use patterns is known as diurnal variation and is accounted for by applying residential and non-residential diurnal curves. BWF and diurnal curves used in this analysis are taken from the 2020 SMP to remain consistent with previous District-wide modeling. The sewer flows discussed in this section are the BWF values representing average flows and are not peaked.

4.1. Project Sewer Flow

Project generated sewer flow is estimated using proposed land use types and densities as provided by the City. Sewer generation rates were determined based on the EPASD Standard Specifications and are summarized in Table 4-1.

Table 4-1: EPASD Sewer Generation Rates

Use Type	Sewer Demand Factor	Units
Industrial Warehouse	100	GPD/1,000 SF
Industrial R&D/Lab	340	GPD/1,000 SF
Commercial - Office	100	GPD/1,000 SF
Retail/Restaurant	100	GPD/1,000 SF
Civic/Amenities	100	GPD/1,000 SF
Residential – Single Family	240	GPD/DU
Residential – Multi-family	180	GPD/DU

The Project scenarios have different sewer generations due to the different levels of development. The Base Scenario represents the previously approved 2013 Specific Plan land use. Development Scenarios 1 and 2 represent the higher density of land use proposed by the Specific Plan Update. Estimated sewer flows for the Project at each level of development proposed, are summarized in Table 4-2.

Table 4-2: Project Estimated Sewer Flow

Condition	Sewer Flow (gpd)		
	2013 Specific Plan Base Scenario	Development Scenario 1	Development Scenario 2
Project	346,798	674,143	854,937

A portion of the Specific Plan Boundary flows towards West Bay Sanitary District (WBSD). Schaaf & Wheeler attempted to contact WBSD to coordinate the efforts of the preparation of this Specific Plan Update and associated UIS. No response was received. The 2013 Specific Plan outlined the requirement of each project that discharges their sewage to the WBSD will need to coordinate with WBSD to ensure their flows do not impact their system (Goal UTIL-1.3).

4.2. Existing Condition

4.2.1. Pre-Project (Baseline)

The pre-Project (baseline) condition sewer flow is based on existing land use types and densities provided by the City and sewer generation factors developed by the EPASD. Table 4-3 provides the estimated flow for existing pre-Project conditions.

Table 4-3: Baseline Flow for Existing Condition (Based on Model)

Condition	Sewer Flow (gpd)
Pre-Project	35,899

4.2.2. Post-Project Incremental Demand

For the Project impact analysis in the Existing Condition, Project sewer flow is added to the Existing Condition model as an incremental difference from pre-Project demand. This overall incremental flow is spread across the Project area given land use types and densities developed as part of the Specific Plan Update. The Project incremental sewer flow for the Existing Condition is given in Table 4-4. Baseline demands are demands proposed as a portion of the 2013 RBD Specific Plan to provide a comparison of the Specific Plan Update proposed land use to the approved land use in the City. Scenarios 1 and 2 are demands proposed as a portion of the RBD Specific Plan Update Project.

Table 4-4: Incremental Project Flow for Existing Condition

	Sewer Flow (gpd)		
	2013 Specific Plan Base Scenario	Scenario 1	Scenario 2
Pre-Project (Baseline) Flow	35,899	35,899	35,899
Project Flow	346,798	674,143	854,937
Incremental Project Flow	*+ 310,899*	*+ 638,244*	*+ 819,038*

4.3. Future Cumulative Condition

4.3.1. Pre-Project (Baseline)

Future Cumulative (baseline) flow for the Project is adopted from the EPASD's model developed as part of the 2020 SMP. In the 2020 SMP model, sewer flows are based on the 2035 General Plan (GP) land use and updated based on the previous 2013 Ravenswood Business District Specific Plan. Table 4-5 presents the pre-project demand.

Table 4-5: Baseline Flow for Future Cumulative Condition (Based on 2013 Specific Plan)

Condition	Sewer Flow (gpd)
Pre-Project (2013 SP)	346,798

4.3.2. Post-Project Incremental Demand

Project flow is added to the Future Cumulative Condition model as an incremental difference from pre-Project flow. The incremental Project flow is given in Table 4-6. As with the Existing Condition model, this incremental flow is spread across the Project area following land use types and densities developed as part of the Specific Plan.

Table 4-6: Incremental Project Flow for Future Cumulative Condition

	Sewer Flow (gpd)	
	Scenario 1	Scenario 2
Pre-Project (Baseline) Flow	346,798	346,798
Project Flow	674,143	854,937
Incremental Project Flow	***+ 327,345***	***+ 508,139***

Chapter 5. Sewer System Impact

The impact of the Project development on the sanitary sewer system is analyzed under Existing and Future Cumulative Conditions. The specific affected area of the gravity system evaluated for the Project impact begins at the Project area and flows east along Bay Road, south along the Eastern Main Trunk, east through the siphon crossing San Francisquito Creek and southeast to RWQCP.

The 2013 Ravenswood Business District Specific Plan EIR had three specific goals relating to the sewer system. Goal UTIL-1.1 outlines the goal to have no Sanitary Sewer Overflows (SSOs). As portion of this study the maximum depth to diameter ratio is 1 which will ensure the risks of SSOs is eliminated. Goal UTIL-1.2 outlines the requirement to work with the City and the EPASD to acquire additional treatment capacity at the treatment plant to ensure there is sufficient treatment capacity in the future. Goal UTIL-1.3 outlines the requirement for developers to work with WBSD to ensure sewer flows do not increase above the capacity of the sewer system and to remove inflow and infiltration where possible, this goals remains relevant and should remain a requirement.

5.1. Scenarios and Performance Criteria

Sewer capacity is analyzed under Peak Wet Weather Flow (PWWF) and Average Dry Weather Flow (ADWF). PWWF is used to determine hydraulic deficiencies according to the performance criteria in Table 5-1. ADWF is used to determine adequacy of treatment capacity.

The ADWF scenario is developed in the model by adding BWF and GWI. Since the ADWF scenario models average daily flows, BWF and GWI are not peaked. The PWWF scenario applies the diurnal peaking curves for residential and non-residential flows and simulates system response to rainfall dependent inflow and infiltration. The diurnal peaking curves are adopted from the City's 2020 SMP. Groundwater Infiltration (GWI) and rainfall-dependent infiltration/inflow (RDI/I) are included, but are not peaked. The EPASD standard performance and design criteria is to ensure no pipes are flowing completely full. This standard is in line with 2013 Specific Plan goal, UTIL-1.1, that outlines the sewer system does not have any SSOs with existing flows or future estimated flows.

Table 5-1: Sewer System Performance Criteria

Criteria	Pipes
Maximum Flow Depth/Pipe Diameter (d/D)	<1

There are multiple levels of development proposed as portion of the Project. Projected sewer flows for each model run is discussed in Section 4. In the Existing Conditions, many deficiencies are identified pre-Project and CIPs are determined to address the deficiencies. All post-Project model runs in the Existing Conditions, are modeled assuming the required CIPs to address existing deficiencies are installed to determine the additional required CIPs due to Project increases in sewer flow. Similarly, in the Future Conditions, many deficiencies are identified pre-Project and CIPs are determined to address the deficiencies. All post-Project model runs in the Future Conditions, are modeled assuming the required CIPs to address future, pre-Project deficiencies are installed to determine the additional required CIPs due to the Project increases in sewer flows.

5.2. Sewer Treatment and Joint Interceptor Capacity

Sewage generated within the City and collected by EPASD is treated at the Regional Water Quality Control Plant (RWQCP) in Palo Alto. The sewer collection system is a gravity system with the majority of flow discharging into one main trunk that conveys flow from the north to south to a siphon under San Francisquito Creek that conveys sewage directly to the RWQCP.

Palo Alto, Mountain View, and Los Altos entered into a joint agreement, referred to as the Basic Agreement, in 1968 for the construction and maintenance of the joint sewer system addressing the need for conveyance, treatment, and disposal of wastewater to meet Regional Board requirements. In accordance with the Basic Agreement, Palo Alto owns the RWQCP and administers the Basic Agreement with the partnering agencies purchasing individual capacity rights in terms of an average annual flow that can be discharged to the RWQCP. East Palo Alto Sanitary District entered into an agreement with Palo Alto in 1940 and in 1971 the District's share of cost was revised. Capacity rights of the cities can be rented or purchased from other neighboring agencies and each partnering agency can sell their capacity to others. Contractual capacity is based upon the 1989 restated and amended the original 1968 Joint Sewer System agreement that revised capacity rates in relationship to facility expansion and is based upon Average Annual Flow (defined as 1.05 times Average Dry Weather Flow). Separate service agreements with the RWQCP have since reallocated current capacity rights to include six partnering agencies. Table 5-2 presents the current capacity rights for each agency.

Table 5-2: RWQCP Joint Facilities Capacity Rights

Partner Agency	Treatment Capacity	72-inch Joint Interceptor Capacity
	Average Annual Flow (MGD)	Peak Wet Weather Flow (MGD)
Palo Alto	15.3	14.59
East Palo Alto Sanitary District	3.06	0
Los Altos Hills	0.63	3.41
Stanford University	2.11	0
Mountain View	15.1	50
Los Altos	3.8	12
Total	***40***	***80***

Source: Long Range Facilities Plan for the Regional Water Quality Control Plant (City of Palo Alto, May 2012)

The total system-wide contractual capacity for East Palo Alto is evaluated in the Existing and Future Cumulative Conditions with increased Project flow. Table 5-3 shows the City's projected flows compared to the RWQCP Joint Facilities capacity rights, based on Average Dry Weather Flow, not Average Annual Flow.

Per the Basic Agreement, the partnering agencies agree to conduct an engineering study when their respective service area reaches 80% of their contractual capacity rights. The Future Cumulative Condition estimates that the projected demand post-Project will exceed the 100% capacity threshold. The required engineering study when the City reaches 80% of their capacity shall redefine the anticipated future needs of the treatment plant.

Table 5-3: Capacity Rights Comparison

RWQCP Joint Facility	East Palo Alto Contractual Capacity * (MGD)	Pre-Project		Post-Project			
		Existing (MGD)	Future Cumulative 2013 SP & GP (MGD)	Existing (MGD)		Future Cumulative (MGD)	
Treatment Capacity (ADWF)	2.89	1.53	2.63	2.17[1]	2.35[2]	2.96[1]	3.14[2]
Treatment Capacity (AAF)	3.06	1.62	2.79	2.30[1]	2.49[2]	3.13[1]	3.33[2]

* *The Ration of ADWF to AAF can be calculated as follows: AAF = 1.06 x ADWF as outlined in the RWQCP LRFP*

[1] Represents Post Project under development levels in Scenario 1

[2] Represents Post Project under development levels in Scenario 2

As described in the 2013 Specific Plan, UTIL-1.2, the requirement to work with the City and the EPASD to acquire additional treatment capacity rights at the treatment plant to ensure there is sufficient treatment capacity in the future is relevant and remains a requirement.

5.3. Existing Condition Results

5.3.1. Hydraulic Model Information

The sewer system is modeled using the InfoSWMM model that was converted from the provided Hydra Model generated as a portion of the 2002 Sanitary Sewer Master Plan and updated in subsequent Sewer Master Plans. Hydraulic deficiencies within the sewer system are evaluated under peak wet weather flow conditions.

Each project scenario was analyzed separately with sewer generation and loading as described in Section 4 of the report above. Sewer loads are included at the closest adjacent public sewer main to the parcels proposed to be developed. Existing Conditions baseline demand is based on existing land uses and associated demands updated in the 2015 Sewer Master Plan based on a flow monitoring study completed in 2011 and 2012. Demands previously approved 2013 Specific Plan were studied to provide a comparison to the demand increases proposed by the Project. Scenarios 1 and 2 are based on the proposed levels of development being studied in the Specific Plan Update Project.

5.3.2. Peak Wet Weather Flow (PWWF) Scenario – Pre and Post Project

The sewer system does not have sufficient capacity downstream of the Project with either the pre-Project nor post-Project flows in the Existing Condition as shown in Figures A-12, A-14, A-15, and A-16. CIPs are recommended to correct existing deficiencies for pre-project and post-project flows as shown in A-13, A-14, A-15, and A-16, and outlined in Section 5.5.

5.3.3. Deficiencies – Pre and Post Project

In the pre-Project condition, approximately 12,789 feet of pipe does not meet the d/D performance criteria along the flow path as shown in Figure A-12. Pipes are in the surcharged conditions, but most are not at risk of overflow. Post-Project conditions are investigated based on each level of development, 2013 Specific Plan Base Scenario, Scenario 1, and Scenario 2 as outlined above. Post-Project scenarios are modeled assuming all required CIPs are installed to meet d/D performance criteria in the existing conditions pre-Project as outlined in Figures A-13 and Table 5-4.

2013 Specific Plan Base Scenario

With the incremental increase in flow due to the Base Scenario level of Project development above existing conditions, an additional 3,490 feet of pipe does not meet the d/D performance criteria compared to pre-Project conditions. All deficient pipes are identified in Table 5-4.

Scenario 1

With the incremental increase in flow due to the Scenario 1 level of Project development above existing conditions, an additional 3,490 feet of pipe does not meet the d/D performance criteria compared to pre-Project conditions. All deficient pipes are identified in Table 5-4.

Scenario 2

With the incremental increase in flow due to the Scenario 2 level of Project development above existing conditions, an additional 3,806 feet of pipe does not meet the d/D performance criteria compared to pre-Project conditions. All deficient pipes are identified in Table 5-4.

5.4. Future Cumulative Condition Results

5.4.1. Hydraulic Model Information

The sewer system is modeled using the InfoSWMM model that was converted from the provided Hydra Model generated as a portion of the 2002 Sanitary Sewer Master Plan and updated as portion of the 2020 Sewer Master Plan Update to include demands from the City's General Plan and the 2013 Specific Plan. Hydraulic deficiencies within the sewer system are evaluated under peak wet weather flow conditions. For the purposes of this report, CIPs were developed to mitigate the deficiencies in the pre-Project condition and these CIPs are assumed to be installed in the post-Project conditions to provide a comparison of required improvements due to the for increases in sewer flows from the Project.

Each project scenario was analyzed separately with sewer generation and loading as described Section 4 of this report. Sewer loads are included at the closest adjacent public sewer main to the parcels proposed to be developed. Baseline sewer flows for Future Cumulative Conditions were developed as a portion of the 2020 SMP to include estimated land uses outlined in the City's General Plan and further modified to include the previously approved 2013 Specific Plan. Scenarios 1 and 2 are based on the proposed levels of development proposed by the Project.

5.4.2. Peak Wet Weather Flow (PWWF) Scenario – Pre and Post Project

The system does not meet d/D performance criteria downstream of the Project in the Future Cumulative Condition pre-Project and post-Project as shown in Figures A-17, A-18, and A-19. It is assumed all CIPs recommended for existing conditions are already installed pre-Project. To meet d/D performance criteria for all pipes within and downstream of the Project, it is recommended that four main segments be upsized. CIPs are developed to address each Project Scenarios proposed land use. Recommended CIPs vary based on each Scenario of development, as discussed below. The CIPs are outlined in Table 5-5.

5.4.3. Deficiencies – Pre and Post Project

In the pre-Project condition, approximately 12,544 feet of pipe does not meet the d/D performance criteria. Pipes are in the surcharged conditions, but most are not at risk of overflow. Post-Project conditions are investigated based on each level of development, Scenario 1 and Scenario 2 as outlined above. Post-Project Scenarios are modeled assuming all required CIPs are installed to meet d/D performance criteria in the Future Condition pre - Project as outlined in Figure A-17 and Table 5-5.

Scenario 1

With the incremental increase in flow due to the Scenario 1 level of Project development above Future Cumulative pre-Project Conditions, an additional 3,648 feet of pipe does not meet the d/D performance criteria. All deficient pipes are identified in Figure A-18 and Table 5-5.

Scenario 2

With the incremental increase in flow due to the Scenario 2 level of Project development above Future Cumulative pre-Project Conditions, an additional 4,051 feet of pipe does not meet the d/D performance criteria. All deficient pipes are identified in Figure A-19 and Table 5-5.

5.5. Recommended Sewer CIPs

In the Existing Condition, approximately 12,550 feet of sewer mains within the Project boundary and along the Project affected flow path to the treatment plant were determined to be deficient based on d/D performance criteria. To address the deficiencies, three CIPs are recommended: Bay Road CIP, Eastern Main Trunk CIP, and Dual Trunk to RWQCP CIP. The CIPs were developed using the 2020 SMP CIPs and are further modified to ensure all pipes in the system meet the hydraulic requirements. The three CIPs include 21 pipe segments totaling approximately 8,500 feet. Bay Road CIP includes upsizing 745 feet of 12-inch to 14-inch. Eastern Main Trunk CIP includes upsizing 1,855 feet of 18-inch and 21-inch pipes to 24-inch and 28-inch. Dual Trunk to RWQCP CIP includes installing 5,935 feet of 18-inch parallel to the existing trunk. With these CIPs, the sewer system meets d/D performance criteria without the Project incremental increase in flow in Existing Conditions. These CIPs are assumed to be installed in the existing post-Project models and the future pre-Project models. The CIPs are outlined in Table 5-4. Additional CIPs are recommended for the additional development Scenarios for the Project and outlined in Table 5-4. For the Base Scenario, one of the previously outlined pipe segments needs to be upsized and an additional 5,610 feet of piping is required to be upgraded. For the Scenario 1, five of the previously outlined pipe segments need to be upsized and an additional 7,660 feet of piping is required to be upgraded. For the Scenario 2, twenty-three of the previously outlined pipe segments need to be larger and an additional 8,030 feet of piping is required to be upgraded. Recommended CIP segments along the flow path for the Existing Condition correspond with CIPs recommended in the Future Condition.

In the Future Condition, approximately 12,545 feet of sewer mains within the Project boundary and along the Project affected flow path to the treatment plant were determined to be deficient based on d/D performance criteria. The Future Condition assumes the CIPs required to address existing deficiencies are already installed. To address the deficiencies pre-Project, 3 CIPs were recommended: Bay Road CIP, Eastern Main Trunk CIP, and Dual Trunk to RWQCP CIP. The 3 CIPS include 37 pipe segments totaling approximately 12,550 feet. Bay Road CIP includes upsizing 2,310 feet of 14-inch to 16-inch and 15-inch to 18-inch. Eastern Main Trunk CIP includes upsizing 4,300 feet of 18-inch and 24-inch pipes to 24-inch and 28-inch. Dual Trunk to RWQCP CIP includes upsizing 5,935 feet of 18-inch to 21-inch of the parallel line to the existing trunk. With these CIPs, the sewer system meets d/D performance criteria without the Project incremental increase in flow in Future Cumulative Conditions. These CIPs are assumed to be installed in the Future Condition post-Project models. The CIPs are outlined in Table 5-5. Additional CIPs are recommended for the additional development scenarios for the Project and outlined in Table 5-5. One addition CIP segment, Intract Piping, is required for post-Project conditions. For the Scenario 1, an additional 3,650 feet of piping is required to be upgraded. For the Scenario 2, seventeen of the previously outlined pipe segments need to be larger and an additional 4,050 feet of piping is required to be upgraded.

Estimated Costs associated with the CIPs within the RBD or along the affected Project flow path outlined above are summarized in Table 5-6. Table 5-6 outlines the costs of CIPs for each scenario compared to the existing system. Existing Pre-Project outlines CIP lengths and sizes to correct the existing deficiencies. Future 2013 SP & GP Pre-Project outlines CIP lengths and sizes to correct deficiencies of the previously approved landuse due to the increased demands of the Specific Plan and General Plan. Scenario 1 and 2 outline CIP lengths and sizes to correct the deficiencies due to the Project demands. Costs are based on recent linear foot estimates developed as a portion of the master plan efforts. Costs are based on nominal pipe sizes and are assumed to be HDPE DR17 pipe to remain consistent with the CIPs proposed in the 2020 SMP. For future years costs should be adjusted for Construction Cost Escalation.

Table 5-4: Recommended RBD SP Sewer CIPs for Existing Conditions

Project Description	Model ID	Length (ft)	Existing Diameter (in)	Deficiency / CIP Diameter				Recommended Future CIP[3]
				Existing Pre-Project[1]	2013 SP Base Scenario[2]	Existing Scenario 1[2]	Existing Scenario 2[2]	
Bay Road	639	181	12	Yes / 14"	Yes / 14"	Yes / 14"	Yes / 16"	Yes
	290	239	12	Yes / 14"	Yes / 14"	Yes / 16"	Yes / 16"	Yes
	262	80	12	Yes / 14"	Yes / 14"	Yes / 16"	Yes / 16"	Yes
	263	244	12	Yes / 14"	Yes / 14"	Yes / 16"	Yes / 16"	Yes
	264	124	15	No	Yes	Yes / 18"	Yes / 18"	Yes
	266	61	15	Yes	Yes	Yes / 18"	Yes / 18"	Yes
	268	181	15	Yes	Yes	Yes / 18"	Yes / 18"	Yes
	269	299	15	Yes	Yes / 18"	Yes / 18"	Yes / 18"	Yes
	270	435	15	Yes	Yes / 18"	Yes / 18"	Yes / 20"	Yes
	275	296	15	Yes	Yes / 18"	Yes / 18"	Yes / 20"	Yes
	276	155	15	Yes	Yes / 18"	Yes / 18"	Yes / 20"	Yes
	281	14	15	Yes	Yes / 18"	Yes / 18"	Yes / 20"	Yes
	282	369	18	Yes	Yes	Yes	Yes / 20"	No
Eastern Main Trunk	283	345	18	Yes	Yes	Yes / 24"	Yes / 24"	Yes
	22	234	18	Yes	Yes	Yes / 24"	Yes / 24"	Yes
	21	162	18	Yes	Yes	Yes / 24"	Yes / 24"	Yes
	20	356	18	Yes	Yes	Yes / 24"	Yes / 24"	Yes
	19	306	18	Yes	Yes	Yes / 24"	Yes / 24"	Yes
	18	282	18	Yes	No	Yes / 24"	Yes / 24"	Yes
	17	317	18	Yes	Yes / 24"	Yes / 24"	Yes / 24"	Yes
	16	446	18	Yes	Yes / 24"	Yes / 24"	Yes / 24"	Yes
	13	332	18	Yes / 24"	Yes / 24"	Yes / 24"	Yes / 24"	Yes
	12	500	21	Yes / 24"	Yes / 24"	Yes / 24"	Yes / 24"	Yes
	11	540	21	Yes / 24"	Yes / 24"	Yes / 28"	Yes / 28"	Yes
	10	482	21	Yes / 24"	Yes / 28"	Yes / 28"	Yes / 28"	Yes
	9	34	28	No	No	No	No	No

Pipe diameters are based on nominal pipe sizes and are assumed to be HDPE DR17 Pipe to remain consistent with the CIPs proposed in the 2020 Sewer Master Plan. Pipe segments that are designated "Yes" but do not have a CIP pipe diameter, deficiency is solved with downstream improvements (backwater).

Notes:

1. *For Existing Pre-Project, deficiency is based on existing pipe diameters.*
2. *For Existing Post-Project, deficiency is based on pipe diameters that include Existing CIPs as outline in Table 5-4.*
3. *Recommended Future CIP column represents the CIP projects that are recommended to be constructed as shown Table 5-5.*

Table 5-4: Recommended RBD SP Sewer CIPs for Existing Conditions (Continued)

Project Description	Model ID	Length (ft)	Existing Diameter (in)	Deficiency / CIP Diameter				Recommended Future CIP[3]
				Existing Pre-Project[1]	2013 SP Base Scenario[2]	Existing Scenario 1[2]	Existing Scenario 2[2]	
Dual Trunk to RWQCP	PN-1	478	-	Yes / 18"	Yes / 18"	Yes / 18"	Yes / 21"	Yes
	PN-2	504	-	Yes / 18"	Yes / 18"	Yes / 18"	Yes / 21"	Yes
	PN-3	482	-	Yes / 18"	Yes / 18"	Yes / 18"	Yes / 21"	Yes
	PN-4	326	-	Yes / 18"	Yes / 18"	Yes / 18"	Yes / 21"	Yes
	PN-5	447	-	Yes / 18"	Yes / 18"	Yes / 18"	Yes / 21"	Yes
	PN-6	498	-	Yes / 18"	Yes / 18"	Yes / 18"	Yes / 21"	Yes
	PN-7	502	-	Yes / 18"	Yes / 18"	Yes / 18"	Yes / 21"	Yes
	PN-8	481	-	Yes / 18"	Yes / 18"	Yes / 18"	Yes / 21"	Yes
	PN-9	382	-	Yes / 18"	Yes / 18"	Yes / 18"	Yes / 21"	Yes
	PN-10	352	-	Yes / 18"	Yes / 18"	Yes / 18"	Yes / 21"	Yes
	PN-11	475	-	Yes / 18"	Yes / 18"	Yes / 18"	Yes / 21"	Yes
	PN-12	500	-	Yes / 18"	Yes / 18"	Yes / 18"	Yes / 21"	Yes
	PN-15	506	-	Yes / 18"	Yes / 18"	Yes / 18"	Yes / 21"	Yes
In-Tract	274	288	6	No	Yes / 8"	Yes / 8"	Yes / 8"	No
	273	412	6	No	Yes / 8"	Yes / 8"	Yes / 8"	No
	272	485	6	No	Yes / 8"	Yes / 8"	Yes / 8"	No
	271	418	6	No	Yes / 8"	Yes / 8"	Yes / 8"	No
	280	340	6	No	Yes / 8"	Yes / 8"	Yes / 8"	No
	279	214	6	No	Yes / 8"	Yes / 8"	Yes / 8"	No
	278	442	6	No	Yes / 8"	Yes / 8"	Yes / 8"	No
	287	311	6	No	Yes / 8"	Yes / 8"	Yes / 8"	No
	286	234	6	No	Yes / 8"	Yes / 8"	Yes / 8"	No
	285	253	6	No	Yes / 8"	Yes / 8"	Yes / 8"	No
	284	251	6	No	Yes / 8"	Yes / 8"	Yes / 8"	No

Pipe diameters are based on nominal pipe sizes and are assumed to be HDPE DR17 Pipe to remain consistent with the CIPs proposed in the 2020 Sewer Master Plan. Pipe segments that are designated "Yes" but do not have a CIP pipe diameter, deficiency is solved with downstream improvements (backwater).

Notes:

1. *For Existing Pre-Project, deficiency is based on existing pipe diameters.*
2. *For Existing Post-Project, deficiency is based on pipe diameters that include Existing CIPs as outline in Table 5-4.*
3. *Recommended Future CIP column represents the CIP projects that are recommended to be constructed as shown Table 5-5.*

Table 5-5: Recommended RBD SP Sewer CIPs for Future Conditions

Project Description	Model ID	Length (ft)	Existing Diameter (in)	Deficiency / CIP Diameter		
				Future Pre-Project[1]	Future Scenario 1[2]	Future Scenario 2[2]
Bay Road	290	239	14	Yes / 16"	Yes / 16"	Yes / 16"
	639	181	14	Yes / 16"	Yes / 16"	Yes / 16"
	262	80	14	Yes / 16"	Yes / 16"	Yes / 16"
	263	244	14	Yes / 16"	Yes / 16"	Yes / 16"
	264	124	15	Yes / 18"	Yes / 18"	Yes / 18"
	266	61	15	Yes / 18"	Yes / 18"	Yes / 18"
	268	181	15	Yes / 18"	Yes / 18"	Yes / 18"
	269	299	15	Yes / 18"	Yes / 18"	Yes / 18"
	270	435	15	Yes / 18"	Yes / 18"	Yes / 20"
	275	296	15	Yes / 18"	Yes / 18"	Yes / 20"
	276	155	15	Yes / 18"	Yes / 18"	Yes / 20"
	281	14	15	Yes / 18"	Yes / 18"	Yes / 20"
	282	369	18	No	No	Yes / 20"
Eastern Main Trunk	283	345	18	Yes / 24"	Yes / 24"	Yes / 24"
	22	234	18	Yes / 24"	Yes / 24"	Yes / 24"
	21	162	18	Yes / 24"	Yes / 24"	Yes / 24"
	20	356	18	Yes / 24"	Yes / 24"	Yes / 24"
	19	306	18	Yes / 24"	Yes / 24"	Yes / 24"
	18	282	18	Yes / 24"	Yes / 24"	Yes / 24"
	17	317	18	Yes / 24"	Yes / 24"	Yes / 24"
	16	446	18	Yes / 24"	Yes / 24"	Yes / 24"
	13	332	24	Yes / 28"	Yes / 28"	Yes / 28"
	12	500	24	Yes / 28"	Yes / 28"	Yes / 28"
	11	540	24	Yes / 28"	Yes / 28"	Yes / 28"
	10	482	24	Yes / 28"	Yes / 28"	Yes / 30"
	9	34	28	No	No	Yes / 30"

Pipe diameters are based on nominal pipe sizes and are assumed to be HDPE DR17 Pipe to remain consistent with the CIPs proposed in the 2020 Sewer Master Plan.

Notes:

1. *For Future Pre-Project, deficiency is based on pipe diameters that include Existing CIPs as outlined in Table 5-4. Future Pre-Project assumes Base Scenario demands are included.*
2. *For Future Post Project, deficiency is based on pipe diameters that include Future CIPs as outline in Table 5-5.*

Table 5-5: Recommended RBD SP Sewer CIPs for Future Conditions (Continued)

Project Description	Model ID	Length (ft)	Existing Diameter (in)	Deficiency[1] / CIP Diameter		
				Future Pre-Project[1]	Future Scenario 1[2]	Future Scenario 2[2]
Dual Trunk to RWQCP	PN-1	478	18	Yes / 21"	Yes / 21"	Yes / 24"
	PN-2	504	18	Yes / 21"	Yes / 21"	Yes / 24"
	PN-3	482	18	Yes / 21"	Yes / 21"	Yes / 24"
	PN-4	326	18	Yes / 21"	Yes / 21"	Yes / 24"
	PN-5	447	18	Yes / 21"	Yes / 21"	Yes / 24"
	PN-6	498	18	Yes / 21"	Yes / 21"	Yes / 24"
	PN-7	502	18	Yes / 21"	Yes / 21"	Yes / 24"
	PN-8	481	18	Yes / 21"	Yes / 21"	Yes / 24"
	PN-9	382	18	Yes / 21"	Yes / 21"	Yes / 24"
	PN-10	352	18	Yes / 21"	Yes / 21"	Yes / 24"
	PN-11	475	18	Yes / 21"	Yes / 21"	Yes / 24"
	PN-12	500	18	Yes / 21"	Yes / 21"	Yes / 24"
	PN-15	506	18	Yes / 21"	Yes / 21"	Yes / 24"
In-Tract	274	288	6	No	Yes / 8"	Yes / 8"
	273	412	6	No	Yes / 8"	Yes / 8"
	272	485	6	No	Yes / 8"	Yes / 8"
	271	418	6	No	Yes / 8"	Yes / 8"
	280	340	6	No	Yes / 8"	Yes / 8"
	279	214	6	No	Yes / 8"	Yes / 8"
	278	442	6	No	Yes / 8"	Yes / 8"
	287	311	6	No	Yes / 8"	Yes / 8"
	286	234	6	No	Yes / 8"	Yes / 8"
	285	253	6	No	Yes / 8"	Yes / 8"
	284	251	6	No	Yes / 8"	Yes / 8"

Pipe diameters are based on nominal pipe sizes and are assumed to be HDPE DR17 Pipe to remain consistent with the CIPs proposed in the 2020 Sewer Master Plan.

Notes:

1. *For Future Pre-Project, deficiency is based on pipe diameters that include Existing CIPs as outlined in Table 5-4. Future Pre-Project assumes Base Scenario demands are included.*
2. *For Future Post Project, deficiency is based on pipe diameters that include Future CIPs as outline in Table 5-5.*

Table 5-6: Estimated Cost of Capital Improvement Projects

Project Description	EX Pre-Project	FCC		
		2013 SP & GP Pre-Project	Scenario 1	Scenario 2
Bay Road	$550,560	$2,405,980	$2,405,980	$2,926,090
Eastern Main Trunk	$2,892,240	$7,211,700	$7,211,700	$7,366,800
Dual Trunk	$6,526,300	$7,060,270	$7,060,270	$9,255,480
In Tract	$0	$0	$1,678,080	$1,678,080
Total	***$9,969,100***	***$16,677,950***	***$18,356,030***	***$21,226,450***

Chapter 6. Storm Drain Impact

Schaaf & Wheeler previously studied the storm drainage system of the RBD SP area as part of the 2014 SDMP. The SDMP resulted in recommendations for system improvements and two primary alternative programs were developed. The City selected Alternative 2 program as a basis for future improvements. The SDMP did not study the potential for outboard levee construction as part of the Alternative 2 improvements.

The 2013 Ravenswood Business District Specific Plan EIR had three specific goals relating to the storm drain system. Goal UTIL-3.1 outlines the goal to upgrade the storm drain system based on the 2008 Draft Engineering Plan. Goal UTIL-3.2 outlines the requirement to incorporate the northern part of the area into the storm drain system design. Goal UTIL-3.3 outlines the requirement to incorporate trash capture into development project storm drain system design. The 2013 RBDSP relied on a previous engineering study, which predates the City's SDMP and is therefore somewhat outdated. This report incorporates the SDMP work and expands the analysis to determine impacts from current development proposals and regional flood control projects.

6.1. System Overview

The East Palo Alto storm drain system is comprised of several different watersheds that primarily gravity discharge to SF Bay. The City prepared a Storm Drain Master Plan in 2014, which is the basis for this study. The SDMP analyzed the existing storm drain capacity under the 10-year design storm event. The downstream boundary conditions at the gravity outfalls are set equal to SF Bay Mean Sea Level or ground surface elevation depending on location within the City. The RBD area is primarily served by storm drain systems that convey flow to O'Connor Pump Station during periods of high tide when gravity outfalls are not active. The northern portion of the RBD (approximately areas north of Bay Road) is comprised of watersheds that discharge directly to SF Bay and are not currently connected to the O'Connor Pump Station.

Similar to the SDMP, the storm drain system has been analyzed with a 10-year design storm. Existing conditions have been analyzed on the assumption that gravity outfall boundary conditions are characterized by a constant water surface elevation equivalent to Mean Sea Level of San Francisco Bay in the vicinity of East Palo Alto (elevation 5.5 feet NAVD88). At O'Connor Pump Station, where outlet water levels impact pump hydraulics, a more conservative assumption was applied, and the FEMA 100-year mapped flood elevation was used. These are the same assumptions applied by the SDMP models.

For development and CIP models, boundaries were altered to reflect the construction of new levees currently being planned by the JPA. Levee heights vary based on the shoreline conditions. However, the levees generally target protection against up to 3.5 feet of sea level rise projected by 2050. Model boundary conditions on the Bay-O'Connor system have been adjusted by 3.5 feet to better reflect future conditions and support analysis of CIPs. Adjustments have only been made on the systems draining to Runnymede and O'Connor Pump Station, as the focus of this analysis is development impacts. Systems draining to other outfalls have not been modified.

6.2. Hydraulic Modeling Results

6.2.1. Existing Conditions

The existing conditions SDMP model was first updated to reflect new infrastructure built as part of the Bay Road Storm Drain Improvement Project, completed in 2018. As-Built drawings were used as a basis for adding and modifying pipe and node elements in the model to reflect current conditions. The modified system is shown in Figure A-20. 1-D model results are shown in Figure A-21, represented by the depth of water beyond the defined ground surface at each node ("Node Flood") based on the maximum hydraulic grades modeled throughout the system.

While slightly different results than those presented in the SDMP are to be expected with the changes to the system, the node flood results from the updated MIKE+ model are very similar to those produced for the SDMP.

6.2.2. Near-Term Development

Schaaf & Wheeler is aware of multiple developments located within the RBD SP area that are currently in varying phases of planning or design. These developments are expected to have some impact on the performance of the existing storm drainage system. Parcels included in these developments are shown in Figure A-22.

Developments other than the waterfront were added to the model first (2020 Bay, Four Corners, and Harvest Property) to form a "Near-Term Development" condition. For 2020 Bay, this required modification of existing catchment boundaries to include a presently low-lying area that does not drain to the storm system at all (adding 9.5 acres to the drainage areas). Other developments were represented by modifying the imperviousness of the catchments at each development to reflect a commercial or mixed-use condition (assumed to be 80% impervious). The model ignores any mitigation or attenuation that may be provided by privately owned stormwater facilities.

Excluding the Waterfront development allows for an incremental approach to evaluating the impacts associated with the Waterfront and Bay Road Pump Station CIP in particular, regardless of what might be constructed first.

This scenario also includes connection of the Harvest development area to Weeks Street, elimination of the Weeks outfall, and connection to the Pulgas Ave system. This also eliminates the Bay Road outfall in favor of connecting everything to the Bay/Pulgas system. This represents a worst-case scenario as far as development impacts are concerned. This provides the best estimate of impacts to be mitigated in the future, should the gravity outfalls be eliminated altogether as they were in the SDMP modeling effort.

There are many ways this could be approached, depending on which development occurs first: For example, Harvest-related improvements connecting to Weeks and Pulgas Ave might occur without removing the outfall. Not all scenarios have been modeled.

Model results are presented in Figure A-23. A comparison to the existing condition results for locations where flooding occurs is shown in Figure A-24. Positive differences represent an increase in flooding compared with existing conditions. The hydraulic grade is affected where flooding does not occur as well. However, these impacts are less important than increases in actual flooding. The results highlight that the connection of Weeks Street and the Harvest area to Pulgas Ave would be susceptible to high HGLs downstream. It may be advisable to make the connection but leave the outfall in place until downstream CIPs are completed that reduce the HGL.

6.2.3. Waterfront Development (Northern Development)

Multiple model scenarios have been developed to represent the potential impacts of the Waterfront development on the system. First, the system has been modified to include the construction of the development without the levee project currently planned by the SFCJPA. This scenario includes the following modifications, in line with SDMP Alternative 2:

1. A new pipe system along Demeter, the future connector street, and Pulgas Ave north of Bay Road (including a new 50 cfs pump station at Bay Road and Pulgas Ave.)
2. Outfalls along Illinois St to the north are eliminated, requiring that a portion of the SDMP "Purdue-Illinois" project be completed. This only includes the portion of that CIP north of Purdue St, along Illinois Street, necessary to drain the area without outfalls
3. The catchments are modified to include additional development area not covered by existing conditions SDMP catchments (approximately 11 acres)

The modifications to the model are shown in Figure A-25. In addition to the "Added Area", which has not historically drained into the City's pipe system, removal of the three outfalls serving University Village area reroutes flow from a large portion of RBD and all of University Village into the new pump station. Effectively, an additional 133 acres of drainage area are being added to the Runnymede/O'Connor system via Pulgas Ave (including the 11 acres that were not previously served by any system).

Node Flood results are shown in Figure A-26. A comparison to the near-term development result is provided in Figure A-27 for nodes where flooding occurs.

The Waterfront model was then further modified assuming that the new levee is constructed seaward of the proposed waterfront park. Addition of the levee is assumed to impound drainage and necessitate that it be managed with the City pipe system. This would direct runoff from an additional 15 acres into the pipe system, as shown in Figure A-28. This area is assumed to have a similar slope and curve number to surrounding catchments, while impervious area has been assumed to be 25% in a parks and open space setting.

Node flood results for this scenario are shown in Figure A-29. The incremental impact of the additional drainage area, compared with the Waterfront development area alone is shown in Figure A-30.

6.3. Recommended Storm Drain CIPs

6.3.1. Overview

The new SD system on Bay Road, which does not flood in the existing conditions model is surcharged by over a foot in some places with the Waterfront development modeled. This is due in part to other developments (Figure A-23 shows flooding in the near-term development condition without the Waterfront). However, the Waterfront development and additional drainage from the new Bay Road Pump Station worsen flooding significantly.

It's also clear from Figure A-27 that the impacts of adding such a significant amount of drainage to the existing system downstream of Bay Road is more widespread. Impacts of over 0.5 foot are found in the neighborhoods draining to the channel to O'Connor Pump Station. Smaller impacts of around 0.1 foot are apparent as far west as Euclid Ave. Pipe in Runnymede appears to be a significant path for drainage from all areas of East Palo Alto to flow to O'Connor Pump Station. Added drainage to the system has the effect of raising the hydraulic grade line along that path and increasing flood depths throughout the city.

Installing larger pipe throughout East Palo Alto based on the CIPs presented in the SDMP may be an option for mitigating these flooding issues. However, that solution may require replacement of the system that's just been constructed along Bay and Pulgas to address all the flooding issues.

There is an alternative that may be more viable for handling the additional drainage without increasing flooding. Currently, the Runnymede system drains to two Tideflex valves located at an outfall structure to the Bay with an invert elevation of -3.35. The model assumes that these valves are ineffective during high tide conditions, especially with the planned levee improvements and sea level rise. Instead, the Runnymede system must fill from its invert (a minimum of approximately elevation -5.6) to beyond the invert of the channel running to O'Connor Pump Station (elevation 2.0).

With outfalls on the north side of Bay Road eliminated, both this model and the SDMP model rely upon O'Connor Pump Station alone to drain the majority of the storm drain system in the East Palo Alto model area. It appears more effective, however, to add a pump station at the end of Runnymede, discharging to the Bay. This greatly improves the function of the system in Runnymede, making greater use of existing pipe capacity. It also has the potential to eliminate the need for other CIPs in the SDMP. For example, the Garden-Beech project, consisting of nearly 1,800 linear feet of new pipe, would not be necessary. This project was to prevent high water levels in the channel from causing flooding in the local systems on Garden Cypress, and Beech. However, significantly greater capacity is available in O'Connor channel if water is pumped to the bay at the east end of Runnymede.

A new Runnymede Pump Station could also provide some redundancy should O'Connor fail or require maintenance. This creates a more resilient system, as well as allowing the Runnymede system to remain drained instead of being filled with water when the tides don't drop sufficiently for the Tideflex valves to open.

Node flood results for the development model with a 215 cfs pump station at the east end of Runnymede are provided in Figure A-31. The results of this model have been compared with existing conditions (prior to any currently planned development). This result is shown in Figure A-32.

It should be noted that the Runnymede Pump Station universally improves flooding throughout the East Palo Alto storm drain system. Because discharge from the system is no longer required to reach the higher elevation invert of the channel to O'Connor, the hydraulic grade line drops significantly.

Despite the overall reduction in flooding compared with existing conditions, CIPs will still be required to achieve a 10-year level of service. However, the effectiveness of further improvements to the system is greater with the added discharge capacity created by the new Runnymede Pump Station.

6.3.2. Pump Stations

This analysis has identified two new pump stations. The need to construct each of the two stations depends on a variety of factors.

Bay Road Pump Station

The new Bay Road Pump Station will be required as soon as development is constructed on the north side of Bay Road that requires new public storm drain infrastructure that is unable to drain to the existing public system by gravity.

It appears that the 2020 Bay Road development proposes a connection to the system with a privately owned pump station on the site. The Harvest Property and Four Corners sites are also likely able to connect to existing infrastructure without the need for the new station.

The proposed Waterfront development is a more isolated site that will require additional stormwater infrastructure in the public right-of-way to reach the system in Bay Road. This triggers the need for at least a portion of the Illinois-O'Connor CIP (shown in this analysis with a modified alignment) and the Bay Road Pump Station CIP.

Runnymede Pump Station

The need for the Runnymede Pump Station depends on the impact of other developments and their ability to mitigate their impacts with improvements to the gravity system. Figure A-24 shows that developments currently in design are likely to have an impact on the existing system, increasing flooding by up to 0.5 foot.

The Four Corners development, for example, may be able to mitigate its impact by constructing the Notre Dame CIP from the SDMP. If the Illinois-O'Connor project isn't constructed yet, impacts of that development project wouldn't be mitigated by a new Runnymede Pump Station, as the storm drain system on Notre Dame and Illinois drains to an outfall north of Bay Road.

Impacts from 2020 Bay and Harvest Property developments would have a direct impact on the system draining to Runnymede and O'Connor. Those impacts might be mitigated by constructing various CIPs, including Bell Street, Bell-Clarke (Alt 2), Weeks-Pulgas and Garden-Beech improvements. The same result shown in Figure A-24 (the increase in flooding due to the developments other than the Waterfront) is shown again in Figure A-33 but overlain on select CIPs from the SDMP that would mitigate these impacts.

The model was run for the near-term development condition (without the Waterfront) to determine whether these CIPs would mitigate for the developments' impact. Flood depths are shown for the mitigated development condition in Figure A-34. A comparison to existing conditions is provided in Figure A-35.

The CIPs shown do largely mitigate the impacts of these projects, in addition to greatly improving flooding in certain areas of the City. However, they also require approximately 11,600 linear feet of pipe ranging approximately 18 inches to 60 inches in diameter (Table 6-1).

Table 6-1: CIPs to Mitigate Near-Term Development

Project	Length (ft)
Illinois-O'Connor	586
Bell St (Euclid to Cooley)	1,350
Bell-Clarke Alt 2	2,987
Euclid-Bell	957
Garden to Beech	1,823
Michigan Ave*	252
Notre Dame and Illinois*	1,360
Sage Larkspur	1,410
Weeks to Pulgas	870

**Projects still required to mitigate impact to Illinois system*

If these CIPs are completed, Runnymede Pump Station is not required to mitigate the impacts of those developments that do not require extension of the existing pipe systems and the Bay Road PS. However, the pump station could be constructed in lieu of most of these CIPs as a mitigation measure.

The model has also been run with the near-term developments complete and the Runnymede Pump Station in place. Results are shown in Figure A-36 and compared with existing conditions in Figure A-37.

Mitigating impacts becomes more difficult once the Bay Road Pump Station is in place, with flooding along Pulgas Avenue and Bay Road being the most prevalent issue. This is apparent in Figure A-38, which shows flooding depths of greater than one foot along Bay Road, even with all Alternative 2 CIPs from the SDMP constructed. The Bay and Pulgas project is modeled in its as-built condition (shown in the SDMP Alternative 2 as part of the Illinois-O'Connor Alt 2 project).

Mitigation for the increase in flow to the Pulgas Ave system requires that either the relatively new systems installed in Bay and Pulgas be upsized or Runnymede Pump Station be constructed to drop the HGL in the system and eliminate flooding. Node flood results are shown for the future condition with a modified set of Alternative 2 CIPs proposed by the SDMP completed and the 215 cfs Runnymede Pump Station in place in Figure A-39. Garden-Beech and Glen Way are not included, as they are made unnecessary by the new pump station.

6.3.3. Conclusion

Based on the analysis of storm drainage systems presented in this document, the need for various CIPs depends on the sequencing of planned developments. With multiple developments in planning and design phases simultaneously, it's difficult to predict exactly when certain CIPs will be required to mitigate impacts of development.

Assuming that the Waterfront is constructed last, however, the Illinois-O'Connor project and Bay Road Pump Station will be required to provide a connection to existing gravity systems. If other developments are completed prior to the Waterfront and Bay Road Pump Station, their impacts could be mitigated by projects identified in the SDMP. However, the Runnymede Pump Station can mitigate for any developments connecting to systems draining to Runnymede and O'Connor.

Regardless of what other CIPs are constructed, the addition of the Bay Road Pump Station will require downstream improvements to mitigate impacts on Bay Road. The addition of discharge from the 50 cfs pump station to Pulgas Avenue raises the downstream hydraulic grade line to a point where it begins to cause flooding along Bay Road. Mitigation will either require replacement and upsizing of the Pulgas Avenue system constructed in 2018, or construction of the Runnymede Pump Station to decrease tailwater on the Pulgas and Bay system to mitigate impacts.

6.3.4. CIP Costs

The SDMP recommends several improvement projects as part of Alternative 2 program. The costs basis for improvements in this study is similar to SDMP and also provides some adjustment to account for pipe depth as part of overall costs in addition to annual cost escalation factors. The CIP projects provided in this study assumes the Runnymede Pump Station is constructed in lieu of upsizing gravity pipes to convey water to O'Connor Pump Station, and therefore CIP costs vary from those in the SDMP. In general, the CIPs in the SDMP Alternative 2 are similar to what is proposed in this study except for the addition of a new Runnymede Pump Station. Depending on timing of the Runnymede Pump Station construction, additional CIPs may be required to provide sufficient capacity and mitigate new development impacts, these additional CIPs are not included in the CIP cost analysis.

Table 6-2: Storm Drain CIP Costs

Project	Cost
Harvest-Weeks Pipe	$1,400,000
Illinois-Purdue Pipe	$2,100,000
Purdue-Bay Pipe	$3,100,000
Bay Road Pump Station	$5,800,000
Runnymede Pump Station	$10,400,000
Total	**$22,800,000**

6.4. Design Capacity for Terminal Facilities

The City has indicated an interest in providing 100-year level of service for storm drain pump stations with anticipation of a bayfront levee being constructed in the future. A significant level of effort will be required to fully update the storm drain master plan model to properly evaluate a 100-year event. Even if it were updated, the pipe systems connecting to existing and potential future pump stations do not have the capacity to convey a 100-year event, and the current computer models lack two-dimensional surface routing.

The City requested Schaaf & Wheeler to determine conceptual capacity requirements to assist them with future planning efforts prior to a more detailed study is conducted. In order to estimate the peak discharge during a 100-year event, drainage areas tributary to each pump station (existing or future) or major outfall are delineated as service areas and the rational method has been applied. For the purposes of this analysis, isolated systems draining by gravity to San Francisquito Creek and the area to the Northwest are ignored. It's assumed that the system draining to the northwest, towards the CalTrans right-of-way, will continue to do so, based on Alternative 2 CIPs presented in the 2014 SDMP. This analysis focuses on three areas in particular:

- The existing O'Connor Pump Station drainage area encompassing only those areas draining directly to the pump station
- The area tributary to a future Bay and Pulgas Pump Station CIP
- The proposed Runnymede Pump Station drainage area

While these three areas may remain interconnected in the future, this analysis estimates runoff from each area individually.

The Rational Method approach presented in the Santa Clara County Drainage Manual methodology has been applied to the three areas. The SDMP was referenced for soil and future land use information in order approximate drainage area characteristics. Times of concentration have also been estimated for each drainage area, based on the longest identified flow paths. Application of the Rational Method applies rainfall intensities for each rainfall event of interest. NOAA ATLAS 14 was used to identify precipitation-frequency relationships near the centroid of the City. In particular, 10- and 100-year event depths were extracted from the website to interpolate depth values corresponding to each drainage area's time of concentration. With all drainage area characteristics considered, runoff coefficients, areas, and rainfall intensities are used to calculate 10- and 100-year peak discharges based on the rational method equation:

$$Q = CiA$$

Where: C = Runoff Coefficient (unitless)

i = Rainfall Intensity (in/hr)

A = Drainage Area (acres)

A summary of rational method calculation results are provided in Table 6-3 below. Typically, Rational Method flow rates will be higher than a more detailed computer model, therefore the 10-year flow differences are expected but help confirm the Rational Method calculations are reasonable.

Table 6-3: Required Pump Station Capacities

Area	C-Value	Area (Acre)	10-yr		100-yr	
			Intensity (in/hr)	Peak Flow (cfs)	Intensity (in/hr)	Peak Flow (cfs)
Bay PS	0.67	153	0.98	**99**	1.66	**170**
Runnymede PS	0.60	550	0.72	**240**	1.22	**400**
O'Connor PS	0.59	416	0.80	**200**	1.36	**330**

The storm drain system does not have adequate capacity to accept 100-year pump station discharges downstream, therefore the 100-year pump stations are assumed to discharge directly to the San Francisco Bay. Pump station location, as well as forcemain and outfall alignments will need to be determined as part of a future study.

Table 6-4 below provides a conceptual level cost estimate for the three pump stations with 100-year pumping capacity. Costs do not include land acquisition or forcemain/outfall construction costs.

Table 6-4: 100-Year Pump Station Costs

Project	Cost
Bay/Pulgas Pump Station	$8,225,000
Runnymede Pump Station	$19,350,000
O'Connor Pump Station	$15,965,000

References

California Building Standards Commission. 2019 California Fire Code. July 2019.

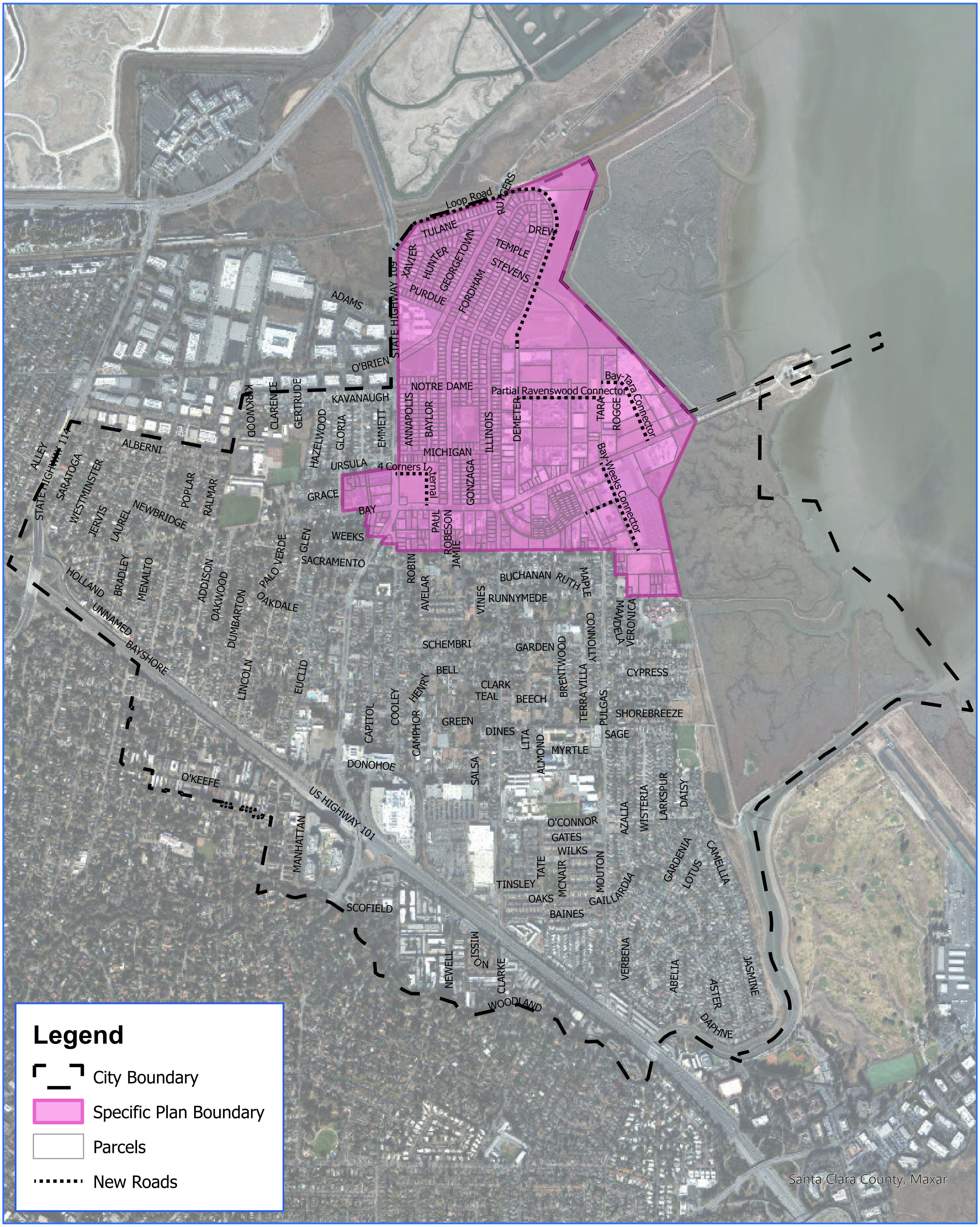
City of East Palo Alto. Water Master Plan. Prepared by EKI Environment & Water, Inc. September 2022.

City of East Palo Alto. Ravenswood / 4 Corners TOD Specific Plan. The Planning Center. February 2013

City of Palo Alto. Long Range Facilities Plan for the Regional Water Quality Control Plant. Prepared by Carollo. October 2012.

East Palo Alto Sanitary District. Sewer Master Plan Update. Prepared by Freyer and Laureta. October 2020.

APPENDIX A:
Figures



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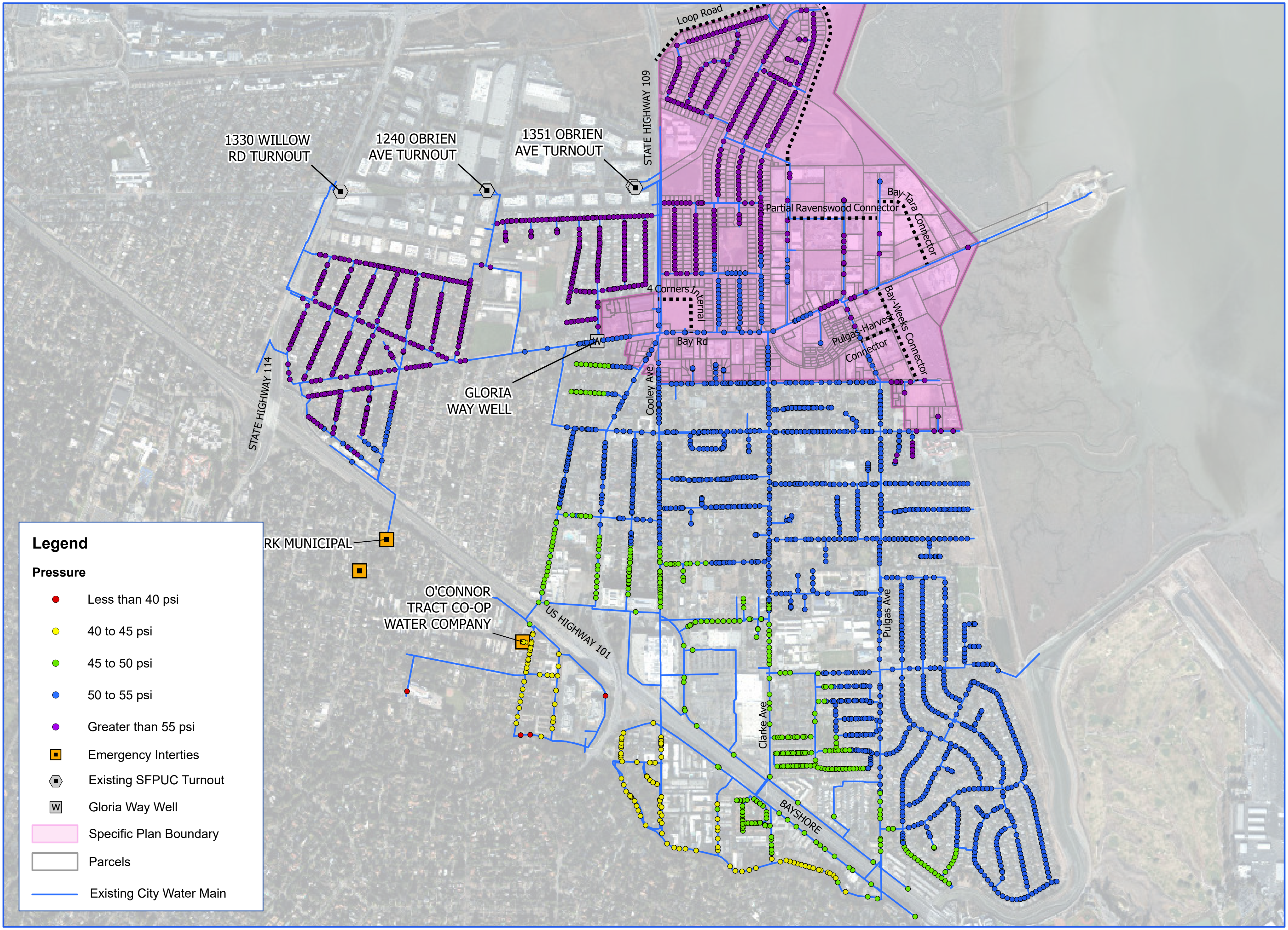
0 800 1,600 Feet

FIGURE A-1: **Project Location**



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0 700 1,400 Feet

N

FIGURE A-2:

Peak Hour Demand (PHD) - Without Project

Water System Model - Existing Condition

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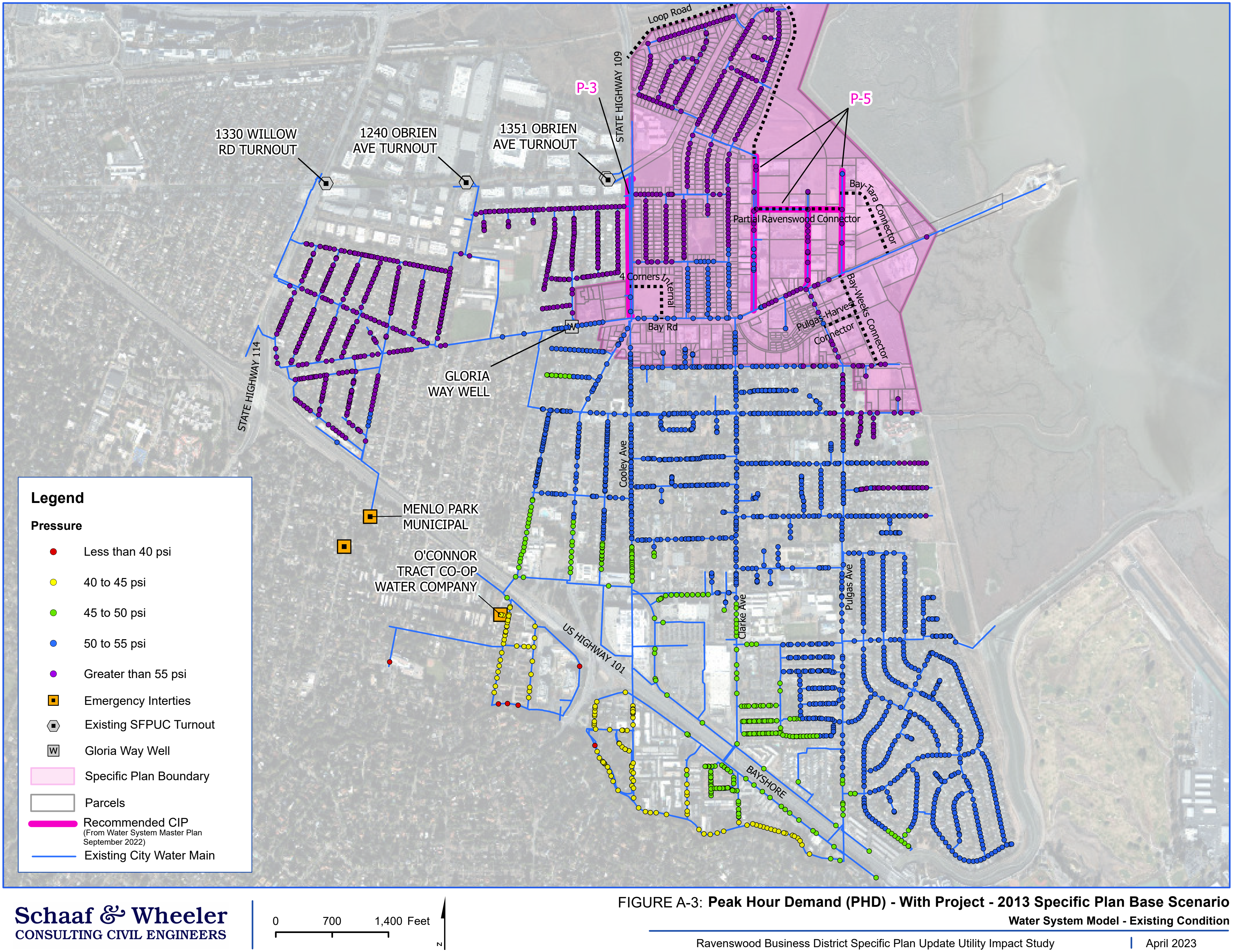

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FIGURE A-3: **Peak Hour Demand (PHD) - With Project - 2013 Specific Plan Base Scenario**

Water System Model - Existing Condition

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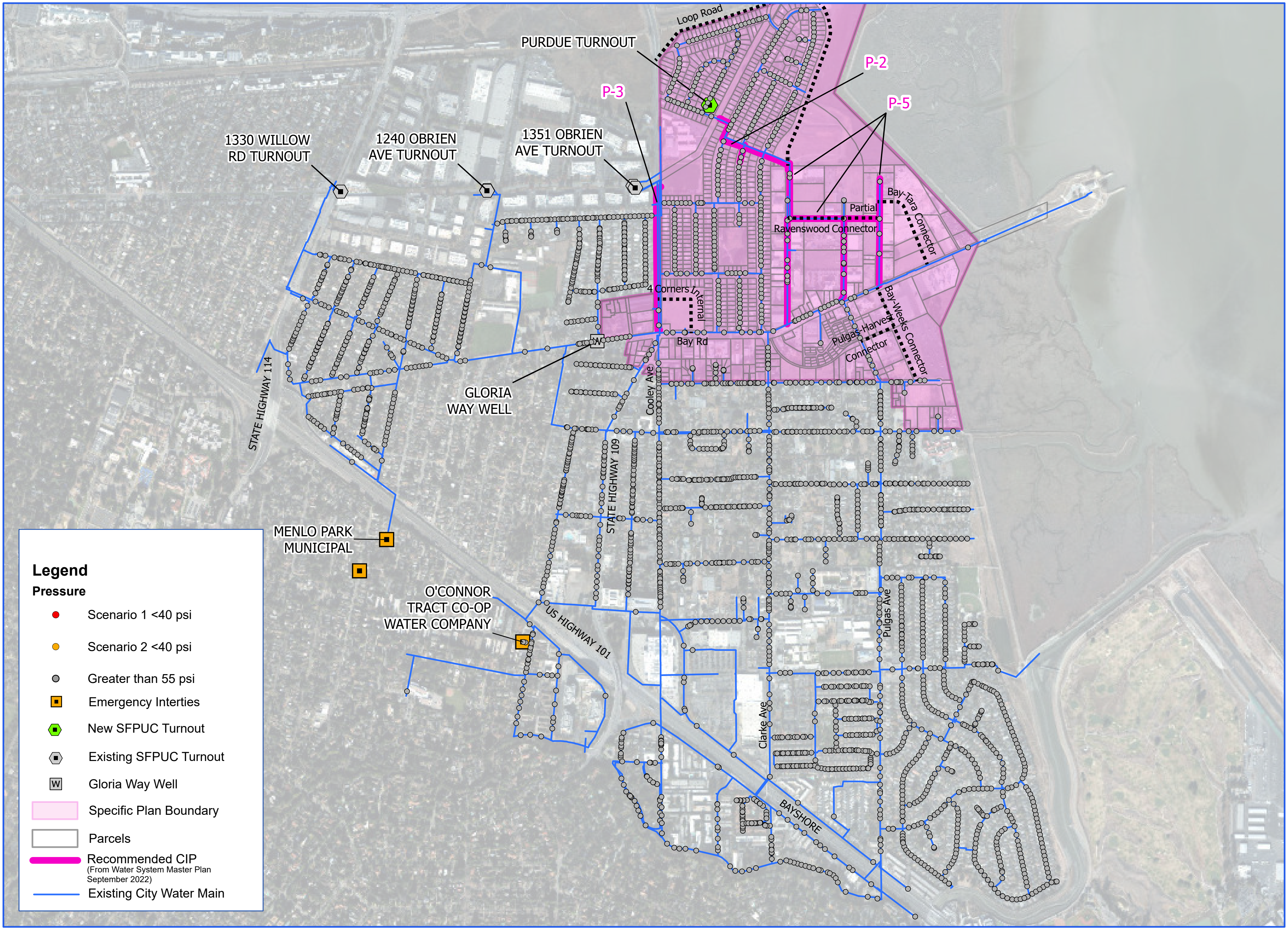

Schaaf & Wheeler
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0 700 1,400 Feet

N

FIGURE A-4: **Peak Hour Demand (PHD) - With Project - Scenario 1 & 2**

Water System Model - Existing Condition

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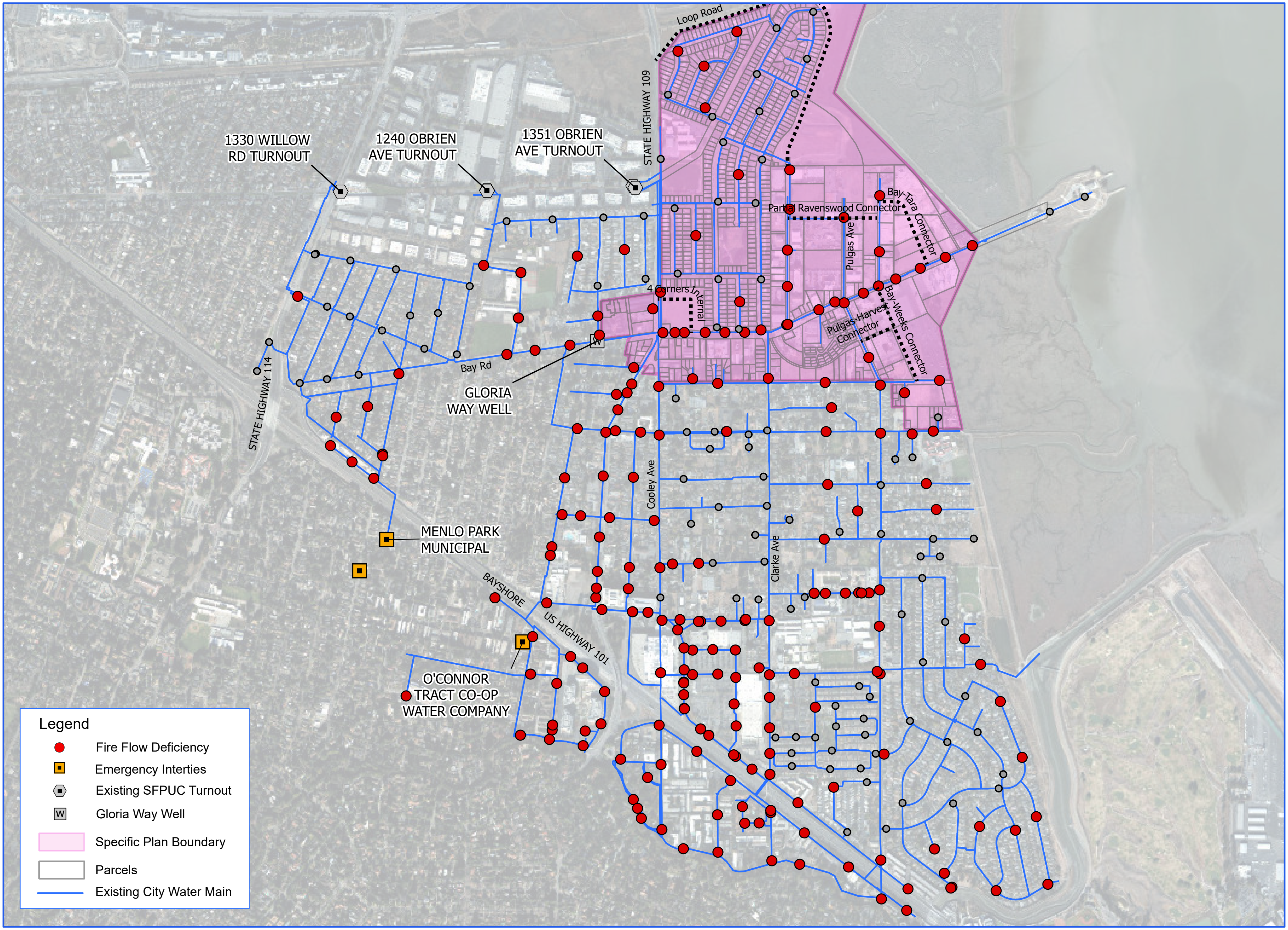

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FIGURE A-5:

Fire Flow Analysis - Without Project

Water System Model - Existing Condition

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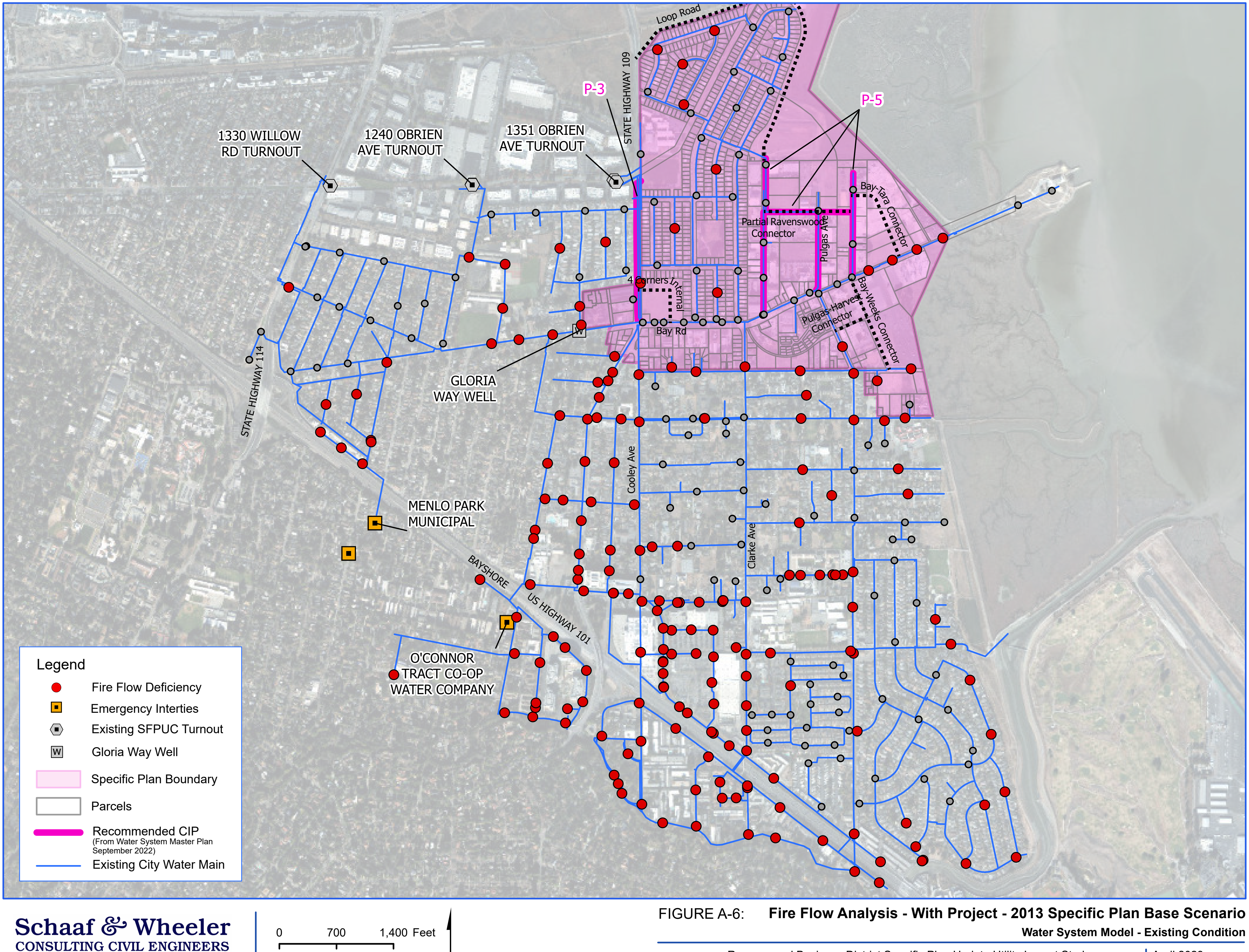

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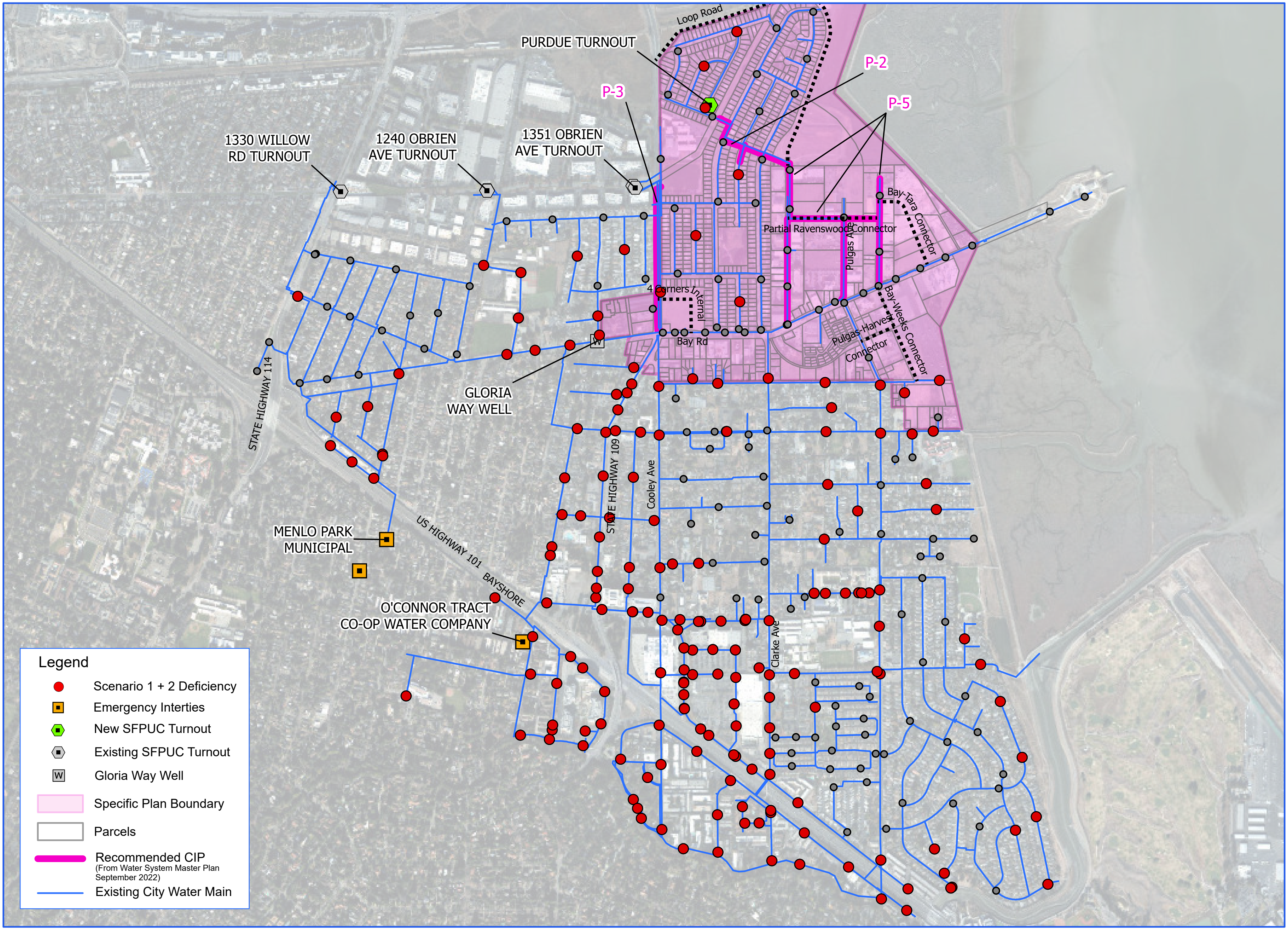
FIGURE A-6: **Fire Flow Analysis - With Project - 2013 Specific Plan Base Scenario**

Water System Model - Existing Condition



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0 700 1,400 Feet

N

FIGURE A-7: **Fire Flow Analysis - With Project - Scenario 1 & 2**

Water System Model - Existing Condition

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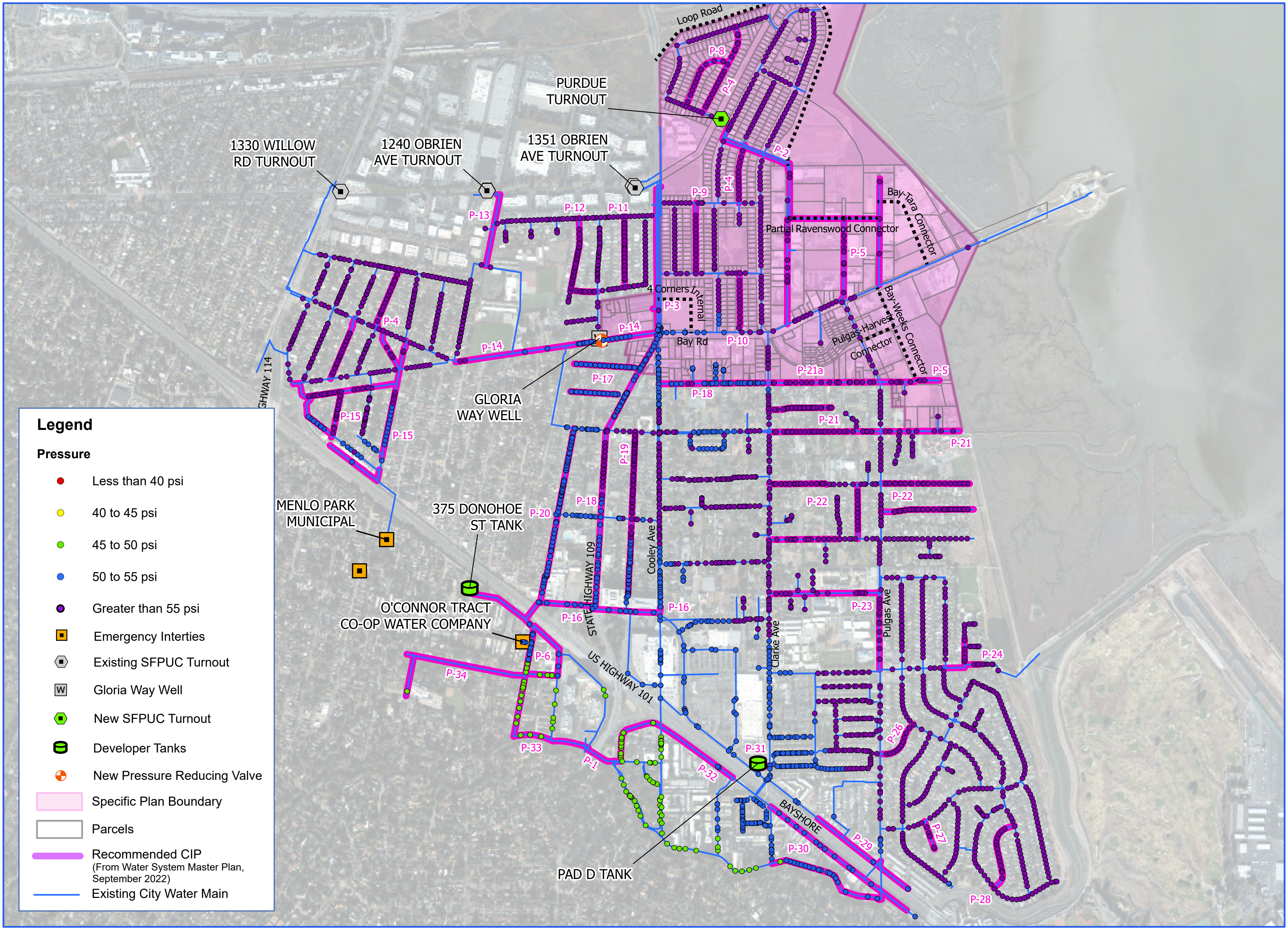

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FIGURE A-8:

Peak Hour Demand (PHD) - Without Project

Water System Model - Future Cumulative Condition

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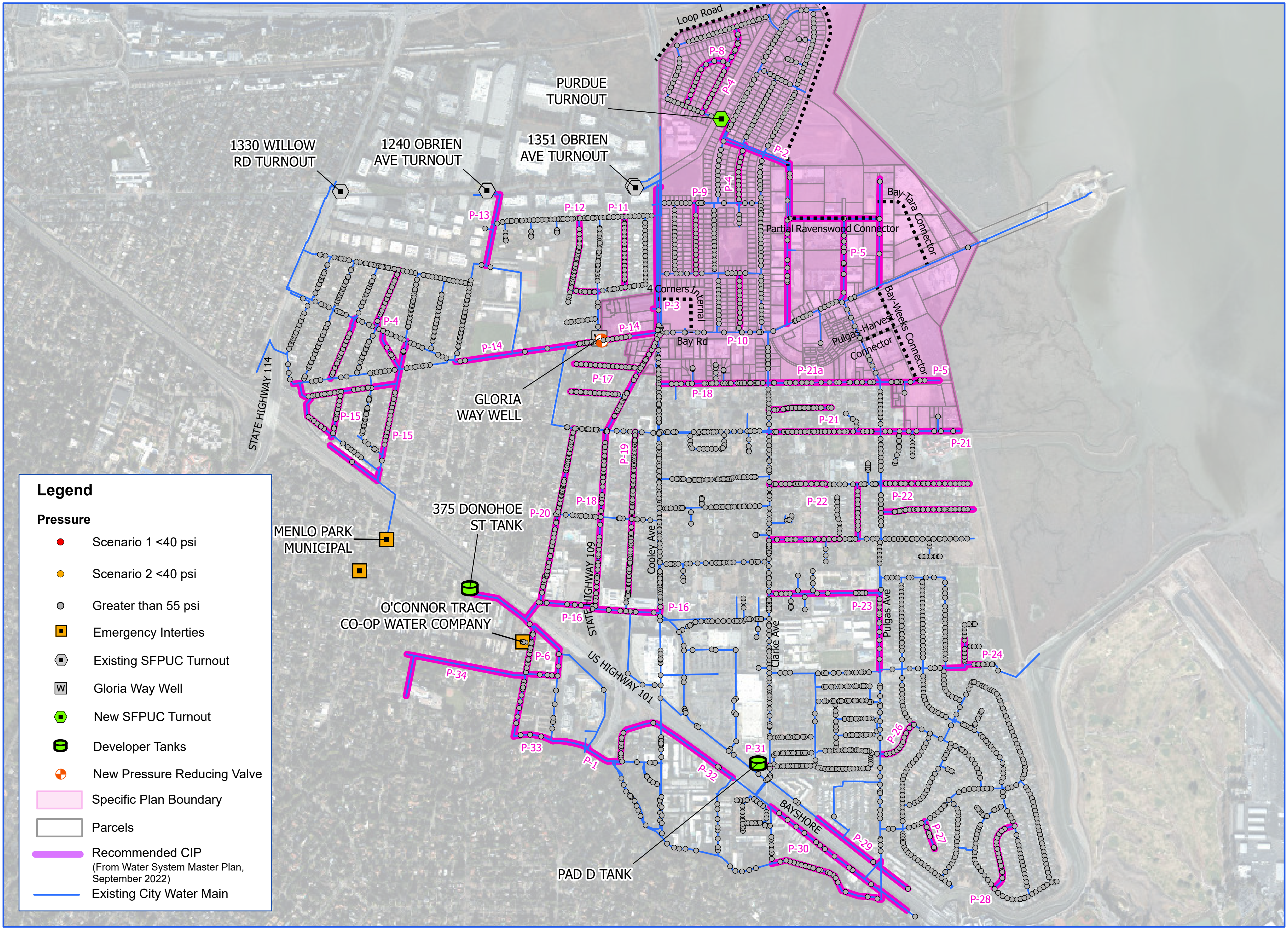

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0 700 1,400 Feet

N

FIGURE A-9: **Peak Hour Demand (PHD) - With Project - Scenario 1 & 2**

Water System Model - Future Cumulative Condition

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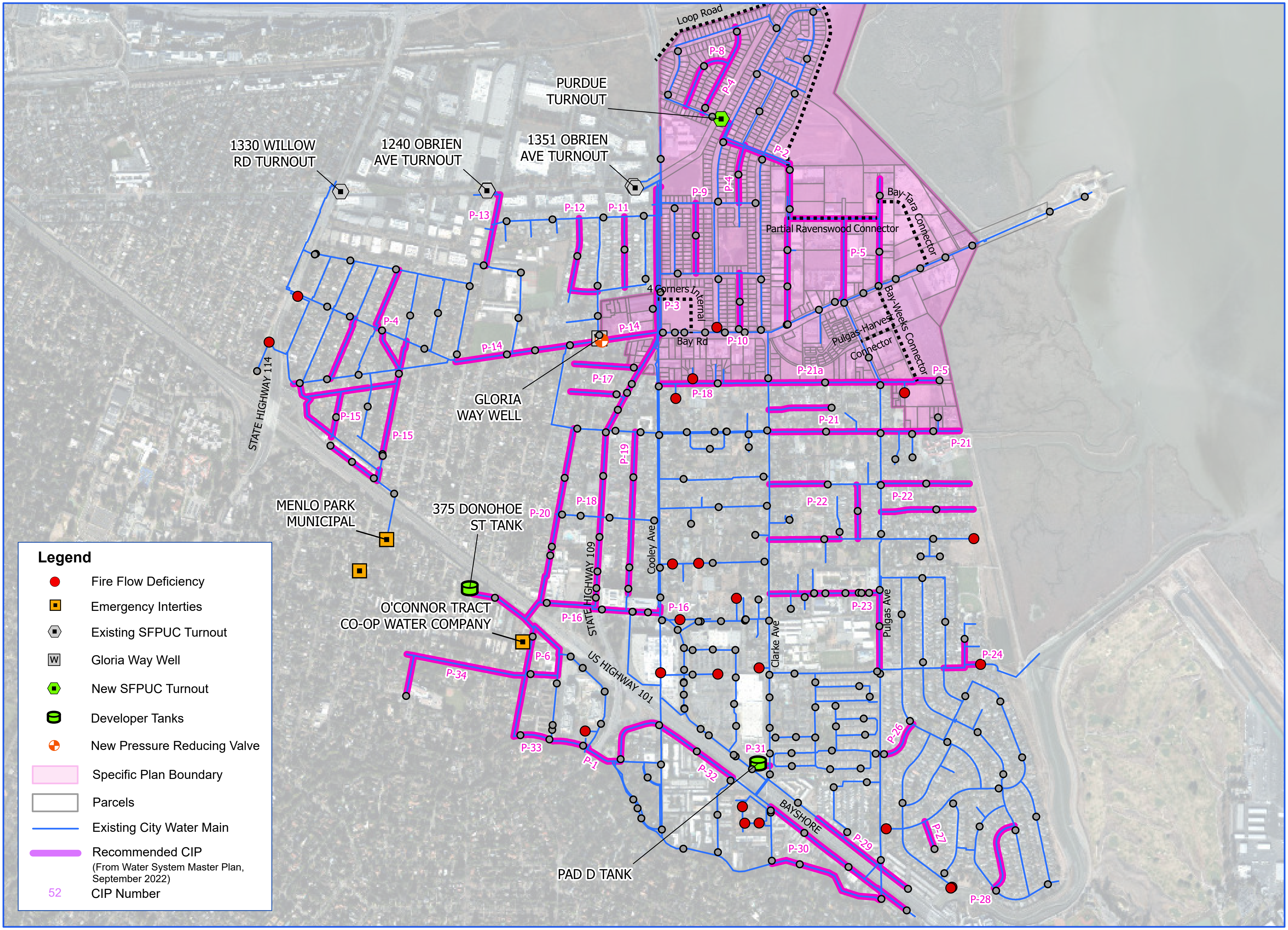

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FIGURE A-10:

Fire Flow Analysis - Without Project

Water System Model - Future Cumulative Condition

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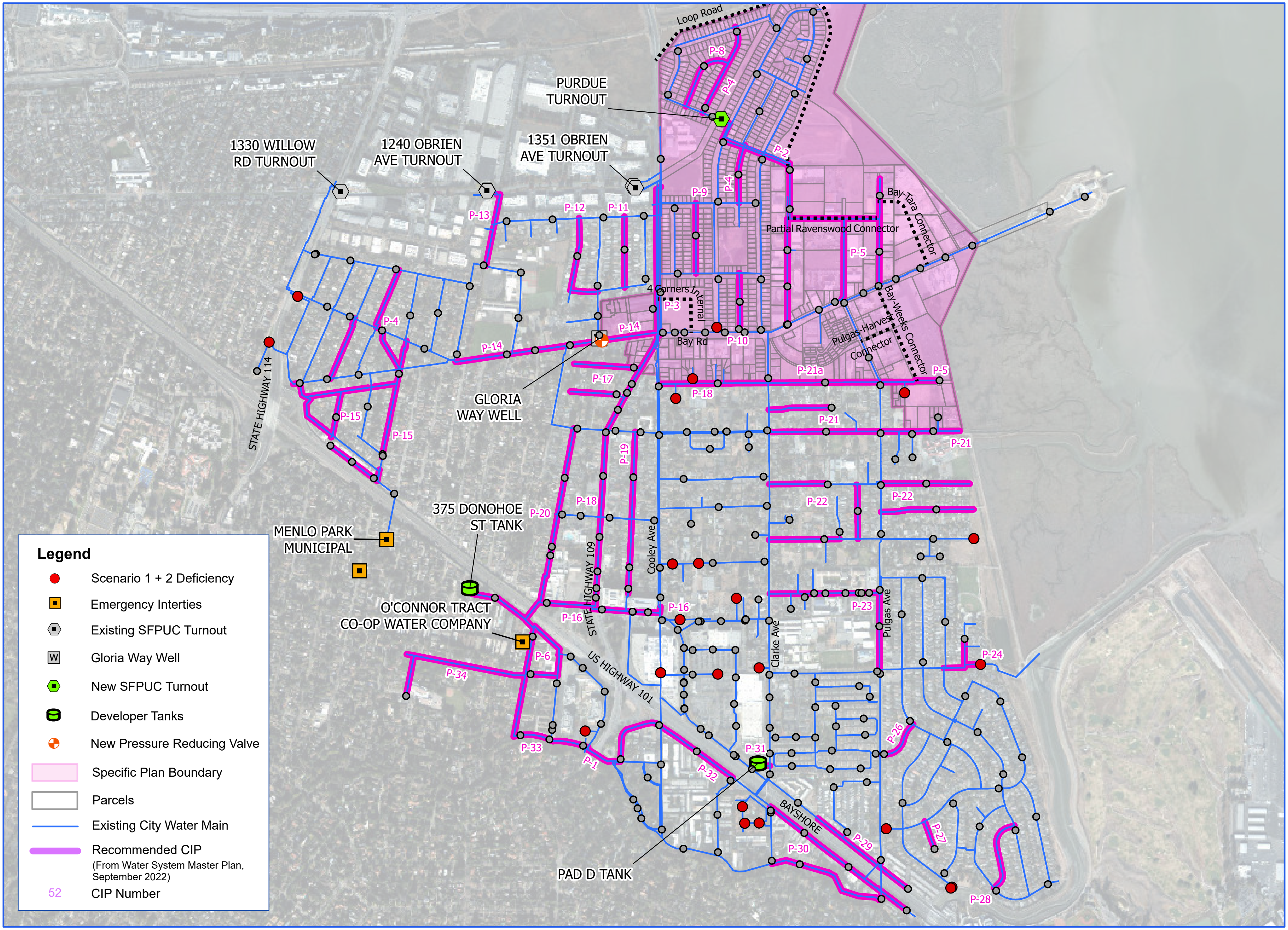

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0 700 1,400 Feet

N

FIGURE A-11: **Fire Flow Analysis - With Project - Scenario 1 & 2**

Water System Model - Future Cumulative Condition

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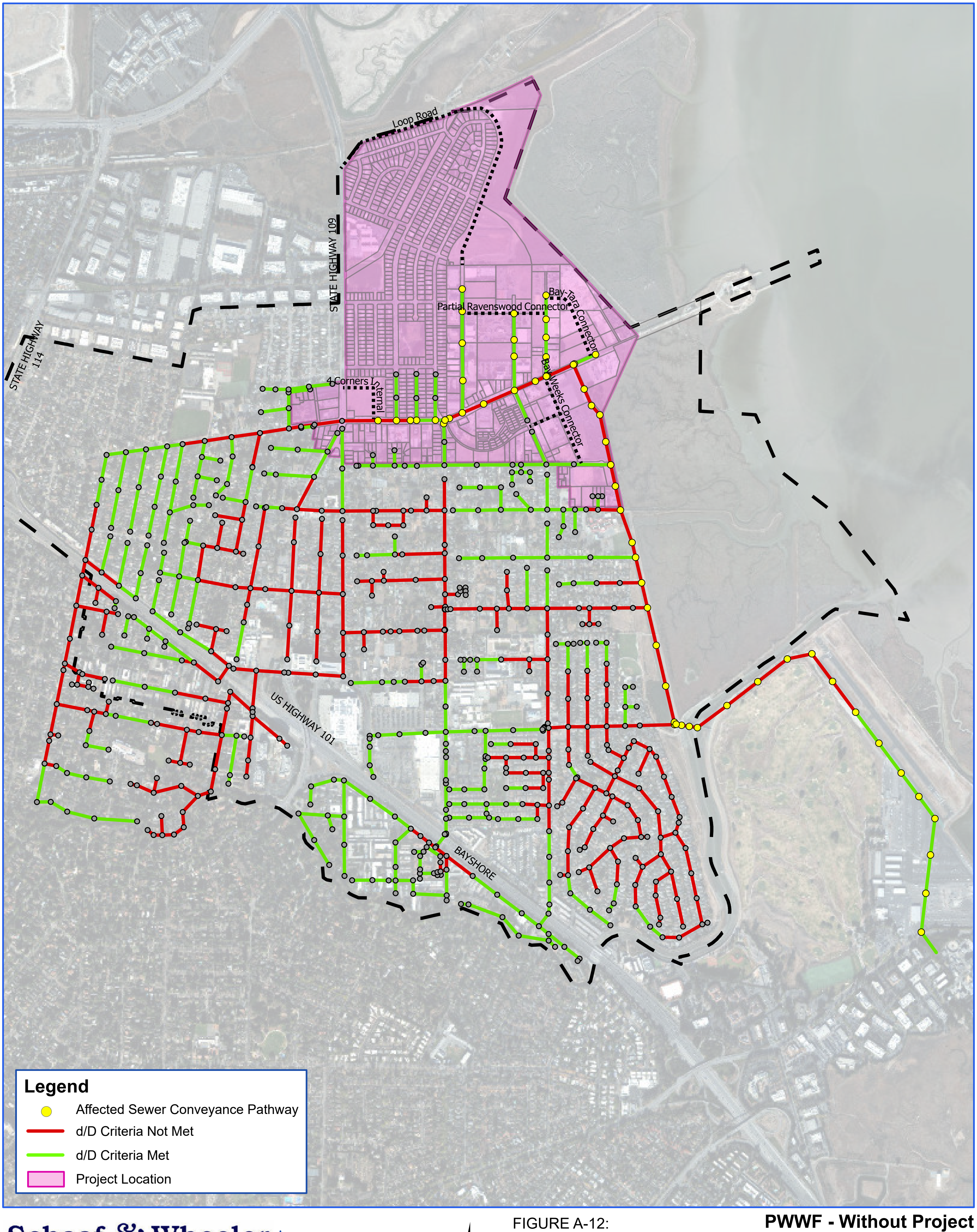

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FIGURE A-12:

PWWF - Without Project

Sewer System Model - Existing Condition

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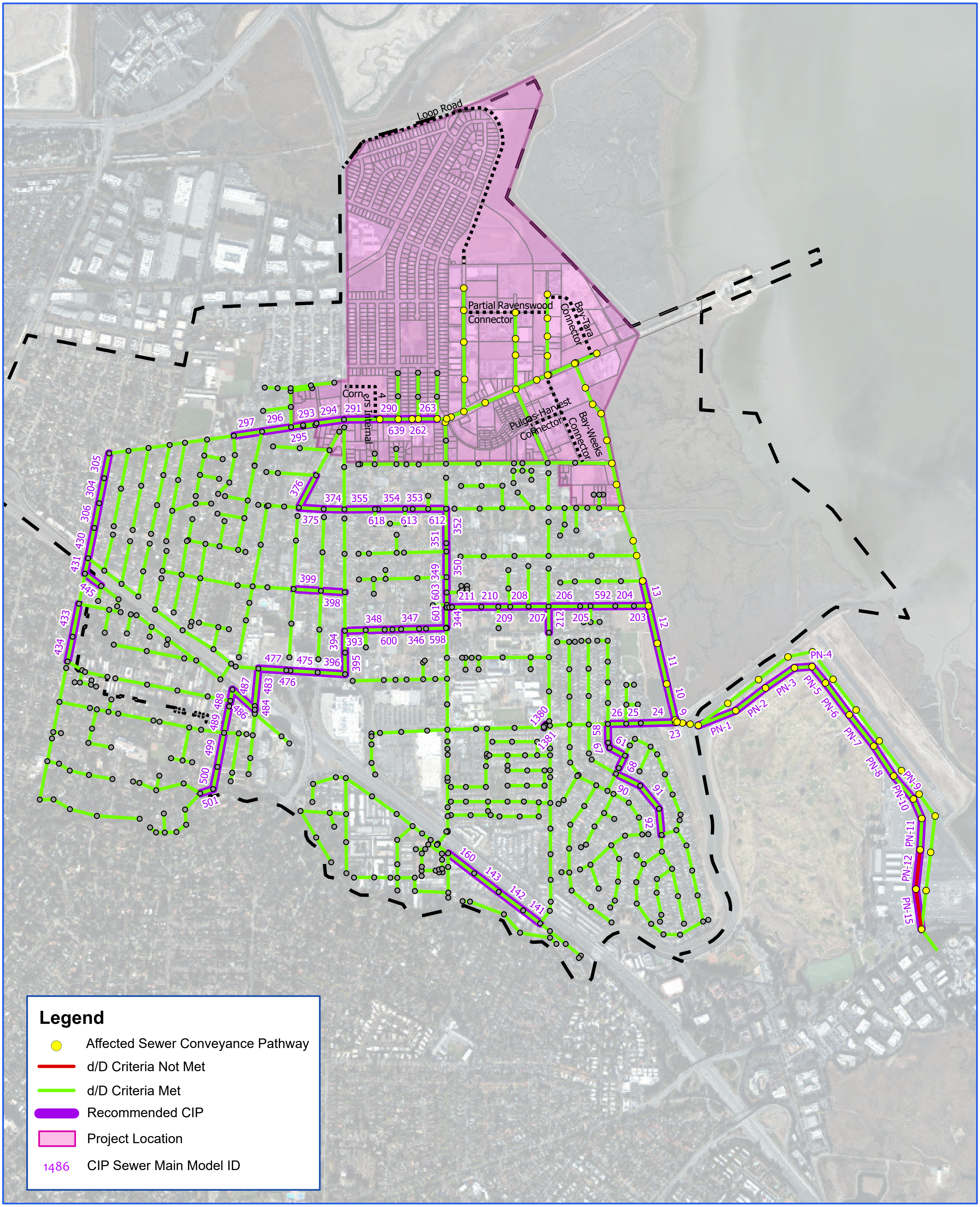

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0 750 1,500 Feet

FIGURE A-13: **PWWF - Without Project - With CIPs**

Sewer System Model - Existing Condition

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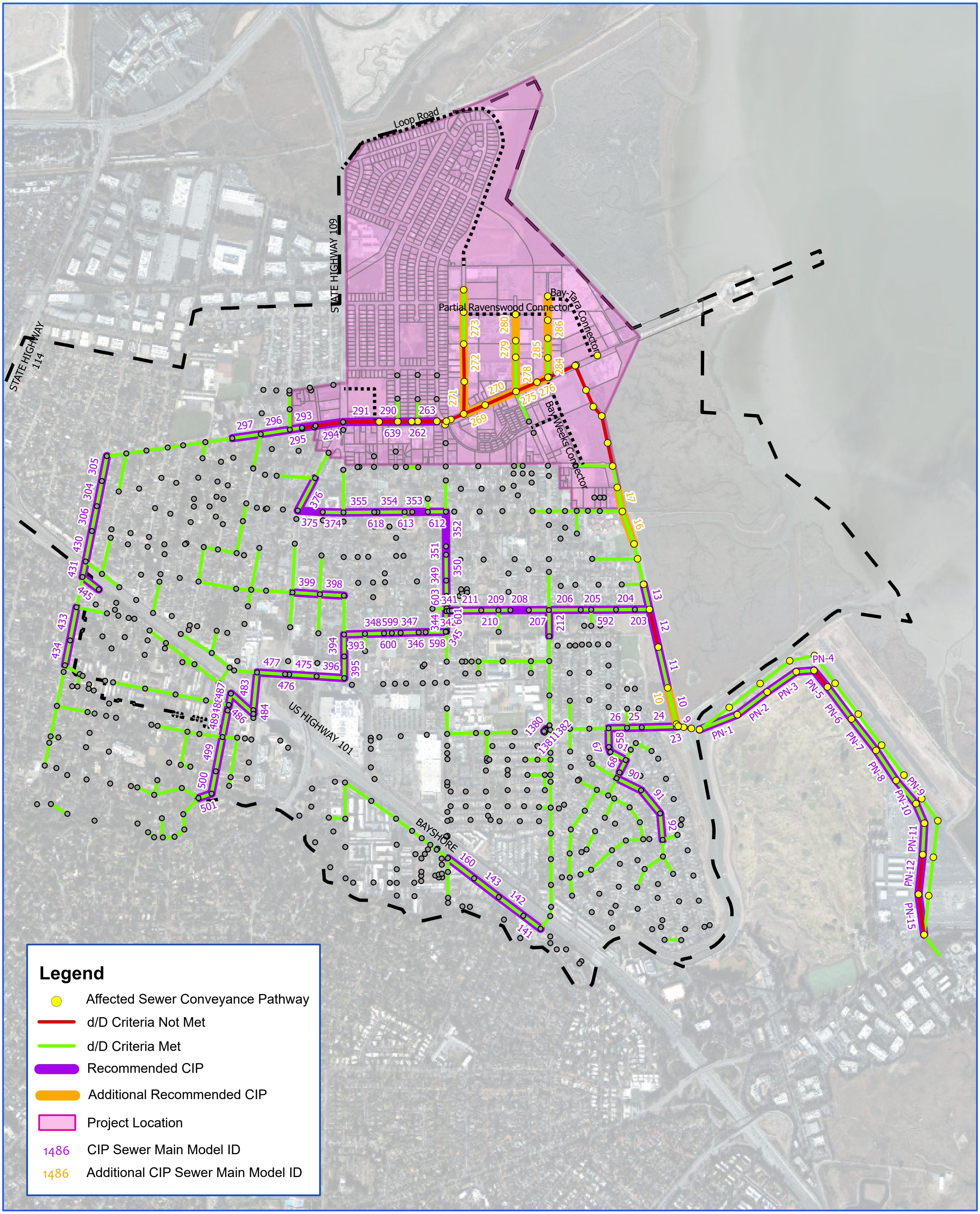

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0 750 1,500 Feet

FIGURE A-14: **PWWF - Without Project - 2013 Specific Plan Base Scenario**

Sewer System Model - Existing Condition

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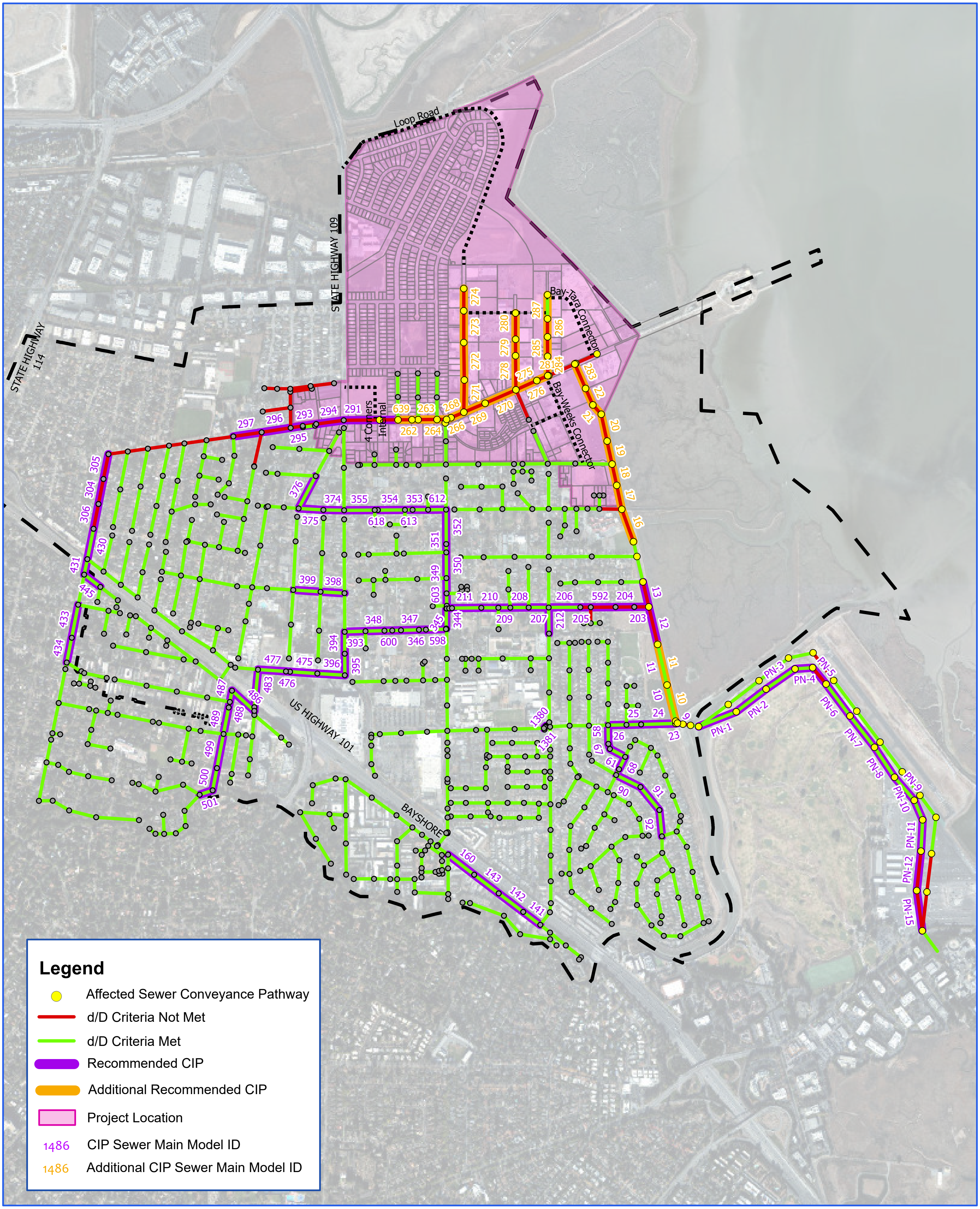

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0 750 1,500 Feet

N

FIGURE A-15: **PWWF - With Project - Scenario 1**

Sewer System Model - Existing Condition

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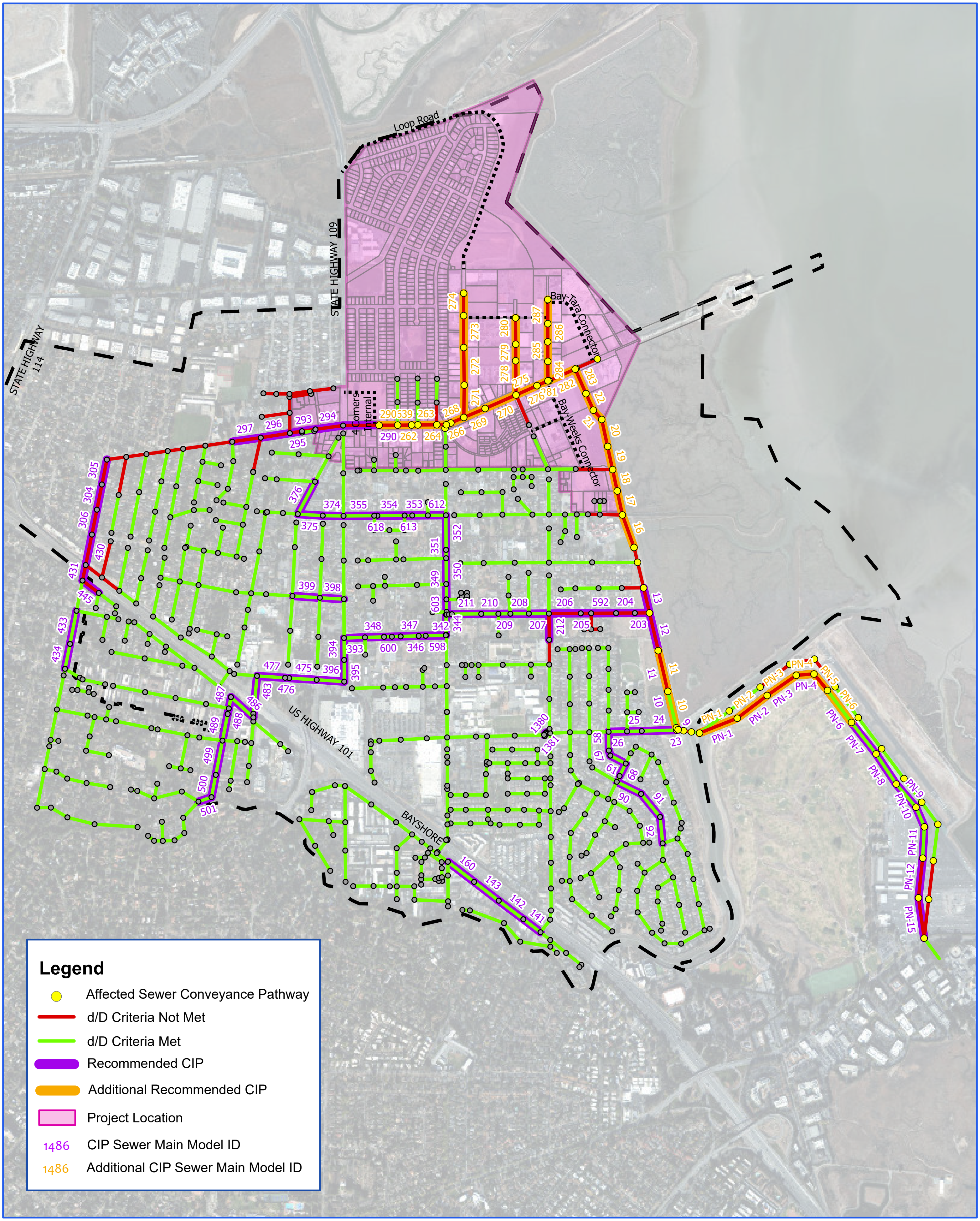

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0 750 1,500 Feet

FIGURE A-16: **PWWF - With Project - Scenario 2**

Sewer System Model - Existing Condition

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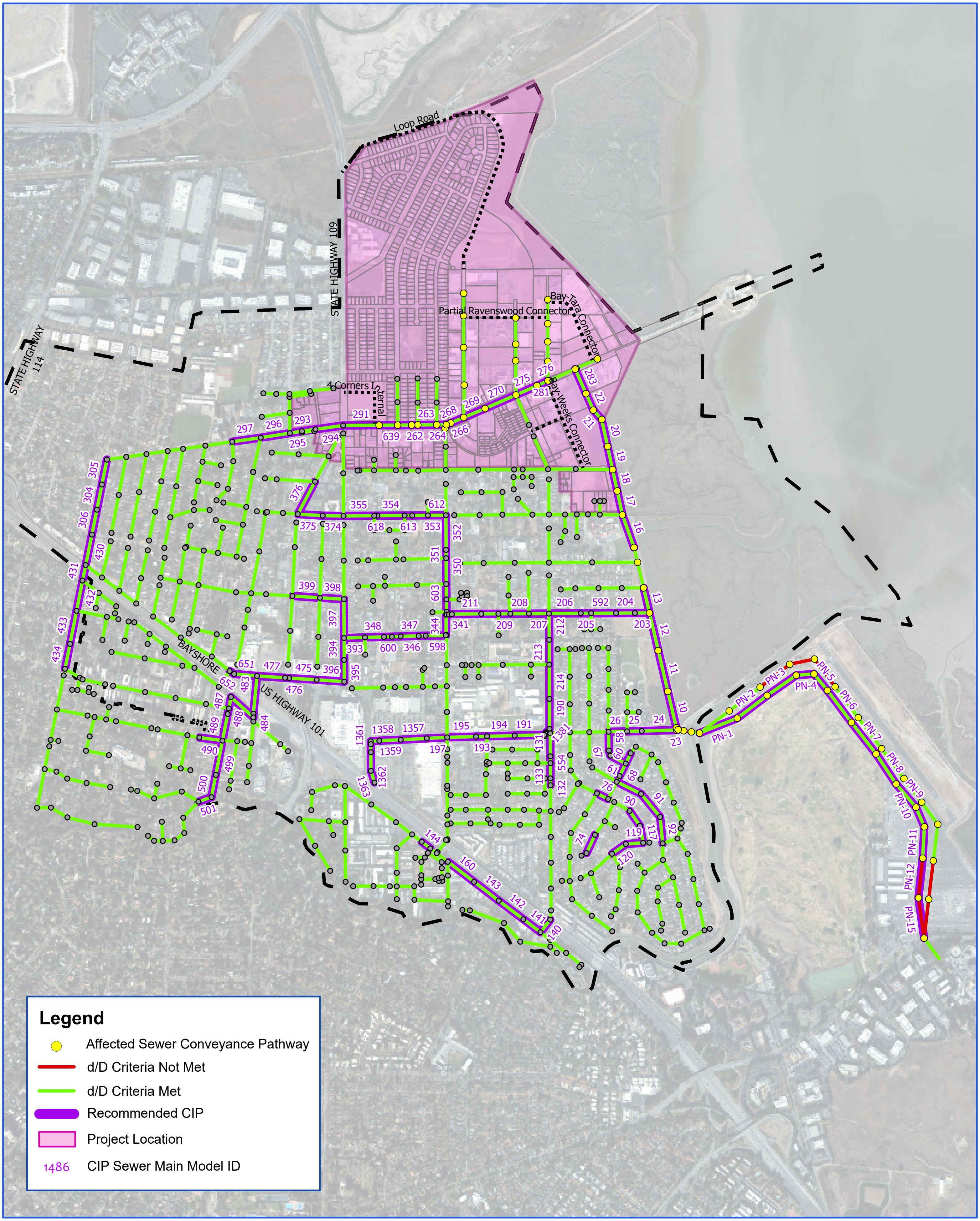

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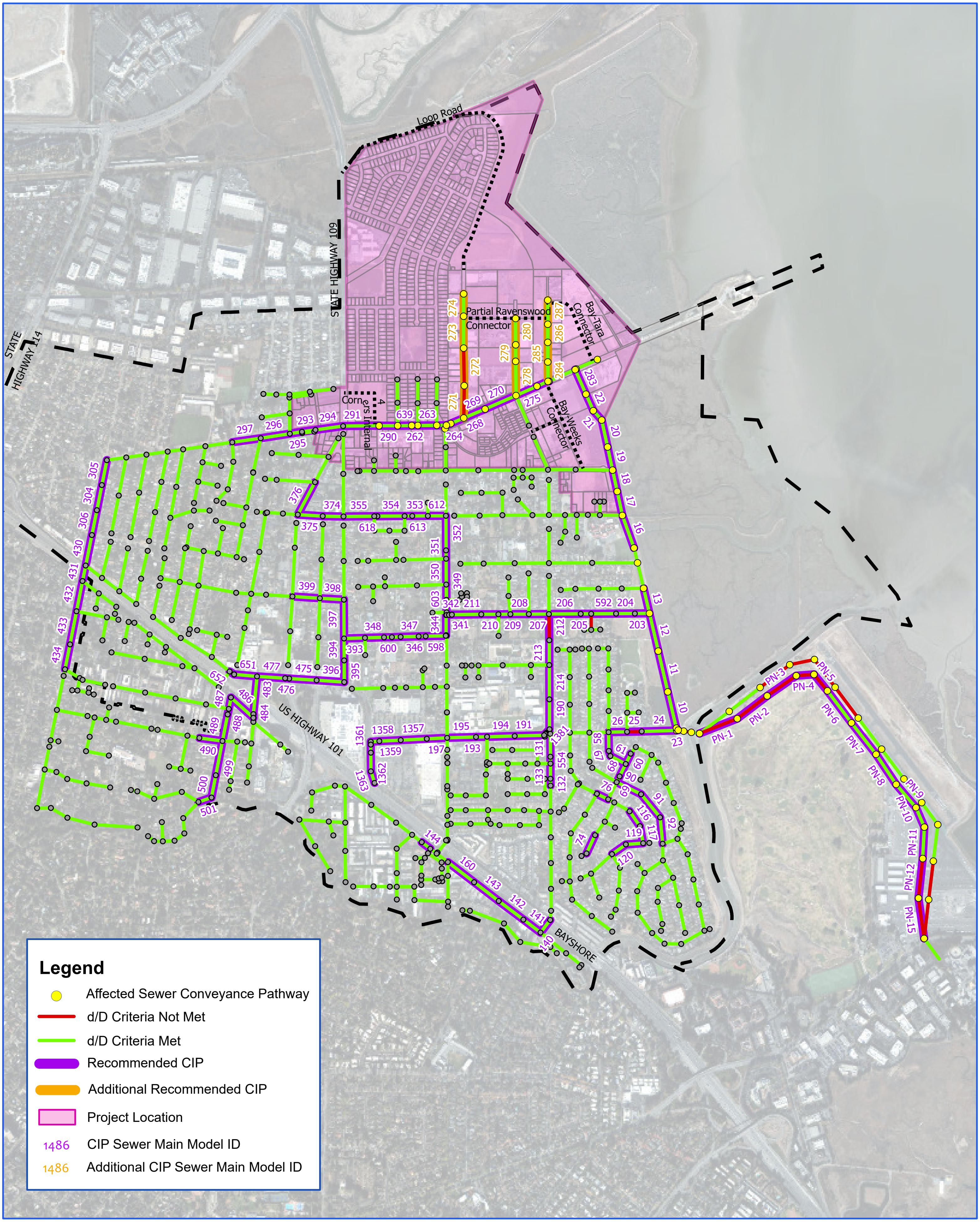
0 750 1,500 Feet

FIGURE A-17:

PWWF - Without Project

Sewer System Model - Future Cumulative Condition

Ravenswood Business District Specific Plan Update Utility Impact Study | April 2023



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0 750 1,500 Feet

N

FIGURE A-18: **PWWF - With Project - Scenario 1**

Sewer System Model - Future Cumulative Condition

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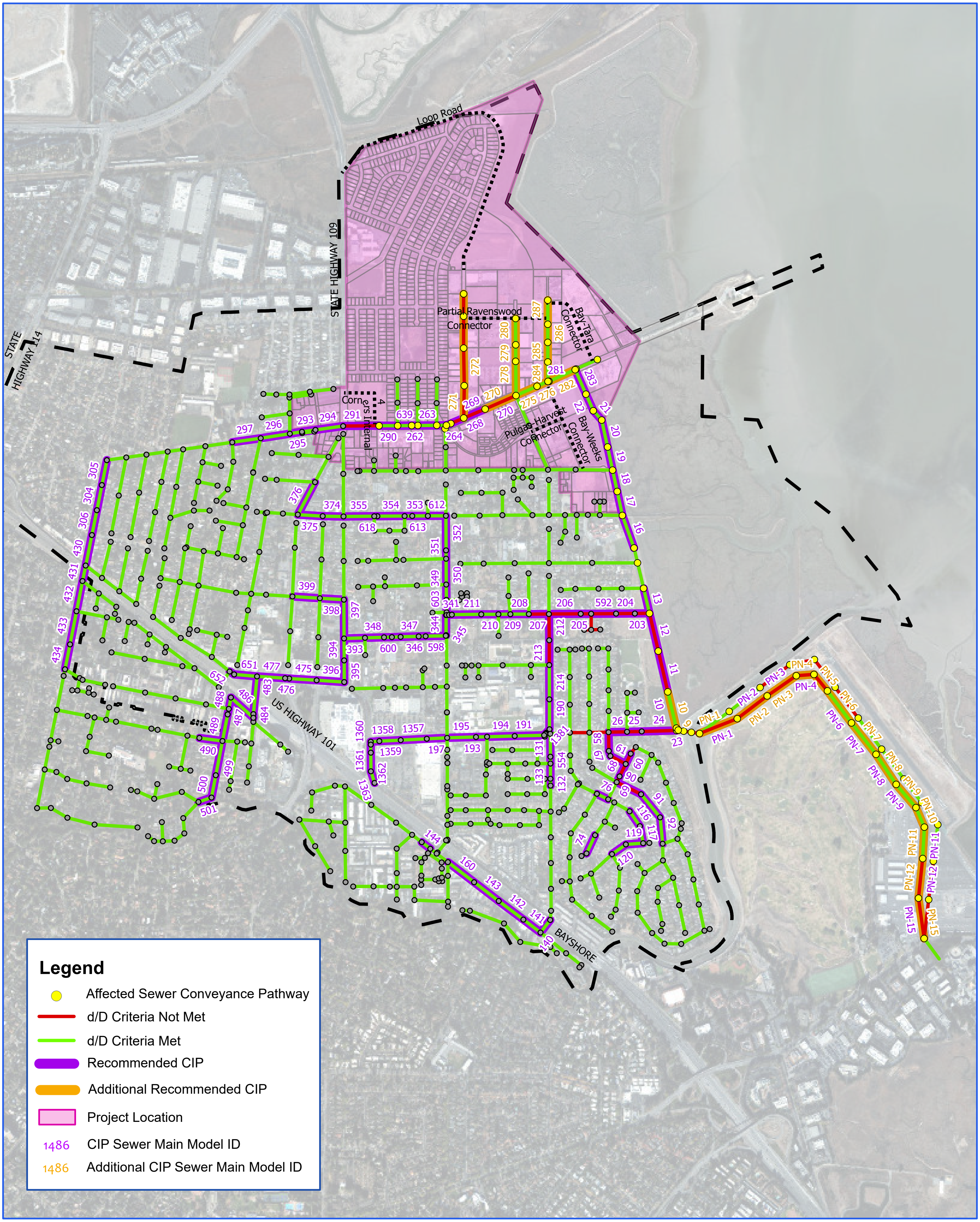

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0 750 1,500 Feet

FIGURE A-19: **PWWF - With Project - Scenario 2**

Sewer System Model - Future Cumulative Condition

Ravenswood Business District Specific Plan Update Utility Impact Study | April 2023

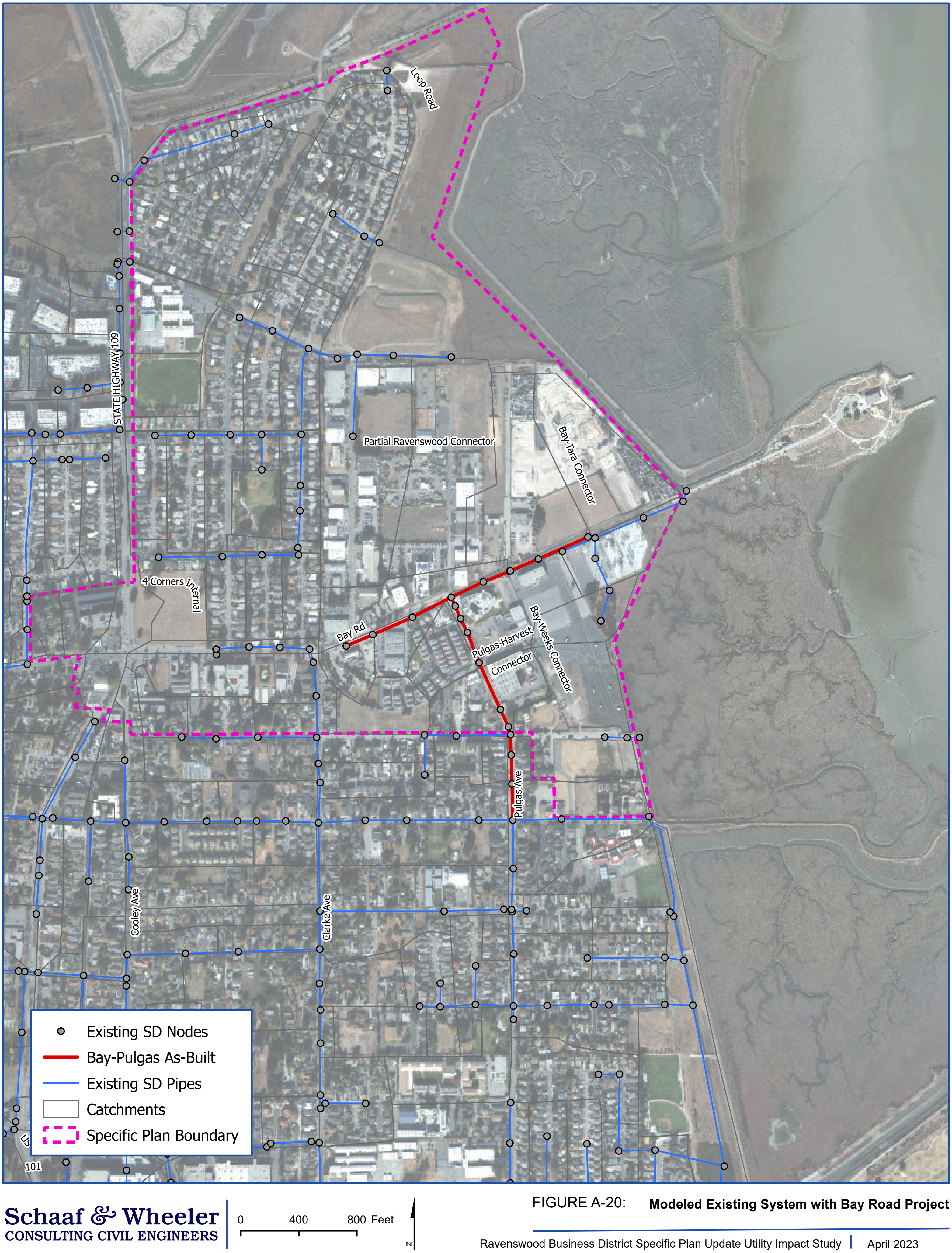

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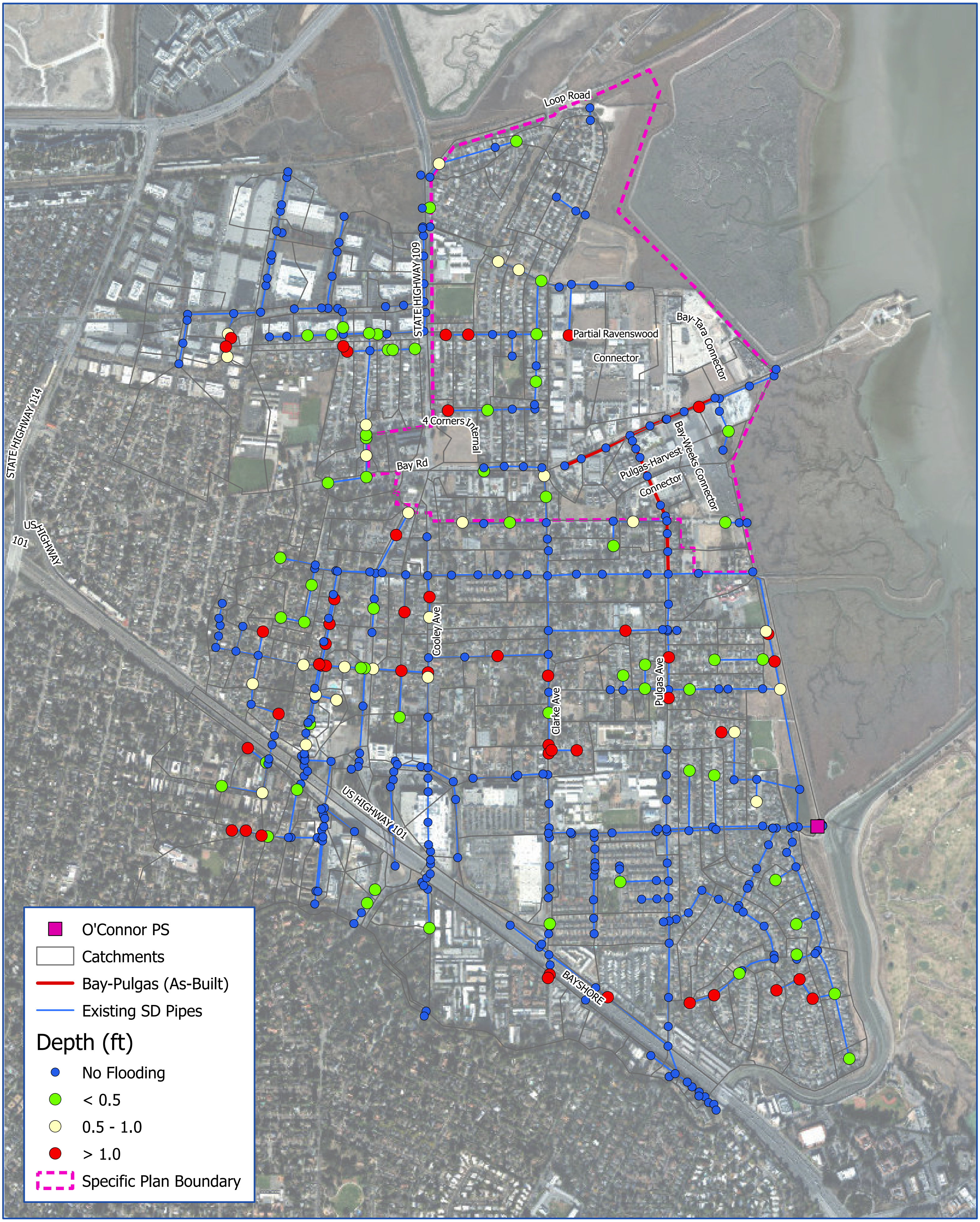
FIGURE A-20: **Modeled Existing System with Bay Road Project**



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0 650 1,300 Feet

N

FIGURE A-21: **10-Year Existing Condition Node Flood Result**

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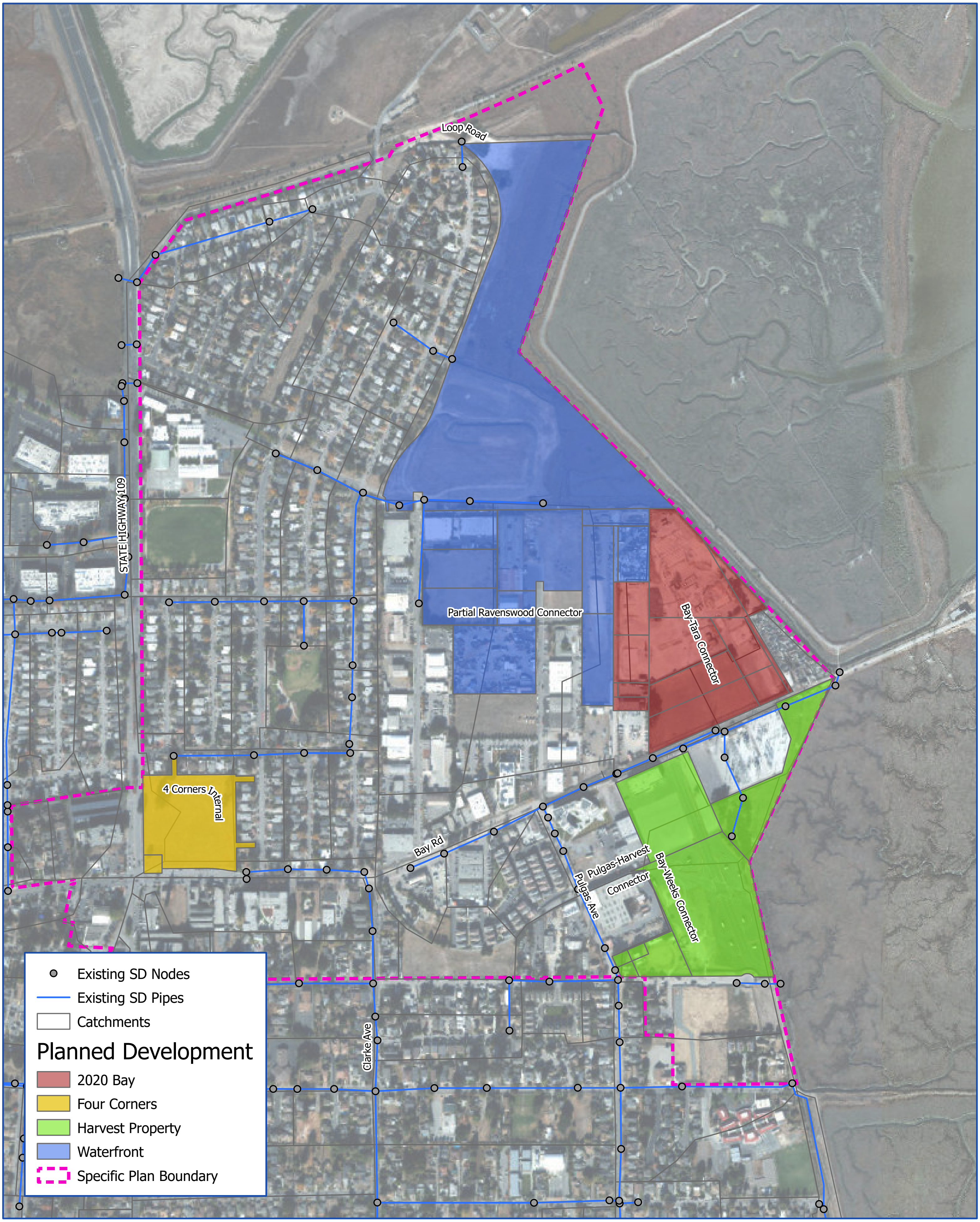

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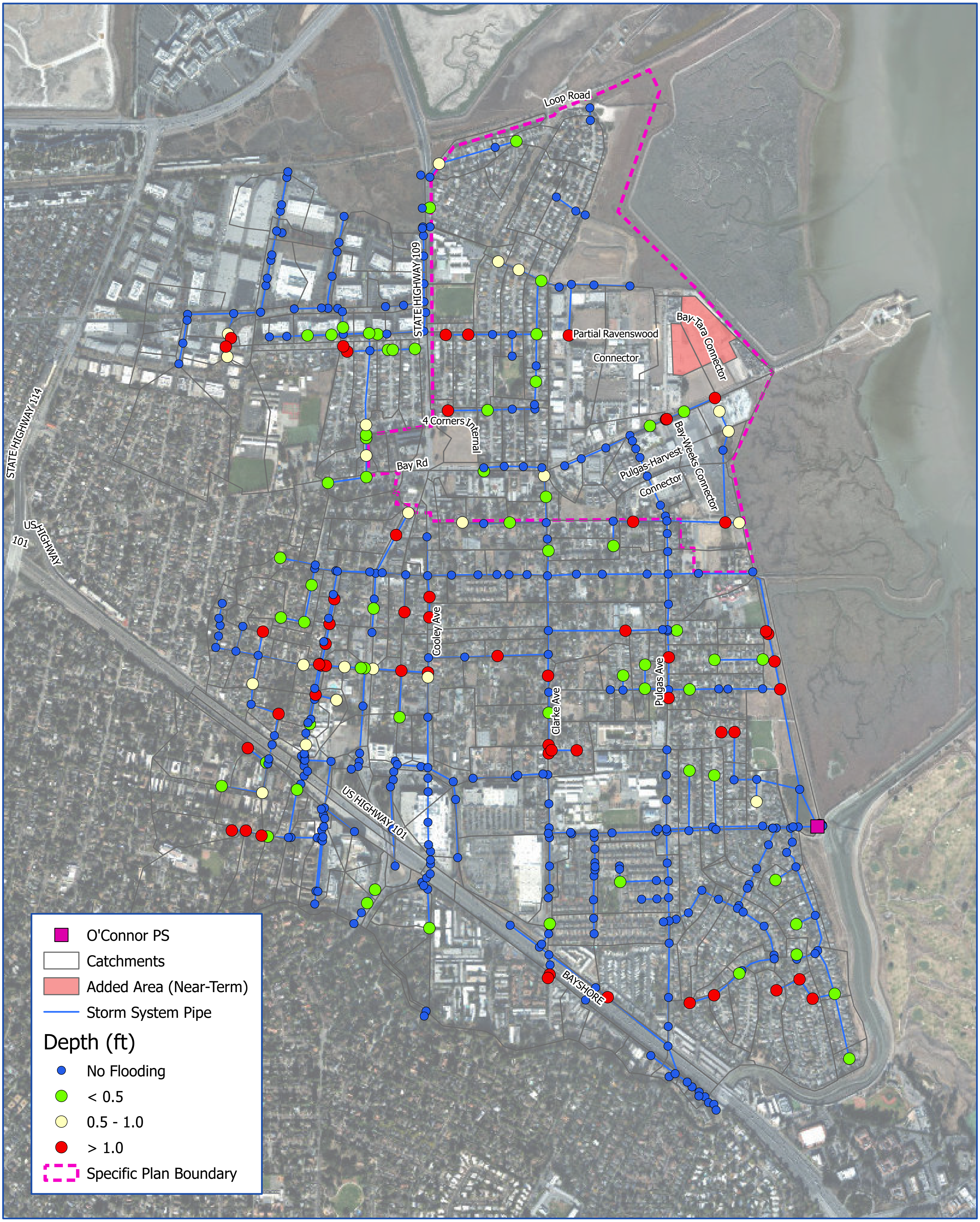
FIGURE A-22: **Development Areas within the East Palo Alto Storm Drain Model Domain**



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0 650 1,300 Feet

N

FIGURE A-23: **10-Year Near-Term Developed Condition Node Flood Result (Excluding Waterfront)**

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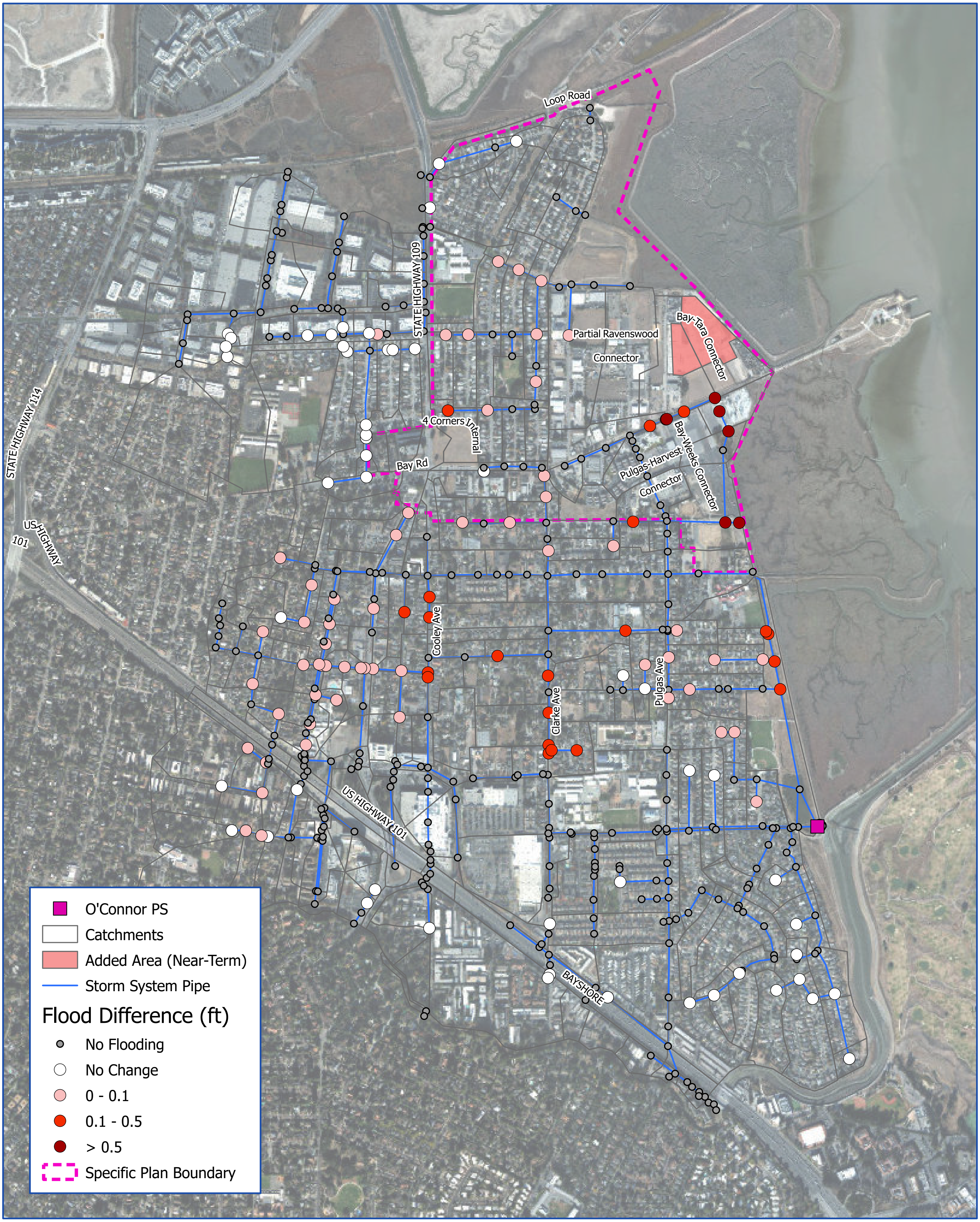

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0 640 1,280 Feet

N

FIGURE A-24: **Changes in 10-year Flooding in Existing System Caused by Near-Term Development**

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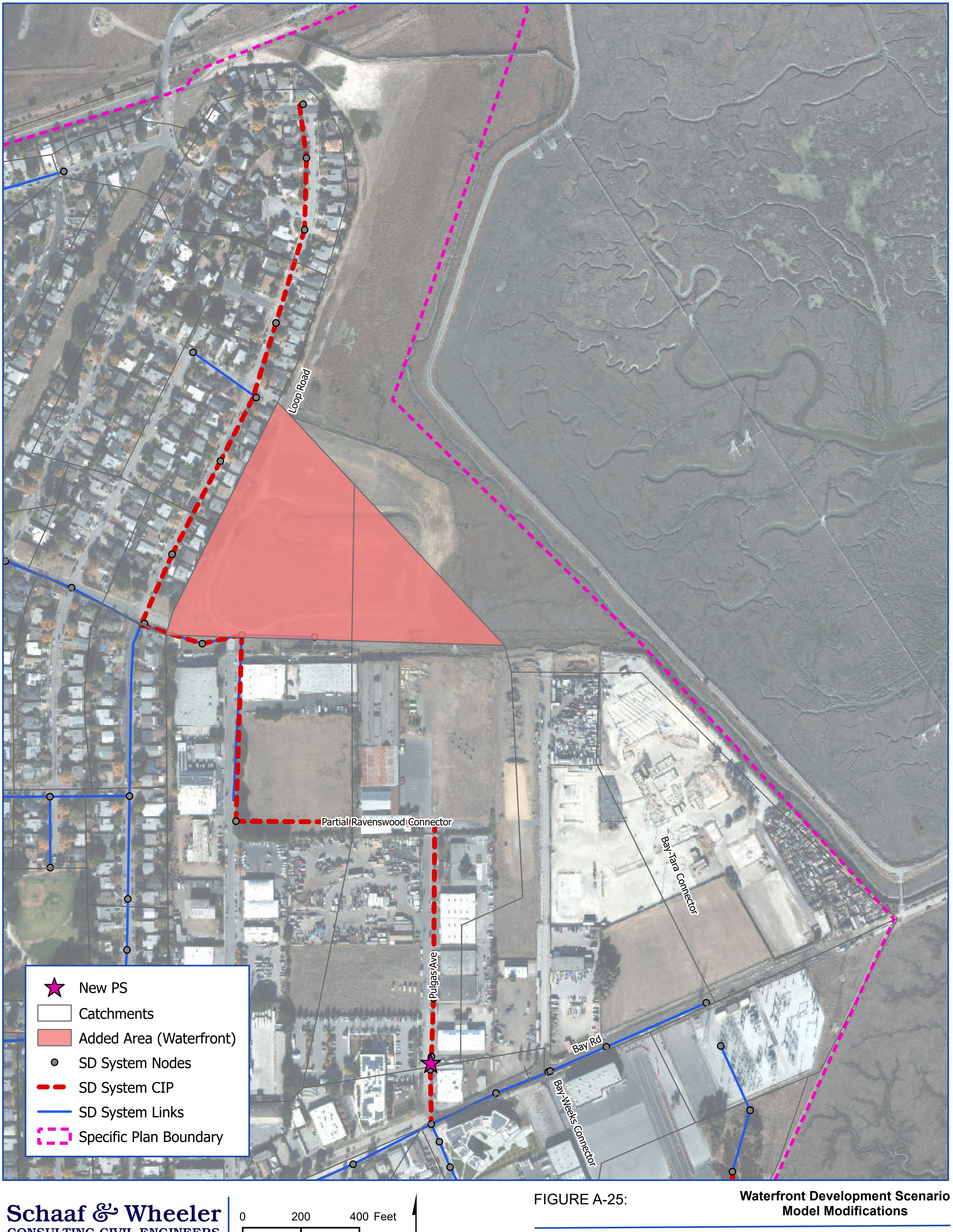

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FIGURE A-25: **Waterfront Development Scenario Model Modifications**

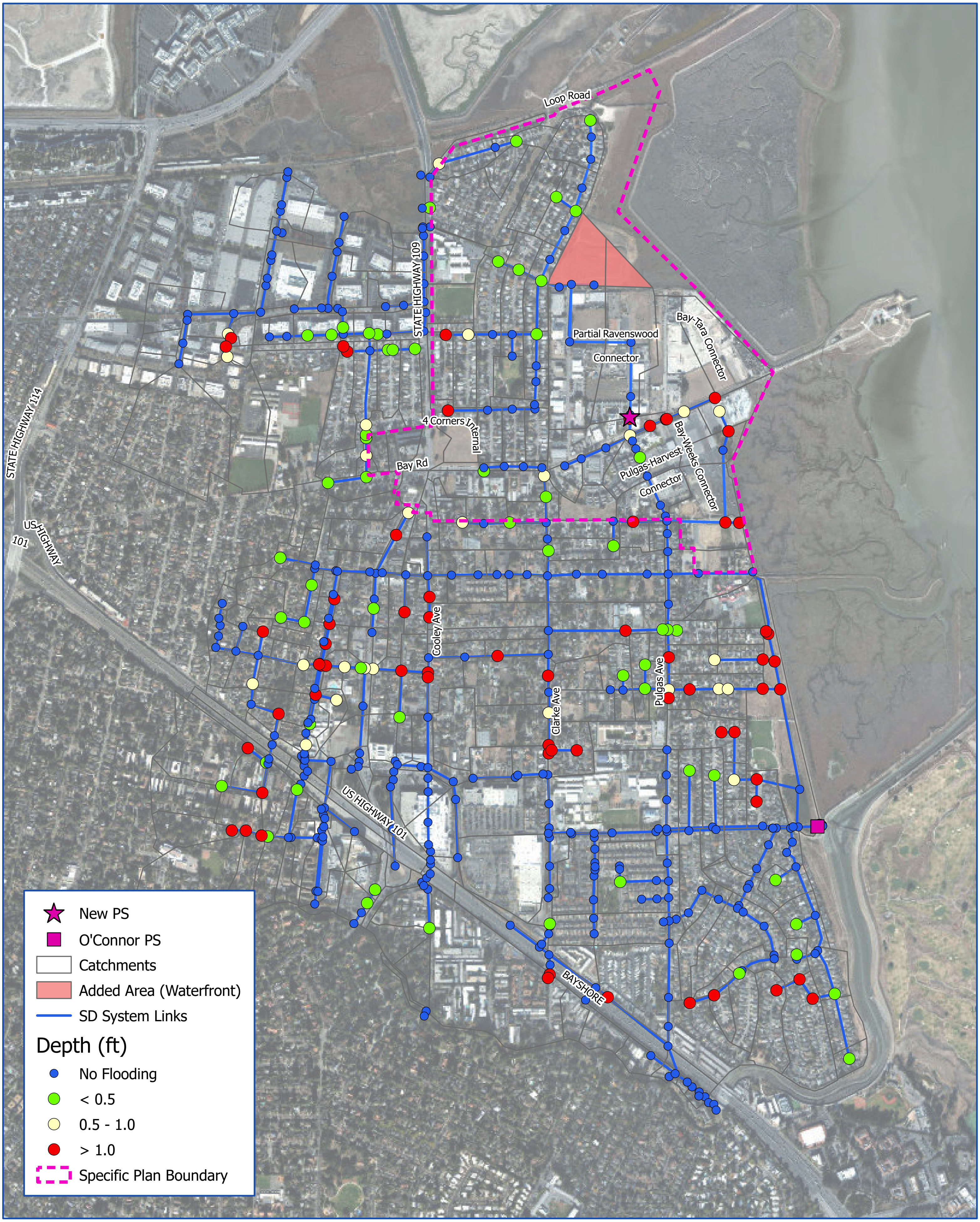

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FIGURE A-26: **10-year Developed Condition Node Flood Result (w/ Waterfront Development))**

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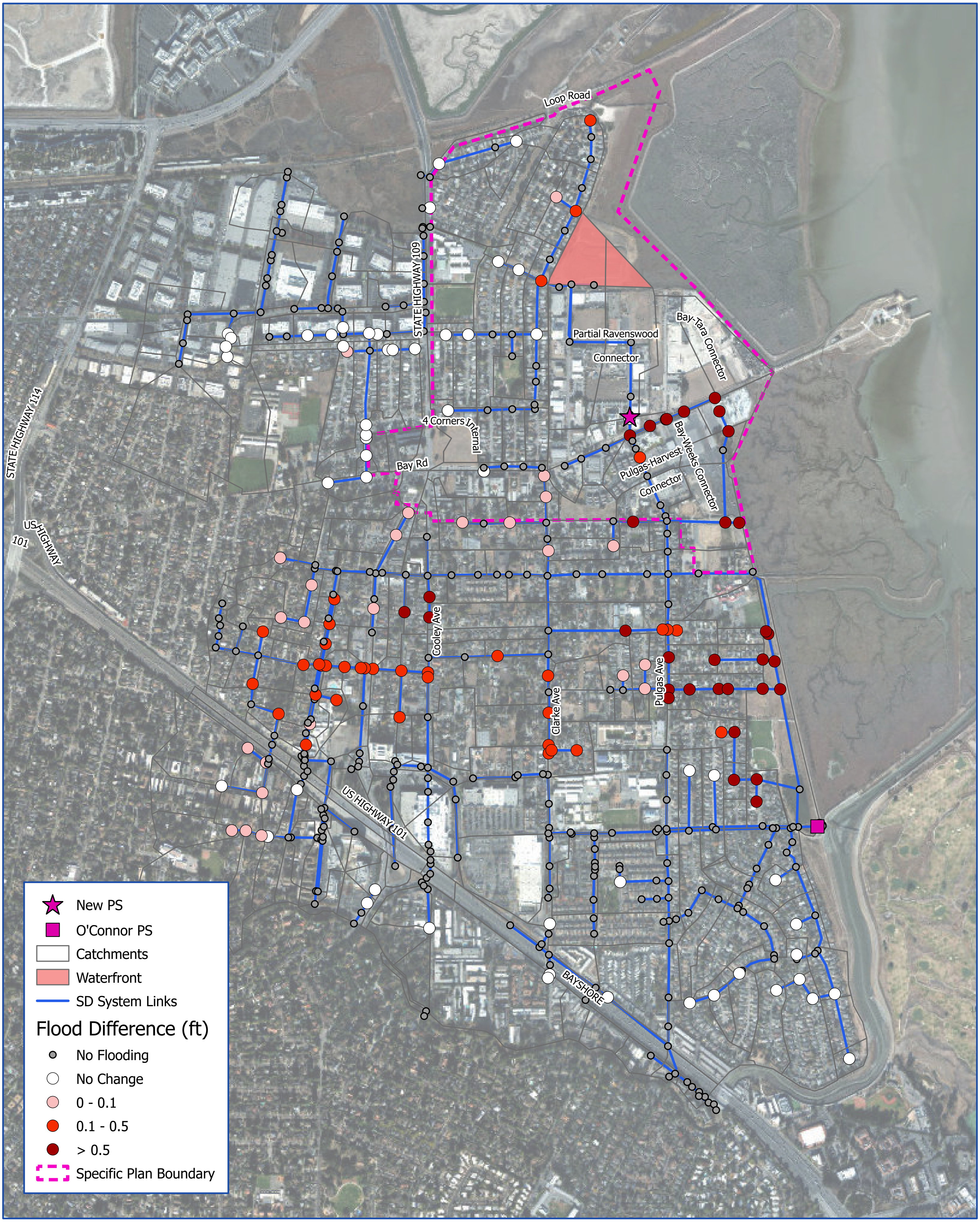

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FIGURE A-27: **Waterfront Impact Compared With Near-Term Development Model**

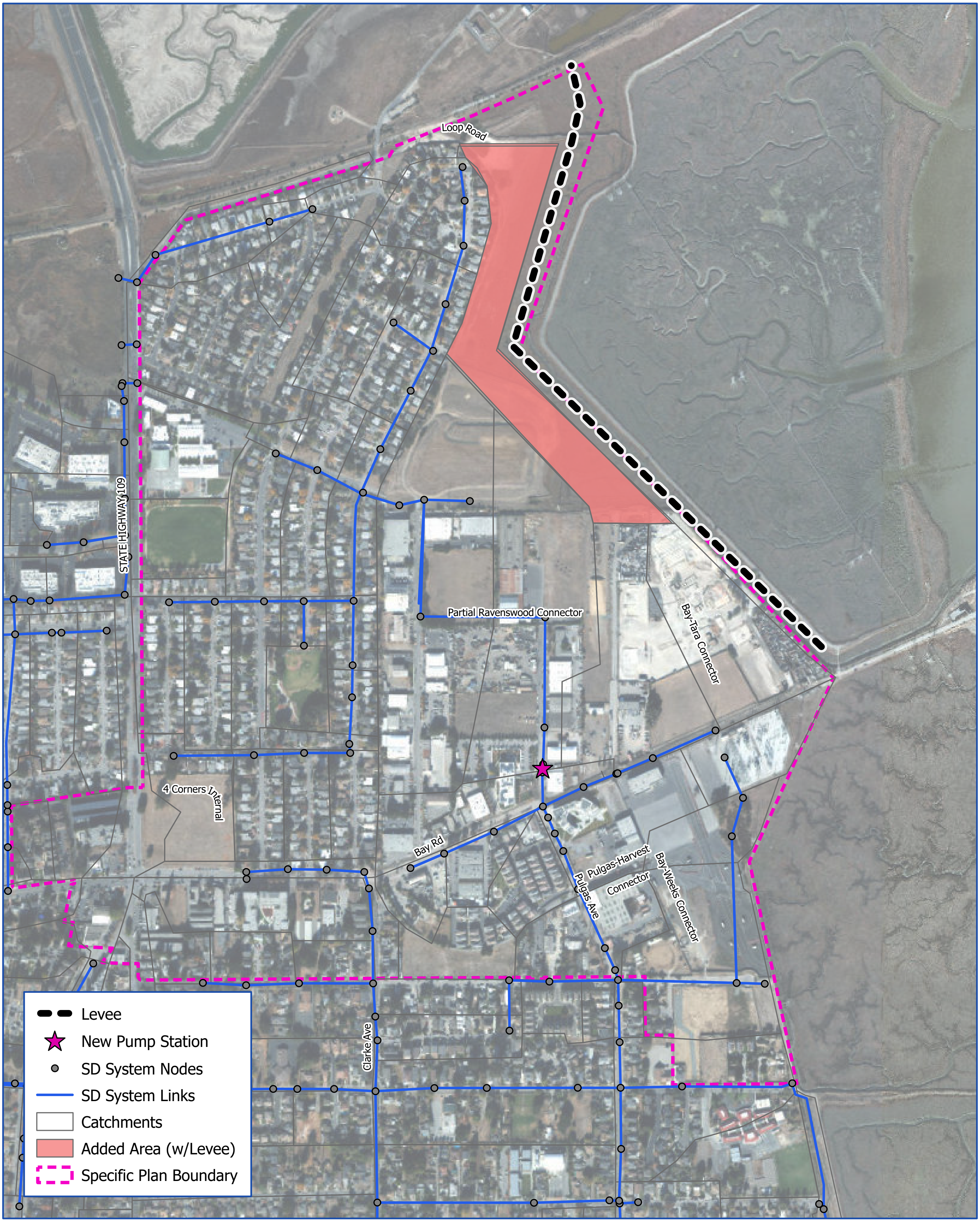

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FIGURE A-28: **Additional Waterfront Catchment with Future Levee**

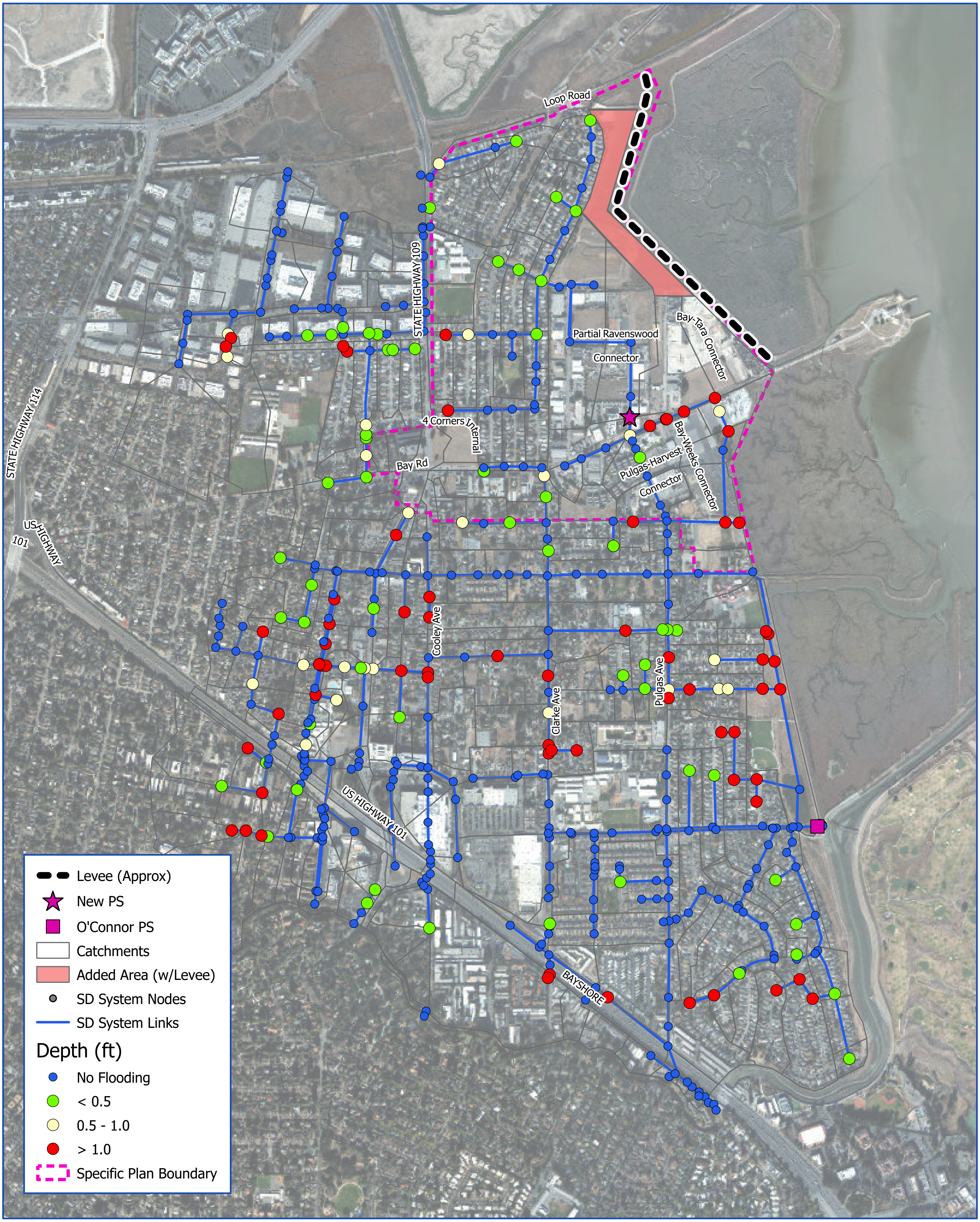

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FIGURE A-29: **10-year Developed Condition Node Flood Result (w/Waterfront Development & Levee)**

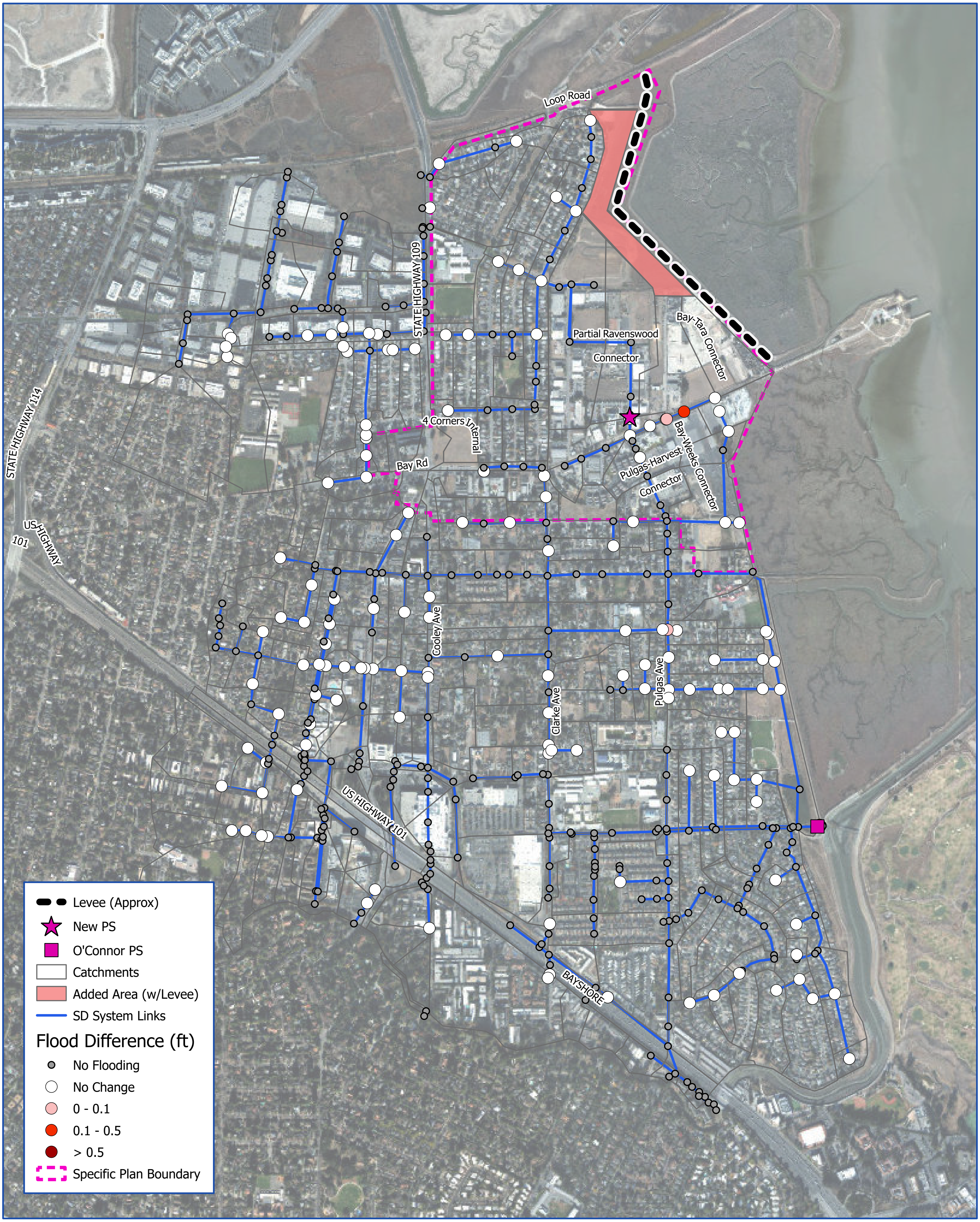

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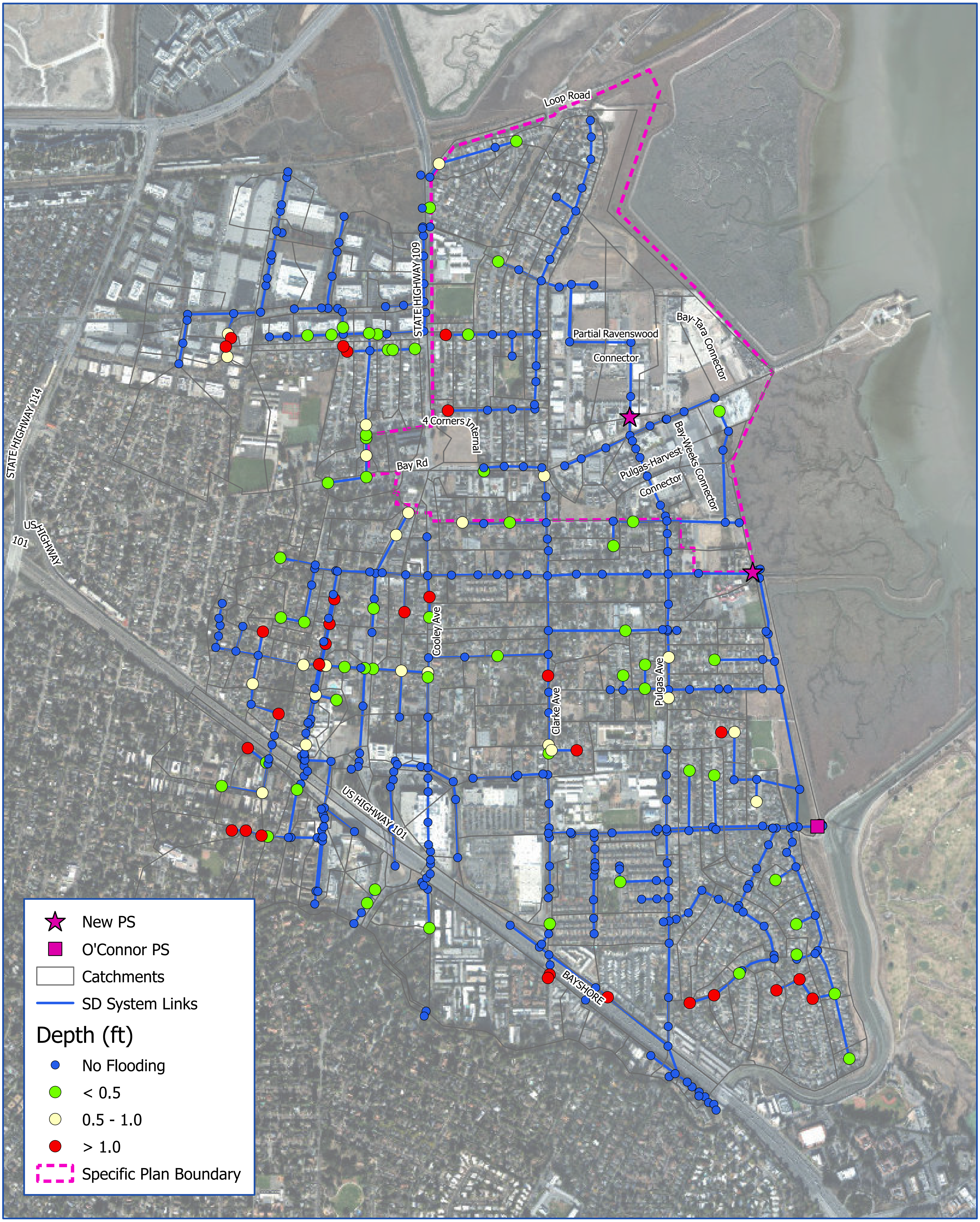
FIGURE A-30: **Impact of Levees Compared with Waterfront Development Model**



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0 650 1,300 Feet

N

FIGURE A-31: **10-year Node Flood Result with All Development and New 215 cfs Runnymede PS**

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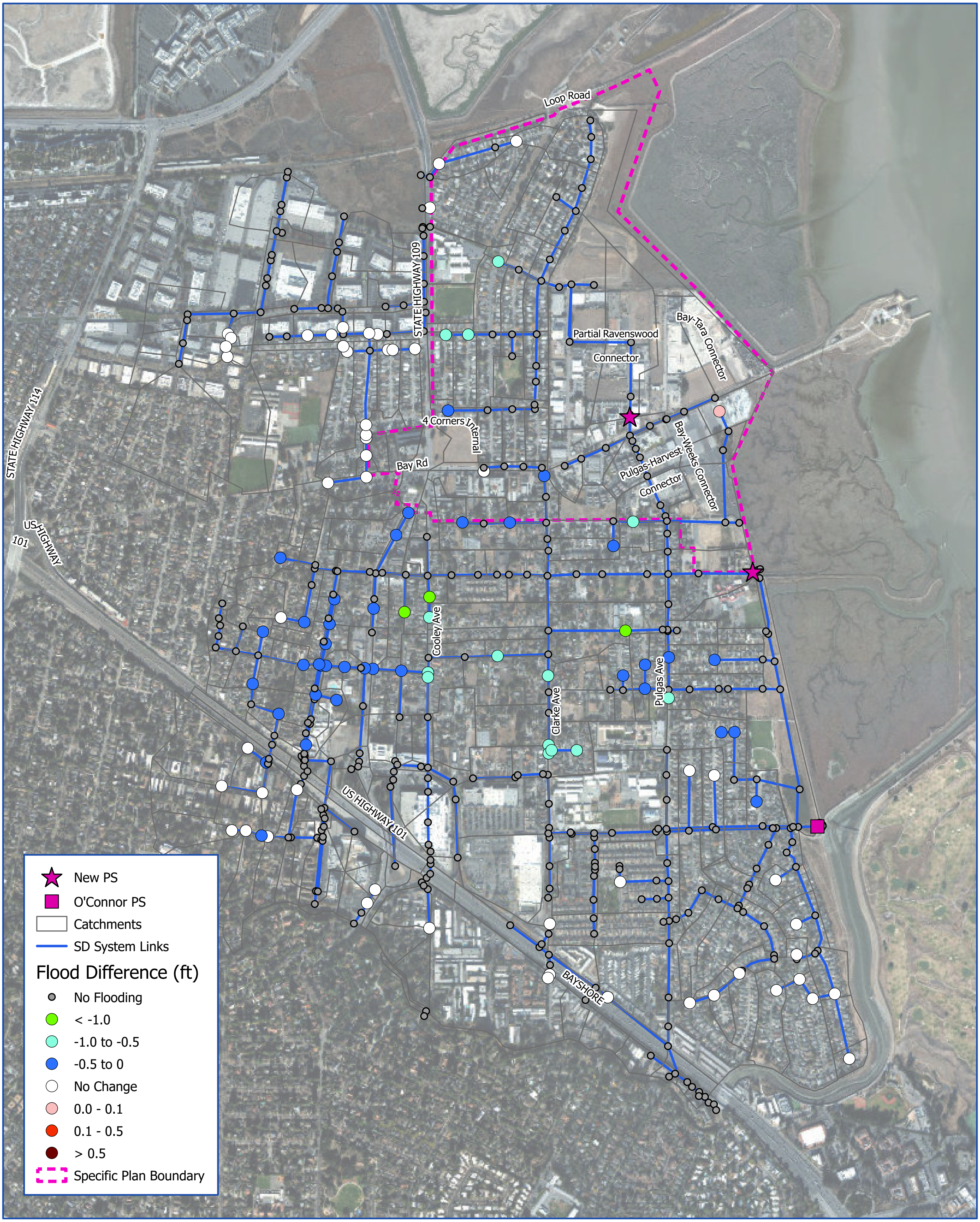

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FIGURE A-32: **Impact of Runnymede Pump Station Compared with Existing Conditions**

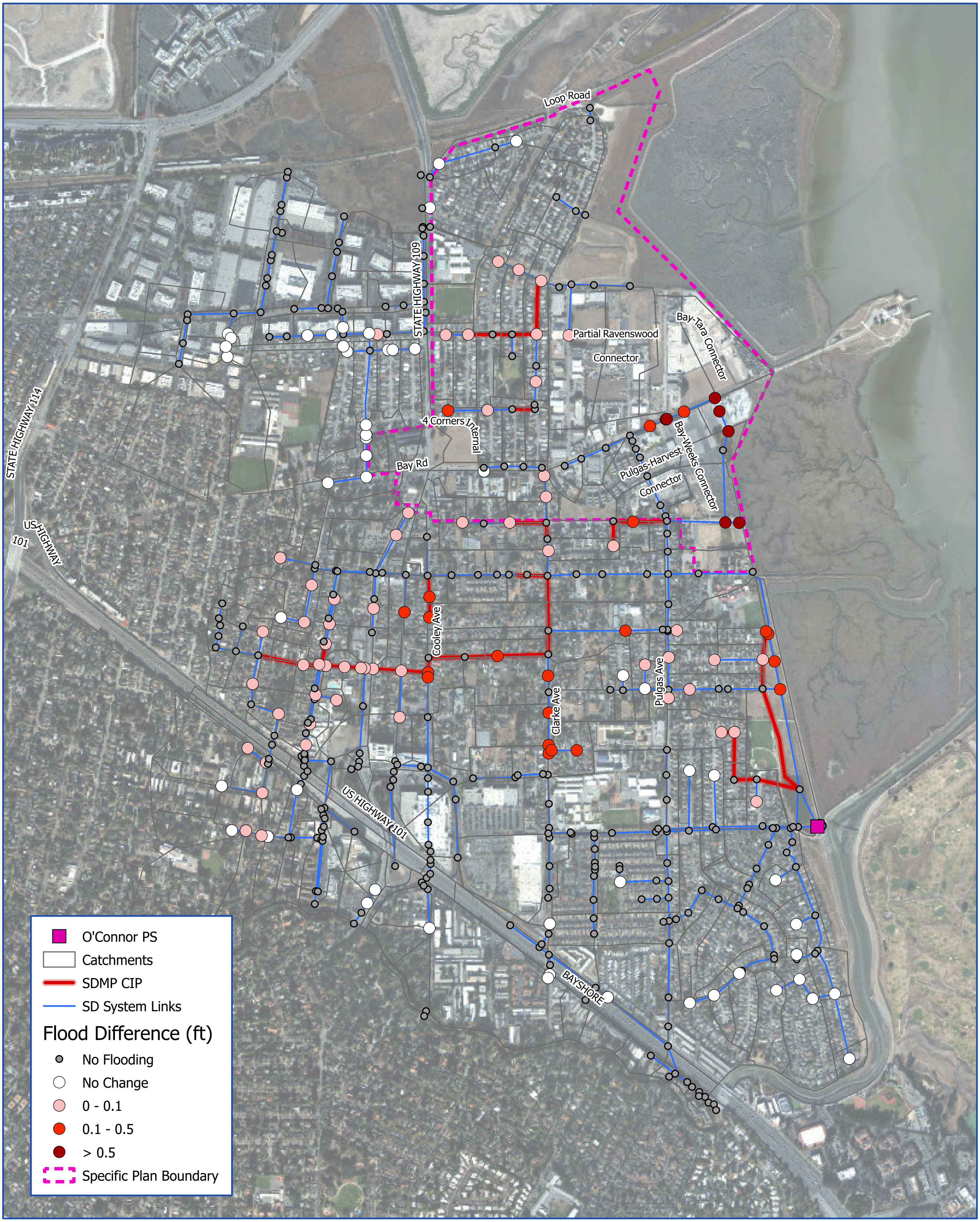

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FIGURE A-33: **Changes in 10-yr Flooding Caused by Near-Term Development, Overlain with Alt 2 CIPs**

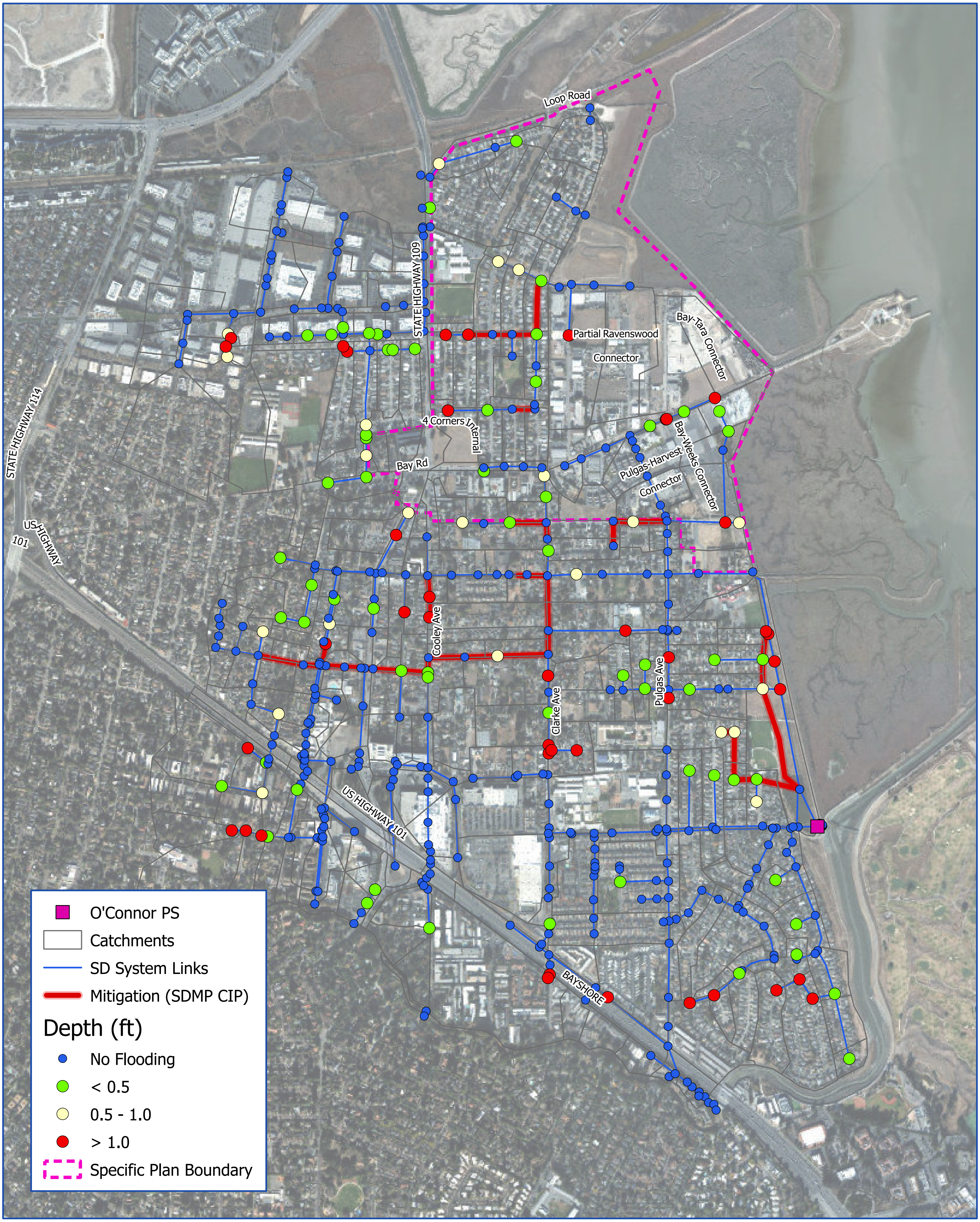

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FIGURE A-34: **10-year Node Flood Result for Near-Term Condition with Select CIPs Constructed**

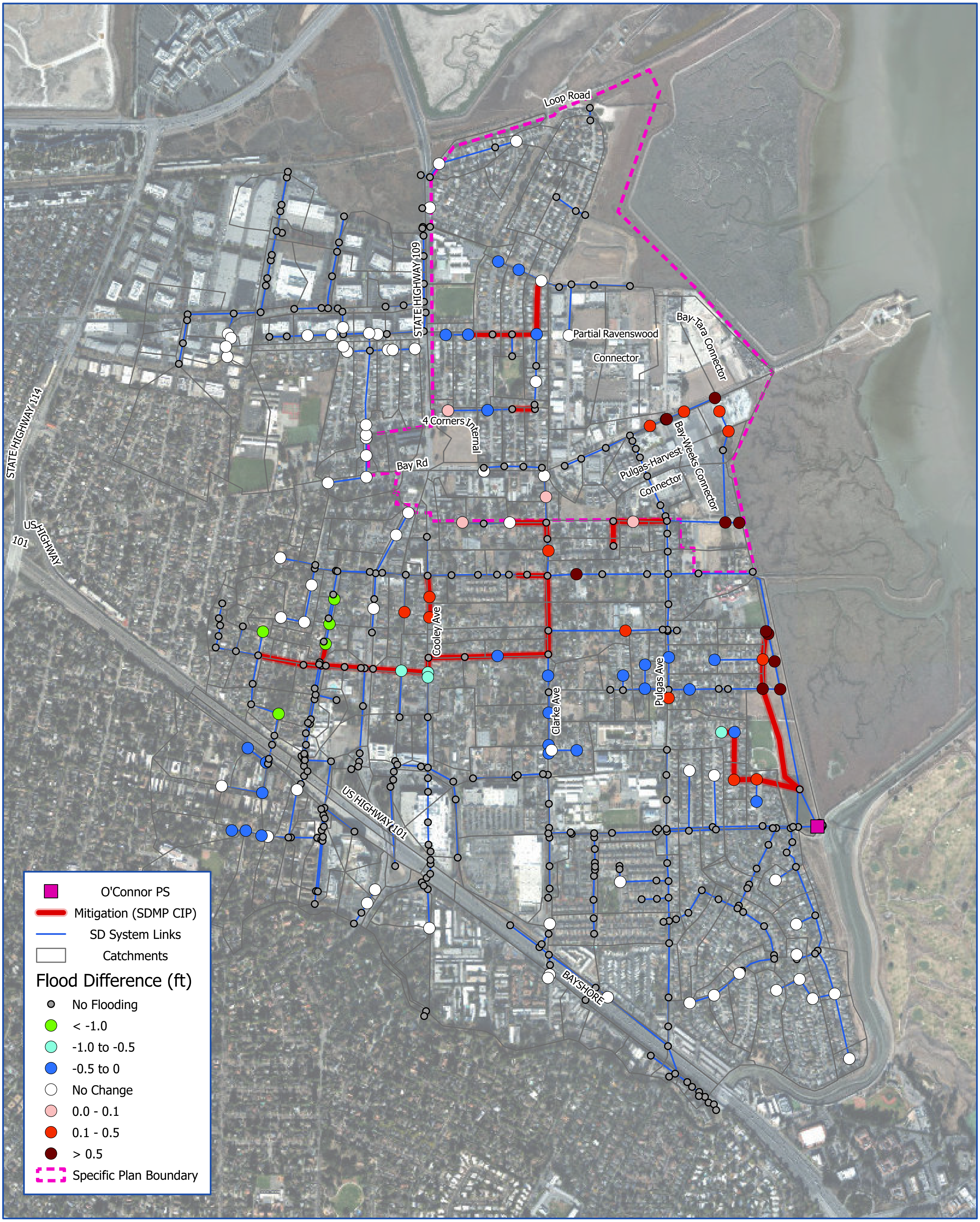

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FIGURE A-35: **Changes in 10-yr Flooding for Near-Term with CIPs Complete, Compared with Existing**

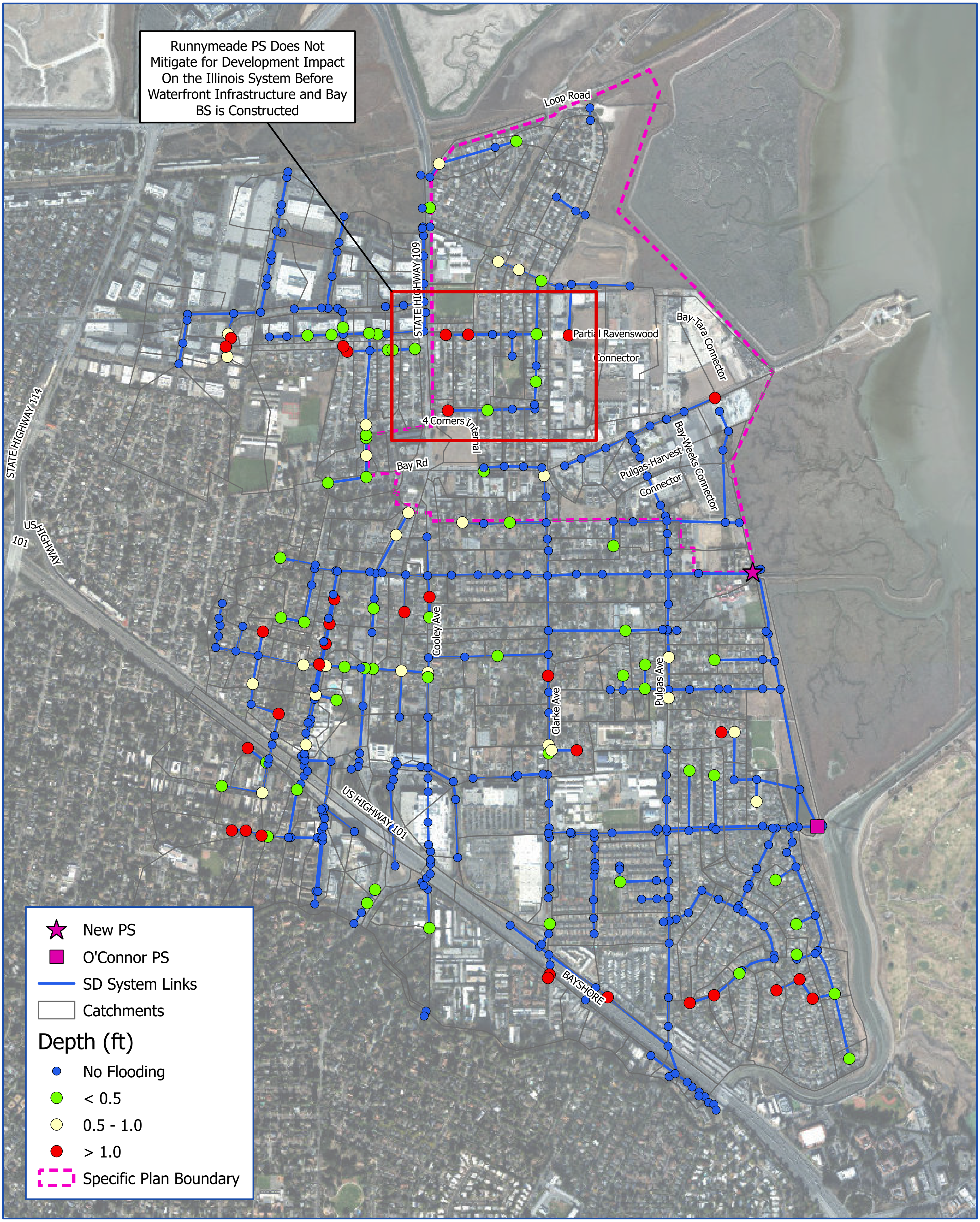

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FIGURE A-36: **10-year Node Flood Result for Near-Term Condition with Runnymede PS Constructed**

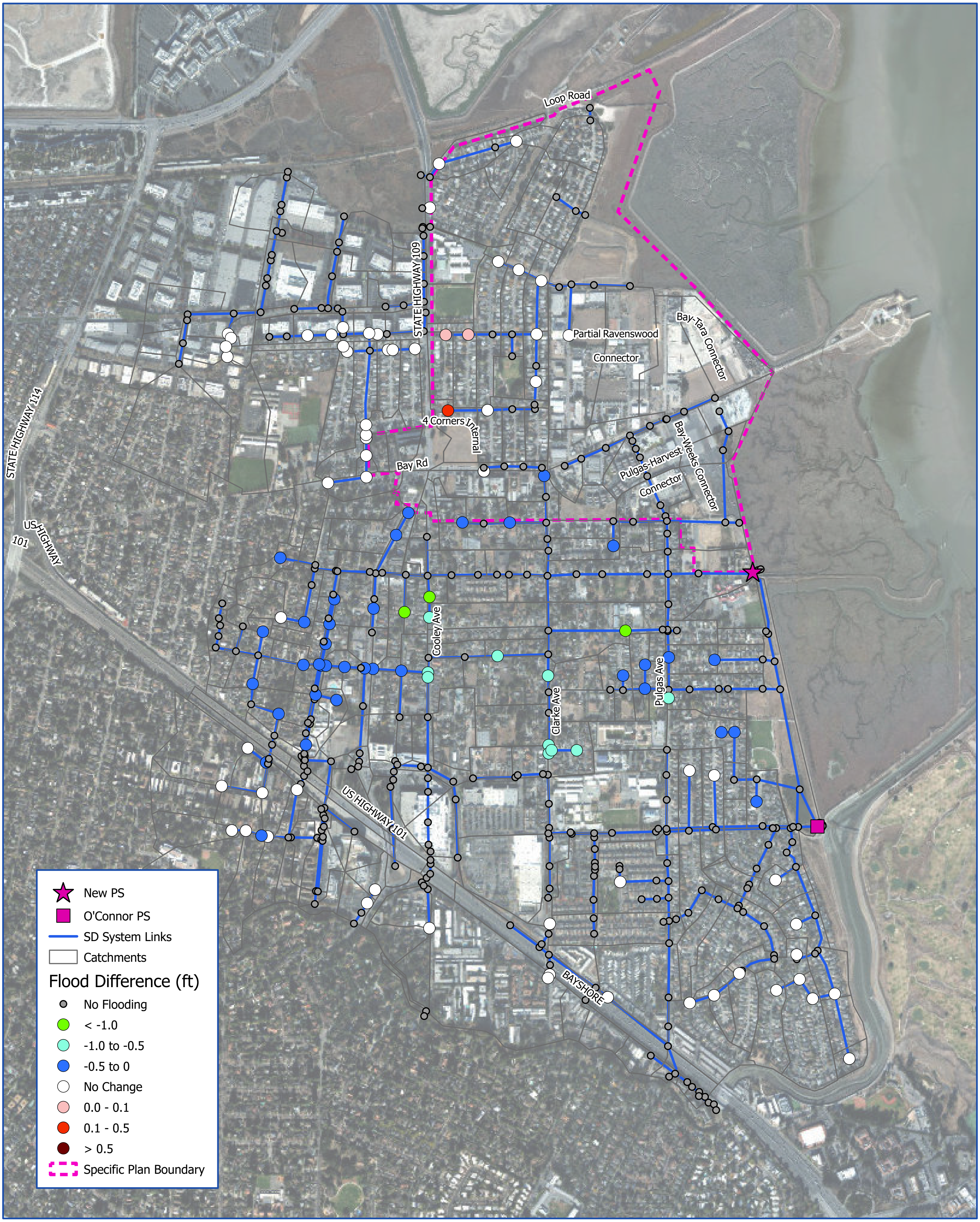

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FIGURE A-37: **Changes in 10-yr Flooding for Near-Term with Runnymede PS Compared with Existing**

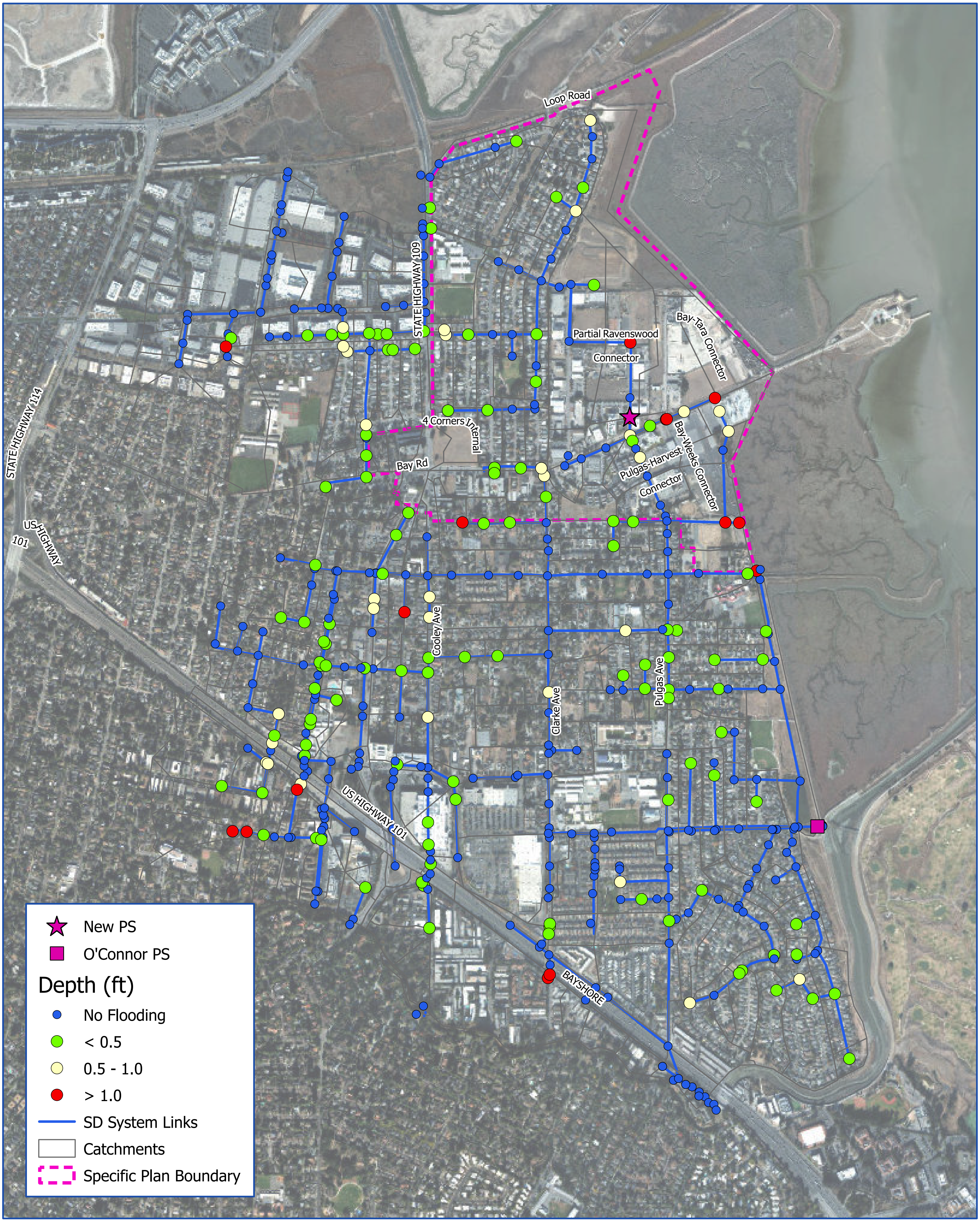

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FIGURE A-38: **10-year Node Flood Results for Future Condition with All Alternative 2 CIPs Complete (no Runnymede Pump Station)**

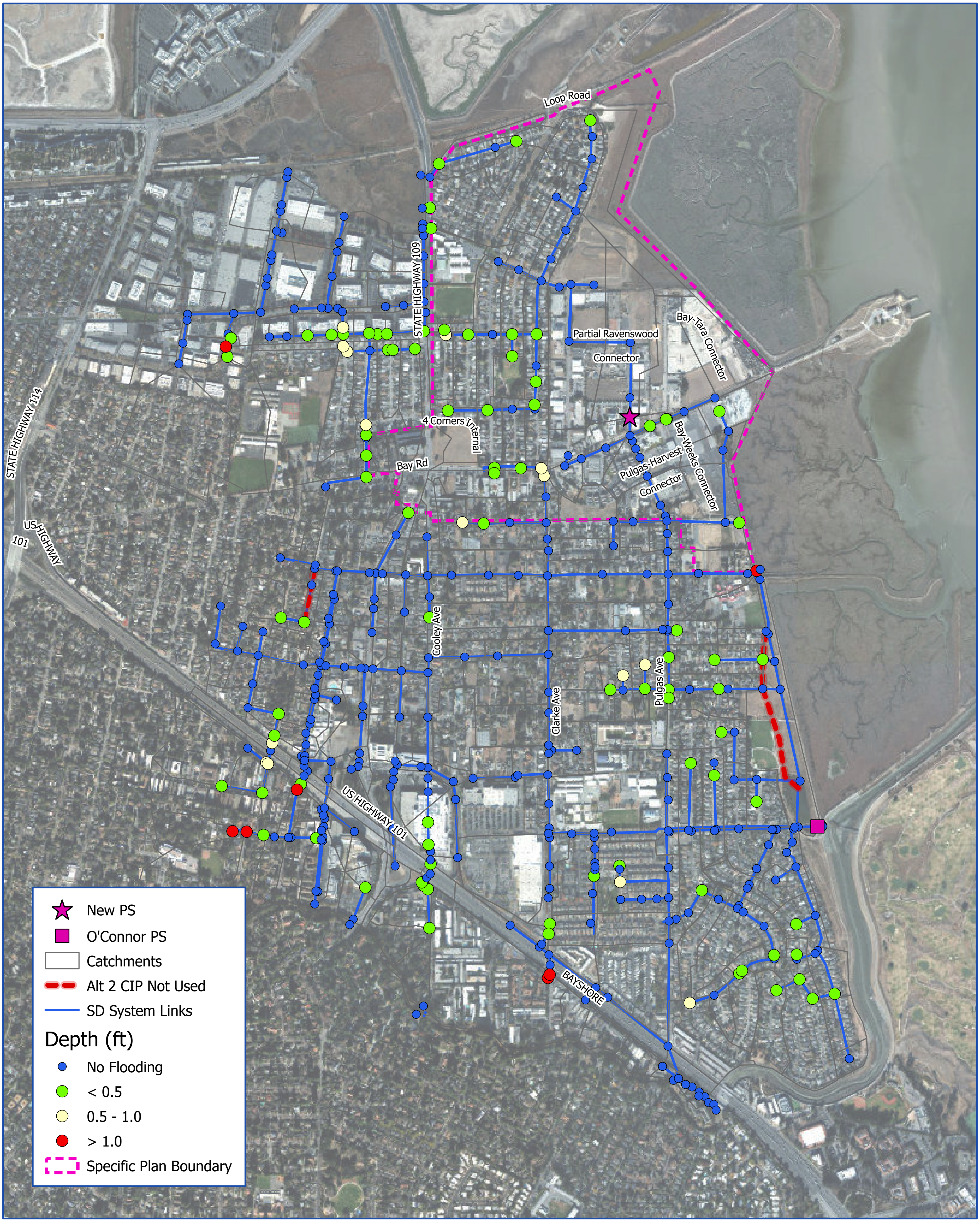

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FIGURE A-39: **10-year Node Flood Results for Future Condition with Modified Alternative 2 CIPs and Runnymede Pump Station Constructed.**